



Understanding key approaches in biodiversity footprinting

A guide for businesses
and organisations

to be used in conjunction with the Circhive
Biodiversity Footprinting Decision Tree

October 2026

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Why you should read this guide:

This guide is designed to help organisations – especially companies – to understand how to measure their impact on nature. While the general approach can be implemented on any sector, the guidance is based on piloting work within agriculture, forestry and finance.

It has been produced for professionals in finance, procurement, operations, strategy, and sustainability roles, and can be used regardless of the organisation's level of experience with biodiversity. However, some sections may be better explored as a team, bringing together the various functions (e.g., procurement, quality, production, product development, etc.), to enhance understanding and successful application.





What this guide supports:

- ◆ Understanding how your organisation impacts nature.
- ◆ Understanding the three common approaches for measuring biodiversity impact:
 - ◆ Input-Output models
 - ◆ Life Cycle Assessment
 - ◆ Natural Capital Accounting.
- ◆ Understanding of the principles of these common approaches and the results they produce, using examples and highlighting application for organisational decisions and action.
- ◆ Discovering how these approaches can be used together for holistic organisational nature assessments.
- ◆ Raising awareness on common pitfalls and how to avoid these.

The guide is NOT:

- ◆ **A compliance checklist:** The guide supports understanding and application of biodiversity footprinting but does not provide a complete interpretation of disclosure or regulatory requirements.
- ◆ **A sector-specific manual:** This guide focuses on broadly applicable principles and methods rather than detailed guidance for individual economic sectors, commodities or value chains.
- ◆ **A one-size-fits-all solution:** Different organisations may require different approaches depending on their sector, value chain, geographic footprint, decision context and data availability.
- ◆ **A replacement for expert analysis:** Robust biodiversity assessments require informed judgement on methods, data and context.

After reading the guide:

Consult the **CircHive Biodiversity Footprinting Decision Tree** for step-by-step guidance on selecting the method and approach that best fits your organisation's needs.



Approach - A structured way of translating human activities into impacts on ecosystems (e.g. using spend data or physical data, measured or modelled). 3 types of approach are presented in this document: Input-Output models (IO); Life Cycle Assessment (LCA) and Nature Capital Accounting (NCA). Each approach includes different methods.

Biodiversity - Variability among living organisms from all sources (terrestrial, marine and freshwater) and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species, and of ecosystems (Convention on Biological Diversity 2011).

Biodiversity footprint - The impact of a commodity, company, person or community on global biodiversity, measured in terms of biodiversity change as a result of production and consumption of particular goods and services (Institute for European Environmental Policy 2021). Biodiversity footprint can be measured or modelled.

Biodiversity footprinting - The process of assessing and quantifying the biodiversity impacts of an organisation, product, service or value chain, typically expressed as changes in the state of nature.

Biodiversity mainstreaming - Placing the value of natural ecosystems directly into business strategies.

Dependencies - The reliance of a business on ecosystem services for its operations and value chain (TNFD, 2023).

Ecosystems - A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Convention on Biological Diversity 2011).

Ecosystem services - Contributions of ecosystems to human well-being, through the benefits that humans derive from ecosystems and use in economic and other human activity (like food, fuel and, medicines, clean water, flood control and climate regulation) (Convention on Biological Diversity, 2011).

Impacts – The effects that a company has on nature, whether positive or negative, direct or indirect, intended or unintended (TNFD, 2023). Represents the change in ecosystem services due to pressures. Impacts can be potential (modelled, as in a modelled footprint) or actual (measured, as in a measured footprint).

Impact pathways - The logical, cause-and-effect sequence that connects an organisation's activities to ultimate changes in ecosystem services.

Indicator - Also "metric"; A quantifiable representation of a measurement focus (ISO, 2006), consisting of single measure or a group of measures contributing to a composite metric of change in state of nature or ecosystem services.

Measured biodiversity footprint - Assesses changes in state of nature and ecosystem services by using location-specific observation, such as remote sensing, field surveys, and ecological monitoring, by tracking ecological condition from a baseline, relative to a reference state.

Methods - Different ways to assess impacts on ecosystems within an approach (e.g. under Life Cycle Assessment approach there is ReCiPe and LC-Impact etc).

Modelled biodiversity footprint - Assesses change in state of nature and ecosystem services by linking organisational activities and pressures to biodiversity impacts through pressure-impact relationships, quantifying the expected effect of pressures on biodiversity.

Opportunity - Activities that create positive outcomes for both business and nature, including resource efficiency, new markets, and enhanced reputation (TNFD, 2023).

Physical data - Operational data expressed in natural units that describe an organisation's activities, resource use, outputs or environmental pressure. It can be measured (direct data collected from the field) or modelled (through estimations).

Pressures - A human-induced driver of change that alters the state of nature by affecting ecosystems, species, or ecological processes. Pressures may include land-use change, resource extraction, pollution, climate change, and invasive species (IPBES).

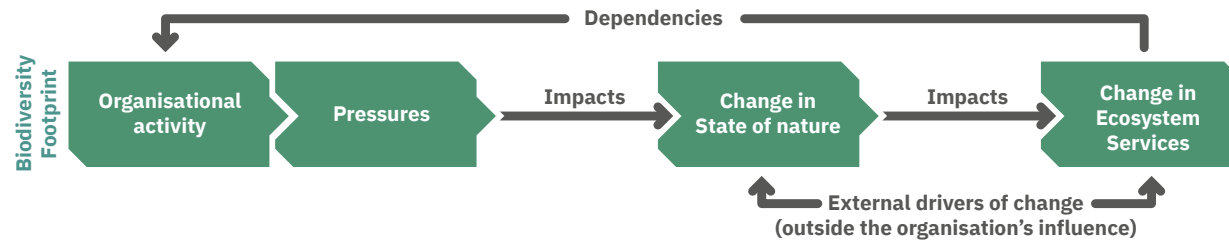
Risk - Nature-related risks are potential threats posed to an organisation linked to its dependencies on nature and impacts on nature (TNFD, 2023). Physical risks are generally linked to dependencies (as if state of nature and ecosystem services degrade, it creates physical risks) while transition risks are often associated with its impacts on nature (as they are often triggered by the consequences of impacts on nature).

