



Draft sector guidance **Forestry and paper**

December 2023
For market consultation and feedback

SASB sectors:

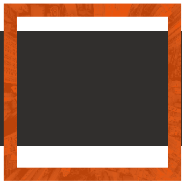
Forestry management (RR-FM)
Pulp and paper products (RR-PP)



Contents

Introduction	3
Scoping a LEAP assessment	6
Locate the organisation's interface with nature	8
L1: Span of the business model and value chain	8
L2: Dependency and impact screening	8
L3: Interface with nature	8
L4: Interface with sensitive locations	10
List of datasets and tools	11
Evaluate dependencies and impacts on nature	13
E1: Identification of environmental assets, ecosystem services and impact drivers	13
E2: Identification of dependencies and impacts	14
E3: Dependency and impact measurement	17
E4: Impact materiality assessment	18
List of datasets and tools	18
Assess nature-related risks and opportunities	20
A1: Risk and opportunity identification	20
A2: Adjustment of existing risk mitigation and risk and opportunity management	27
A3: Risk and opportunity measurement and prioritisation	27
A4: Risk and opportunity materiality assessment	27
List of datasets and tools	27
Prepare to respond and report	29
P1: Strategy and resource allocation plans	29
P2: Target setting and performance management	30
P3: Reporting	31
P4: Presentation	31
Glossary	32
Annex 1: Sector-specific metrics – Forestry management and pulp & paper products	36
Proposed guidance on the application of the core global disclosure metrics	36
Proposed core sector disclosure indicators and metrics	46
Proposed additional sector disclosure indicators and metrics	47
References	48





Draft for consultation

This sector guidance is a draft for consultation with market participants and other interested stakeholders. The Taskforce welcomes feedback via the [TNFD website](#) by 29 March 2024.

Feedback will be reviewed by the Taskforce and final sector guidance issued by the TNFD by 30 June 2024.

Introduction

The purpose of this guidance

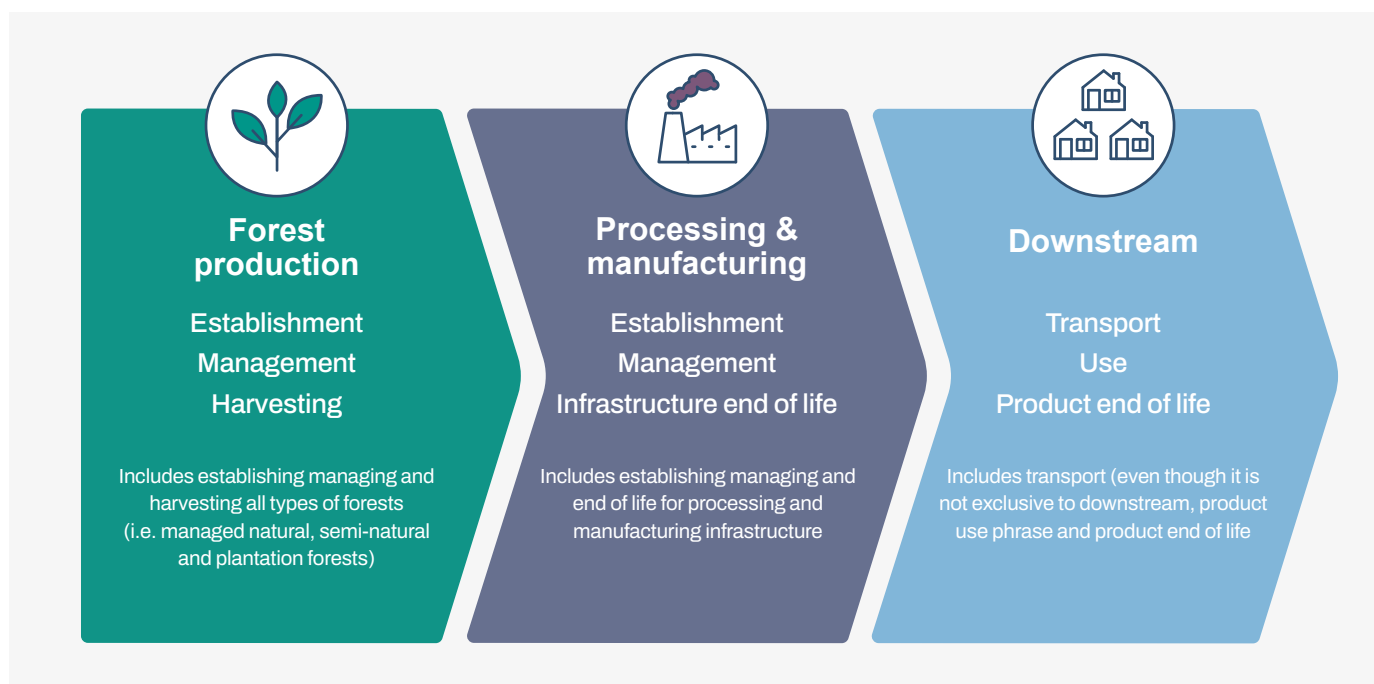
In September 2023, the TNFD published its recommendations for disclosure of nature-related issues. Accompanying those recommendations is a set of additional guidance, including [Guidance on the identification and assessment of nature-related issues: The LEAP approach](#). The TNFD recognises that there can be significant differences across sectors for corporates applying the LEAP approach. It has published this additional guidance to help forestry and paper sector participants apply the LEAP approach in their context. The overall structure of the LEAP approach is set out in Figure 2. This guidance follows that structure and Table 2 sets out the components of LEAP for which this document provides additional guidance.

The Taskforce also recognises that investors and other stakeholders require quantitative information to compare performance and nature-related issues within sectors. To facilitate that sector-level analysis, this guidance also includes recommended sector disclosure metrics for the forestry and paper sector, including guidance on the application of the core global disclosure metrics and core and additional sector disclosure indicators and metrics. These complement the disclosure indicators and metrics outlined in Annexes 1 and 2 of the [TNFD recommendations](#).

What this guidance covers

This guidance covers the value chain of organisations in the SASB forestry management and pulp and paper products industries (Figure 1). For simplicity, all organisations in either or both of the forestry management and pulp and paper products industries (Table 1) are referred to as ‘forestry and paper sector organisations’ in this guidance.

Figure 1: Forest products value chain



Source: WBCSD-FSG (2022) [Forest Sector Nature Positive Roadmap](#).

Box 1: Main industries in scope of this guidance

- Forestry management (RR-FM)
- Pulp and paper products (RR-PP)

This guidance is a supplement to the TNFD's [Guidance on the identification and assessment of nature-related issues: The LEAP approach](#) and should be read in conjunction with that guidance.

Figure 2: The TNFD approach for identification and assessment of nature-related issues (LEAP)

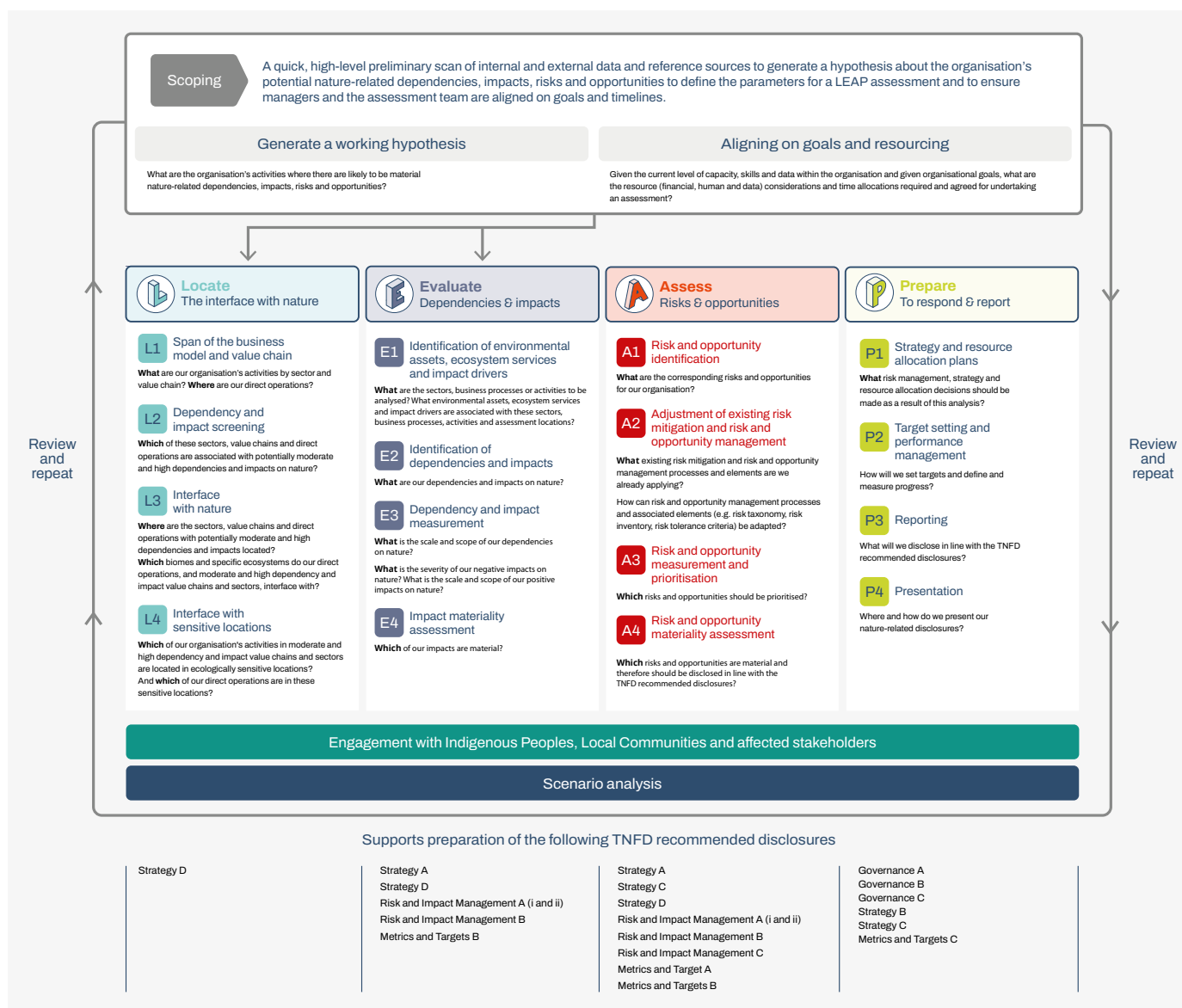
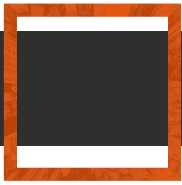


Table 2: Areas of LEAP with additional guidance for this sector

Scoping	✓						
L1	✓	E1	✓	A1	✓	P1	✓
L2		E2	✓	A2	✓	P2	✓
L3	✓	E3	✓	A3		P3	
L4	✓	E4		A4		P4	



Scoping a LEAP assessment

Working hypothesis generation:

What are the organisation's activities where there are likely material nature-related dependencies, impacts, risks and opportunities?

