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ASSESSMENT OF BIODIVERSITY MEASUREMENT APPROACHES FOR BUSINESSES AND FINANCIAL INSTITUTIONS

EU Business @ Biodiversity Platform

UPDATE REPORT 4

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CONTENTS

READER'S GUIDE

This report is the fourth report in the "Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions" series, started by the European Business and Biodiversity Platform (EU B@B Platform) in 2018. Previous editions (2018, 2019, 2021) are available on the website of the EU B@B Platform[1].

The series of Update Reports reflects the rapid evolution in the development of biodiversity measurement approaches for businesses and financial institutions. As approaches are constantly improved and new tools are developed, the structure and content of the reports may vary from edition to edition.

This report includes three main updates and additions:

- Update of the Biodiversity Measurement Navigation Wheel
- Update on biodiversity and ecosystem services measurement approaches
- Link to the Align recommendations on measuring and valuing biodiversity.

The Biodiversity Measurement Navigation Wheel, as introduced in Update Report 3, provides a pragmatic decision framework to select the most suitable measurement approaches for a specific business context. It is underpinned by a range of criteria and tables that provide information about the key features of the measurement approaches. The range of criteria has now been expanded with a sector criterion (as some measurement tools are restricted to one specific sector).

The measurement approaches covered in this report have been carefully reviewed by the respective tool developers, to include methodological and scope-related updates. New in this Update Report 4 are *ecosystem services measurement* approaches, which complement the list of updated and newly added *biodiversity measurement* approaches.

Finally, this report attempts to illustrate the recently published Align[2] recommendations with specific examples of measurement approaches that, according to us, would be compliant with the 'good' and 'best' practice criteria provided by Align.

The Update Report 4 is structured as follows:

- Section 1: Overview of biodiversity measurement approaches analysed in this report
- Section 2: The Biodiversity Measurement Navigation Wheel 2.0
- Section 3: Conformity check with Align criteria
- ANNEX 1: Short descriptions of biodiversity measurement approaches covered by the Biodiversity Measurement Navigation Wheel version 2.0
- ANNEX 2: Short descriptions of ecosystem services measurement approaches covered by the Biodiversity Measurement Navigation Wheel version 2.0

We welcome new measurement approaches, new case studies and any constructive contribution from members of the EU B@B Platform and beyond for the development, alignment, and adoption of measurement approaches by businesses and financial institutions.

[1] https://ec.europa.eu/environment/biodiversity/business/workstreams/methods/index_en.htm

[2] The EU Business @ Biodiversity Platform | Home (europa.eu)

1 BIODIVERSITY MEASUREMENT APPROACHES COVERED IN THIS REPORT

Table 1 provides an overview of the biodiversity measurement approaches covered in this report. The information contained in this report builds on previous editions of this series, notably Update Report 3[3]. It has been updated following feedback received from developers. New approaches and their respective description are based on information received from developers or information collected online (mainly for open-source tools).

[3] Available at https://ec.europa.eu/environment/biodiversity/business/assets/pdf/EU%20B@B%20Platform%20Update%20Report%203_FINAL_1March2021.pdf

Table 1: Overview of biodiversity measurement approaches described in this report.

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
A. Approaches with one or more quality reviewed case studies[4]				
Biodiversity Footprint Financial Institutions (BFFI)	ASN Bank; CREM; PRé Sustainability	The BFFI is designed to provide an overall biodiversity footprint of the economic activities a financial institution (FI) invests in. The methodology allows calculation of the environmental impact and the environmental footprint of investments within an investment portfolio.	Operational	Info from Update Report 3 and additional internet research
Biodiversity Footprint Methodology (BFM)	SarVision; Plansup	The pressure-based methodology is used to quantify the biodiversity impact of a product, sector or company for the three major pressure types: Land use, GHG emission, and N and P emission to water. Cause - effect relations from GLOBIO are used and impact is calculated per part of the production chain. Used to determine which part of the chain leads to the highest impact, and to test effectiveness of company measures. The Biodiversity Footprint Calculator is a simple open source tool that allows to calculate the terrestrial impact of land use and GHG for most relevant parts of the production chain.	Operational	Updated by tool developer

[4] Quality reviewed case studies that illustrate the application of the majority of the measurement approaches that are described in this report, can be found in Update Report 3.

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Biodiversity Impact Metric (BIM)	Cambridge Institute for Sustainable Leadership (CISL)	The BIM can be used to assess and track how a business's sourcing affects nature, through the biodiversity lost as a result of agricultural production. The metric allows comparison of potential impacts across different sourcing locations and between commodities. The metric is an ideal entry-level approach that allows a company to undertake a rapid risk-screening of its sourcing in order to identify where the greatest impacts are likely to occur, thereby helping to prioritise further investigations and interventions.	Operational	Updated by tool developer
Biodiversity Indicator and Reporting System and Ecosystem Services Assessment (BIRS and ES assessment Holcim)	Ecoacsa; Holcim	The overall methodology – as elaborated by Ecoacsa – combines an approach for measuring habitats and species condition with an approach for measuring and monetizing ecosystem services. Habitats and species condition is measured by BIRS index (Biodiversity Indicator and Reporting System, developed by IUCN) and LBI (Long Term Biodiversity index, developed by Lafarge[5], IUCN France and WWF). Holcim is improving the methodology to assess how habitats (ecosystem assets) and social benefits from restoration evolve over time (ecosystem services flows). A template will be developed to facilitate and harmonize the assessment of natural assets extent and condition, social uses, as well of economic values over time to develop an integrated system of ecosystem services accounts.	Operational	Updated by tool developer

[5] Before merging with Holcim

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Biodiversity Indicators for Site-based Impacts (BISI)	UNEP-WCMC; Conservation International; Fauna & Flora International	It is a joint initiative between UNEP-WCMC, Conservation International and Fauna & Flora International, with support from IPIECA and the Proteus Partnership. The methodology provides an approach for companies with significant site-based impacts to understand their impacts on biodiversity and link this to their performance in mitigating them. The methodology is being piloted by extractives companies throughout 2019-2020.	Site-level stages are operational. Corporate-level stage piloted in 2021	Updated by tool developer
Biodiversity Net Gain Calculator (BNGC)	Arcadis	The Arcadis Biodiversity Net Gain Calculator (BNGC) has been developed to provide insight in the land use related biodiversity value at site level. The main purpose of the BNGC is to provide insight in the actual and potential biodiversity value of the different spatial units of the site by means of a metric built on extent, condition and significance. By means of field survey assessments by experienced ecologists a biodiversity value score between 0 and 1 is attributed to each spatial unit. It provides a pragmatic accounting approach allowing the company to verify compliance to 'no net loss' and to demonstrate 'net gain'.	Operational	Updated by tool developer
Corporate Biodiversity Footprint (CBF)	Iceberg Data Lab	The Corporate Biodiversity Footprint measures the impact of corporates on biodiversity. It is designed to serve the needs of financial institutions to have a science-based and scalable approach capable of covering large portfolios with a bottom-up approach covering the most material impacts of constituents throughout their value chain.	Operational	Updated by tool developer

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
GBS® for financial institutions (GBS®-FI), including Biodiversity Impact Analytics powered by the GBS® (BIA-GBS®)	CDC Biodiversité; Carbon4Finance	GBS® combined to company-level data from non-financial rating agencies and data providers. Provides data on the biodiversity impacts of a large universe of companies. The GBS® for financial institutions is actually made of several distinct tools, one with each data provider, including the Biodiversity Impacts Analytics (BIA) developed with Carbon4Finance.	Operational	Updated by tool developer
Global Biodiversity Score® (GBS®)	CDC Biodiversité	It provides an overall and synthetic vision of the biodiversity footprint of economic activities. It is measured by Mean Species Abundance (ratio between the observed biodiversity and the biodiversity in its pristine state), based on PBL Netherlands Environmental Assessment Agency's model of five terrestrial pressures (land use, nitrogen deposition, climate change, fragmentation, infrastructure/ encroachment) and 5 aquatic pressures, and their impacts on biodiversity.	Operational	Updated by tool developer
LIFE Methodology (LIFE)	LIFE Institute	The methodology provides quantitative information on a company´s performance (pressure and positive impacts on biodiversity) and provides strategic guidance to organizations to ensure the effectiveness of their conservation actions. Is characterized by being a robust and measurable methodology, integrating business and biodiversity, being adaptable to any country or region and applicable to companies of any size or sector.	Operational in Brazil and Paraguay, LIFE was adapted for Europe in 2020 with first pilots in 2021	Updated by tool developer

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Product Biodiversity Footprint (PBF)	I CARE; Sayari	PBF combines biodiversity studies and companies' data to quantify the impacts of a product on biodiversity along its life cycle stages. PBF provides guidance for product changes, especially in an ecodesign approach. PBF is also declined at site level, with a life cycle approach, taking into account direct impact of on-site operations and indirect impacts (off-site) related to site inbound and outbound flows.	Operational.	Updated by tool developer
ReCiPe	Radboud University; RIVM; Norwegian University of Science and Technology; PRé Sustainability	Life cycle impact assessment (LCIA) translates emissions and resource extractions into a limited number of environmental impact scores by means of so-called characterisation factors. There are two mainstream ways to derive characterisation factors, i.e. at midpoint level and at endpoint level. To further progress LCIA method development, the ReCiPe2008 method was updated to its version of 2016. Human health, ecosystem quality and resource scarcity as three areas of protection were implemented. Endpoint characterisation factors, directly related to the areas of protection, were derived from midpoint characterisation factors with a constant mid-to-endpoint factor per impact category. 17 midpoint impact categories were included. The update of ReCiPe provides characterisation factors that are representative for the global scale instead of the European scale, while maintaining the possibility for a number of impact categories to implement characterisation factors at a country and continental scale. The number of environmental interventions have been expanded and impacts of water use on human health, impacts of water use and climate change on freshwater ecosystems and impacts of water use and tropospheric ozone formation on terrestrial ecosystems were added as novel damage pathways.	Operational	From Update Report 3