Spend data - Represents the monetary transactions between different industries, households, and governments. can be used as a proxy when physical data is unavailable, to estimate a business's biodiversity impact and is expressed in monetary units.

State of nature - The condition of ecosystems and species and their ecological functions (extent, structure and health), at a given point in time (IPBES).

What are biodiversity footprints?

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Biodiversity footprints assess how organisational activities contribute to biodiversity loss and changes in the state of nature.

Activities such as procurement, production, transport and investment generate pressures on nature through land use, water use, emissions - including greenhouse gas emissions that contribute to climate change, pollution and resource extraction. These pressures can alter ecosystem extent, abiotic conditions, species and habitat state, and landscape integrity, and may ultimately reduce the availability of ecosystem services.

Biodiversity footprints primarily focus on measuring impacts on nature.

Certain biodiversity footprint methods can assess impacts on ecosystem services (i.e. how ecosystem service provision may change due to pressures and resulting changes in state of nature). Biodiversity footprint methods do not assess organizational dependencies on ecosystem services (i.e. the extent to which and organization relies on these services). Changes in ecosystem services are influenced not only by an organisation's own activities, but also by the cumulative effects of other actors and external drivers of change, such as climate change, invasive species and broader land-use dynamics. This is an important consideration when interpreting biodiversity-related risks. Different organisations may enter the assessment process at different points in this impact pathway depending on their sector, value chain, geographic footprint and the availability of data.

Why is biodiversity footprinting useful?

Biodiversity footprinting helps organisations understand their impacts on nature and how these may affect the ecosystem services they depend on.

Biodiversity footprinting helps organisations better understand how their activities affect nature and availability of ecosystem services in different parts of the value chain. Biodiversity footprinting is not just an approach for producing results, but a process that builds a broader understanding of impacts across the value chain and supports better business decisions.

Biodiversity footprinting can help organisations:

- Identify where their most significant biodiversity impacts occur.
- Prioritise where action is likely to have the greatest effect.
- Compare different products, suppliers or management options.
- Track changes over time as data and assessments improve.
- Support sustainability reporting and target setting.

Used well, biodiversity footprinting is an enabler for better decision-making across strategic planning, investment, sourcing, operations and stakeholder engagement. Biodiversity footprint information can also provide valuable inputs into corporate nature-related risk assessments.



Biodiversity footprints can be modelled or measured. They answer complementary questions.

Modelled biodiversity footprints

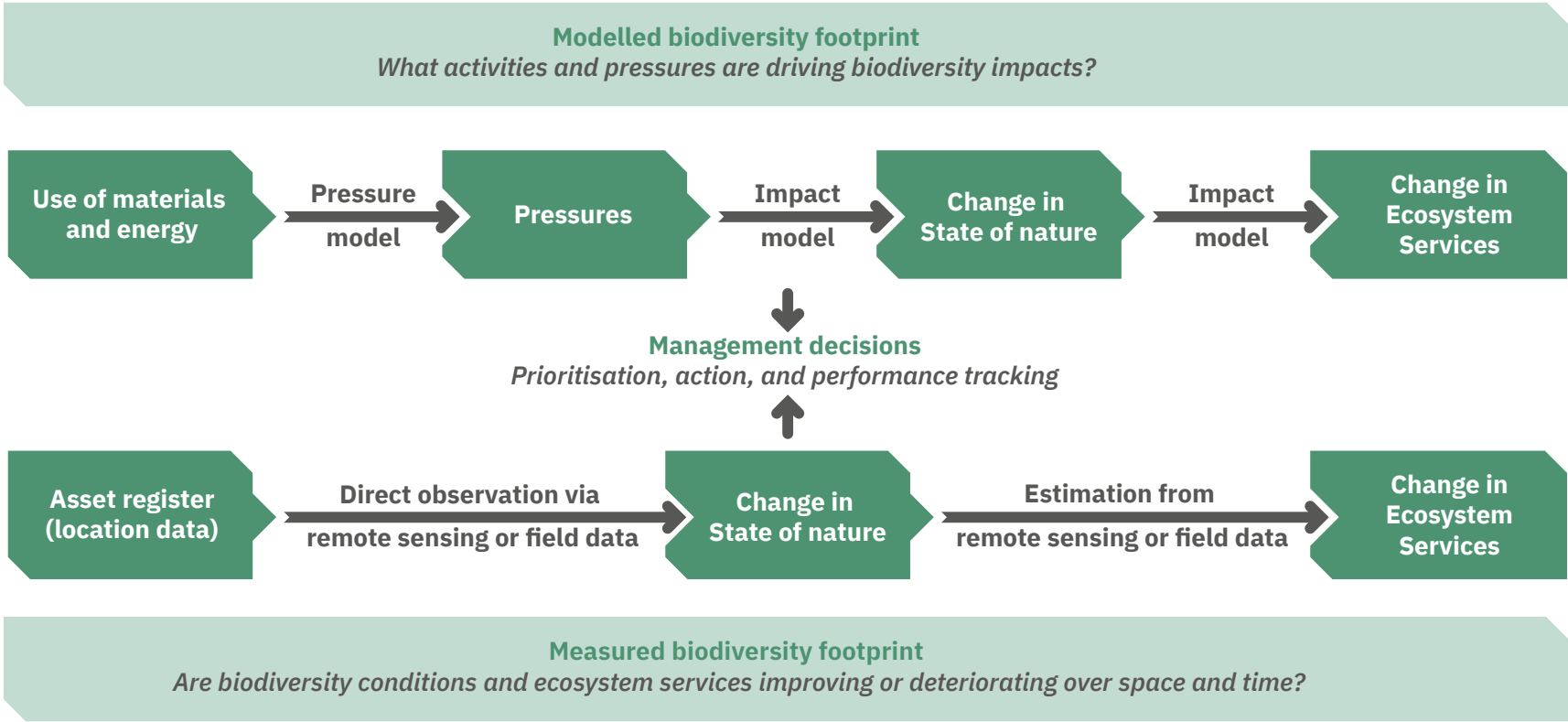
Understanding the drivers of nature impacts

Modelled biodiversity footprints originate primarily from the fields of Life Cycle Assessment (LCA) and input-output modelling (IO).

They use data on materials, energy, emissions, land use or expenditure to estimate how organisational activities are likely to affect biodiversity and ecosystem services.