Goals and resourcing alignment:

Given the current level of capacity, skills and data within the organisation and given organisational goals, what are the resource (financial, human and data) considerations and time allocations required and agreed for undertaking an assessment?

Table 3 provides additional questions that can be used by forestry and paper sector organisations to help scope their nature-related assessment using the LEAP approach.

Table 3: Questions for forestry and paper sector organisations to help scope a LEAP assessment

Direct operations	1. Which forests are affected by forest management practices carried out by other parties? 2. Where is your organisation responsible for/influential in forest management practices carried out by other parties, such as contractors?
Upstream	3. What is the right level of granularity for assessing, and/or assets associated with, forest products sourced from areas where there are likely to be material nature-related dependencies, impacts, risks and opportunities?
Downstream	No additional sector-specific questions

Upstream considerations

Different land tenure arrangements exist in the forestry sector that may affect how an organisation considers its responsibility for, or leverage over, potential impacts on nature and the dependencies, risks and opportunities to which it may be exposed. The TNFD recommends taking an inclusive approach to these considerations when scoping a LEAP assessment. Box 2 provides an illustrative example.

Box 2: Defining direct operations and upstream according to types of control

Organisation A owns both private forestlands and long-term forest leases. It also purchases timber from other landowners within a larger mosaic of forestlands. These include protected areas and areas owned and controlled by other stakeholders and rightsholders, including government and Indigenous Peoples and Local Communities. Organisation A also has a joint venture with an Indigenous group, in which they have rights to harvest timber on land controlled by their partner in exchange for a 50% share in the net revenue.



When defining the scope of its LEAP assessment, Organisation A considers its private forestlands to be under direct operational control. In this case, long-term forest concessions that are leased from the government (where the organisation owns and controls the standing timber and is responsible for land stewardship) are considered capital leases and, therefore, also under direct operational control.

Timber sales or joint ventures in which the organisation has the rights to harvest timber from lands controlled by another entity are considered operating leases. These are therefore defined as part of the organisation's upstream value chain. Their inclusion within the LEAP assessment depends on whether these locations are likely to create material dependencies, impacts, risks or opportunities for the organisation.

No additional guidance on scoping is provided for forestry and paper sector organisations with operations further downstream in the forest products value chain, such as manufacturers.

Forestry and paper sector organisations may find it useful to refer to the following resources for additional guidance and data when scoping their assessment:

- The Greenhouse Gas (GHG) Protocol: [A corporate accounting and reporting standard \(2001\)](#);
- [Technical guidance for Science Based Targets for Nature – Step 1 \(2023\)](#);
- [GHG protocol dealing with leases](#);
- Geospatial asset location data for direct operations, direct procurement and/or for suppliers (where available);
- Forest management or product certification databases that list the locations of suppliers' operations as well as chain of custody certificates; and
- Local or regional conservation management plans or strategies that specify land management objectives to be considered when assessing nature-related issues.

When scoping an assessment, the LEAP assessment team should use these datasets to conduct a basic scan of the organisation's activities to help inform and create a working hypothesis, rather than to conduct a deeper analysis. The team will return to these datasets in the Locate phase to undertake a more detailed analysis.



Locate the organisation's interface with nature

This section provides additional considerations to support forestry and paper sector organisations with the Locate phase of the LEAP approach.

L1: Span of the business model and value chain

Guiding questions:

What are our organisation's activities by sector, value chain and geography? Where are our direct operations?

No additional sector-specific guidance identified for L1.

L2: Dependency and impact screening

Guiding question:

Which of these sectors, value chains and direct operations are associated with potentially moderate and high dependencies and impacts on nature?

No additional sector-specific guidance identified for L2.

L3: Interface with nature

Guiding questions:

Where are the sectors, value chains and direct operations with potentially moderate and high dependencies and impacts located?

Which biomes and specific ecosystems do our direct operations, and moderate and high dependency and impact value chains and sectors, interface with?

Organisations operating in the forestry and paper sector value chain should consider different scales when identifying or locating business operations. For example, an organisation should consider not only forest management units but also the surrounding landscapes that may affect the nature-related issues of these forest management units.

Biomes of relevance (according to IUCN GET typology)

The forestry and paper sector typically interfaces with the following biomes:

- Tropical and sub-tropical forests (T1);
- Temperate boreal forests and woodlands (T2);
- Shrublands and shrubby woodlands (T3);
- Savannas and grasslands (T4);

- Deserts and semi-deserts (T5);
- Polar/alpine (T6);
- Intensive land use systems (T7);
- Shoreline systems (MT1);
- Vegetated wetlands (TF1);
- Rivers and streams (F1);
- Lakes (F2);
- Artificial wetlands (F3);
- Subterranean freshwaters (SF1); and
- Artificial subterranean freshwaters (SF2).

This list can be considered as a reference. However, organisations should review all applicable biomes connected to their specific interfaces across their value chains and associated activities where significant dependencies and impacts on those biomes exist.

Organisations may also refer to the TNFD [biome guidance](#) for further guidance when analysing their interfaces with these biomes.

Identifying specific locations for assessment – traceability considerations

Where granular location information and precise tracing information for upstream and downstream activities with potentially moderate and high dependencies and impacts on nature is not available, organisations can look at the likely dependencies and impacts associated with the relevant forest product types or geographic region.

Forestry and paper sector organisations may find it useful to follow [SBTN's Step 3 Guidance on Nature Targets for Land](#) to classify their activities into three levels of traceability and granularity:

- Production unit of origin;
- Sourcing area; and
- Limited/no traceability.

Where full traceability to specific locations is not possible, organisations should aim to acquire data for the fibre sourcing area (e.g. forest district, cooperative, jurisdiction) and work to improve the precision of the location data of their suppliers' operations through supplier engagement. This is particularly important when sourcing product types that are likely to be associated with elevated dependencies or impacts on nature (e.g. certified and non-certified materials sourced from certain regions).

If the initial analysis in L2 determined the site or asset is associated with low dependencies and impacts on nature, then using third-party certified chain of custody or other accepted fibre-sourcing certification standards may be sufficient. It is recommended that organisations use the chain of custody and other fibre-sourcing certification standards at their disposal, but do not rely on certification as the sole method of tracing and identifying locations for further analysis, especially when sourcing product types, or from regions, associated with moderate or high dependencies and impacts on nature.

For downstream value chains, organisations should consider geographies with poor manufacturing and end-of-life practices, including those with weak legislation and enforcement, poor infrastructure, low recycling and reuse of materials.

L4: Interface with sensitive locations

Guiding questions:

For our organisation’s activities in moderate and high dependency and impact value chains and sectors, which are located in ecologically sensitive locations? And which of our direct operations are in sensitive locations?

Direct operations

Table 5 provides additional guidance for forestry and paper sector organisations to consider when identifying their interface with sensitive locations. Forestry and paper sector organisations should also refer to the relevant TNFD [biome guidance](#) for further details on what are considered sensitive locations in each biome, as applicable.

When assessing whether locations are sensitive, organisations should ensure they are adopting an appropriate scale for their operations and for the larger regions from which they are operating or sourcing.

Table 5: Additional guidance for sensitive location identification for forestry and paper sector organisations

Area	Additional guidance for forestry and paper sector organisations
Biodiversity importance	<p>Consider, whenever possible, landscape-level biodiversity objectives, such as forest age, class representation or habitat connectivity, which may be influenced beyond the direct location of operational activities.</p> <p>Consider areas highly relevant for threatened or endemic species. For example, caribou populations in North America¹ or koalas in Australia² face challenges due to increasing forest degradation.</p>
Ecosystem integrity	<p>Consider areas with medium or high risk of deforestation, forest conversion and forest degradation within the regions of operation.</p> <p>Even if ecosystem integrity is assessed as good within an organisation’s territory, if the integrity of the surrounding forests is low (e.g. if there are high incidences of insect pests or poor habitat connectivity for an endangered species), then this should be considered a sensitive location.</p> <p>Soil and water quality are also aspects of ecosystem integrity that are of particular relevance to the sector and should be assessed.</p>

1 Johnson, C. A., et al. (2022) [Protecting boreal caribou habitat can help conserve biodiversity and safeguard large quantities of soil carbon in Canada](#). Scientific Reports 12(1), 17067.

2 Rus, A. I., et al. (2021) [Habitat fragmentation affects movement and space use of a specialist folivore, the koala](#). Animal Conservation 24(1), 26–37.