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Species Threat Abatement and Restoration metric (STAR)	BirdLife International; Conservation International; IUCN; UNEP-WCMC	The STAR* measures the contribution that investments can make to reducing species extinction risk. It can help the finance industry and investors target their investments to achieve conservation outcomes, and can measure the contributions these investments make to global targets such as the Sustainable Development Goals.	Pilot testing in Indonesia, New Zealand and with other private sector operators finalized. Guidance notes for private sector users are available.	Updated by tool developer
B. Approaches without quality reviewed case studies				
Agrobiodiversity Index (ABDI)	Alliance of Bioversity International and CIAT	ABDI assesses risks in food and agriculture related to low agrobiodiversity. The framework is based on 22 indicators, assessing multiple components of agrobiodiversity in markets and consumption, agricultural production, genetic resource management, and related actions and commitment.	Piloting with an EC-funded project	Updated by tool developer
Biodiversity Integrated Assessment and Computation Tool (B-INTACT)	FAO	The B-INTACT tool developed by the FAO is a land-based accounting system that assesses the impacts on biodiversity of projects, programmes and policies implemented in the Agriculture, Forestry and Other Land Use (AFOLU) sector. The tool takes on both a quantitative and a qualitative approach. The quantitative approach assesses the impacts of four anthropogenic pressures on biodiversity. The qualitative approach guides the contextualization of the area and assesses the project's intended impacts on the landscape and on agrobiodiversity.	Operational	New; info from tool developer

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Biodiversity Metric 3.1	Natural England UK Department for Environment, Food & Rural Affairs (Defra)	The Biodiversity Metric 3.1 is a scoring system which uses habitats and their condition as a proxy to quantify biodiversity. This is a pragmatic, though well-balanced manner to measure and value biodiversity and is thus apt for businesses and developers. Furthermore, the system also incorporates the mitigation hierarchy and offers a framework in case offsetting is needed.	Operational	New; internet research
Biodiversity Monitoring System (BMS)	EU LIFE Initiative "Biodiversity in Standards and Labels for the Food Sector"	The tool (also elaborated in the frame of the EU LIFE Project "Biodiversity in standards and labels for the food sector") has been created to offer food standards and food companies the possibility to monitor indicators with relevance for biodiversity of their certified farms / their producers. The monitoring is divided into two levels. Level 1 monitoring is a system-wide approach with 25 indicators to evaluate the potential created for biodiversity (ecological structures, biotope-corridors, buffer zones, etc.) and the reduction of negative impacts on biodiversity (use of chemical pesticides and fertilizers, erosion, water use, etc.). Level 2 is yet to be developed and will include in-depth sampling beyond the scope of certification. It will monitor the mid- and long-term effects of certification on wild biodiversity on the farm and its immediate environment through selected key indicator species.	Piloting ongoing / operational	Updated by tool developer; internet research

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Biodiversity Performance Tool (BPT)	EU LIFE Initiative "Biodiversity in Standards and Labels for the Food Sector"	The Biodiversity Performance Tool (BPT) is being elaborated in the frame of the EU LIFE Project "Biodiversity in standards and labels for the food sector". This project aims at proposing a methodology to easily assess the integration of functional biodiversity at farm level for food sector actors (product quality or sourcing managers) as well as for certification companies (certifiers and auditors). The BPT should help farmers and farm advisors to elaborate and implement sound Biodiversity Action Plans, which contribute substantially to a better biodiversity performance on farm level. The tool will support auditors and certifiers of standards as well as product, quality and sourcing managers of food companies to better assess the preservation and improvement of integration of biodiversity at farm level.	Operational	Updated by tool developer
BioScope	Ministry of Economic Affairs; CODE; Arcadis; PRé Sustainability	BioScope provides users with an estimation of where the most important impacts on biodiversity in their supply chain could be. The use of country level data on economic activities and their impacts means that the confidence of the outcome is limited. For a complete impact assessment, subsequent steps will always remain necessary. The results of this tool are meant for internal purposes only and cannot be used for public communication. This is a first step into determining which of the purchased products and services may actually matter, allowing to focus on the relevant commodities and suppliers for managing the biodiversity risks and opportunities in a supply chain.	Operational, but not maintained	From Update Report 3

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
ECOPLAN Scenario Evaluator (ECOPLAN-SE)	University of Antwerp; Ghent University; KU Leuven; Flemish Institute for Technological Research; Institute for Nature and Forest Research	ECOPLAN-SE models the effects of spatial development project scenarios on the delivery of ecosystem services. The results are spatially explicit and are presented in an understandable way, so that they are comparable between scenarios. The tool consists of 18 different ecosystem service models, which are linked in one integrated model. This makes it possible to show the changes in the delivery of a particular ecosystem service when the delivery of another ecosystem service changes.	Operational	New; internet research
Ecosystem Services Identification & Inventory (ESII)	The Nature Conservancy; Dow Chemical Company; EcoMetrix Solutions Group	The ESII Tool helps non-ecologists make relative comparisons of the expected levels of ecosystem service performance across a given site, under a variety of conditions. As a planning-level tool, it can inform business decisions while enhancing the user's relationship with nature.	Operational	New; internet research
Environmental Profit & Loss (EP&L)	Kering	The EP&L measures carbon emissions, water consumption, air and water pollution, land use, and waste production along the entire supply chain, thereby making the various environmental impacts of the company's activities visible, quantifiable, and comparable. These impacts are then converted into monetary values to quantify the use of natural resources.	Operational	Internet research

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)	UNEP-WCMC	ENCORE's nature capital module enables users to visualise how the economy potentially depends on and impacts nature and how environmental change creates risks for businesses. The biodiversity module enables users to explore the potential alignment of financial activities in selected sectors (currently mining and agriculture) with a 'nature positive' future.	Operational	New; info from tool developer
Global Impact Database (GID)	Impact Institute	Global Impact Database quantitatively describes environmental, social and economic impact estimates for countries and sectors in the global economy, for the purpose of impact reporting and impact management. GID estimates this impact with input-output analysis based on data on trade between industries in various countries and their environmental, social and economic performance. GID includes positive and negative metrics for impact themes such as climate change, human health, human rights and more. It covers companies' own operations, upstream and downstream value chain, without double counting. Impact estimates are available in monetary units to facilitate comparison across impact themes. It is applicable for multiple asset classes.	Operational	New; info from tool developer
Integrated Biodiversity Assessment Tool (IBAT)	BirdLife International; Conservation International; IUCN; UNEP-WCMC	IBAT is a biodiversity data provider licensing commercial access to global biodiversity datasets and derived data layers consisting of the World Database on Protected Areas (WDPA), the World Database of Key Biodiversity Areas (WDKBA) and the IUCN Red List of Threatened Species™. IBAT also provides access to biodiversity reports that offer fast, easy and web-based methods of querying these global datasets to gain site-specific insights on biodiversity risk and opportunities. The Species Threat Abatement and Restoration Metric (STAR) is incorporated into IBAT.	Operational	New; info from tool developer; internet research

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Integrated Valuation of Ecosystem Services and Tradeoffs (INVEST)	Stanford University	InVEST is a suite of models used to map and value the goods and services from nature that sustain and fulfil human life. It helps explore how changes in ecosystems can lead to changes in the flows of many different benefits to people. The toolset includes distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems, as well as a number of "helper tools" to assist with locating and processing input data and with understanding and visualizing outputs.	Operational	New; internet research
Nature Value Explorer	Flemish Institute for Technological Research (VITO)	The nature value explorer is a free web-based tool that makes it possible to calculate the impact of a project in Flanders (Belgium) on ecosystem services in a qualitative, biophysical and monetary way. It quickly assesses the impact and makes it possible to compare scenarios and discuss with stakeholders.	Operational	New; internet research
READS	Repsol	READS is a natural capital valuation and accounting approach, based on the analysis of the relationship between the activities carried out by the energy industry and the components of natural capital stocks (plants, animals, air, water, etc.) and the ecosystem services they provide. The relationship is measured in economic terms and dimensionless (no unit) Impact Units.	Operational	New; info from tool developer

OVERVIEW OF BIODIVERSITY MEASUREMENT				
Name of biodiversity measurement approach	**Developer**	**Description**	**Status**	**Information source**
Toolkit for Ecosystem Service Site-Based Assessment (TESSA)	Anglia Ruskin University; BirdLife International; Royal Society for the Protection of Birds; Tropical Biology Association; UNEP-World Conservation Monitoring Centre; University of Cambridge; University of Southampton	TESSA provides accessible guidance on low-cost methods for how to evaluate the benefits people receive from nature at particular sites in order to generate information that can be used to influence decision making. A variety of practical resources are included in the toolkit, including detailed interview guides and step-by-step screen guides for online databases and modelling applications. Decision trees help determine which tools to use in a particular case and general guidance is provided on confidence measures of Ecosystem Services estimates using different methods.	Operational	New; internet research

2 THE BIODIVERSITY MEASUREMENT NAVIGATION WHEEL

2.1 Introduction

This chapter presents a **performant decision framework** for selecting biodiversity measurement tools and metrics that respond to specific business needs. The Biodiversity Measurement Navigation Wheel 1.0 was introduced in Update Report 3. The **Biodiversity Measurement Navigation Wheel 2.0** (see Figure 1) has the following key features[6]:

- It uses **7 main selection criteria**: business context, biodiversity pressures, biodiversity ambition, biodiversity scope, metrics, level of efforts, sector (*sector is a new criterion compared to version 1.0*);
- It offers a **'Fast Track' approach** as it allows for considering **multiple criteria at once** (e.g. no need to follow a sequential process of 'Yes' and 'No' questions);
- It relies on **easy-to-use overview tables** full of information on how tools can be differentiated based on specific criteria;
- It brings in **unique selection criteria** such as **information on accessibility, costs and efforts** and the **maturity level** of tools based on the application frequency for specific business contexts;
- It explicitly highlights the **possibility to combine approaches**, either sequentially (e.g. from risk identification to deep-dive) or in parallel (e.g. several site level approaches applied to one or more sites making use of different metrics);
- It also takes into account the **combination of different metrics**;
- It acknowledges the **different perspective of the financial sector** and made a start with an adapted version for that sector;
- It covers **29 biodiversity measurement approaches**; and,
- It has been built based on (updated) information from tool developers and on the thorough review of **16 quality reviewed** and **well elaborated case studies** (see Update Report 3).

The Biodiversity Measurement Navigation Wheel is a dynamic tool. To the extent possible it will be updated by the EU B@B Platform team to reflect the continuous evolutions in the field of biodiversity measurement, at the level of target setting, data collection, etc. The objective is to ensure it reflects the latest state of the art and the needs of the business community as the feedback from the EU B@B network suggests.

Acknowledging that not all business sectors have the same needs, the project team made first steps with regard to an approach which is more adapted to the finance sector. Please direct to Update Report 3 (chapter 2.4) to find out more on this topic.

2.2 Scope

The current version of the Biodiversity Measurement Navigation Wheel covers biodiversity measurement approaches for businesses and financial institutions. They provide quantitative information on the significance of impacts on biodiversity and – while informed by concrete application cases - they are not company specific but can be applied by a wide range of businesses. The latter is important, as businesses and financial institutions need approaches that can inform various management decisions and be applied by several companies and for different types of business applications, different levels of application (e.g. project, site), and in different locations.