Such assessments can support:

- identifying drivers of impact.
- identifying value-chain hotspots.
- comparing products and suppliers.
- prioritising action.



Measured biodiversity footprints

Tracking biodiversity outcomes and performance

Measured biodiversity footprints originate primarily from conservation science, ecology and environmental monitoring.

They use field observations, satellite imagery and ecosystem assessments to measure observed changes in ecosystems, species and ecosystem services.

When applied through Natural Capital Accounting, these measurements can be organised into accounts that support:

- performance tracking.
- target setting.
- outcome verification.
- no-net-loss and nature-positive reporting.

Modelled biodiversity footprints help organisations identify impact drivers, compare options and prioritise action across products, operations and value chains.

Measured biodiversity footprints help organisations track biodiversity outcomes, verify progress and demonstrate whether actions are delivering results.

Why is biodiversity footprinting useful?

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Key Takeaways

- Biodiversity footprinting helps organisations understand how their activities impact nature and how these impacts may affect the ecosystem services they depend on.
- Its value lies in supporting better decisions by helping organisations identify impact hotspots, prioritise actions, compare options and track progress over space and time.
- Biodiversity footprints can be modelled or measured. These complementary approaches answer different questions. Together help organisations better understand, manage and monitor their impacts on nature.

What are the most important approaches for biodiversity footprinting to know about?

There are three main approaches to biodiversity footprinting, whether it is modelled or measured. Each one is designed to answer different types of business questions, uses different types of data, and produces different kinds of results and insights. Ideally, they are used in conjunction.

No single biodiversity footprinting approach is right for every situation; understanding their differences is the first step to using them well.

The three main approaches used to estimate biodiversity footprints are:

- **Input-Output (IO) models**, which use economic flow data to model impacts on biodiversity at sector and supply chain level.
- **Life Cycle Assessment (LCA)**, which uses physical flow data to model environmental pressures and impacts on biodiversity across the full life cycle of a product or process.
- **Natural Capital Accounting (NCA)**, which applies accounting frameworks to measure the state and change of ecosystems and species over time at specific locations.

IO and LCA approaches work from organisational activity data (such as monetary spend or physical volumes of resource use), estimating emissions and land use to model their impacts on biodiversity.

NCA uses measured ecosystem data (e.g. from 3rd party datasets, satellite imagery or field surveys) to assess changes in biodiversity and organises these into accounts that can be tracked over space and time.

Together, these approaches support the measurement of three aspects of biodiversity: the state and change of ecosystems, the status of individual species or groups of species, and the availability of ecosystem services.

Not every approach covers all three dimensions equally well. This is explored in more detail in the summary section.



At a glance

key biodiversity footprinting approaches

	Question answered	Data requirement	Result type	Typical effort
Input-Output (IO)	"Where are our biggest biodiversity impacts across our supply chain?"	Spend data by sector/country	Modelled (estimated) impact	Small (2-8 weeks)
Life Cycle Assessment (LCA)	"Which products/materials have the lowest potential biodiversity impact?"	Product data, life cycle data	Modelled (estimated) impact, by life stage	Medium (2-6 months)
Natural Capital Accounting (NCA)	"Is the ecosystem/landscape we operate in improving or degrading?"	Site data, satellite imagery, field surveys	Measured impact (on-the-ground change)	Large (3-12 months)

Within each approach, multiple specific methods and tools exist. This guidance focuses on approaches to help organisations understand the landscape before selecting a specific method and tool. Here we provide a non-exhaustive list of examples. For an overview of methods and tools, readers are referred to Circhive D2.1.

Link

Examples of IO methods and tools:

- EXIOBASE
- FABIO
- Eora

Examples of LCA-based methods and tools:

- ReCiPe
- LC-IMPACT
- IMPACT World+
- LANCA/BioMAPS

Examples of NCA methods and tools:

- System of Environmental-Economic Accounting–Ecosystem Accounting (SEEA-EA)
- Biological Diversity Protocol

Modelled versus measured impacts: an important distinction.

IO and LCA approaches estimate potential impacts based on company activity data (spend or use of resources). NCA approaches estimate actual impacts based on measurements for specific locations.

Understanding how organisational activities connect to biodiversity loss requires following a chain of cause and effect. This chain runs from what organisations do, through the pressures they place on nature, to the resulting changes in the state of nature and the impacts on services they provide.

Different biodiversity footprinting approaches allow for different entry points in this cause-effect chain. The choice of entry point and approach depends on the organizational question to be answered and the available input data.

- **IO and LCA approaches produce modelled impacts;** they estimate the potential biodiversity consequences of pressures, based on average data with different granularity (from global to regional, depending on the chosen method). The results are modelled, not measured.
- **NCA approaches measure impacts;** using site-level data or satellite imagery, they track actual changes in the state of ecosystems over time at specific locations.



Location matters regardless of choice of method.

Even without conducting full on-the-ground measurement, organisations can use geographic data to refine their IO or LCA results. For example, use of geographic data can reveal that the same land-use pressure has consequences depending on whether it occurs in a biodiversity hotspot or a low-sensitivity area.





Key Takeaways

- There are three main approaches: Input-Output (IO) modelling, Life Cycle Assessment (LCA), and Natural Capital Accounting (NCA). Each approach answers different questions.
- IO and LCA output modelled potential impact from activity data; NCA output measured actual on-the-ground impacts.
- No approach is “best” in isolation. The choice of approach depends on the needs and resources of the organisation.

At a glance

Input-Output models use economic data — typically financial spend by sector and country — to estimate the biodiversity impacts embedded in an organisation's supply chain. Certain IO models are also based on physical data. They are "top-down" models, tracing flows of goods and services across sectors and geographies and linking these flows to known biodiversity pressure factors. When combined with pressure-impact relationships, IO models can be used to calculate biodiversity footprints.

IO models are the natural starting point for organisations that have limited data on their supply chains. If you know what you spend and with which sectors, you can run an IO assessment. The result is a broad picture of where your highest biodiversity impacts are likely to sit — across industries and regions.

Watch out

IO models are highly scalable but lack accuracy and responsiveness. They produce generalised, time-bound modelled results that do not reflect actual state of nature. These methods are useful for understanding potential biodiversity impacts and high-impact activities at the industry or economy level.