Area	Additional guidance for forestry and paper sector organisations
Ecosystem service delivery importance	Forest ecosystems play a significant cultural and economic role for all landscape stakeholders and rights holders. Organisations should therefore engage relevant stakeholders in line with the TNFD Engagement Guidance , including Indigenous Peoples and Local Communities, who may be affected by forest management activities.
High physical water risks	The effective use of water resources by other actors, and their cumulative water impacts within watersheds, should be considered carefully. Water-related ecosystem services are critical for forest production, processing and manufacturing activities of the forestry and paper sector value chain. Activities performed by other actors in the sector, or in other sectors, can also impact the availability and quality of water-related ecosystem services. These can include changes in hydrological function due to water-demanding species in plantations and altered patterns of precipitation associated with climate change.

In addition to the criteria outlined in the TNFD LEAP guidance, organisations should focus in particular on the identification of sensitive locations in geographies where:

Upstream

There is high conversion/deforestation or forest degradation, weak forest regulation and enforcement, and/or where suppliers are not certified by internationally recognised third-party certification systems, such as the Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC) and Sustainable Forestry Initiative (SFI).

Downstream

In geographies where poor manufacturing and end-of-life practices are identified, including those with weak legislation and enforcement, poor infrastructure, low recycling and reuse of materials.

List of datasets and tools

Forestry and paper sector organisations operating upstream in the value chain, such as forest managers, typically maintain nature-related databases and/or make use of local datasets for their forest management planning and risk assessments. However, forestry and paper sector organisations further down the value chain, such as those sourcing fibre or manufacturing forest or forest-based products, may need to rely on regional or global databases from external providers.

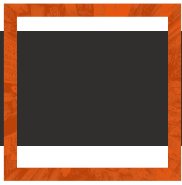
The following datasets may be particularly relevant to build on the initial scoping analysis:

- Geospatial asset location data for direct operations, direct procurement and/or for suppliers (where available);
- Forest management or product certification databases that list the locations of suppliers' operations as well as chain of custody certificates; and
- Local or regional conservation management plans or strategies that specify land management objectives.

Table 6 provides a list of tools that forestry and paper sector organisations may find useful for the Locate phase of LEAP, in addition to those listed in the cross-sector [LEAP guidance](#). Organisations should also reference tools in the [TNFD Tools Catalogue](#).

Table 6: Additional tools for forestry and paper sector organisations for the Locate phase of LEAP

<p>Additional tools highly relevant to forestry and paper sector organisations:</p> <ul style="list-style-type: none"> • Common Guidance for the Identification of High Conservation Values • Forest Stewardship Council (FSC) Certificate Database • FSC Risk Assessment Platform • Global Forest Watch • MapBiomas (Brazil) • Preferred by Nature – Timber Risk Score • Sustainable Forestry Initiative (SFI) Fiber Sourcing Standard and Certificate Holder locations • SFI Water Benefits Tool • USDA Forest Service Climate Change Tree Atlas <p>Further tools that are not yet covered in the v1.0 LEAP guidance that may be useful to forestry and paper sector organisations and other sectors:</p> <ul style="list-style-type: none"> • Co\$tingNature • Copernicus • Corruption Perceptions Index • ESG Signals Biodiversity • Global Assessment of Ecoregion Intactness • Google Earth Engine • Crowther Lab interactive maps • NatureServe Explorer • RepRisk ESG Data
--



Evaluate dependencies and impacts on nature

This section provides additional guidance to help forestry and paper sector organisations with the Evaluate phase of the LEAP approach.

E1: Identification of environmental assets, ecosystem services and impact drivers

Guiding questions:

What are the sectors, business processes or activities to be analysed?

What environmental assets, ecosystem services and impact drivers are associated with these sectors, business processes, activities and assessment locations?

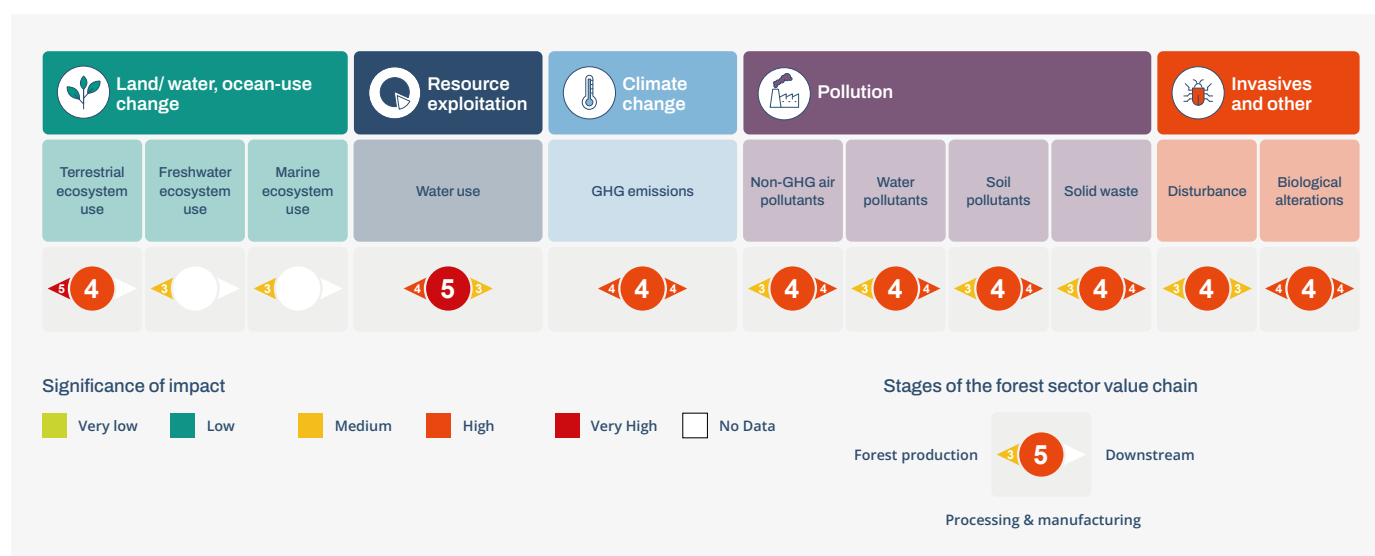
Table 7 identifies ecosystem services that are highly relevant for organisations in the forestry and paper sector and should be considered for a LEAP assessment. This includes ecosystem services that:

- Forestry and paper sector organisations commonly depend on;
- Can be promoted and enhanced by forestry activities; and
- Are typically present in areas where forestry and paper sector organisations operate.

Table 7: Ecosystem services relevant to the forestry and paper sector

Ecosystem service category	Ecosystem services
Provisioning services	<ul style="list-style-type: none">• Water supply; and• Biomass provisioning services (e.g. wood-provisioning services).
Regulating and maintenance services	<ul style="list-style-type: none">• Soil and sediment retention;• Water flow regulation; and• Global climate change regulation.
Cultural services	<ul style="list-style-type: none">• Recreation-related services; and• Spiritual, artistic and symbolic services and other cultural services (e.g. livelihoods for Indigenous Peoples and Local Communities).

Figure 3: Potential sector-level impact drivers on nature along the forestry and paper sector value chain



Note: SBTN's Sectoral Materiality Tool provides information on potential sector-level impacts on nature along different value chains. The ratings of the sector-level materiality assessment above represent a sectoral average based on data from ENCORE (direct operations and upstream) and EXIOBASE (upstream). The most recent version at the time of assessment only provided information for direct operations and upstream, so data from the Forest Products Sector Guide to the Natural Capital Protocol were used to fill the gap. The significance of impact from impact driver categories factors in the frequency, timeframe and severity of impacts, and varies along the different stages of the forest and paper sector value chain. The figure shows that all impact driver categories, except for freshwater ecosystem use and marine ecosystem use (where data is not yet available), are relevant for the forest and paper sector in at least one stage of the value chain.

Source: [WBCSD-FSG \(2022\) Forest Sector Nature Positive Roadmap](#), p18, adapted from SBTN's Sectoral Materiality Tool and the Natural Capital Protocol.

E2: Identification of dependencies and impacts

Guiding question:

What are our dependencies and impacts on nature?

Table 8 and Figure 4 include a list of common nature-related dependencies and impacts along the forestry and paper sector value chain. The LEAP assessment team may choose to use these tables as a reference and to identify those common to their business activities.