[6] The presented version is version 2.0. We anticipate that the Navigation Wheel will be subject to updates based on new insights and a growing experience and will number new versions accordingly.

For this reason and without any prejudice to their value and usefulness, certain types of biodiversity measurement approaches are not included in this assessment, such as:

- Purely process-based approaches which only provide qualitative insights on the level of actions undertaken by a company in the field of biodiversity (but no quantitative impact). They rely on 'process indicators' (e.g. 'Do you have a biodiversity action plan?') rather than 'impact indicators'. Examples of such approaches include the European Biodiversity Standard[7], the Biodiversity Benchmark[8], and the Biodiversity Check[9]. Several approaches in this assessment report also include process indicators but only to complement the information collected on the basis of quantitative indicators.
- Approaches applied in Environmental Impact Assessment and similar types of specialized studies, which focus on a specific development in a specific area.
- Approaches which are company specific and which rely on a methodology which is not open source or which the company does not want to share.

However, future versions of the Biodiversity Measurement Navigation Wheel might provide guidance on how to combine qualitative and quantitative approaches and/or might include biodiversity risk assessment approaches.

Table 1 provides an overview of the 29 measurement approaches that are covered by the Navigation Wheel 2.0: 24 biodiversity measurement approaches and 5 ecosystem services measurement approaches. This table includes a short description of the tool, information on the developer, the state of the art in terms of development stage, and whether it concerns an updated or a new tool relative to Update Report 3. A detailed description of most of these tools is included in the Annexes to the Update Report 2. Quality reviewed case studies that illustrate the application of the majority of the measurement approaches that are described in this report, can be found in Update Report 3.

Compared to the Update Report 3, the following biodiversity measurement approaches were added in the assessment:

- READS
- Global Impact Database (GID)
- Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)
- Integrated Biodiversity Assessment Tool (IBAT)
- The Biodiversity Integrated Assessment and Computation Tool (B-INTACT)

This report also includes a description of a "biodiversity scoring system" and measurement approaches for ecosystem services:

- Biodiversity scoring systems are scoring systems that rely on extent and condition of habitats as a proxy for scoring biodiversity value. They are often developed at a national level (e.g. Biodiversity Metric 3.1 in the United Kingdom, Natuurpuntensysteem in the Netherlands, Okokonten in Germany) and therefore are not in scope of this assessment. However, the Biodiversity Metric 3.1 that is used in the UK is a very mature metric that also has gained some prominence outside the UK and is increasingly being used for 'no net loss' calculations by businesses. Therefore, we have decided to include the **Biodiversity Metric 3.1** in this Update report.
- Ecosystem Services measurement approaches (ES):
  - Ecosystem Services Identification & Inventory (ESII)
  - Nature Value Explorer
  - ECOPLAN scenario evaluator (ECOPLAN-SE)
  - Toolkit for Ecosystem Services Site-Based Assessment (TESSA)

[7] http://www.europeanbiodiversitystandard.eu/en
[8] https://www.wildlifetrusts.org/sites/default/files/2018-06/BBOM4%20Biodiversity%20Benchmark%20Requirements.pdf
[9] https://www.business-biodiversity.eu/docs/ebbc_index01.aspx?id=36799&basehrefrequ=true&isalias=true

- Integrated Valuation of Ecosystem Services and Tradeoffs (INVEST)

To maintain clarity and overview, the measurement approaches that are mainly applied for the calculation of ecosystem services are displayed in the tables and matrix in a cluster under the abbreviation ES or "ecosystem services measurement approaches". This abbreviation represents the following measurement approaches: ESII, Nature Value Explorer, ECOPLAN-SE, TESSA and INVEST.

ANNEX 2 provides an overview of the 5 ecosystem services measurement approaches that are covered by the Navigation Wheel 2.0. This annex includes a short description of the tool, information on the developer and the state of the art in terms of development stage.

Compared to the Update Report 3, the following tools were removed from the assessment:

- Biological Diversity Protocol[10] (BD Protocol), as this concerns an accounting framework instead of a measurement approach.
- The Biodiversity Footprint Calculator, as this is now fully integrated in the description of the Biodiversity Footprint Methodology (BFM). In the previous report they were still discussed separately. The focus is on the BFM which describes the real methodology that is behind the measurement approach. To improve user-friendliness, the BFC was developed as an online tool that is purely based on the BFM Methodology, and thus is not considered as a separate approach. Nevertheless, reference is made to the BFC throughout the report, as the Calculator is a valuable tool and complements the BFM.

2.3 The Biodiversity Measurement Navigation Wheel 2.0 for Businesses

Any business or financial institution deciding to quantitatively assess the impact of its activities on biodiversity faces many questions, from the level at which this impact must be assessed, to the type of pressures that must be measured, or the type of metrics that the assessment should deliver. Evidently, the costs and level of effort associated with different measurement approaches will also affect the choice of the preferred tool or approach.

Each company will approach this decision from its specific context and is likely to put more emphasis on some criteria than others. The Biodiversity Measurement Navigation Wheel addresses this complexity and offers flexibility in applying these decision criteria, by providing multiple entry points for users to follow, rather than a prescribed sequential process that may not fit well with user needs.

As mentioned before, compared to version 1.0, an additional criterion "Sector Applicability" is added to distinguish the sector to which the measurement approach applies.

How does it work?

The **Biodiversity Measurement Navigation Wheel 2.0 for businesses** presented below is structured around the seven criteria that were identified as impacting the selection of a measurement approach or tool by a business. It has been designed from a user perspective and the businesses approaching this question can decide which criteria they wish to take into account in their decision.

Each of the seven criteria is briefly introduced below and discussed in more detail in the **Navigation Wheel Support Table** (Table 2). This Table provides further guidance on how to address each of the seven criteria. Sections 2.3.1 to 2.3.7 then go in the details of the seven criteria. The seven criteria are:

[10] Note that this specifically concerns the protocol, not the associated tool.

- **Business context**: This criterion is composed of the business applications (BA) and organizational focus areas (OFA) and is key for selecting a suitable measurement approach. This is presented in the Business Context Matrix under section 2.3.1. This matrix also includes information on the maturity of the measurement approaches;
- **Biodiversity pressures**: Businesses will look for a tool, or combination of tools, that covers those pressures which are material to their own activities. The spectrum of pressures covered by the different tools ranges from only one pressure (e.g. land use) to multiple pressures. The Biodiversity Pressures Table presented in section 2.3.2 offers an updated overview of the pressures which are covered by the different measurement approaches;
- **Biodiversity ambitions**: An increasing number of businesses are committing to biodiversity ambitions or targets such as 'no net loss' or 'science-based targets for nature' and some tools are more suitable for measuring progress against specific targets than others. As such this might be a relevant selection criterion for some businesses. The Biodiversity Ambitions Table presented in section 2.3.3 offers more insights on this decision criterion;
- **Biodiversity scope**: Biodiversity has multiple dimensions and a business will need to decide which dimension(s) will be measured, e.g. only habitats/species or also ecosystem services? Even genetic diversity can be measured. The Biodiversity Scope Table presented in section 2.3.4 brings clarity about this criterion;
- **Biodiversity metrics**: There are different metrics for measuring biodiversity and they all have their advantages and disadvantages. The Biodiversity Metrics Table in section 2.3.5 explains which metrics are used by which tools and provides suggestions on how to combine these metrics; and,
- **Level of efforts**: The level of expertise required for applying the tools and the accessibility of the different measurement approaches (i.e. whether they are open source or not) differ considerably, as do their costs and the efforts required for applying them. Evidently this might be an important selection criterion. The Effort Table presented in section 2.3.6 provides an overview of the level of effort associated with each tool.
- **Sector**: In update of the previous report, an additional criterion is added to distinguish the sector to which the measurement approach applies (section 2.3.7). In the Sector Table a distinction is made between the marine, finance and agriculture sector and tools that can cover a broad spectrum of sectors.

Applying the Biodiversity Measurement Navigation Wheel works best by systematically eliminating the approaches that do not fit with a business's preferred selection criteria.

There is no specific hierarchy among the criteria, providing full flexibility to the user based on their specific needs. It is however recommended to start with the criteria focusing on the Business Context as it will eliminate a number of approaches and provide a sound basis for the selection process. Moreover, starting with this criterion is aligned with the step-by-step approach of the Natural Capital Protocol.

The approaches remaining after application of the Business Context criterion should be assessed one-by-one based on the other six selection criteria.