What IO models are good for

- Initial screening of biodiversity impacts across a whole organisation or supply chain.
- Identifying the sectors and geographies that contribute most to your modelled impact.
- Getting started when only spend data is available.
- Supporting financial portfolio-level analysis.

What IO models cannot do

- Break down a sector into individual products or materials (e.g. tell PET plastic apart from PVC, or one type of oil from another).
- Reflect the measured state of nature at specific locations.
- Respond to changes in management practice or sourcing decisions.
- Track progress over time against biodiversity targets.



Input-Output (IO) models



Typical effort:
Low (≈ 2-8 weeks)



Scope:
Supply chain screening

EXAMPLE USE CASE

The situation:

Sportswear manufacturer (€200M revenue), 50+ suppliers across 15 countries. New to biodiversity footprinting and wants to get started with understanding nature impacts.

The question:

“Where are our biggest biodiversity impacts across the supply chain?”

Methods used:

- Spend-based IO screening mapped to sector/country
- Complementary qualitative risk-screening tools*
- Sector level indicators

Data needed:

- Purchase spend
- Spend category
- Supplier country

Geographical scope:

- Country level (15 countries where organisation sources from)
- No supplier or facility-level details

Fictive example:

Biodiversity dependencies + impacts (sector-based) heatmap

Sectors (by spend)	Water Stress	Water depletion	Habitat loss	Land use change	Climate change
Cotton	High	High	Medium	Medium	Low
Leather tanning	High	High	High	High	Low
Rubber	Low	Medium	High	High	Low
Other ag. materials	Medium	Medium	High	High	Medium
Textiles (man-made)	Medium	Low	Low	Low	High
Packaging	Medium	Medium	High	High	Low
Other	Low	High	Low	High	High

What they found:

- Cotton (India/Pakistan) → water stress
- Leather tanning (India) → water depletion
- Rubber (Indonesia) → habitat loss
- Agricultural raw materials dominate impacts.
- Biodiversity pressure is concentrated upstream in the supply chain

*Qualitative dependency/impact-screening tools are not Input-Output models. But they are often used alongside IO approaches for early screening. Rely on expert scoring rather than economic input-output data. One example is the ENCORE tool.

Resulting decisions:

- Prioritised cotton, leather, rubber for supplier engagement
- Shifted from broad engagement → targeted intervention
- Allocated budget to improve supply chain data
- Initiated deeper analysis (LCA) on priority materials

What IO enabled:

- Rapid hotspot identification across full supply chain
- Data-based prioritisation for internal discussions
- Credible input for early stakeholder / investor communication

Limitations:

- Sector averages hide best/worst practices
- No differentiation between suppliers (e.g. certifications)
- Results reflect potential, not actual impact
- Limited transparency in underlying model assumptions



Key Learnings

IO shows where impacts are concentrated but cannot assess individual supplier performance or improvements.

Key Takeaways

- IO model approaches uses spend data by sector/country producing broad and rapid screening of where biodiversity impacts are concentrated across a supply chain.
- It is the natural starting point with limited data, but it cannot distinguish between suppliers or reflect changes in biodiversity impacts on-the-ground.
- **Best use:** initial hotspot identification to prioritise where to look deeper (e.g., with LCA).





At a glance

Life Cycle Assessment evaluates environmental pressures and models their biodiversity impacts, across the full life cycle of a product or process. This includes raw material extraction, production, use, and end of life of a product. LCA works with "bottom-up" physical data (volumes, masses, energy inputs) rather than top-down financial spend, which gives it greater precision than IO models.

LCA can be used in two ways for biodiversity footprinting. First, organisations can draw on existing LCA databases to benchmark the biodiversity impact of specific commodities without commissioning a full study. Second, a full LCA can be conducted for a specific product or value chain, providing detailed insight into which life cycle stages and which practices matter most.

What LCA is good for

- Comparing the modelled biodiversity impact of different commodities, materials or products
- Identifying which life cycle stage (raw materials, production, transport, end of life) creates the strongest pressures and impacts
- Informing sustainable sourcing decisions and eco-design
- Responding to changes in production practices or supplier choices
- Supporting science-based targets to reduce biodiversity pressures

What LCA cannot do

- Directly measure the state of nature at a location
- Verify whether biodiversity outcomes are improving or deteriorating over time
- Fully capture all management practices and sourcing characteristics that influence biodiversity outcomes
- Replace site-level ecological assessment, monitoring or Natural Capital Accounting



! Watch out

LCA results express nature impacts in broad units such as PDF (Potentially Disappeared Fraction of species) or MSA (Mean Species Abundance). These represent modelled biodiversity footprints and estimate potential biodiversity impacts based on available data and models. They are valuable for identifying impact hotspots and comparing options but should not be interpreted as direct evidence of ecological change on the ground.

These methods are useful for understanding potential biodiversity impacts and high-impact activities at the level of products and processes.

Life Cycle Assessment (LCA) – screening using life-cycle inventory data



Typical effort:
Low- medium (4-8 weeks)



Scope:
Products / Materials screening

EXAMPLE USE CASE

The situation:

Consumer goods company (€150M revenue), sourcing multiple raw materials (e.g. palm oil, cotton, plastics). Has completed an initial IO screening and wants to refine results for priority sectors.

The question:

“Which materials in our portfolio drive the highest biodiversity impact?”

Methods used:

- Data from LCA databases
- Pressure-impact models

Data needed:

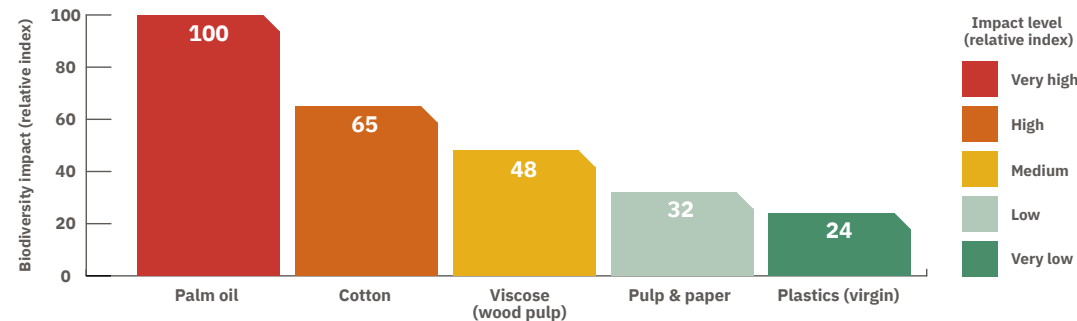
- Material volumes (e.g. tonnes)
- Basic product composition data
- (Potentially) Generic country or regional assumptions