Table 8: List of potential impacts on nature along the forestry and paper sector value chain

Nature-related issue	Pressure category	Impacts	Examples of processes that can cause such impacts		
			Forest production	Processing & manufacturing	Downstream
Land-/ water-/ sea-use change	Terrestrial ecosystem use	<ul style="list-style-type: none"> Biodiversity loss Habitat loss 	<ul style="list-style-type: none"> Unsustainable forest management Road construction 	<ul style="list-style-type: none"> Infrastructure construction Road construction 	<ul style="list-style-type: none"> Landfill establishment in sensitive areas
Resource exploitation	Water use	<ul style="list-style-type: none"> Depletion of water resources Habitat loss 	<ul style="list-style-type: none"> Water-demanding tree species and nursery irrigation in water stressed areas 	<ul style="list-style-type: none"> Bleaching of wood pulp 	<ul style="list-style-type: none"> Paper and board recycling
Climate change	GHG emissions	<ul style="list-style-type: none"> Increased GHG concentration in the atmosphere 	<ul style="list-style-type: none"> Forestry machinery Carbon released at harvest 	<ul style="list-style-type: none"> Wood and recovered fiber pulping Burning biomass without carbon capture technology 	<ul style="list-style-type: none"> Waste decomposition in landfills Transportation Paper and board recycling
Pollution	Non-GHG air pollutants	<ul style="list-style-type: none"> Biodiversity loss Habitat loss 	<ul style="list-style-type: none"> Forestry machinery Fertilizers and pesticides 	<ul style="list-style-type: none"> Incineration of process residuals and waste 	<ul style="list-style-type: none"> Shipping Waste incineration
	Water pollutants	<ul style="list-style-type: none"> Changes in water quality Eutrophication 	<ul style="list-style-type: none"> Fertilizers and pesticides 	<ul style="list-style-type: none"> Chemicals Wastewater discharge 	<ul style="list-style-type: none"> Shipping Waste decomposition in landfills
	Soil pollutants	<ul style="list-style-type: none"> Changes in soil quality Biodiversity loss 	<ul style="list-style-type: none"> Fertilizers and pesticides 	<ul style="list-style-type: none"> Chemicals Wastewater discharge 	<ul style="list-style-type: none"> Waste decomposition in landfills
	Solid waste	<ul style="list-style-type: none"> Increased GHG concentration in the atmosphere 	<ul style="list-style-type: none"> Solid waste disposal (e.g., unused fertilizers, pesticides and containers) 	<ul style="list-style-type: none"> Solid waste disposal (e.g., sludge) 	<ul style="list-style-type: none"> Hazardous and non-hazardous waste disposal in landfills
Invasives and other	Disturbances	<ul style="list-style-type: none"> Habitat loss 	<ul style="list-style-type: none"> Light, noise and vibration pollution from harvesting 	<ul style="list-style-type: none"> Odor, noise and light pollution from industrial facilities 	<ul style="list-style-type: none"> Waste decomposition in landfills Transportation
	Biological alterations/ interference	<ul style="list-style-type: none"> Biodiversity loss Habitat loss 	<ul style="list-style-type: none"> Introduction of unadapted non-native tree species 	<ul style="list-style-type: none"> Released water changing local water temperature 	<ul style="list-style-type: none"> Introduction of invasive species through transportation

Notes: Based on pressure categories from SBTN, equivalent to impact drivers in the TNFD guidance. The table focuses on negative impacts on nature. Positive impacts are shown as opportunities linked to resource efficiency in Table 13.

Source: [WBCSD-FSG \(2022\) Forest Sector Nature Positive Roadmap](#), pp. 20 and 22.

Figure 4: Common dependencies on nature along the forestry and paper sector value chain

Stages of the value chain	Bio-remediation	Climate regulation	Filtration	Flood & storm protection	Ground water	Mass stabilisation and erosion control	Surface water	Water flow maintenance	Water quality	Fibres and other materials	Pollination	Soil quality	Disease/pest control
Forest production	M	VH	VL	H	VH	H	VH	H	NA	VH	H	H	H
Processing & manufacturing	VL	VL	VL	M	H	L	M	M	L	H	NA	NA	NA

Key: Very High (VH) High (H) Medium (M) Very Low (VL) Low (L) Not Applicable (NA)

Note: The ecosystem service classification used by ENCORE, the source of this table, differs from the classification used by TNFD guidance, based on the UN SEEA. A crosswalk is available from [UN SEEA](#).

Source: [ENCORE](#).

Box 3: Illustrative example identifying dependencies and impacts on nature for a forestry and paper sector organisation

Organisation A has identified its likely impact drivers and dependencies on ecosystem services by consulting the ENCORE database. Organisation A then reviews its assessment locations to confirm whether those impact drivers and ecosystem services are present.

It identifies that its impact drivers are potentially contributing to sediment loss and impacts on soil quality, and that this could also undermine soil quality in the future, on which its business depends. To do this, it uses a variety of resources, including geospatial tools, audit reports, industry assessments and stakeholder engagement.

Organisation A engaged with internal subject-matter experts, on-the-ground staff, Indigenous Peoples and Local Communities, and external stakeholders, e.g. affected communities and academics. Through this engagement, they identified topographies and soil types where certain harvesting practices were a potential contributing factor to sediment loss and erosion.

Organisation A also analysed its forest inventory and conducted a growth and drain analysis. This identified issues with forest productivity and health caused by changing climatic conditions affecting natural disturbance and the growth and survival rates of commercial species.

To better understand the scale and scope of its impact, Organisation A identified its highest impact locations based on ground surveys. From this approach, Organisation A was able to establish a clear impact pathway for this nature-related issue and understand its relative importance compared to other identified impacts and dependencies that will inform its work during the Assess phase.

E3: Dependency and impact measurement

Guiding questions:

What is the scale and scope of our dependencies on nature?

What is the severity of our negative impacts on nature? What is the scale and scope of our positive impacts on nature?

Table 9: Additional considerations for highly relevant dependencies for the forestry and paper sector

Category of ecosystem services	Additional considerations
Provisioning services	<ul style="list-style-type: none"> The availability of direct physical inputs (e.g. high quality soil and water supply, resilience against pests and diseases), extending beyond current land use borders, and their availability in the medium and long term.
Regulating and maintenance services	<ul style="list-style-type: none"> The availability of pollinators, adequate water supply and soil quality for optimum production, comparing life cycle needs against short, medium and long-term horizons. The availability of water flow, in the context of the water needs of the ecosystem, local and other stakeholders. The resilience of ecosystems in providing protection against pests and invasive species, as well as against extreme events, such as fires, droughts, floods and storms.

Table 10: Additional considerations for highly relevant impact drivers for the forestry and paper sector

Driver of nature change	Additional considerations
Land, freshwater and ocean use change	<ul style="list-style-type: none"> Habitat loss and changes to the composition, structure and/or function of the ecosystem are consequences of deforestation/forest conversion and/or ecosystem fragmentation. These can have impacts on biodiversity and ecosystem services. To capture the impacts of both direct activities and the knock-on effects of business activities, organisations should consider evaluating deforestation/forest conversion, habitat loss, fragmentation and biodiversity loss at the landscape level. Organisations can narrow their investigations where evidence and analysis make the appropriate focus clear. Organisations should consider land and ecosystem connectivity across managed forest areas and landscapes.

Driver of nature change	Additional considerations
Resource use/replenishment	<ul style="list-style-type: none"> Organisations should consider high water consumption and water diversion from critical habitats and reduction in ecosystem services to the organisation and stakeholders, given the importance of water to the forestry and paper sector.
Climate change	<ul style="list-style-type: none"> Organisations should consider GHG emissions separately from forest planting or other carbon offsetting activities.
Pollution/pollution removal	<ul style="list-style-type: none"> To capture the impacts of both direct activities and the knock-on effects of business activities, organisations should consider evaluating potential soil and water pollution (and any other sources of pollution) at the landscape level. Organisations can narrow the investigation where evidence and analysis make the appropriate focus clear. Organisations should compare changes in soil quality to protected or otherwise intact forest areas, or a similar classification. Impacts from sediment due to harvesting and other production processes should also be assessed.
Invasive alien species introduction/removal	<ul style="list-style-type: none"> Organisations should consider disease/pest control in the context of both ecosystem change and climate change impacts. For example, as the climate changes, ecosystems that were once resilient or protected from specific diseases/pests may experience novel or worsened infestations and infections. Organisations should consider assessing locations and forest management practices for prevention and early detection of invasive and alien species to avoid and minimise impacts.

E4: Impact materiality assessment

Guiding question:

Which of the identified impacts are material?

No additional sector-specific guidance identified for E4.

List of datasets and tools

Table 11 provides a list of tools that forestry and paper sector organisations may find useful for the Evaluate phase of LEAP, in addition to those listed in the cross-sector [LEAP guidance](#). Organisations should also reference tools in the [TNFD Tools Catalogue](#).

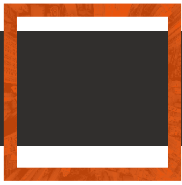
Table 11: Additional tools for forestry and paper sector organisations in the Evaluate phase of LEAP

Additional tools highly relevant to forestry and paper sector organisations:

- [Biostar](#)
- [Common Guidance for the identification of High Conservation Values](#)
- [Forest Stewardship Council \(FSC\) Certificate Database](#)
- [FSC Risk Assessment Platform](#)
- [Global Forest Watch](#)
- [MapBiomass](#)
- [Natural Capital Protocol Forest Products Sector Guide](#)
- [Programme for the Endorsement of Forest Certification \(PEFC\) Certificate Holder Database](#)
- [Preferred by Nature – Timber Risk Score](#)
- [Sustainable Forestry Initiative \(SFI\) Fiber Sourcing Standard and Certificate Holder locations](#)
- [SFI Water Benefits Tool](#)
- [United States Department of Agriculture \(USDA\) Forest Service Climate Change Tree Atlas](#)

Further tools that are not yet covered in the v1.0 [LEAP guidance](#) that may be useful to forestry and paper sector organisations and other sectors:

- [AWARE](#)
- [Co\\$tingNature](#)
- [Copernicus](#)
- [Corruption Perceptions Index](#)
- [Environmental Justice Atlas](#)
- [ESG Signals Biodiversity](#)
- [EXIOBASE](#)
- [FAO Aquastat](#)
- [GEMI Local Water Tool](#)
- [Global Assessment of Ecoregion Intactness](#)
- [Global Impact Database](#)
- [Crowther Lab interactive maps](#)
- [NatureServe Explorer](#)
- [RepRisk ESG Risk Data](#)
- [Rezatec Geospatial AI](#)
- [Universal Human Rights Index](#)



Assess nature-related risks and opportunities

This section provides additional considerations to help forestry and paper sector organisations with the Assess phase of the LEAP approach.

A1: Risk and opportunity identification

Guiding question:

What are the corresponding risks and opportunities for our organisation?

Forestry and paper sector organisations can leverage the data and processes already in place for risk assessment and risk mitigation for compliance with forest certification and other relevant standards.