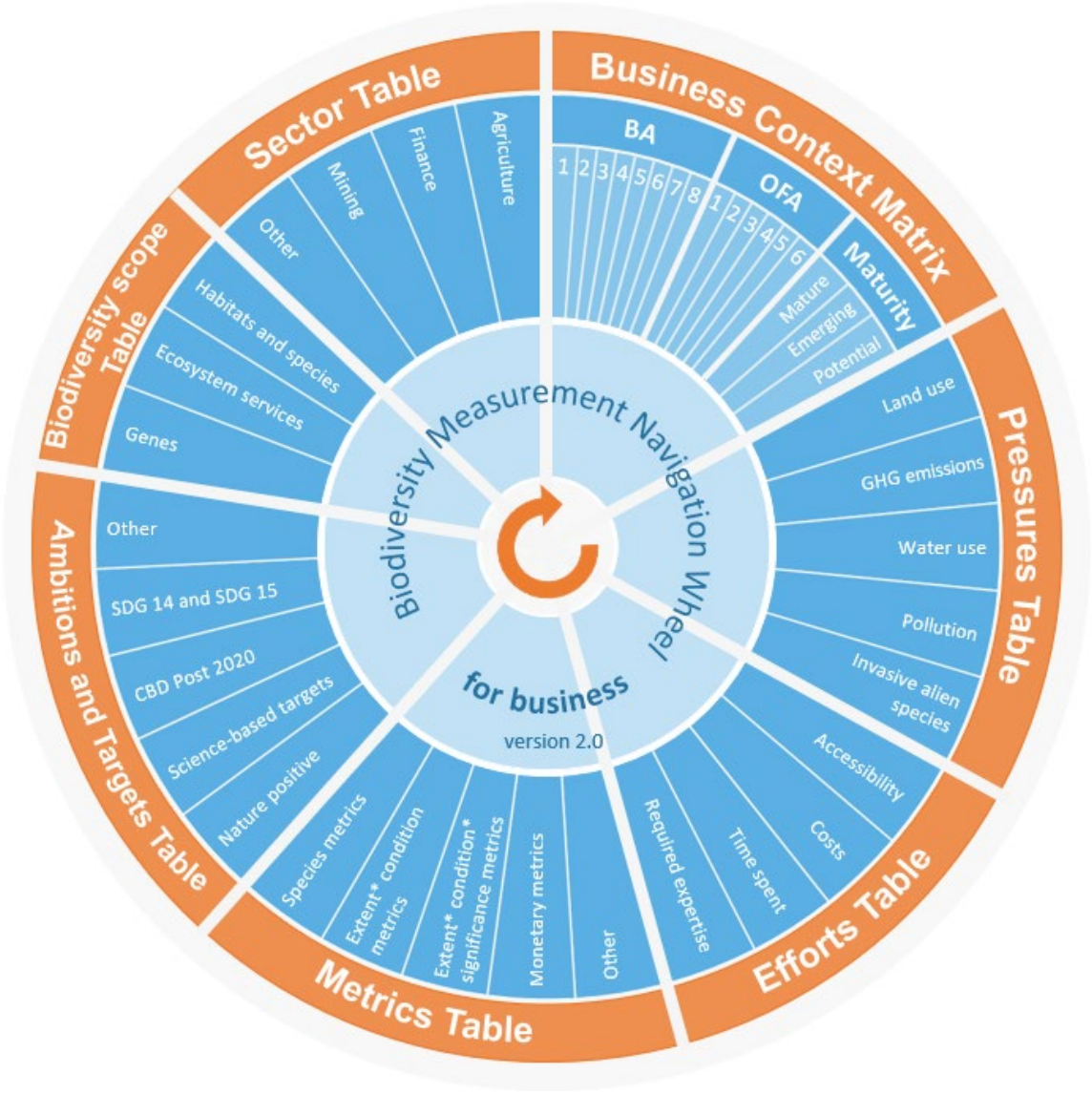


Figure 1: The Biodiversity Measurement Navigation Wheel 2.0 for Business

Table 2: Support table of the Navigation Wheel

NAVIGATION WHEEL SUPPORT TABLE (green boxes provide clarifications and blue boxes provide guidance for selecting tools and metrics)			
Criteria	**Navigation questions**	**Guidance**	
BUSINESS CONTEXT			
Business application (BA)	1. *What is the objective of the measurement?*	• See Box 2 with overview and clarification of 7 different types of business applications **BOX 2 on BA**	**Select relevant BA – OFA combination and corresponding tools, informed by information on level of maturity** **Business Context Business Context Matrix**
Organisational focus area (OFA)	2. *Does biodiversity need to be measured at corporate level? Or rather at product level, project level, site level, supply chain level?*	• See Box 3 with overview and clarification of 6 different organizational focus areas **BOX 3 on OFA**	
Maturity level	3. *Have available tools for a given BA-OFA combination proved to be applicable?*	• 3 different levels of maturity are distinguished (mature, emerging, potential)	
BIODIVERSITY PRESSURES			
Pressures	1. *Which are the pressures on biodiversity that need to be covered by the measurement approach?* 2. *Which approach or combination of approaches covers these pressures?*	**Select tools or combination of tools that cover the pressures which are relevant for your company** **Biodiversity Pressures Table**	
BIODIVERSITY SCOPE			
Biodiversity scope	1. *Does the measurement approach need to measure impacts on species and habitats?* 2. *Does the measurement approach need to measure ecosystem services benefits?* 3. *Does the measurement approach need to measure genetic diversity?*	**Select tools that are suitable for your particular biodiversity scope** **Biodiversity Scope Table**	
BIODIVERSITY AMBITIONS			
Ambitions	1. *Has the company defined/committed to a specific biodiversity ambition (e.g. 'nature positive')?* 2. *Which measurement approaches do allow me to track progress towards company targets on biodiversity?* 3. *Which metrics are suitable for tracking progress towards company targets on biodiversity?* 4. *Am I clear on how to define the baseline?*	**Select tools and metrics which are suitable for tracking progress to target by applying BA3 'tracking progress to targets' in the business context matrix and by using the Ambitions Table and the Biodiversity Metrics Table** **Business Context Matrix** **Ambitions Table** **Biodiversity Metrics Table**	

NAVIGATION WHEEL SUPPORT TABLE (green boxes provide clarifications and blue boxes provide guidance for selecting tools and metrics)		
Criteria	**Navigation questions**	**Guidance**
BIODIVERSITY METRICS		
	1. *Are quantified results sufficient (i.e. quantified pressures, quantified biodiversity impacts and/or state) or do I need to have monetized outcomes?* 2. *Does the measurement approach cover the relevant 'biodiversity features' for the BA and ambition/target that I have defined?* 3. *Can I combine several metrics to obtain a more comprehensive picture of biodiversity?*	**Select most appropriate metrics or combination of metrics in combination with respective tools** **Biodiversity Metrics Table**
LEVEL OF EFFORTS		
Required expertise	1. *Do you have the required expertise to apply the measurement approach?*	**Select tools which are compatible with the available budget and time** **Effort Table**
Accessibility	2. *Is the measurement approach open source or commercial?*	
Costs	3. *Which budget am I prepared to pay for purchasing software, consultancy?*	
Time investment	4. *What time efforts am I prepared to invest in applying the measurement approach (including training, data collection, ...)?*	
SECTOR		
Sector	1. *To which sector does the measurement approach apply?*	**Select tools that are suitable for your sector** **Sector**

2.3.1 Business Context

In the majority of cases the combination of **business application (BA)** and **organizational focus area (OFA)** will be a key criterion for selecting a suitable measurement approach. Typically, this business context is applied as the first criterion in the selection process, which is in line with the steps of the Natural Capital Protocol[11].

More information on the concept of business applications and the description of the categories of business applications is included in Box 2. More information on the concept of organizational focus area and the respective categories is provided in Box 3.

Once you have decided on a BA-OFA combination, the range of possible measurement approaches will already be much more (purpose) focused (see the Business Context Matrix in Figure 2).

The Business Context Matrix also contains information on the **maturity level of the measurement approaches for each specific BA-OFA combination** which is claimed by the respective tool developers. Three levels of maturity are distinguished:

- Mature: the approach has been applied successfully at least 3 times by business to the specific BA-OFA combination
- Emerging: the approach has only been applied 1 or 2 times to the specific BA-OFA combination
- Potential: the approach has not been applied yet to the specific BA-OFA combination, but tool developers claim that the approach can be applied.

Key findings from this business context matrix are the following (focus on product, site, supply chain and corporate level as these are most relevant from a business perspective):

- Most tools are addressing 'measuring current performance' and 'comparing options';
- The tools are mostly applied at product, site and supply chain level and only to a limited extent at corporate level;
- The maturity level of tools is relatively high for product level measurements which is due to the fact that these approaches are LCA-based and have strong methodological basis to start from (although proper integration of biodiversity in LCA is challenging and is currently subject of ongoing research[12]);
- There is much untapped potential as many tools haven't been applied on their full range of potential applications;
- Some tools cover different organizational focus areas which can be relevant for obtaining corporate figures (aggregation of outcomes over different organizational focus areas);
- This matrix provides a first insight on how tools can be combined in order to cover the range of business applications and organizational focus areas a company is interested in. A good example is the application of risk screening tools as a first step, to be followed by more in-depth measurements by other tools. However, combining tools over different organizational focus areas for obtaining an outcome at corporate level will require additional insights such as aggregation potential of metrics (see 2.3.5) and level of coverage of pressures (see 2.3.2).

[11] Business application is Step 2 of the Protocol ('Define your objective' – Action 3 'Articulate the objective of your assessment') and organizational focus area is Step 3 of the Protocol ('Scope the assessment' – Action 1 'Determine the organizational focus' and Action 2 'Determine the value chain boundary')
[12] As an example, efforts are ongoing to have biodiversity better integrated in the Product Environmental Footprint (PEF)

ORGANISATIONAL FOCUS AREAS (OFA) →

BUSINESS APPLICATIONS (BA) ↓

BA	Product / service	Site / project	Supply chain	Corporate	Portfolio / sector	Country / region
1 Current performance	ABDI, BFM, BPT, PBF, ReCiPe, BioScope, GID	ABDI, BFFI, BIRS, BISI, BMS, BNGC, READS, IBAT, ES; BPT, CBF, GBS, LIFE, PBF, STAR, B-INT, BM 3.1	ABDI, BFM, BIM, BMS, CBF, GID, IBAT, ENCORE; EP&L, GBS, LIFE, PBF, ReCiPe, BioScope, STAR	ABDI, BFFI, BFM, BIM, BISI, PBF, READS, IBAT; BMS, CBF, EP&L, GBS, LIFE, STAR, GID, ENCORE	ABDI, BFFI, BFM, BIRS, PBF, B-INT, GID, IBAT; CBF, GBS, GBS-FI, LIFE, STAR, READS, ENCORE	ABDI, LIFE, STAR, B-INT, GID, READS
2 Future performance	BFM, BPT, PBF, ReCiPe, BioScope	BPT, BNGC, GBS, READS, ES; LIFE, PBF, STAR, B-INT, BM 3.1	BFM, BIM, EP&L; PBF, LIFE, STAR	BIM, CBF, EP&L, READS; GBS, LIFE, STAR	BFFI, BFM, CBF, ENCORE; STAR, B-INT, READS	STAR, B-INT, READS
3 Tracking target progress	ABDI, BPT, PBF, ReCiPe, BioScope, GID	ABDI, BFFI, BISI, BNGC, READS, B-INT, ES; BPT, CBF, LIFE, PBF, STAR, BM 3.1	ABDI, BIM, BMS, EP&L; LIFE, PBF, STAR, GID	ABDI, BFFI, BIM, BISI, PBF, READS; CBF, EP&L, GBS, LIFE, STAR, GID	BFFI, CBF, PBF, B-INT, GBS-FI; STAR, GID, READS, ENCORE	ABDI, STAR, B-INT, GID, READS
4 Comparing options	ABDI, BFM, BPT, PBF, ReCiPe, BioScope, GID	ABDI, BFFI, BIRS, BISI, BPT, READS, IBAT, ES; CBF, GBS, LIFE, PBF, STAR, B-INT, BM 3.1	ABDI, BFM, BIM, BMS, EP&L, IBAT, GID; GBS, LIFE, PBF, ReCiPe, BioScope, STAR	ABDI, BFFI, BFM, BIM, BISI, GID, IBAT; CBF, EP&L, GBS, LIFE, PBF, READS	BFFI, BFM, BIRS, PBF, B-INT, IBAT; GBS-FI, STAR, GID, READS, CBF	ABDI, STAR, B-INT, GID, READS
5 Third party assessments / ratings		CBF, IBAT, ES; READS, STAR, BM 3.1	IBAT; STAR	CBF, IBAT; STAR	BFFI, CBF, STAR; GBS-FI, IBAT, READS	READS
6 Third party certification		BMS, CBF, IBAT, ES; LIFE, STAR, BM 3.1	BMS, IBAT; STAR	BMS, IBAT; CBF, STAR	CBF, IBAT; STAR	
7 Risk & opportunity assessment	BPT, GID	ABDI, BFFI, BISI, BNGC, READS, IBAT, ES; BPT, CBF, STAR, LIFE, B-INT, BM 3.1	BIM, EP&L, IBAT; STAR, GID, ENCORE	ABDI, BFFI, BIM, BISI, READS, IBAT; CBF, EP&L, GBS, LIFE, GID, ENCORE	BFFI, CBF, GBS-FI, ENCORE, IBAT; STAR, B-INT, GID, READS, LIFE	ABDI, B-INT, GID, READS

Figure 2: BA - OFA matrix of biodiversity measurement approaches for the business community.