Geographical scope:

- Country or regional sourcing per commodity
- Enables indicative geographic prioritization (If location information has been used)

Fictive commodity analysis using LCA data:

Materials compared using a biodiversity impact metric (e.g. PDF or MSA; normalized, with 100 = largest impact commodity). Results broken down at material level (e.g. palm oil, cotton, plastics):



What they found:

- Palm oil shows the highest biodiversity impact across materials
- Materials previously grouped together for IO analysis show distinct impact profiles
- Impact is concentrated in specific commodities, not evenly distributed
- Material-level view provides clearer prioritisation than sector-level IO

Resulting decisions:

- Focus engagement on specific materials and product lines
- Move from sector-level → material-level prioritisation
- Palm oil selected for full LCA deep dive

What LCA enabled:

- Refined hotspot identification from IO screening
- Clear comparison between materials
- Stronger basis for procurement prioritisation

Limitations:

- Based on global or regional averages
- Limited supplier-specific differentiation
- Value chain stages aggregated
- Results represent potential, not actual impact

Key Learnings

Screening with data from LCA databases improves resolution from “where” (IO) to “which materials.” It does not identify which parts of the product value chain contribute to impacts.

Life Cycle Assessment (LCA) – full study



Typical effort:
Medium- high (3-6 months)



Scope:
Product / Value chain deep dive

The situation:

Same consumer goods company as on p.19 investigates palm oil (identified as hotspot) to understand drivers of biodiversity impact.

The question:

“Where in the palm oil supply chain do impacts occur, and what actions will reduce them?”

Methods used:

- Full process-based LCA of palm oil supply chain
- Explicit modelling of life cycle stages

Data needed:

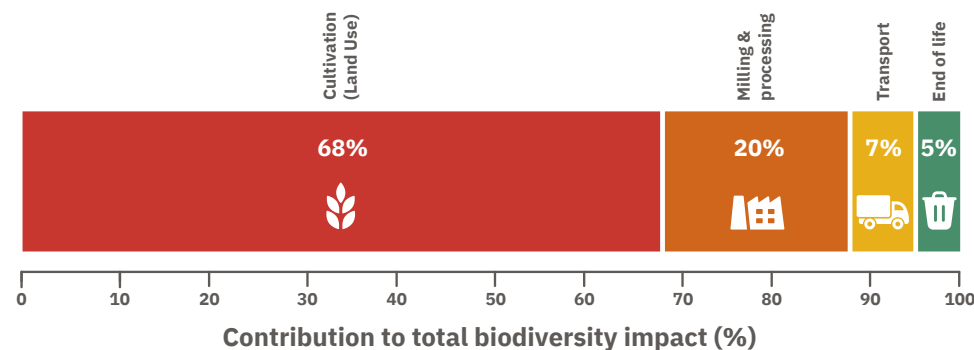
- Supplier-specific cultivation and processing data
- Land use, yields, emissions, effluent treatment methods
- Transport distances and waste treatment methods

Geographical scope:

- Country or regional datasets per commodity
- Enables indicative geographic prioritisation (if location data has been used)

Fictive full LCA output by life cycle stages:

Biodiversity impact broken down by life cycle stage (e.g. cultivation, milling, transport, end-of-life)



What they found:

- Land conversion (cultivation) drives most biodiversity impact
- Palm oil mill runoff contributes to water pollution
- Downstream improvements (e.g. recycling) have limited effect on upstream impacts
- Impacts are concentrated in specific life cycle stages
- Upstream activities (cultivation) dominate total impact

Resulting decisions:

- Engage suppliers on land use practices and deforestation risk
- Shift sourcing model (e.g. from mass balance → segregated supply) to enable traceability
- Work with mills on water and effluent management

What LCA enabled:

- Identification of impact drivers within the value chain
- Targeted supplier engagement
- Clear prioritisation of interventions

Limitations:

- Impacts are still modelled, not measured
- Results sensitive to data quality and assumptions
- Resource-intensive and not scalable across all products

Key Learnings

Full LCA explains “which impacts are most important” and “where to act”, enabling targeted interventions.

Key Takeaways

- LCA uses physical data (volumes, materials, energy) across a product's full life cycle, giving more precision than IO, down to material or life-cycle-stage level.
- It can be done in two ways: fast benchmarking against existing databases, or a full study of a specific product/value chain.
- Results (using units such as PDF or MSA) are still modelled estimates of potential nature impacts, not proof of real-world change.





At a glance

Natural Capital Accounting is a framework for systematically measuring and recording the state and change of ecosystems (and species) and the services they provide to organisations and people over time. Unlike IO and LCA, NCA does not model impacts from pressure data, it measures conditions on the ground, using spatial data (satellite imagery, field surveys, GIS mapping) and applies accounting rules to organise these measurements into comparable, trackable asset records.

NCA is the approach that allows organisations to answer questions such as:

- **Is the forest we manage improving or degrading?**
- **Have our restoration efforts made a measurable difference?**
- **What is the baseline condition of the ecosystems in our supply chain landscapes?**

NCA can be used for two related but distinct purposes:

- Biodiversity footprint assessment (NCA for BF): measuring the state and change of ecosystems and species, producing biodiversity accounts that track positive and negative impacts over time. Such an analysis can be prepared one-off for a single point in time but it is more useful when conducted regularly to monitor changes over time.
- Ecosystem services assessment (NCA for ES): measuring the stocks and flows of benefits that ecosystems provide, and how these can potentially change under different land use and management scenarios. Such an assessment is not a biodiversity footprint analysis.