For a list of potential nature-related risks and opportunities tailored to the forestry and paper sector, please refer to Table 12 and Table 13. A wider list is also accessible via the [TNFD nature-related risk and opportunity registers](#).

Box 4: Illustrative example of nature-related risk and opportunity assessments for a forestry and paper sector organisation

Organisation A identified nature-related risks and opportunities arising from each of its dependencies and material impacts.

Risks

Physical risks

Organisation A identified that changes to the capacity of its forest estate to provide timber was the most material physical risk. This was determined through timber supply analysis, which considered the effect of changing climatic conditions on growth rates and incidence of natural disturbance to estimate long-term sustainable harvest yields. Through this analysis, the organisation found that changes in precipitation and temperature, combined with other increased natural disturbances, may be affecting growth rates and survival, which would result in lower allowable annual cut (AAC) levels. The resulting financial impacts were estimated based on the difference in harvest revenue from current and forecast cut levels.

Transition risks

Organisation A used a regulatory landscape review to assess potential transition risks relevant across its value chain. Where risks were presented – for example, the upcoming EU Deforestation Regulation, relevant to forestry products in Europe – it created a risk mitigation and management plan. Organisation A integrated this into its overall risk management structure by incorporating nature-related risks as a new sub-category under sustainability risks.

Opportunities

Organisation A identified an opportunity to increase biodiversity and ecosystem resilience at all sites that were deemed to be of high biodiversity importance. It measured the baseline using eDNA, bioacoustics and ground surveys and identified activities that could improve habitat crucial to sustaining key species. By engaging local stakeholders, regulators and Indigenous Peoples and Local Communities in this work, the organisation has increased trust, which translates into quicker approvals of forest harvesting plans and corresponding cost savings. Organisation A is also able to engage with key customers and shareholders on these issues and support its sustainable forest management claims associated with its products. This provides a competitive advantage and differentiator in key markets.

Organisation A also undertook a market analysis to understand what nature-related opportunities exist and what other organisations in the forestry and paper sector are doing in this space. It analysed:

- Nature-related technological innovation, e.g. bioacoustics and eDNA being used jointly to measure biodiversity present in forestry assets;
- Consumer preferences and demand, e.g. market sentiment towards forest certification; and
- Market dynamics, e.g. product pricing of timber.

Table 12: Examples of nature-related risks highly relevant for the forestry and paper sector and associated exposure and magnitude metrics

Risk category	Nature-related risks	Illustrative exposure metrics	Illustrative magnitude metrics
Physical risk	<p>Acute (the following can also identify chronic risks)</p> <ul style="list-style-type: none"> • Ecosystem degradation and biodiversity loss may diminish yield • Increased occurrence of disease and pests affecting forest health • Degradation of ecosystems services and increased exposure and impacts from extreme weather • Loss of key species <p>Chronic</p> <ul style="list-style-type: none"> • Increased scarcity of key natural inputs, such as water and fibre, due to climate change and invasive alien species • Changing climate or nature conditions, impacting resilience of tree species and intactness of ecosystems where organisation operates 	<p>Acute</p> <ul style="list-style-type: none"> • Quantity and concentration of pollutants emitted (impact driver) • Change in population number of keystone species (state of nature) • Changes to annual visitor rates (ecosystem service) • Changes in tree growth/ increased mortality rates (state of nature) • Levels of sediment loss to water bodies (impact driver) <p>Chronic</p> <ul style="list-style-type: none"> • Change in abundance of pollinators (ecosystem service) • Occurrence/increase of storms/floods in area (external driver) • Changes in biodiversity/ ecosystem intactness, e.g. fragmentation, soil erosion and depletion, species diversity and composition (state of nature) 	<ul style="list-style-type: none"> • Increased costs of natural inputs/reduced supply • Increased costs due to interruption of operations/ supply chain • Write-offs and early retirement of existing assets • Number of locations/ business lines/facilities exposed • Insurance costs



Risk category	Nature-related risks	Illustrative exposure metrics	Illustrative magnitude metrics
Transition risk	Policy and legal <ul style="list-style-type: none">• Changes in regulation aimed at achieving nature-positive outcomes• Tighter regulation on activities that impact and alleviate pressures on nature, such as permits for natural resources• Enhanced reporting obligations	<ul style="list-style-type: none">• Quantity and concentration of pollutants emitted into water (impact driver)• Forest management and harvesting practices adopted by the organisation (impact driver)	<ul style="list-style-type: none">• Increased costs of operations and input, including compliance costs, fines and penalties• Increased capital costs• Reduced revenue due to reduction in production capacity/loss of licence of operate• Costs related to the loss of operating area• Increased fines/penalties

Risk category	Nature-related risks	Illustrative exposure metrics	Illustrative magnitude metrics
	Market <ul style="list-style-type: none"> Shifting customer values or preferences (e.g. away from single-use forest products) Volatility or increased costs of materials due to increased competition or scarcity 	<ul style="list-style-type: none"> Amount of input used in the production process (ecosystem service) Increase in price of alternative products (external driver) 	<ul style="list-style-type: none"> Reduction in revenue due to lower demand for products and services Increased production/raw material costs Costs related to substituting existing products Loss of market share and investor goodwill
	Reputation <ul style="list-style-type: none"> Shift of customer sentiment away from brands with poorly perceived nature management 	<ul style="list-style-type: none"> Decline in brand perception Decline in recreational value of area (ecosystem service) 	<ul style="list-style-type: none"> Increased costs due to employee turnover Increased operational costs due to reduction in loyalty of suppliers or stakeholders
	Technology <ul style="list-style-type: none"> Transition to more efficient and cleaner technologies with lower nature impact Lack of access to high quality data, that hampers nature-related assessments 	<ul style="list-style-type: none"> Reduction in negative impact drivers expected as a result of innovation (impact driver) 	<ul style="list-style-type: none"> Increased expenditure for R&D of new and alternative technologies Increased costs of operations required to achieve nature-related costs Lack of access to technology developed by a competitor resulting in higher operational costs

Source: Adapted from [TNFD LEAP Guidance](#), Table 16, and the WBCSD-FSG (2022) [Forest Sector Nature Positive Roadmap](#), p46.

Table 13: Examples of potential nature-related opportunities highly relevant for the forestry and paper sector and illustrative associated exposure and magnitude metrics

Opportunity category	Nature-related opportunities	Illustrative exposure metrics	Illustrative magnitude metrics
Resource efficiency	<ul style="list-style-type: none"> • Transition to processes with increased positive impact on nature (e.g. restoration, reduced pollution) • Adoption of resource circularity mechanisms that reduce dependencies and impacts on nature • Diversification of nature-related resources • Adoption of nature-based solutions 	<ul style="list-style-type: none"> • Improved water quality and supply in area (ecosystem condition and ecosystem service) • Area of degraded land restored (impact driver) • Improvement in ecosystem condition (state of nature) • Reduced incidence of flooding events (ecosystem service) 	<ul style="list-style-type: none"> • Reduced exposure to raw material and natural resource price volatility • Increased resilience to reduction in availability of natural resources • Reduced capital/infrastructure costs
Products/services	<ul style="list-style-type: none"> • New business model activities with positive/reduced impacts on nature • Development of new product to leverage woody material to replace non-renewable and environmentally damaging materials 	<ul style="list-style-type: none"> • Number of products/services with increased efficiency compared to a baseline (impact driver) • Number of products with reduced impact on nature compared to a baseline (impact driver) 	<ul style="list-style-type: none"> • Increased resilience due to business diversification • New revenue streams • Reduced costs of raw materials and production inputs • Increased revenue due to better competitive position • Increased market valuation through resilience planning
Markets	<ul style="list-style-type: none"> • Access to new and emerging markets • Access to new assets and locations • Development of value streams from new areas or waste materials 		<ul style="list-style-type: none"> • Access to new sources of finance • Increased resilience due to business diversification • Increased revenue due to better competitive position
Capital flow and financing	<ul style="list-style-type: none"> • Access to nature-related green funds, bonds or loans • Use of financial incentives for suppliers • Use of public service initiatives 		<ul style="list-style-type: none"> • Access to new sources of finance • Access to capital for high-risk projects • Reduced operational costs (suppliers)

Opportunity category	Nature-related opportunities	Illustrative exposure metrics	Illustrative magnitude metrics
Reputational capital	<ul style="list-style-type: none"> • Collaborative engagement with stakeholders • Actions that create positive changes in sentiment towards the brand 		<ul style="list-style-type: none"> • Increase in revenue due to improved reputation • Increase in brand value • Reduced costs due to engagement of suppliers and stakeholders
Ecosystem protection, restoration and regeneration	<ul style="list-style-type: none"> • Direct or indirect (e.g. financing partners, advocacy) restoration, conservation or protection of important ecosystems or habitats • Implementation of site-based, nature-based solutions • Investment in multi-stakeholder action at land/ jurisdictional level 	<ul style="list-style-type: none"> • Water quality and supply in area (state of nature and ecosystem service) • Area of degraded land restored (impact driver) • Improvement in ecosystem condition (state of nature) Reduced incidence of flooding events (ecosystem service) 	<ul style="list-style-type: none"> • Increased resilience, e.g. to natural disasters • Reduced capital/ infrastructure costs • Avoided fines/penalties • Reduction in operational costs due to improved readiness and response to regulatory changes • Reduced costs of potential impacts on operations that are out of control of the organisation (e.g. impacts at the landscape level)
Sustainable use of natural resources	<ul style="list-style-type: none"> • Transition to processes with increased positive impacts on nature • Increased reuse and recycling of natural resources • Adoption of nature-based solutions within services and product lines • Certification for products/ services • Actions that create positive changes to the supply of natural resources 	<ul style="list-style-type: none"> • Improvement in ecosystem condition (state of nature) • Reduction in total freshwater discharge in areas with water stress (impact driver) 	<ul style="list-style-type: none"> • Transmission mechanisms to business performance benefits: <ul style="list-style-type: none"> • Markets • Resource efficiency • Reputational capital • Capital flow and financing • Avoided fines/penalties • Reduction in operational costs due to improved readiness and response to regulatory changes

Source: Adapted from [TNFD LEAP Guidance](#), Table 17.