ABBREVIATIONS

- **ABDI**: Agrobiodiversity Index
- **BM 3.1**: Biodiversity Metric 3.1
- **BFM**: Biodiversity Footprint Methodology
- **BFFI**: Biodiversity Footprint for Financial Institutions
- **BIM**: Biodiversity Impact Metric
- **B-INT**: B-INTACT, Biodiversity Integrated Assessment and Computation Tool
- **BioScope:** /
- **BIRS**: Biodiversity Indicator and Reporting System LafargeHolcim
- **BISI**: Biodiversity Indicators for Site-based Impacts
- **BMS**: Biodiversity Monitoring System
- **BNGC**: Biodiversity Net Gain Calculator
- **BPT**: Biodiversity Performance Tool
- **CBF**: Corporate Biodiversity Footprint
- **ENCORE**: Exploring Natural Capital Opportunities, Risks and Exposure
- **EP&L**: Environmental Profit & Loss
- **ES**: Ecosystem services measurement approaches (ESII, Nature Value Explorer, ECOPLAN-SE, TESSA, INVEST)
- **GBS**: Global Biodiversity Score®
- **GBS-FI**: Global Biodiversity Score® for Financial Institutions
- **GID**: Global Impact Database
- **IBAT**: Integrated Biodiversity Assessment Tool
- **LIFE**: LIFE Methodology
- **PBF**: Product Biodiversity Footprint
- **READS**: /
- **ReCiPe**: /
- **STAR**: Species Threat Abatement and Restoration Metric

MATURITY

- Potential
- Emerging
- Mature

BOX 2: Business applications for the business community

The concept of 'business applications' (BAs) in a natural capital context is introduced in the Natural Capital Protocol (2016) [13]. It is defined as "the intended use of the results of your natural capital assessment, to help inform decision making".

In the 2019 Update Report 2 and the 2021 Update Report 3 on the Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions[14], **8 different BA** were distinguished, including biodiversity accounting. This typology has been referred to by other leading initiatives e.g. Biodiversity Guidance to NCP and by several tool developers such as UNEP WCMC (for the BISI tool) and CDC Biodiversité (for GBS® tool) in their latest methodological updates. However, as accounting is a different approach and in principle can be done with the measurement outcomes of any biodiversity measurement approach, it was decided to remove it from the list of BA (see also Align recommendations for a standard on biodiversity measurement and valuation, which also includes a section on biodiversity accounting).

The BA 'internal reporting and external disclosure' is not included in the list as it is not a differentiating element for the selection of the most appropriate biodiversity measurement approach for a company's specific purposes.

BA 1: Assessment of current biodiversity performance	*This is a very common BA. A company might do this just to demonstrate that it's doing well in terms of biodiversity performance, or simply to know its current level of performance. It could be part of BA 3 (tracking progress to targets), 4 (comparing options) or 7 (assessing risks and/or opportunities).*
BA 2: Assessment of future biodiversity performance	*A company might be interested in assessing future biodiversity performance as a result of, for instance positive impact actions (e.g. restoration actions and/or actions that reduce pressures on biodiversity) or changes in its activities.*
BA 3: Tracking progress to targets	*Companies that have set targets on biodiversity performance will need to track progress periodically. There are many categories of targets (see Biodiversity Ambitions Table in section 2.3.3).*

[13] More specifically, see Table 1.2 in the Natural Capital Protocol: https://capitalscoalition.org/capitals-approach/natural-capital-protocol/?fwp_filter_tabs=guide_supplement (direct link to the report: : https://capitalscoalition.org/wp-content/uploads/2021/01/NCC_Protocol.pdf)

[14] https://ec.europa.eu/environment/biodiversity/business/assets/pdf/European_B@B_platform_report_biodiversity_assessment_2019_FINAL_5Dec2019.pdf

BA 4: Comparing options	*A company might want to compare the impact of different options on biodiversity. Although the focus of the biodiversity measurement tools is on measuring biodiversity impacts, any decisions will also rely on economic considerations. While some tools have explicitly integrated an economic indicator other tools provide useful input for an internal cost benefit analysis.* *This BA can inform different levels of decision. Some examples of this BA:* • *Which site offers least harm to biodiversity values?* • *Which mitigation measures offer best result in terms of both ecological and economic terms?* • *Which product scores best considering both biodiversity performance and economic return?* • *Which investments in biodiversity conservation or restoration score offer the best value for money?* • *Which supply chains are riskier from a biodiversity point of view?* • *Which companies within a sector are performing best (according to rating agencies)?* • *Which sectors are performing best in terms of biodiversity (for investment decisions by Fis)?*
BA 5: Assessment / rating of biodiversity performance by third parties, using external data	*Third party assessment based on biodiversity criteria and fed with external data (into the absence of company data). This can be applied to compare company biodiversity performance across a sector.* *This is typically a BA applied by many financial institutions or by data providers to these FI*
BA 6: Certification by third parties	*Third party certification based on auditing of a clearly established methodological approach.*
BA 7: Screening and assessment of biodiversity risks and opportunities	*Biodiversity measurement approaches can be used, for instance in case of due diligence assessments as part of mergers and acquisitions, or assessment undertaken by investors to differentiate between investment options, either based on the biodiversity performance or return on investment of different companies. This might also be undertaken by FI to assess biodiversity risk and inform pricing credit.* *This application often, but not always, overlaps with BA 4.*

BOX 3: Organisational focus areas for the business community

A second filter that could be used to select appropriate biodiversity measures, is the **organizational focus area** of the approach. For businesses, the following organizational focus areas are distinguished:

- Product or service level
- Site and project level
- Supply chain level, i.e. upstream part of the value chain[15]
- Corporate level, i.e. covering all activities (value chain, all locations)
- Sector or portfolio level[16] .

These **organisational focus areas** do not completely align with the Natural Capital Protocol. It is a simplified combination of the focus areas distinguished in the Protocol, which was made to prevent complicating overlaps. The "value chain focus area" as defined by the Natural Capital Protocol, i.e. upstream, direct operations, and downstream is fully covered: 'supply chain' is 'upstream', 'site/project' is 'direct operations' and 'product/service' covers the whole value chain as biodiversity measurement tools for products are LCA (Life Cycle Analysis) based. Portfolio and sector are added as this is a specific focus area for financial institutions.

We have added 'country / region' as an additional organizational focus area in recognition of the trend towards alignment between approaches developed for public authorities and approaches for businesses. Some measurement approaches are designed to support this level of decision making. Specific tools that have been developed with a primary focus on national or subnational geographical areas (e.g. GLOBIO) are not included in the assessment.

BOX 4: Business Context in the Align recommendations

In the Align recommendation for a standard on biodiversity measurement and valuation, two main organizational focus areas are covered: site/project level and supply chain level. The Navigation Wheel covers six organizational focus areas.

Align provides good practice and best practice criteria for two core business needs: screening risks and opportunities and measuring impacts to biodiversity state. The first business need from Align corresponds to BA7 (Screening and assessment of biodiversity risks and opportunities) while measuring impacts connects closely with BA1 (Current biodiversity performance), BA2 (Future biodiversity performance), BA3 (Tracking progress to targets) and BA4 (Comparing options) in the Navigation Wheel.

When a selected BA-OFA combination overlaps with the BA and OFA discussed in Align (e.g. the combination 'current performance' and 'site/project' overlaps in Align with measuring biodiversity at site/project level), it is worth checking the Align's technical criteria in terms of the good and best practices.

Align also considers spatial precision, accuracy, responsiveness to change and feasibility to apply at scale as factors in selecting a measurement approach.

[15] It is possible that in a next iteration of this report series supply chain will be further split into 'commodities' and 'farm level' as there are a number of tools that specifically address farm level (e.g. Coolfarm, Biodiversity Performance Tool, Biodiversity Monitoring Tool, ….)

[16] Sector or portfolio level is mainly relevant for financial institutions. It is possible that in a next iteration of this report series this OFA will disappear from the BA-OFA matrix for business

2.3.2 Biodiversity Pressures

In most cases, not all drivers of biodiversity loss ('pressures') are material for a company. Companies will look for a tool or combination of tools that covers those pressures which are material from the company's perspective. The spectrum of pressures covered by the different tools ranges from a single pressure (e.g. land use) to multiple pressures. The **Biodiversity Pressures Table** (Table 3) below offers a simplified and concise overview of the pressures which are covered by the different measurement approaches, and therefore is only indicative. Full details can be found in the more detailed Biodiversity Pressures Table in Annex 2 of Update Report 3[17].

The Biodiversity Pressures Table provides the following insights:

- The Product Biodiversity Footprint (PBF), the Integrated Biodiversity Assessment Tool (IBAT), and the Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) natural capital module cover all pressures. PBF covers products and sites (Site Biodiversity Footprint Approach), and at this stage it must be acknowledged that coverage of overexploitation and invasive alien species has not been widely applied.
- All biodiversity measurement approaches but the Agrobiodiversity Index (ABDI) cover land use, while the picture for other pressures is mixed.
- Global Biodiversity Score® (GBS®), Biodiversity Footprint Methodology (BFM), Biodiversity Impact Metric (BIM) and Corporate Biodiversity Footprint (CBF) rely on GLOBIO; GBS® and CBF are very similar in terms of covered pressures.