What NCA is good for

- Tracking changes in ecosystem condition at specific sites or landscapes
- Measuring the effectiveness of restoration or mitigation actions
- Meeting no-net-loss requirements and demonstrating progress toward nature-positive targets
- Long-term reporting and disclosure with high credibility
- Understanding dependencies on specific ecosystem services

What NCA cannot do

- Easily scale across large, complex or global supply chains without significant data investment
- Produce results quickly with limited data — NCA requires spatial delineation, condition measurement and consistent accounting rules

⚠ Watch out

NCA requires choosing a reference state against which change is measured. The reference state provides the ecological context needed to interpret results, helping determine whether an observed condition represents a relatively favourable or unfavourable state and whether a measured change constitutes a meaningful improvement or deterioration. Transparency regarding the chosen reference state is therefore critical for interpreting results and comparing assessments.

The quality of NCA depends on the quality of the input (field survey, satellite data etc). This will determine how well the NCA captures on the ground change in state of nature. For best results, satellite assessments should be validated with field data.



Natural Capital Accounting (NCA)



Typical effort:
High (multi-year)



Scope:
Site / Project / Landscape

The situation:

Mid-sized property developer (10–15 projects/year, 500+ hectares). Faced regulatory requirements to demonstrate no-net-loss of biodiversity across developments.

The question:

*“Are our developments maintaining or improving biodiversity condition over time?
Are we achieving our no-net-loss commitments in practice?”*

Methods used:

- NCA framework applied to biodiversity
- Baseline establishment (Year 0)
- Ongoing monitoring and measurement relative to reference state over time
- Verification against no-net-loss targets (e.g. Year 5)

Data needed:

- Site-level biodiversity condition data (species, habitats and ecosystem condition relative to a reference state)
- Field surveys and/or satellite data
- Monitoring data over time (annual or periodic)

Geographical scope:

- Site and landscape level
- High spatial precision (specific locations)

Example output from NCA:

Change in biodiversity indicators over time (e.g. species counts, habitat extent, ecosystem condition index)

Ecosystem type	Area (ha)		Condition index		Change in ecosystem extent x condition (eco-units)
	Period 1	Period 2	Period 1	Period 2	
Woodland	100	110	0.60	0.65	▲ +11.5 (+18%)
Wetland	50	45	0.50	0.48	▼ -4.7 (-19%)
Grassland	30	30	0.70	0.80	▲ +3.0 (+14%)
Heathland	20	18	0.40	0.38	▼ -1.8 (-22%)
Total (all ecosystems)	200	203	0.56	0.59	▲ +8.0 (+14%)

What they found:

- Some projects achieved net gains in biodiversity (e.g. increased species, habitat creation)
- Others failed to meet targets despite mitigation efforts
- Results vary significantly between sites and interventions
- Generic measures are not sufficient
- Site-specific management matters

Resulting decisions:

- Introduced standardised biodiversity baseline assessments across all projects
- Adjusted restoration strategies (more targeted, species-specific interventions)
- Strengthened monitoring and accountability per project
- Triggered corrective action where targets were not met

What NCA enabled:

- Measurement of biodiversity change over time
- Credible reporting for regulatory compliance
- Clear identification of which projects succeed or fail
- Evidence base for improving restoration strategies

Limitations:

- Data-intensive and resource-heavy
- Results can depend strongly on the selection of the reference state.
- Long time horizons often needed to observe change
- Difficult to scale across large/global supply chains

Key Learnings

NCA shows what is happening on the ground, not just what is expected based on models. It enables accountability but requires long-term commitment and ecological expertise.

Key Takeaways

- NCA measures actual, on-the-ground ecosystem condition and change over time, using spatial/field data rather than modelling.
- It is the only approach that can verify whether real biodiversity outcomes (e.g. restoration, no-net-loss) are being achieved.
- It requires using a transparent reference state, sustained data investment, and traceability information, if used in the supply chain.



Combined LCA + NCA

 **Typical effort:**
(4–6 months + multi-year monitoring)

 **Scope:**
Products + operations

The situation:

Consumer goods company sourcing palm oil from multiple regions. Wants to identify biodiversity hotspots in its value chain and demonstrate that biodiversity outcomes are improving in priority sourcing landscapes.

The question:

"Which parts of our value chain should we prioritise for biodiversity action? Are those actions delivering measurable ecological improvements?"

Methods used:

- LCA for product-level impact comparison
- NCA for site-level ecosystem monitoring in priority landscapes
- Integration of footprinting and ecosystem accounting results to inform decisions

Data needed:

- LCA: life cycle inventory and sourcing data (activities, materials, locations, life cycle stages)
- NCA: ecosystem extent, condition and biodiversity data for the selected landscape

Geographical scope:

- LCA: supply chain and sourcing regions
- NCA: priority landscape(s) informed by geographic LCA
- Nested scales from value chain hotspot to ecosystem level

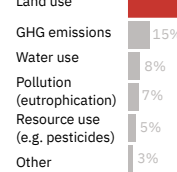
Example output from combined LCA + NCA:

LCA: biodiversity impact per product (relative comparison)
NCA: change in ecosystem extent and condition.

Geographic LCA results

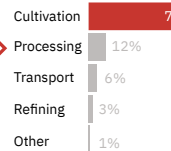
1. Impact by pressure

Share of total biodiversity impact (%)



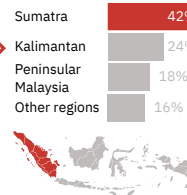
2. Land-use impact by Life cycle stage

Share of land-use related biodiversity impact (%)



3. Cultivation impact by sourcing location

Share of cultivation-related biodiversity impact (%)



Ecosystem account for the selected landscape (Sumatra)

Ecosystem type	Area (ha)		Condition index		Change in ecosystem condition (eco-units)
	Year 0	Year 5	Year 0	Year 5	
Forest	12,000	12,800	0.58	0.66	▲ +9.6 (+14%)
Wetland	2,500	2,300	0.62	0.60	▼ -3.1 (-5%)
Grassland	5,000	4,800	0.45	0.43	▼ -4.5 (-10%)

What they found:

- Land use during cultivation was identified as the dominant driver of biodiversity impact
- Sumatra was identified as the highest-priority cultivation region for biodiversity action
- NCA showed improvements in forest extent and condition, but declines in some ecosystem types
- Footprinting results alone would not have revealed whether ecosystem condition was improving on the ground

Resulting decisions:

- Prioritised biodiversity interventions in the Sumatra sourcing landscape
- Established ecosystem monitoring and accounting for priority areas
- Set landscape-level biodiversity targets and performance indicators
- Allocated resources to locations with the greatest biodiversity impact

What LCA + NCA enabled:

- Identification of where biodiversity impacts occur in the value chain (LCA)
- Measurement of whether biodiversity outcomes are improving in those locations (NCA)
- Stronger prioritisation, accountability and decision-making

Limitations:

- Requires combining different data types and methods
- Resource-intensive
- Needs careful interpretation to avoid mixing “modelled” and “measured” results

Key Learnings

An LCA provides a high-level understanding of environmental impacts across the value chain, helping to identify key hotspots and prioritize intervention areas. Based on these results, an NCA can be conducted on these priority areas to establish a baseline, guide decision-making, and monitor the effectiveness of implemented actions. Together, they provide both credibility and actionability.