A2: Adjustment of existing risk mitigation and risk and opportunity management

Guiding questions:

What existing risk mitigation and opportunity management processes and elements are we already applying?

How can risk and opportunity management processes and associated elements (risk taxonomy, risk inventory and risk tolerance criteria) be adapted?

Forestry and paper sector organisations can leverage risk mitigation or opportunity management processes already in place for compliance with forest certification and other relevant standards and adapt these as required.

A3: Risk and opportunity measurement and prioritisation

Guiding question:

Which risks and opportunities should be prioritised?

No additional sector-specific guidance identified for A3.

A4: Risk and opportunity materiality assessment

Guiding question:

Which risks and opportunities are material and therefore should be disclosed in line with the TNFD recommended disclosures?

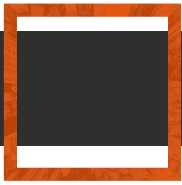
No additional sector-specific guidance identified for A4.

List of datasets and tools

Table 14 provides a list of tools that forestry and paper sector organisations may find useful for the Assess phase of LEAP, in addition to those listed in the cross-sector [LEAP guidance](#). Organisations should also reference tools in the [TNFD Tools Catalogue](#).

Table 14: Additional tools for forestry and paper sector organisations in the Assess phase of LEAP

<p>Additional tools highly relevant to forestry and paper sector organisations:</p> <ul style="list-style-type: none"> • Forest Stewardship Council (FSC) Certificate Database • FSC Risk Assessment Platform • Global Forest Watch • Global Illegal Logging and Associate Trade Risk Assessment Tool (ILAT Risk) • Programme for the Endorsement of Forest Certification (PEFC) Certificate Holder Database • Preferred by Nature – Timber Risk Score • Sustainable Forestry Initiative (SFI) Fiber Sourcing Standard and Certificate Holder locations • SFI Water Benefits Tool <p>Further tools that are not yet covered in the v1.0 LEAP guidance that may be useful to forestry and paper sector organisations and other sectors:</p> <ul style="list-style-type: none"> • Biostar • Co\$tingNature • Copernicus • Corruption Perceptions Index • Environmental Justice Atlas • GEMI Local Water Tool • Global Impact Database • LIME • RepRisk ESG Data
--



Prepare to respond and report

This section provides additional considerations to help forestry and paper sector organisations with the Prepare phase of the LEAP approach.

P1: Strategy and resource allocation plans

Guiding question:

What risk management, strategy and resource allocation decisions should be made as a result of this analysis?

Organisations can leverage existing sustainable forest management plans and nature strategies to support their decision-making process about risk and opportunity management, strategy and resource allocation. Table 15 provides a summary of key actions to halt and reverse nature loss for organisations in the forestry and paper sector.

Table 15: Priority actions to halt and reverse nature loss for organisations operating in the forestry and paper sector value chain

Stage of forestry and paper sector value chain	Priority actions to halt and reverse nature loss		
	Actions to avoid negative impacts on nature	Actions to reduce negative impacts on nature	Actions to conserve, restore and regenerate nature
Forest production (upstream)	<ul style="list-style-type: none">• Avoid deforestation in direct operations and value chain• Avoid conversion of areas of significant biodiversity value to intensively managed forests	<ul style="list-style-type: none">• Reduce deforestation/ forest land conversion in direct operations and value chain• Reduce conversion of areas of significant biodiversity value to intensively managed forests• Reduce contribution to climate change by reducing GHG emissions• Reduce drivers related to invasive alien species introduction• Replant productive forests after harvest	<ul style="list-style-type: none">• Conserve and protect water bodies, as well as areas of significant biodiversity and carbon value• Preserve forest diversity when replanting after harvest• Protect forest diversity during harvesting• Restore areas of significant biodiversity and carbon value• Restore connectivity between habitats• Restore native or endangered tree species adapted to climatic conditions• Enhance carbon removals in soils and forests

Stage of forestry and paper sector value chain	Priority actions to halt and reverse nature loss		
	Actions to avoid negative impacts on nature	Actions to reduce negative impacts on nature	Actions to conserve, restore and regenerate nature
Processing and manufacturing	<ul style="list-style-type: none"> Avoid establishing new operations in/adjacent to areas of significant biodiversity value or in water-stressed regions 	<ul style="list-style-type: none"> Reduce operational GHG emissions Reduce and reuse operational waste 	
Downstream		<ul style="list-style-type: none"> Reduce waste by promoting the recovery and recycling of forest products Reduce use of fossil-based and non-renewable materials by stimulating use of forest products 	

Source: Adapted from WBCSD-FSG (2022) [Forest Sector Nature Positive Roadmap](#), p49–51.

P2: Target setting and performance management

Guiding question:

How will we set targets and define and measure progress?

Table 16 provides illustrative examples of highly relevant targets in key areas for the forestry and paper sector, and examples of relevant indicators. Targets such as these could be adopted as response metrics to manage identified material risks and opportunities.

Table 16: Illustrative examples of highly relevant targets of the forestry and paper sector.

Topics	Illustrative target	Illustrative indicator
Reduce water use and waste	By 2030, reduce water use in water stress locations by X%	Water consumed (m ³)
Reduce waste generation	By 2030, reduce process and residual waste generated across all manufacturing sites by X%	Share of reused process residuals and total waste generated (%)
Resource use	By 2025, increase the share of certified wood fibre sourced by X%	Share of certified wood fibre sourced (%)
Reduce GHG emissions	By 2030, reduce scope 3 emissions by X%	GHG emissions (tCO ₂ e)

Source: Adapted from WBCSD-FSG (2022) [Forest Sector Nature Positive Roadmap](#), p39.

P3: Reporting

Guiding question:

What will we disclose in line with the TNFD recommended disclosures?

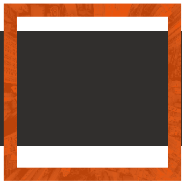
No additional sector specific guidance identified for P3. Please refer to the TNFD proposed disclosure metrics for forestry management and pulp and paper products (Annex 1).

P4: Presentation

Guiding question:

Where and how do we present our nature-related disclosures?

No additional sector specific guidance identified for P4.



Glossary

In addition to the concepts and definitions provided in the [TNFD glossary](#), the table below outlines concepts detailed in this guidance. The TNFD glossary will be updated with these definitions once the forestry and paper sector guidance is finalised, based on market consultation and feedback.

Concept	Definition
Deforestation	<p>The conversion of forest to other land use independently, whether human-induced or not.</p> <p>Explanatory notes:</p> <ol style="list-style-type: none">1. Includes permanent reduction of the tree canopy cover below the minimum 10% threshold.2. Includes areas of forest converted to agriculture, pasture, water reservoirs, mining and urban areas.3. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures.4. The term also includes areas where, for example, the impact of disturbance, overutilisation or changing environmental conditions affects the forest to an extent that it cannot sustain a canopy cover above the 10% threshold.5. The concept of ‘long-term’ is central to this definition and is defined as 10 years.6. Note that to determine whether the removal of trees from an area is classed as deforestation, it is necessary to predict the future development of the area. If new forest trees are established in the near future, the land is classified as forest throughout the regeneration period. This regrowth is considered ‘reforestation’ and the full process ‘conversion’. If, on the other hand, a sufficient density of trees is not established in the near future, or if land is converted to other land use, the area should be considered deforested. <p>FAO (2020) Forest resources assessment – Terms and definitions; FAO (2000) Forest resources assessment – Definitions of forest change processes.</p>
Forest	<p>Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.</p> <p>FAO (2020) Forest resources assessment – Terms and definitions; Accountability Framework Initiative (2020) Terms and definitions.</p>

Concept	Definition
Forest degradation	<p>Entails a reduction or loss of the biological or economic productivity and complexity of forest ecosystems, resulting in the long-term reduction of the overall supply of benefits from forest, which includes wood, biodiversity and other products or services, provided that the canopy cover stays above 10% (cf. definition of forest).</p> <p>FAO and UNEP (2020) The State of the world's forests 2020: forests, biodiversity and people; FAO (2000) Forest resources assessment – Definitions of forest change processes.</p>
Forest ownership	<p>Generally refers to the legal right to freely and exclusively use, control, transfer or otherwise benefit from a forest. Ownership can be acquired through transfers such as sales, donations and inheritance.</p> <p>FAO (2020) Forest resources assessment – Terms and definitions.</p>
Highly hazardous pesticides	<p>Pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment, according to internationally accepted classification systems, such as WHO or Global Harmonized System (GHS), or their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered and treated as highly hazardous.</p> <p>FAO & WHO (2016) International code of conduct on pesticide management: Guidelines on highly hazardous pesticide.</p> <p>For toxicity hazard classification, refer to the World Health Organization (2019) The WHO recommended classification of pesticides by hazard and guidelines to classification.</p>
Naturally regenerating forest	<p>Forest predominantly composed of trees established through natural regeneration.</p> <p>FAO (2020) Forest resources assessment – Terms and definitions.</p>
Plantation forest	<p>Planted forest that is intensively managed and meets all the following criteria at planting and stand maturity: one or two species, even age class and regular spacing.</p> <p>FAO (2020) Forest resources assessment – Terms and definitions.</p>
Planted forest	<p>Forest predominantly composed of trees established through planting and/or deliberate seeding.</p> <p>FAO (2020) Forest resources assessment – Terms and definitions.</p>