The Biodiversity Pressures Table offers no insight in the level of measurement accuracy. Land use related biodiversity impacts can be either based on modelled calculations relying on global maps but can also be based on field surveys. Accuracy levels can be different for different pressure groups covered within the same biodiversity measurement approach. Information on accuracy of measurement is not included in this report but might be in a next update report. For now, information can be found in:

- The Annexes of the Update 2 Report which provide detailed information for a series of measurement approaches covered by the Biodiversity Measurement Navigation Wheel 2.0;
- The Biodiversity Metrics Table (see2.3.5): some metrics are inherently more accurate than others;
- The Effort Table (see 2.3.6): generally, increased accuracy requires increased efforts for data collection.

BOX 5: Biodiversity Pressures in the Align recommendations

In the Align recommendations for a standard on biodiversity measurement and valuation, the best practice criteria for measuring biodiversity at site and project level state that measurement should be based on data on material impact drivers. This is compatible with the Navigation Wheel, as companies will look for a tool or combination of tools that covers those pressures which are material from the company's perspective.

While the Biodiversity Pressures Table offers no insight in the level of measurement accuracy, Align provides good and best practice recommendations on accuracy. Medium accuracy complies with good practice criteria at site and project level, i.e. measures should reflect potential presence and impacts on species and ecosystems, but they do not need to be ground-truthed by collecting primary data. Compliance to Align's best practice criteria at site and project level requires a high accuracy level: the measures should in this case reflect the actual, ground-truthed presence of impacts on species and ecosystems. In the case of supply chain level, low accuracy is still good practice: the tool should be able to measure potential impact based on sector-average impact driver data. To be compliant to the best practice criteria, the accuracy level can be medium, i.e. the potential impact can be based on company-specific impact driver data.

[17] Available at https://ec.europa.eu/environment/biodiversity/business/assets/pdf/EU%20B@B%20Platform%20Update%20Report%203_FINAL_1March2021.pdf

Furthermore, Align provides technical criteria on the spatial precision (medium for good practice, high for best practice at site and project level; low for good practice and medium for best practice at supply chain level) and on responsiveness (this should be medium: the tool should be responsive to changes in impact drivers, it should be able to reflect how changes in pressures affect biodiversity). Both for good and best practice criteria, Align states the feasibility of the tool (the applicability for screening) should be high.

Table 9, Table 10 and Table 11 show the applicable tools compliant with the good and best practice criteria from Align for respectively measuring ecosystem and species (Table 9), site/project level (Table 10) and supply chain level (Table 11).

Table 3: Navigation Wheel – Biodiversity Pressures table

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor)								
Biodiversity measurement approach	**Land / sea use change**	**Direct exploitation[18]**		**Invasive alien species**	**Pollution**		**Climate change**	**Other**
		Biological Resource Use (e.g. overfishing)	**Water Use**		**Atmospheric nitrogen deposition**	**Nutrient emissions to water**		
Agrobiodiversity Index (ABDI)	O	X	X	O	O	X	O	O
B-INTACT	X	X	X[19]	X	O	O[20]	O	Human encroachment, habitat fragmentation, infrastructure
Biodiversity Footprint Financial Institutions (BFFI)	X	O	X	O	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
Biodiversity Footprint Methodology (BFM)	X	O	X[21]	O	O	X	X	O
Biodiversity Impact Metric (BIM)	X	O	LUIF	O	O	LUIF	O	O

[18] 'Water use' is considered under 'direct exploitation' according to IPBES categorization of drivers of biodiversity loss
[19] Are working to include aquatic biodiversity which will analyze in a quantitative way water use and nutrient emissions to water
[20] Are working to include aquatic biodiversity which will analyze in a quantitative way water use and nutrient emissions to water
[21] Only for The Netherlands

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor)

Biodiversity measurement approach	Land / sea use change	Direct exploitation[18]		Invasive alien species	Pollution		Climate change	Other
		Biological Resource Use (e.g. overfishing)	Water Use		Atmospheric nitrogen deposition	Nutrient emissions to water		
Biodiversity Indicators for Site based Impacts (BISI)	X	X	X	X	X	X	O	Air quality, noise and light disturbance, hunting
Biodiversity Metric 3.1	X	O	O	X	O	O	O	O
Biodiversity Monitoring System (BMS)	X	O	X	X	O	X	O	Erosion, pesticide use
Biodiversity Net Gain Calculator (BNGC)	X	O	X	X	O	X	O	Noise and light disturbance
Biodiversity Performance Tool (BPT)	X	O	X	X	O	X	O	Erosion, pesticide use
BioScope	X	O	X	O	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
BIRS and ES assessment Holcim	X	O	O	X	O	O	O	O

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor)								
Biodiversity measurement approach	**Land / sea use change**	**Direct exploitation[18]**		**Invasive alien species**	**Pollution**		**Climate change**	**Other**
		Biological Resource Use (e.g. overfishing)	**Water Use**		**Atmospheric nitrogen deposition**	**Nutrient emissions to water**		
Corporate Biodiversity Footprint (CBF)	X	O	O	O	X	X	X	Terrestrial acidification and eutrophication Freshwater ecotoxicity
Ecosystem services measurement approaches (ESII, Nature Value Explorer, ECOPLAN-SE, TESSA and INVEST)	X	X	X	(O)	X	X	X	Other ecosystem services such as pollination, coastal protection, food provisioning, cultural and recreational benefits etc.
Environmental Profit & Loss (EP&L)	X	O	X	O	X	X	X	Impact of solid waste disposal
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) natural capital module	X	X	X	X	X	X	X	

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor)								
Biodiversity measurement approach	**Land / sea use change**	**Direct exploitation[18]**		**Invasive alien species**	**Pollution**		**Climate change**	**Other**
		Biological Resource Use (e.g. overfishing)	**Water Use**		**Atmospheric nitrogen deposition**	**Nutrient emissions to water**		
GBS® for financial institutions (GBS®-FI), including Biodiversity Impact Analytics powered by the GBS® (BIA-GBS®)	X	O	X	O	X	X	X	Encroachment, fragmentation, land use in catchment of rivers and wetlands, terrestrial and freshwater ecotoxicity
Global Biodiversity Score® (GBS®)	X	O	X	O	X	X	X	Encroachment, fragmentation, land use in catchment of rivers and wetlands, terrestrial and freshwater ecotoxicity
Global Impact Database (GID)	LUIF	O	O	O	O	X	X	Terrestrial acidification, terrestrial/freshwater ecotoxicity, photochemical oxidant formation
Integrated Biodiversity Assessment Tool (IBAT)	X	X	X	X	X	X	X	See https://www.iucnredlist.org/resources/threat-classification-scheme
LIFE Methodology	X	O	X	O	X	X	X	Impact of solid waste disposal

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor)								
Biodiversity measurement approach	**Land / sea use change**	**Direct exploitation[18]**		**Invasive alien species**	**Pollution**		**Climate change**	**Other**
		Biological Resource Use (e.g. overfishing)	**Water Use**		**Atmospheric nitrogen deposition**	**Nutrient emissions to water**		
Product Biodiversity Footprint (PBF)	X	X	X	X	X	X	X	Marine and freshwater eutrophication / freshwater ecotoxicity / terrestrial acidification
READS	X	X	X	O	X	O	X	Fauna collisions and electrocutions, light, terrestrial/marine noise, air emissions (NO_x, SO_2, PM), terrestrial/marine ecotoxicity (process and production chemicals discharge, hazardous waste disposal, and contaminated land)
ReCiPe	X	O	X	O	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
Species Threat Abatement and Restoration metric (STAR)	X	X	X	X	O	X	X	Wide range of pressures, including energy production & mining, human intrusion & disturbance, droughts, etc.

2.3.3 Biodiversity Ambitions

A key business application of measuring biodiversity is 'tracking progress to targets' (BA 3 in Box 2, see 2.3.1). An increasing number of companies is committing to biodiversity ambitions or targets such as 'no net loss', 'nature positive'[22] or 'Science-Based Targets for Nature' and some tools are more suitable for demonstrating compliance or measuring progress to targets than others. As a consequence, this might be a relevant selection criterion for some companies.

A range of biodiversity ambitions, targets and goals is set out below. A good understanding of these targets will be useful to guide the selection of an appropriate biodiversity measurement tool.

The Biodiversity Ambitions Table (Table 4) provides the following insights:

- By the time of publication of this report, the outcomes of COP15 were not known (December 2022). Nevertheless, the expectation is that there will be a common vision on the Global Goal for Nature (implications for a 'nature positive' target).
- Despite a general consensus on the fact that businesses will have their role to play in achieving this global goal, there is less clarity on what it means to be a 'nature positive' company. Given the challenges related to becoming a fully 'nature positive' company, it is expected that the majority of businesses will commit to start a 'nature positive' journey. The EU Business and Biodiversity Platform has elaborated a 'current working definition' what this should mean[23].
- Highly relevant in the context of setting ambitions is the Science-Based Targets for Nature network (SBTN). Guidance has only been published for steps 1 (identifying material issues) and 2 (prioritizing) while guidance on step 3 (setting targets) is only expected in 2023 and later.
- Based on current indications regarding contents and direction of these biodiversity target frameworks, companies will need to rely on a combination of biodiversity measurement approaches. Today, there is no *single* tool available that addresses *all* expected requirements. But also vice-versa, none of the tools can be qualified yet as not suitable for tracking progress to these targets (albeit partially).
- The choice is clearer with regard to measuring against a 'no net loss' or 'net gain' target, as far as land use impacts at site level are considered. In that case, the Biodiversity Net Gain Calculator (BNGC) is a suitable tool.
- Marine biodiversity, covered by SDG 14, is poorly addressed by the assessed biodiversity measurement tools. STAR and READS might offer a solution.

BOX 6: Biodiversity Ambitions in the Align recommendations

The Align project aims to ensure integration of credible approaches to measure and value corporate biodiversity impacts and dependence within broader sustainability measurement and disclosure efforts. The Align recommendations are developed with the intention that they will be adopted by standard setting bodies.

By now (Nov 2022), Align does not provide technical criteria on 'nature, but this will be covered in the remaining part of Align (2023 until middle of 2024).