Different approaches are complementary, not mutually exclusive!

IO and LCA are best suited to assessments requiring broad coverage across value chains or portfolios. NCA is best suited to assessments requiring spatial analysis, and situations where site-level ecosystem data can be obtained. Combining all three often provides the most meaningful biodiversity footprint.

In practice, the three approaches are most powerful when used in conjunction, each one building on the insights of the previous one and sharpening the focus on the issues and locations that matter most:

- **IO identifies hotspots;** the sectors and geographies where biodiversity impacts are concentrated. This is where organisations start, especially if you have limited data or are new to biodiversity footprinting.
- **LCA provides more detailed understanding of the hotspots,** moving from the sector level to the commodity, product and value chain level, revealing which life cycle stages and processes drive the most impact.

- **NCA moves from modelled to measured impacts,** investigating the real-world changes in state of nature over time (and intervention effectiveness). To start off with, organizations can use NCA for hotspots identified via LCA or IO approaches.

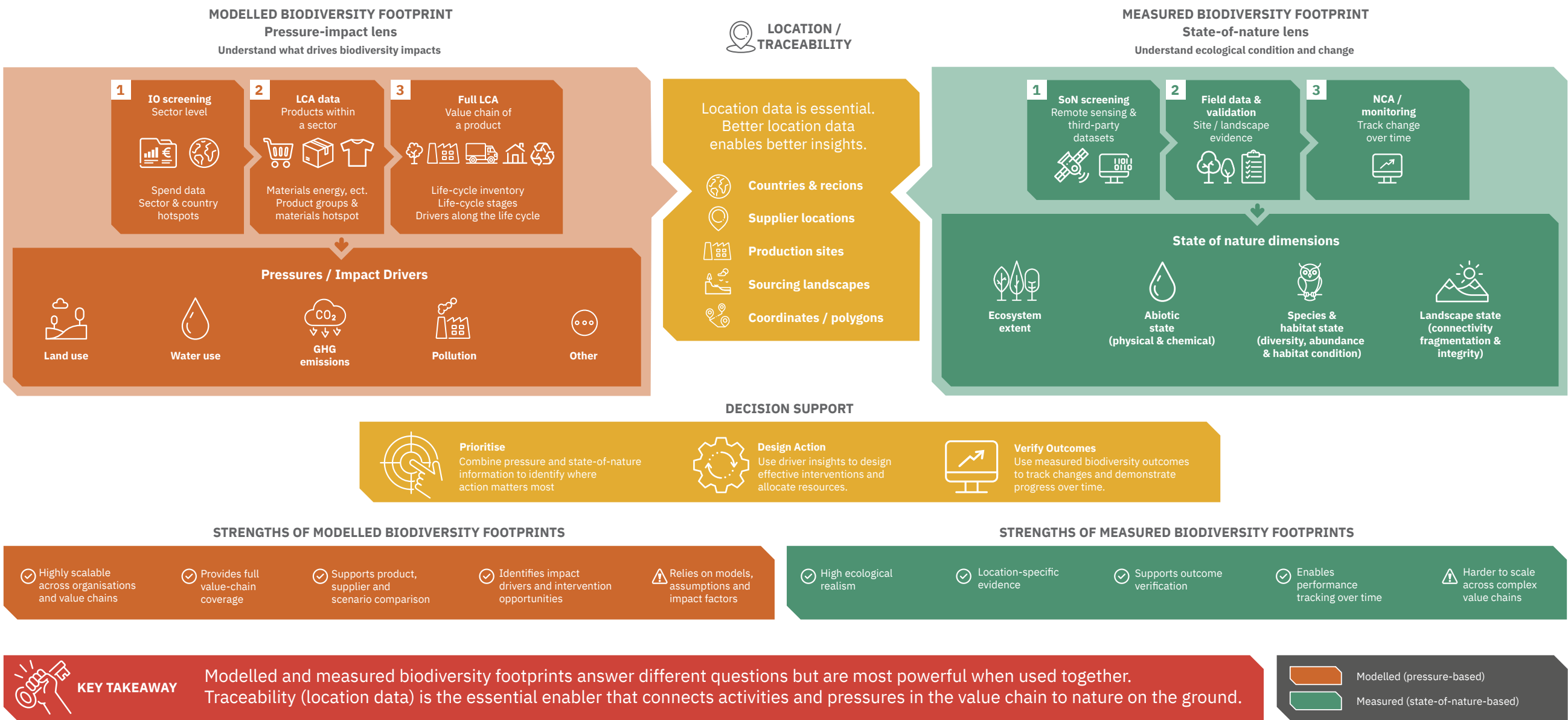
However, progression in this order is not a rigid requirement. Organisations can enter the process at any level depending on their data, resources and objectives. Some may never engage in NCA; others will move directly to site-level accounting because of regulatory requirements or operational priorities.



Watch out

Location data adds value at every stage of this journey. For example, even within an IO or LCA assessment, knowing where your supply chain activities take place allows you to apply location-specific impact factors, recognising that the same pressure (e.g. water use) has very different consequences depending on location.





Biodiversity footprinting serves the whole organisation.

IO and LCA model pressures and impacts. NCA measures the actual state of nature on the ground.

Based on findings from these methods, Sustainability Managers can help various organisational functions identify risks and opportunities, and inform action, from strategic and operational changes to remedial measures, to achieve beneficial outcomes such as risks averted, opportunities seized, or detrimental impacts reduced. The table below gives illustrative examples per function, not an exhaustive or prescriptive list.