Concept	Definition
Primary forest	<p>Naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities, and the ecological processes are not significantly disturbed.</p> <p>Explanatory notes:</p> <ol style="list-style-type: none"> 1. Includes both pristine and managed forests that meet the definition. 2. Includes forests where Indigenous Peoples engage in traditional forest stewardship activities that meet the definition. 3. Includes forest with visible signs of abiotic damages (such as storm, snow, drought and fire) and biotic damages (such as insects, pests and diseases). 4. Excludes forests where hunting, poaching, trapping or gathering have caused significant native species loss or disturbance to ecological processes. 5. Examples of key characteristics of primary forests: <ul style="list-style-type: none"> • They show natural forest dynamics, such as natural tree species composition, occurrence of dead wood, natural age structure and natural regeneration processes; • The area is large enough to maintain its natural ecological processes; • There has been no known significant human intervention, or the last significant human intervention was long enough ago to have reestablished natural species composition and processes. <p>FAO (2020) Forest resources assessment – Terms and definitions.</p>
Reforestation	<p>Reforestation is the re-establishment of forest formations after a temporary condition with less than 10% canopy cover due to human-induced or natural perturbations.</p> <p>FAO (2000) Forest resources assessment – Definitions of forest change processes.</p>
Semi-natural forest	<p>Forest of native species, established through planting, seeding or assisted natural regeneration.</p> <p>Explanatory notes:</p> <ol style="list-style-type: none"> 1. Includes areas under intensive management where native species are used and deliberate efforts are made to increase/optimize the proportion of desirable species, leading to changes in the structure and composition of the forest. 2. Naturally regenerated trees from species other than those planted or seeded may be present. 3. May include areas with naturally regenerated trees of introduced species. 4. Includes areas under intensive management where deliberate efforts, such as thinning or fertilising, are made to improve or optimise desirable functions of the forest. These efforts may lead to changes in the structure and composition of the forest. <p>FAO (2005) Global forest resources assessment update.</p>



Concept	Definition
Sustainable forest management	<p>A dynamic and evolving concept, intended to maintain and enhance the economic, social and environmental value of all types of forests for the benefit of present and future generations, considering the following seven thematic elements as a reference framework:</p> <ol style="list-style-type: none">1. Extent of forest resources;2. Forest biodiversity;3. Forest health and vitality;4. Productive functions of forest resources;5. Protective functions of forest resources;6. Socio-economic functions of forests; and7. Legal, policy and institutional framework. <p>FAO (n.d.) Sustainable forest management.</p>

Annex 1: Sector-specific metrics – Forestry management and pulp and paper products

Proposed guidance on the application of the core global disclosure metrics

Forestry and paper sector organisations should refer to Annex 1 of the [TNFD Recommendations](#) for further information on the core global disclosure metrics.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Climate change				
	GHG emissions	Refer to IFRS S2 Climate-related Disclosure Standard.	No further guidance.	
Driver of nature change: Land/freshwater/ocean-use change				
C1.0	Total spatial footprint	Total spatial footprint (km ²) (sum of): <ul style="list-style-type: none"> • Total surface area controlled/managed by the organisation, where the organisation has control (km²); • Total disturbed area (km²); and • Total rehabilitated/restored area (km²). 	No further guidance.	

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C1.1	Extent of land/ freshwater/ocean-use change	Extent of land/freshwater/ocean ecosystem use change (km ²) by: <ul style="list-style-type: none"> Type of ecosystem;³ and Type of business activity. 	<p>Land-use change to report under the core global disclosure metric includes:</p> <ul style="list-style-type: none"> Conversion of primary forests, naturally regenerated secondary forests and any other areas of high biodiversity value/carbon stock that are not currently managed for productive purposes, regardless of the future forest management plans (e.g. conversion of primary forests into plantation forests or other non-forest land-uses). <p>Organisations should use the UN FAO terms/concepts of forest, conversion, deforestation and plantation forests (see TNFD glossary).</p> <p>For the purpose of the core global disclosure metric:</p> <ul style="list-style-type: none"> Extent of land use change should be measured relative to the land cover type present at an established cut-off date (no later than 2020); Business activity refers to core business activities/stages of the value chain. A forestry and paper sector organisation should follow the same approach as defined in the WBCSD-FSG Nature Positive Roadmap: forest production, processing and manufacturing, downstream; and An organisation may provide information additional to the IUCN Global Ecosystem Typology (GET) to define the type of ecosystem, such as regional or local classifications. 	FSC (2023); AFi (2019); WBCSD-FSG (2022)

³ When disclosing on ecosystem types, refer to the International Union for Conservation of Nature [Global Ecosystem Typology](#).

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C1.1	Extent of land/ freshwater/ocean-use change	Extent of land/freshwater/ocean ecosystem conserved or restored (km ²), split into: <ul style="list-style-type: none"> • Voluntary; and • Required by statutes or regulations. 	For the purposes of responding to the core global disclosure metric, an organisation should report land conserved and restored separately, if data are available. If applicable, an organisation should describe its long-term (3+ years) efforts in context-based landscape management approaches focused on fire prevention, watershed stewardship, enhancing biodiversity and/ or ecosystems services. This should refer to initiatives engaging land tenants and other stakeholders at a landscape level.	WBCSD-FSG (2022)
		Extent of land/freshwater/ocean ecosystem that is sustainably managed (km ²) by: <ul style="list-style-type: none"> • Type of ecosystem;⁴ and • Type of business activity. 	This metric applies only to land owned/managed/ leased by the organisation. For the purposes of the core global disclosure metric: <ul style="list-style-type: none"> • Sustainably managed refers to the UN FAO definition of Sustainable Forest Management (see TNFD glossary); • An organisation may provide information additional to the GET to define the type of ecosystem, such as regional or local classifications; • An organisation should provide additional detail on the type of forest, where applicable (e.g. semi-natural forests); and • 'Business activity' refers to forest production activities only, refer to the WBCSD-FSG Nature Positive Roadmap for definition. 	WBCSD-FSG (2022)

⁴ When disclosing on ecosystem types, refer to the International Union for Conservation of Nature [Global Ecosystem Typology](#).

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Pollution/pollution removal				
C2.0	Pollutants released to soil split by type	Pollutants released to soil (tonnes) by type, referring to sector-specific guidance on types of pollutants.	<p>Pollutants to report under the core global disclosure metric include:</p> <ul style="list-style-type: none"> • Pesticides from forestry operations; • Nitrogen; • Phosphorus; • Perfluoroalkyl and Polyfluoroalkyl substances (PFAS); and • Ash (e.g. from boilers in processing and manufacturing activities). <p>In determining which pollutants to report, an organisation should consider:</p> <ul style="list-style-type: none"> • The FAO and WHO definitions of highly hazardous pesticides, with an emphasis on extremely hazardous and highly hazardous pesticides (class 1A and 1B, respectively). Consider FAO and WHO definition of ‘Highly Hazardous Pesticides’ (see TNFD glossary); • The chemicals included in the list of banned persistent organic pollutants (POPs) of the Stockholm Convention; • Other pollutants that are not inherently hazardous, but where significant quantities or poor disposal practices may be damaging, including fertilisers, wood debris and bark accumulation from forestry operations, non-recyclable paper, rejects from recycling processes or other solid waste; and • Pollutants of concern identified during engagement with stakeholder groups, Indigenous Peoples and Local Communities. 	Ashrafi et al. (2015); IFC (2007); OECD and UNEP (2013); UNEP and WHO (2016); The Stockholm Convention (2001); WBCSD-FSG (2022); WHO (2019); WRI and WBCSD (2015)



Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.1	Wastewater discharged	<p>Volume of water discharged (m³), split into:</p> <ul style="list-style-type: none"> • Total; • Freshwater; and • Other.⁵ <p>Including:</p> <ul style="list-style-type: none"> • Concentrations of key pollutants in the wastewater discharged, by type of pollutant, referring to sector-specific guidance for types of pollutants; and • Temperature of water discharged, where relevant. 	<p>Reporting of water discharged under the core global disclosure metric should additionally be broken down by destination:</p> <ul style="list-style-type: none"> • Original water source; • Wider water supply; and • Third parties. <p>Pollutants and water quality metrics to report under the core global disclosure metric include:</p> <ul style="list-style-type: none"> • Absorbable Organic Halogens (AOX); • Nitrogen; • Phosphorus; • Chemical Oxygen Demand (COD); and • Total suspended solids (TSS) from fibre production, bleaching, recycling and/or other chemical processes; and forest production. • In determining which pollutants to report, an organisation should also consider the pollutants listed under the pollutants to soil metric (C2.0). 	Ashrafi et al. (2015); IFC (2007b); WBCSD-FSG (2022); WRI and WBCSD (2015)

⁵ Freshwater: (≤1,000 mg/L Total Dissolved Solids). Other: (>1,000 mg/L Total Dissolved Solids). Reference: GRI (2018) [GRI 303-4 Water discharge](#).



Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.2	Waste generation and disposal	<p>Weight of hazardous and non-hazardous waste generated by type (tonnes), referring to sector-specific guidance for types of waste.</p> <p>Weight of hazardous and non-hazardous waste (tonnes) disposed of, split into:</p> <ul style="list-style-type: none">• Waste incinerated (with and without energy recovery);• Waste sent to landfill; and• Other disposal methods. <p>Weight of hazardous and non-hazardous waste (tonnes) diverted from landfill, split into waste:</p> <ul style="list-style-type: none">• Reused;• Recycled; and• Other recovery operations.	No additional guidance.	