[22] See for instance Business for Nature's pledge for 'reversing nature loss by 2030' (Advocate — Business For Nature) and the B@B Platform's current working definition of 'nature positive' (published 11 October 2022).
[23] EU B@B_Platform_Current working definition Nature Positive.pdf (europa.eu)

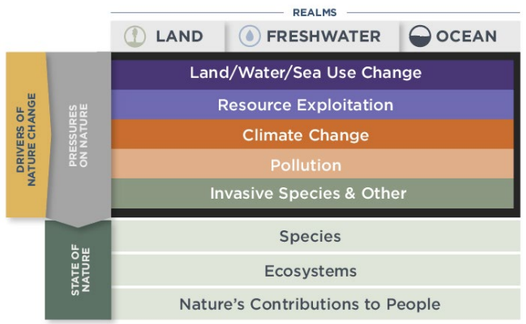
Table 4: Navigation Wheel – Biodiversity Ambitions table

BIODIVERSITY AMBITIONS TABLE			
Biodiversity targets	**Description**	**Consequences for tool selection**	**Suitable tools**
CBD post-2020 biodiversity targets	The Global Biodiversity Framework (GBF) that will be negotiated and decided at COP15 in Montreal will also have important consequences for the business community, as decisions will need to be translated into national legislation by each of the participating countries. By the time of publication of this report, the outcomes of COP15 (December 2022) were not known. Nevertheless, the expectation is that at least on the following issues with relevance for the business community decisions will be taken: • The Global Goal for Nature (bending the curve of biodiversity decline from 2020 into 'net gain' in 2030 and full recovery of nature by 2050) will most likely be adopted as a common goal for all stakeholders, including the business community; this means that an increased number of businesses and financial institutions will engage on a journey towards 'nature positive' ('nature positive' target either at company level, or at sector level, landscape level, etc.). • Target on mandatory disclosure by businesses and financial institutions of impacts and dependencies on biodiversity • Target on protection of biodiversity ("By 2030, protect and conserve through well connected and effective system of protected areas and other effective area-based conservation measures at least 30 per cent of the planet with the focus on areas particularly important for biodiversity"). • Target on reduction of pollution ("By 2030, reduce pollution from all sources, including reducing excess nutrients [by x%], biocides [by x%], plastic waste [by x%] to levels that are not harmful to biodiversity and ecosystem functions and human health"). • Target on reduction of pressures ("By 2030, achieve reduction of at least [50%] in negative impacts on biodiversity by ensuring production practices and supply chains are sustainable"). • Target on eliminating harmful subsidies ("By 2030, redirect, repurpose, reform or eliminate incentives harmful for biodiversity, including [X] reduction in the most harmful subsidies, ensuring that incentives, including public and private economic and regulatory incentives, are either positive or neutral for biodiversity.") Furthermore, decisions will be taken on the monitoring framework. Extensive lists of indicators are included in the latest documents[24].	Although many targets will mainly apply at international and national level, it can be expected that these types of targets will also trickle down to the business community. The expected outcomes at COP15 will most probably affect the selection of biodiversity measurement tools and metrics in the following way: • Increased importance of measuring biodiversity performance (e.g. mandatory reporting is already being established at EU level[25] and will now apply globally); this will positively affect all approaches • Increased demand for demonstrating compliance to the Global Goal for Nature. This will drive the application of corporate biodiversity accounting approaches based on measurement approaches which are suited for measuring and comparing positive and negative impacts on biodiversity • Increased demand for tools that can measure pressure reduction at corporate level • Increased demand for tools that can measure and value ecosystem services • Increased demand for tools that can (also) measure biodiversity performance in marine environments • Calculating production and consumption footprints will be in favor of LCA approaches. • Metrics related to risk identification and interpretation will probably become more important.	Measurement approaches will need to be combined to cover: • Both impacts and dependencies • Both habitats/species and ecosystem services (see Biodiversity Scope Table) • All material pressures to biodiversity (see Pressures Table) • The whole value chain including the consumption phase (LCA approaches for covering consumption phase too) • Terrestrial, freshwater and marine biodiversity as far as relevant for the company • Also risks and opportunities on top of impacts and dependencies • Accounting approaches (e.g. Biological Diversity Protocol) based on underlying measurement approaches that are suited for measuring and comparing positive and negative impacts (e.g. losses and gain in extent/condition of habitats) Application of these targets at site level opens the door to more specific site-level measurement tools which also can be combined.

[24] DRAFT DECISIONS FOR THE FIFTEENTH MEETING OF THE CONFERENCE OF THE PARTIES TO THE CONVENTION ON BIOLOGICAL DIVERSITY (cbd.int)

[25] CSR Directive

BIODIVERSITY AMBITIONS TABLE

Biodiversity targets	Description	Consequences for tool selection	Suitable tools
Science Based Targets for Nature	How much should a company contribute to biodiversity restoration and/or conservation? Science-based targets (SBTs) aim to provide a rigorous, objective and transparent process for companies to answer this question and to develop measurable, actionable and evidence-based targets aligned with societal environmental sustainability goals. A broad coalition of organisations and companies are developing SBTs for terrestrial, marine and freshwater realms. Methods are being developed to assess the scale and geographical location of negative impacts on biodiversity to avoid, restore, regenerate and transform these impacts, to establish a mechanism to allocate responsibility, and to carry out monitoring, reporting and verification. SBTN is promoting a 5-steps approach and has published guidance to cover step 1 (identification of material issues in the value chain) and step 2 (prioritization) while guidance on how to define targets (step 3) will only become available from 2023 on, together with guidance on step 4 (taking action) and step 5 (monitoring). For climate, global goals can be translated into tonnes of carbon emissions and this can be apportioned across individual companies using a single measure – $tC0_2e$. A science-based target for biodiversity is more complicated than the target for carbon emissions for two main reasons: 1. Biodiversity has multiple facets – species, ecosystems, ecosystem services, genes for example – and so cannot be expressed by a single measure such as $tC0_2e$. 2. Biodiversity is place-specific, so a given impact (e.g. loss of 1 ha of an ecosystem) in one part of the world is not equivalent to a similar impact in another. Science-based targets for biodiversity **will therefore require the use of multiple metrics**. SBTN's initial guidance sets out the scope of components of biodiversity and pressures on it that companies will need to assess (Figure 3). Detailed guidance on appropriate metrics and assessment tools is being developed. In the meantime, companies can use the scope of SBTs as set out in the initial guidance as a framework to guide their choice of biodiversity assessment approach, and can also register with SBTN to share their experiences and pilot new methods.  *Figure 3: The planned scope of SBTs for nature. Companies wishing to set SBTs will first need to assess their impacts on these components of biodiversity and their contribution to the five drivers of nature change*	From Figure 3 it looks like measuring compliance to science based targets for nature will require fulfillment of the following conditions: • Not only species (and habitats) should be measured but also ecosystem services ('nature's contributions to people') • All material pressures will need to be covered in all 'realms', i.e. land, freshwater and marine ecosystems. Current SBTN guidance also suggests that material impacts and dependencies on biodiversity should be identified and assessed throughout the whole value chain. Measurement approaches that cover more pressures are better placed than those that only cover one pressure, unless the latter are more accurate (which is always better from a science-based perspective) and can replace part of the outcomes in more comprehensive but less accurate tools. Measurement approaches will need to be scientifically robust. It is not clear yet how the announced detailed guidance on appropriate metrics and assessment tools will look like and if on that basis the use of certain measurement approaches will be promoted and the use of other approaches will be discouraged.	Measurement approaches will need to be combined to cover: • Both habitats/species and ecosystem services (see Biodiversity Scope Table) • All material pressures to biodiversity (see Pressures Table) • The whole value chain including the consumption phase (LCA approaches for covering consumption phase too) • Terrestrial, freshwater and marine biodiversity as far as relevant for the company • Impacts and dependencies.
'No net loss' / 'net gain'	'No net loss' or 'net gain' commitments within the context of the biodiversity mitigation hierarchy are increasingly being adopted by business. The UK government, for example, have mandated a 'net gain' commitment for all new spatial planning developments[26]. Such ambitions might also be included in the CBD post-2020 biodiversity targets (see above). 'No net loss' / 'net gain' can be a specific site level target in 'nature positive' ambitions for biodiversity. However, next to biodiversity, the full scope of 'nature positive' also includes land, fresh water & oceans, and atmosphere.	See comment related to interpretation of scope under 'CBD post 2020 biodiversity targets'. Most 'no net loss' / 'net gain' approaches nowadays are restricted to land use and rely on a extent*condition metric or an extent*condition*significance metric (see Metrics Table)	Biodiversity Net Gain Calculator. All measurement approaches making use of national 'no net loss' metrics if available[27] (e.g. Biodiversity Metric 3.1, Dutch Natuurpunten)

[26] https://deframedia.blog.gov.uk/2019/03/13/government-to-mandate-biodiversity-net-gain/
[27] Not discussed in this report

BIODIVERSITY AMBITIONS TABLE

Biodiversity targets	Description	Consequences for tool selection	Suitable tools
Sustainable Development Goals	Corporate disclosure of progress against the SDGs is increasing. However, indications are that the biodiversity focused targets (SDG 14,15) currently are not well addressed by companies[28]. It should be noted that these goals are well aligned with Aichi Targets and most likely also with the post 2020 GBF (see above), so approaches aiming to support one should also support the other. Measurement approaches that can demonstrate contribution to these targets are likely to resonate with the private sector. Those most relevant to businesses are listed below. It should be noted that many targets require updated timelines. **SDG 14 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development'** • *14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution* • *14.4: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics* **SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss** • *15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements* • *15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally* • *15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world* • *15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species* • *15.8: By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species*	Biodiversity measurement approaches that specifically address the marine environment are rather scarce, unfortunately. However, the topics included under 14.1 (pollution) and 14.4 (overfishing) might require specific measurement approaches. Companies who have identified plastic debris as a material issue in their value chain (e.g. consumption phase) will need to develop specific KPIs that allow measuring progress. Same for overfishing: there are several data sources and certification systems in place where companies can rely on to reduce their impact (e.g. retailers). Other threats to marine wildlife which are not explicitly mentioned by SDG 14 and its indicators are disturbance to seabirds (barrier effect) and marine mammals (underwater noise) by the construction and operation of offshore wind farms. With regard to 'life on land' (SDG 15) a specific topic relates to forests (e.g. sustainable forest management, halting deforestation) Threatened species is another KPI under SDG 15. Some measurement approaches explicitly rely on such metrics. Restoring degraded land is another important target under SDG 15 and highly relevant for companies with agricultural supply chains. Finally, invasive alien species (IAS) is another relevant driver for biodiversity loss which can be tackled by many companies. Due to its local presence IAS is hard to cover in generic models like Globio and ReCiPe and therefore can only be measured by methods relying on field surveys. Attempts are being done to incorporate IAS in LCA approaches but this requires additional literature review to include specific information in LCA.	None of the assessed biodiversity measurement approaches in this report, apart from STAR, qualifies as sufficiently solid for measuring a company's marine biodiversity impact (SDG 14). Due to the coverage of threatened marine species by STAR and the link to specific activities which are affecting the status of species, application of STAR is worth exploring. ReCiPe-based approaches cover some marine biodiversity threats (see Pressures Table). READS is able to identify material environmental aspects and impacts related to noise in the marine environment and covers pressures related to marine ecotoxicity (see Pressures Table). With regard to SDG 15, approaches making use of MSA and PDF and relying on models such as Globio and ReCiPe can provide a rough idea of the biodiversity impact related to land use intensity categories. Similar to its use in marine ecosystems, STAR can also be useful in terrestrial and freshwater ecosystems. Data sources focusing on the state and extent of forests (satellite imagery) are definitely a very useful tool for measuring deforestation and afforestation in supply chains of certain commodities. Invasive alien species are only covered by some site level tools such as the Biodiversity Net Gain Calculator (BNGC) and the Biodiversity Indicators for Site level Impacts (BISI) approach.
ISO 14001, EMAS	Environmental management system requirements (e.g., ISO 14001, EMAS) are more process level oriented targets, describing how an organisation should be organized in order to continuously improve in environmental performance.	As mentioned under Scope (see 2.2) purely process-based approaches are not covered in this assessment. Evidently, evidence of application of biodiversity measurement approaches based on quantified indicators will be considered as a strong point by external auditors.	LIFE Methodology includes a process related assessment.