Example actions and outcomes by function (illustrative, non-exhaustive)

	Sustainability reporting	Finance	Procurement	Operations	Strategy
IO (modelled, potential impacts)	Compliance reporting based on estimates of spend / activity impact	Investor / shareholder / stakeholder reporting based on estimates of spend / activity impact	Procurement / supply chain issue flagging based on estimates of spend / activity impact	n/a*	Impact screening based on estimates of spend / activity impact
LCA (modelled, potential impacts)	Compliance reporting based on estimates of product / process impact	Investor / shareholder / stakeholder reporting based on estimates of product / process impact	Procurement / supply chain decision-making based on estimates of product / process impact	Process issue identification and decision-making based on estimates of product / process impact	Risk screening based on estimates of product / process impact
NCA (measured, actual state and impacts on nature)	Compliance reporting based on evidence of organisational impact	Investor / shareholder / stakeholder reporting based on evidence of organisational impact	Supplier-level verification and decision-making based on activity / supplier-level evidence	Site-level impact identification and remedial action decision-making based on evidence of site-level impact	Positive positioning and long-term risk management based on evidence of organisational impact

*spend data has no site or process resolution, so it can't drive an operational decision.

Key Takeaways

- IO, LCA and NCA answer complementary questions. Together they provide a stronger basis for understanding biodiversity impacts and supporting better decisions than any single approach alone.
- Location and traceability strengthen biodiversity footprinting at every stage, connecting value chain activities and pressures to biodiversity outcomes on the ground.
- The value of biodiversity footprinting comes from informing organisational decisions and actions; from identifying priorities and designing interventions to verifying outcomes over time.



Biodiversity footprinting requires thoughtful consideration across all phases: identification of information needs, methodological planning, implementation and sense-making of the results.

Biodiversity footprinting is a rapidly developing field. The methods available are powerful, but they come with important limitations that users need to understand in order to get meaningful results and avoid common pitfalls.



Know what you are measuring

There is a fundamental difference between a modelled estimated impact and a measured impact. IO and LCA tell you what impacts are likely, based on average relationships between pressures and biodiversity outcomes. NCA tells you what is actually happening. Mixing these up — or presenting modelled results as evidence of real-world change — undermines credibility.

Aggregation hides trade-offs

Many biodiversity metrics aggregate impacts across different pressures, species and geographies into a single number. This can conceal important trade-offs: a reduction in water-related impacts may be offset by an increase in land-use impacts, yet the overall metric improves. Always look beneath the headline number at the underlying drivers. In addition, the granularity of impact factors in LCA, i.e. global/regional/national data may produce very different results.

Baselines and reference states matter

For NCA in particular, a clear and consistent baseline is essential. Without it, you cannot determine whether change is positive or negative or compare results across time periods. Establishing the baseline is often more effort than the ongoing measurement — invest in it upfront. The involvement of experts in biodiversity surveys is strongly recommended.

Scale your method to your purpose

Different decisions require different levels of analytical rigour. Screening approaches are appropriate for prioritisation and hotspot identification, while detailed assessments are needed for target setting, performance measurement and compliance-related claims. Selecting the appropriate method helps avoid both unnecessary complexity and over-interpretation of results.

Four quality dimensions to consider:

- **Spatial precision:** how geographically specific are the results? (global average → site-specific)
- **Accuracy:** how well does the metric reflect real-world biodiversity conditions? (modelled estimate → verified measurement)
- **Responsiveness:** does the method detect changes due to management actions or mitigation measures?
- **Scalability:** how easily can the method be applied across your full operations and supply chain?





Key Takeaways

- **Know your metric type.** Do not confuse modelled estimates (IO, LCA) with measured impacts (NCA). Presenting one as the other undermines credibility.
- **Aggregation can hide trade-offs.** A single headline number may mask offsetting shifts between impact types (e.g., water vs. land use). Always check the underlying drivers.
- **Baselines are foundational.** Especially for NCA, a clear and consistent baseline is essential to judge change and compare across time. Invest effort here upfront.

- ◆ **Match method to purpose.** Avoid over-engineering (detailed methods where screening suffices) and under-engineering (screening methods used for compliance or site-level targets).
- ◆ **Evaluate quality across four dimensions.** Spatial precision, accuracy, responsiveness, and scalability should all be considered when selecting or interpreting a method.





There is no single “best” approach to biodiversity footprinting.

The right choice depends on an organisation's context, objectives, available data, and the decisions it needs to support. The tables below summarise how the three main approaches compare across key dimensions. This guidance is a starting point; the CircHive Decision Tree gives step-by-step help choosing the right method for your situation. Further reading and tool links are provided for organisations ready to move from understanding to implementation.

Scope	IO for BF	LCA for BF	NCA for BF	Operations
Whole organisation	Yes	Yes	Yes, subject to data availability	Yes, subject to data availability
Projects / sites	No	Selected methods	Yes	Yes
Products / services	No	Yes	Limited	No
Supply chains / Suppliers / Clients	Yes (sector level)	Yes	Needs supplier data	Needs supplier data
Financial Portfolios	Yes	With adjustments	No	No
Landscapes	No	No	Yes	Yes

Criterion	IO for BF	LCA for BF	NCA for BF	NCA for ES
Spatial precision	Low	Low to high	Medium to high	Medium to high
Accuracy	Low	Medium	Medium to high	Low to high
Responsiveness to interventions	Low	Medium	Medium to high	Low to high
Scalability	High	Low to medium	Low to medium	Low to medium

After reading the guide: Consult the **CircHive Biodiversity Footprinting Decision Tree** for step-by-step method selection support and to understand which approach best fits which organisational needs





It results from an in-depth review of 45 Biodiversity Footprinting methods. These can be categorised as follows:

Assessment approach	Assessment type	Assessment focus	Scope	Output type
Natural Capital Accounting (10)	Performace assessment (27)	Dependency (7)	Product (19)	Qualitative (2)
Life Cycle Assessment (30)	Risk assessment (13)	Impact (31)	Company / Production site (13)	Quantitative (35)
Input-Output Models (5)		Impact driver (12)	Business sector / investor portfolio (5)	Monetary (7)
			Global (2)	
			Country / region (5)	
			Local (1)	
			All levels (1)	

This guidance was developed by the CircHive project on the basis of its **Deliverable Synthesizing landscape of approaches for NCA and BF for private and public sectors (Bhattarai, I. et al. 2023).**



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