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.3	Plastic pollution	<p>Plastic footprint as measured by total weight (tonnes) of plastics (polymers, durable goods and packaging) used or sold broken down into the raw material content.⁶</p> <p>For plastic packaging, percentage of plastics that is:</p> <ul style="list-style-type: none"> • Reusable; • Compostable; • Technically recyclable; and • Recyclable in practice and at scale. 	No further guidance.	
C2.4	Non-GHG air pollutants	<p>Non-GHG air pollutants (tonnes) by type:</p> <ul style="list-style-type: none"> • Particulate matter (PM_{2.5} and/or PM₁₀); • Nitrogen oxides (NO₂, NO and NO₃); • Volatile organic compounds (VOC or NMVOC); • Sulphur oxides (SO₂, SO, SO₃, SO_x); and • Ammonia (NH₃). 	<p>Additional pollutants to report under the core global disclosure metric include:</p> <ul style="list-style-type: none"> • Hazardous air pollutants (HAPs). <p>From the list of pollutants under the core global disclosure metric, an organisation should particularly look to include particulate matter from the combustion of wood fuel during production; and sulphur and nitrogen oxides, particulate matter and volatile organic compounds (VOCs) from processing and manufacturing.</p>	IFC (2007b); SASB (2018a); SASB (2018b); WRI and WBCSD (2015)

⁶ Raw material content: % of virgin fossil-fuel feedstock; % of post-consumer recycled feedstock; % of post-industrial recycled feedstock; % of virgin renewable feedstock.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Resource use/replenishment				
C3.0	Water withdrawal and consumption from areas of water scarcity	Water withdrawal and consumption ⁷ (m ³) from areas of water scarcity, including identification of water source. ⁸	No further guidance.	
C3.1	Quantity of high-risk natural commodities sourced from land/ocean/freshwater	Quantity of high-risk natural commodities ⁹ (tonnes) sourced from land/ocean/freshwater, split into types, including proportion of total natural commodities.	<p>For forestry and paper sector organisations reporting the core global metric:</p> <ul style="list-style-type: none"> The metric only applies to procured volumes; High-risk natural commodities refers to certified and non-certified materials sourced. These should be broken down by regions classified as high risk and low risk according to the organisation risk assessment. This includes both natural ecosystems and established plantations; and For wood products, types refers to biomass, pulp or wood. <p>In reporting the core global metric, an organisation should:</p> <ul style="list-style-type: none"> Provide information on the organisation's traceability and due diligence systems. 	TNFD

⁷ Water consumption is equal to water withdrawal less water discharge. Reference: GRI (2018) [GRI 303-5](#).

⁸ Surface water; groundwater; seawater; produced water; third-party water. Reference: GRI (2018) [GRI 303-3](#).

⁹ Users should refer to the Science Based Targets Network (SBTN) [High Impact Commodity List \(HICL\)](#) and indicate what proportion of these commodities represent threatened and [CITES listed species](#).

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C3.1	Quantity of high-risk natural commodities sourced from land/ocean/freshwater	Quantity of high-risk natural commodities ¹⁰ (tonnes) sourced under a sustainable management plan or certification programme, including proportion of total high-risk natural commodities.	<p>In reporting the core global metric, an organisation should:</p> <ul style="list-style-type: none"> Note that this metric only applies to procured volumes; Provide information on the forest management conditions for the wood or fibre, such as whether these are certified by a broadly recognised third-party certification system with a global presence, such as the Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC) and Sustainable Forestry Initiative (SFI). ‘Controlled Wood’, ‘Controlled Sources’ or ‘SFI Fiber Sourcing’ are excluded from this definition; and Refer to the UN FAO definition of ‘Sustainable Forest Management’ (see glossary). 	TNFD
Driver of nature change: Invasive alien species and other				
C4.0	Placeholder indicator: Measures against unintentional introduction of invasive alien species (IAS) ¹¹	Proportion of high-risk activities operated under appropriate measures to prevent unintentional introduction of IAS, or low-risk designed activities.	No further guidance.	

¹⁰ Users should refer to the Science Based Targets Network (SBTN) [High Impact Commodity List \(HICL\)](#) and indicate what proportion of these commodities represent threatened and [CITES listed species](#).

¹¹ Due to the measurement of levels of invasive species for organisations being a developing area, the chosen indicator focuses on whether an appropriate management response is in place for the organisation. The additional sets of metrics contain measurement of the level of invasive species within an area. The TNFD intends to do further work with experts to define ‘high-risk activities’ and ‘low-risk designed activities’.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
State of nature				
C5.0	Placeholder indicator: Ecosystem condition	For those organisations that choose to report on state of nature metrics, the TNFD encourages them to report the following indicators, and to refer to the TNFD additional guidance on measurement of the state of nature in Annex 2 of the LEAP approach:	No further guidance.	
	Placeholder indicator: Species extinction risk	<ul style="list-style-type: none"> Level of ecosystem condition by type of ecosystem and business activity; Impacts on mean species extinction risk. <p>There are a number of different measurement options for these indicators. The TNFD does not currently specify one metric as there is no single metric that will capture all relevant dimensions of changes to the state of nature and a consensus is still developing.</p> <p>The TNFD will continue to work with knowledge partners to increase alignment.</p>	No further guidance.	

Proposed core sector disclosure indicators and metrics

Metric category	Driver of nature change	Indicator	Proposed core sector disclosure indicator or metric	Source
Impact driver	Land/freshwater/ocean-use change	Forest certification	The share of forests (%) certified by broadly recognised third-party certification systems with a global presence, such as: the Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC) and Sustainable Forestry Initiative (SFI). ‘Controlled Wood’, ‘Controlled Sources’ or ‘SFI Fiber Sourcing’ are excluded from this definition.	WBCSD-FSG KPI
Impact driver	Land/freshwater/ocean-use change	Forest conservation/restoration	Share of total land owned, leased or managed that is designated for restoration or conservation (%).	WBCSD-FSG KPI

Proposed additional sector disclosure indicators and metrics

Metric category	Driver of nature change	Cross-sector indicator	Proposed additional sector disclosure indicator or metric	Source
Impact driver	Land/freshwater/ocean use change	Land-use change	Area of high biodiversity value or high conservation value protected.	Adapted from GRI 304-3
	Resource use/replenishment	Water use	Water withdrawn per tonne of saleable production (m ³).	WBCSD-FSG KPI
		Water use	Share (%) of total water consumed in regions of high water stress. For the definition of water stress, see the TNFD glossary .	WBCSD-FSG KPI
		Other resource use	Area (km ²) that the organisation controls and/or manages that is used for the production of natural commodities from land/ocean/freshwater (extent of area split into types, change from previous year). This metric only applies to land owned/managed/leased and not to fibre procured. The organisation should provide information on how the land is managed, i.e. if forests are certified by a robust third-party certification system. Accepted internationally recognised third-party certification systems include the Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC) and Sustainable Forestry Initiative (SFI). ‘Controlled Wood’, ‘Controlled Sources’ or ‘SFI Fiber Sourcing’ are excluded from this definition.	TNFD
	Invasive species and other	Biological alterations	Number/extent of non-purposefully introduced species, varieties or strains in areas owned, operated, used or financed in priority areas (absolute, presence/absence and/or number removed, change year-on-year).	TNFD
State of nature	Ecosystem services	All	Potential indicators include: carbon sequestration; cultural services; number/type of recreational licenses issued (for managers); water quality and availability for downstream from operations; wood supply (e.g. long-term sustainable yield, including timber supply analysis and growth and drain analysis).	TNFD



References

- AFi (2019) [The Accountability Framework: Operational Guidance on Cutoff Dates](#).
- Ashrafi, O. et al. (2015) [Wastewater Treatment in the Pulp-and-Paper industry: A Review of Treatment Processes and the Associated Greenhouse Gas Emission](#). *J env manag*, 158, 146–157.
- FAO (2000) [Forest Resources Assessment – Definitions of Forest Change Processes](#).
- FAO (2005) [Global Forest Resources Assessment Update](#).
- FAO (2020) [Forest Resources Assessment – Terms and Definitions](#).
- FAO (n.d.) [Sustainable Forest Management Concept](#).
- FAO and WHO (2016) [Guidelines on Highly Hazardous pesticides](#).
- FSC (2023) [Forest Stewardship Council Conversion & Remedy \(An in-depth look at motions 37 and 45\)](#).
- GRI (2020) [GRI 306: Waste \(306-4\)](#).
- IFC (2007)a [International Finance Corporation: Environmental, Health, and Safety Guidelines – Forest Harvesting Operations](#).
- IFC (2007)b [International Finance Corporation: Environmental, Health, and Safety Guidelines – Pulp and Paper Mills](#).
- OECD and UNEP (2013) [Synthesis Paper on Per- and Polyfluorinated Chemicals \(PFCS\)](#).
- SASB (2018a) [Sustainability Accounting Standards Board: Industry Standard – Pulp & Paper Products](#).
- SASB (2018b) [Sustainability Accounting Standards Board: Industry Standard – Biofuels](#).
- The Stockholm Convention (2001) [The Stockholm Convention on Persistent Organic Pollutants](#).
- UN Water (2021) [Summary Progress Update 2021: SDG 6 — Water and Sanitation for All](#).
- UNEP and WHO (2016) [Guidelines on Highly Hazardous Pesticides](#).
- WBCSD-FSG (2022) [Forest Sector Nature Positive Roadmap](#).
- WBCSD-FSG KPI (n.d.) [WBCSD Forest Solutions Group Key Performance Indicators](#).
- WHO (2019) [The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification, 2019 edition](#).
- WRI and WBCSD (2015) [Sustainable Procurement of Forest Products: 7\) Have appropriate environmental controls been applied?](#)



Taskforce on Nature-related
Financial Disclosures

tnfd.global