[28] KPMG (2018) How to report on the SDGs. What good looks like and why it matters.

BIODIVERSITY AMBITIONS TABLE			
Biodiversity targets	**Description**	**Consequences for tool selection**	**Suitable tools**
Voluntary standards at sector level or product level	Compliance to voluntary standards at sector or product level that aim to preserve biodiversity as its main focus (e.g. Roundtable on Sustainable Palm Oil RSPO) or secondary focus (e.g. EU Ecolabel) is another type of target. The spectrum of biodiversity requirements under these voluntary standards can be very different. As an example, the ASI standard for the aluminium sector[29] requires adherence to the biodiversity mitigation hierarchy (requiring offsets if needed) and tackling the issue of invasive alien species.	Tools will need to be selected with respect to the specific biodiversity requirements of the voluntary standard	Dependent on specific requirements.
Voluntary biodiversity assessment and reporting frameworks	Voluntary disclosure initiatives and frameworks are GRI, CDP and increasingly TNFD (Taskforce for Nature Related Financial Disclosure). These are all under development and are expected to be finalised in 2023. While GRI's biodiversity standard is being revised and CDP is making first steps with including biodiversity disclosure requirements within their climate standard, TNFD is rapidly emerging as a key disclosure initiative. It's focus is very much on reporting risks and opportunities and much attention is being paid to location-specific impacts and dependencies which result in risks.	The increased focus on location related risks resulting from impacts and dependencies drives the demand for tools that provide information on location-specific biodiversity values and dependencies. IBAT is a key information source. ENCORE provides information on dependencies but so far only at a sector level and to a minor extent at a location level.	IBAT, ENCORE
Voluntary biodiversity agreements	Companies can also undersign so-called 'green deals' with public agencies or can establish cooperation with conservation NGOs, all of them entailing specific requirements to be compliant with.	Tools will need to be selected with respect to the specific biodiversity requirements of the voluntary agreement	No preference
Regulatory and permitting requirements	Evidently, also in the field of biodiversity there is plenty of legislation that companies need to be compliant with. Examples within the EU are the obligations of the Birds and Habitats Directives (site level impacts), the Product Environmental Footprint PEF (product level impacts)[30] and on short term the Green Claims initiative stricter obligations under the revised Non-Financial Reporting Directive (extended by the recently approved Corporate Sustainability Reporting Directive (CSRD)), as well as the Taxonomy on sustainable finance products (including biodiversity criteria).	Tools will need to be selected with respect to the specific biodiversity requirements of the regulation. And this might go beyond the suite of tools which are covered in this report. As an example, compliance to the Birds and Habitats Directive will often require the preparation of a so called Appropriate Assessment, which is a kind of in-depth EIA focused on the specific protected species and habitats of the protected Natura 2000 site in question.	No preference (apart from LCA based approaches for PEF and Green Claims)
Financial institutions requirements	International financial institutions do increasingly request guarantees that projects are implemented with full respect to biodiversity (e.g. International Finance Corporation Performance Standard 6)	This refers to project level	Biodiversity Indicators for Site-based Impacts (BISI) provides a good solution here, at least as an initial assessment of wildlife related impacts. The Biodiversity Metric 3.1 is another suitable approach for measuring 'no net loss' or 'net gain' in the context of IFC PS6. As IFC PS 6 also requires investigating ecosystem services additional ES focused approaches will be required too (and this doesn't require monetized outcomes).

[29] ASI Performance Standard - Aluminium Stewardship Initiative (aluminium-stewardship.org)

[30] At this moment, biodiversity is only indirectly and insufficiently addressed in PEF. Efforts are underway to increase the 'weight' of biodiversity in LCA approaches underpinning the PEF

BIODIVERSITY AMBITIONS TABLE			
Biodiversity targets	**Description**	**Consequences for tool selection**	**Suitable tools**
Site to landscape level commitments	These are location specific commitments in the field of biodiversity conservation. These commitments can be underwritten towards a local government agency or an NGO in charge of a river catchment area or a protected area. Very often a landscape level multi stakeholder approach is applied, with the company as one of the stakeholders. Also companies having committed to work towards 'nature positive' will need to set landscape level targets to achieved by cooperating with other actors in the landscape. It often makes much more sense to work towards a common 'nature positive' goal at a landscape level instead of trying to become fully 'nature positive' at a company level. The same applies to supply chains.	Depending on the scope of this type of commitments, this might require he application of site level tools or supply chain level tools or a combination of both.	Selection of landscapes or sites within the supply chain of a certain commodity might require the application of supply chain tools such as BIM (on condition of sufficient granularity of sourcing locations). Site or landscape level assessments might require tailored solutions with involvement of stakeholders or application of site level tools such as Biodiversity Indicators for Site-based Impacts (BISI), Biodiversity Net Gain Calculator (BNGC), …
Specific corporate-level biodiversity commitments or engagements	Many companies and financial institutions commit e.g. to avoid operating in high biodiversity value areas, to exclude purchasing of non-certified palm oil, wood, etc. These are detailed in the corporate biodiversity policy/strategy and apply to all activities of the company. Financial institutions apply ESG exclusion criteria and benchmarking approaches (e.g. 'best in class').	In many cases, this rather requires the use of biodiversity data sources instead of biodiversity measurement approaches. Financial institutions can apply tools allowing to measure 'best in class'.	This aspect is included in the scoring system of the LIFE Methodology. Data providers to financial institutions can make use of specific tools such as Corporate Biodiversity Footprint (CBF) and Global Biodiversity Score® for Financial Institutions (GBS®-FI)

2.3.4 Biodiversity Scope

Biodiversity has multiple dimensions and a company will need to decide which dimensions are pertinent and material and should therefore be measured. Will only wildlife features be measured (habitats and species)? Or is the company interested in measuring and valuing ecosystem services and dependencies, for instance in the context of risk assessment and management? In certain cases, there might even be a need to measure genetic diversity (i.e. when linked to resilience of ecosystem services or genetic crop diversity).

The **Biodiversity Scope Table (**Table 5**)** below provides insights on the biodiversity scope covered by the assessed biodiversity measurement approaches. These insights show that the majority of biodiversity measurement approaches covers habitats and species, and to a lesser extent ecosystem services. In practice, ecosystem services are usually measured by means of a specific ecosystem services measurement approach. With regard to genes, only the B-INTACT approach partially (qualitatively) covers genetic biodiversity.

Table 5: Navigation Wheel – Biodiversity scope table

BIODIVERSITY SCOPE TABLE (X: covered, (X): only covered qualitatively, O: not covered)			
Biodiversity measurement approach	**Habitats / Species**	**Ecosystem Services**	**Genes**
Agrobiodiversity Index (ABDI)	X	(X)	O
B-INTACT	X	X	(X)
Biodiversity Footprint Financial Institutions (BFFI)	X	O	O
Biodiversity Footprint Methodology (BFM)	X	O	O
Biodiversity Impact Metric (BIM)	X	O	O
Biodiversity Indicators for Site-based Impacts (BISI)[31]	X	O	O
Biodiversity Metric 3.1	X	O	O
Biodiversity Monitoring System (BMS)	X	X/O	O
Biodiversity Net Gain Calculator (BNGC)	X	O	O
Biodiversity Performance Tool (BPT)	X	X/O	O

[31] BISI is the updated name for BIE (Biodiversity Impact of Extractive industries)

BIODIVERSITY SCOPE TABLE (X: covered, (X): only covered qualitatively, O: not covered)

Biodiversity measurement approach	Habitats / Species	Ecosystem Services	Genes
BioScope	X	O	O
BIRS and ES assessment Holcim	X	X	O
Corporate Biodiversity Footprint (CBF)	X	O	O
Ecosystem Services measurement approaches (ESII, Nature Value Explorer, ECOPLAN-SE, TESSA and INVEST)	(X)	X	O
Environmental Profit & Loss (EP&L)	X	X	O
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) Natural capital module	X	X	O
GBS® for financial institutions (GBS®-FI)	X	X (dependencies)	O
Global Biodiversity Score® (GBS®)	X	X (dependencies)	O
Global Impact Database (GID)	X	X	O
Integrated Biodiversity Assessment Tool (IBAT)	X	O	O
LIFE Methodology (LIFE)	X	(X)	O
Product Biodiversity Footprint (PBF)	X	O	O
READS	X	X	O
ReCiPe	X	O	O
Species Threat Abatement and Restoration metric (STAR)	X	O	O

BOX 7: Biodiversity Scope in the Align recommendations

In the Align recommendations for a standard on biodiversity measurement and valuation, ecosystems, species, and genes are considered as the components of biodiversity to be measured. Align provides universal recommendations on biodiversity measurement. Furthermore, it developed good and best practice technical criteria for collecting species and ecosystem data (based on expert opinions). These technical criteria help to achieve robust data collection.

Best practice data collection can help address some of the limitations associated with different methodologies (e.g. accuracy or spatial precision in models).

An overview of the good and best practice criteria for collecting species and ecosystem data from the Align recommendations, and the applicable tools to use, can be found in Table 9 in the chapter on Align.

Chapter 6 of the Align recommendations is about the valuation of impacts and dependencies and covers ecosystem services. Align provides universal recommendations on valuation but it does not provide technical criteria or good and best practices to measure ecosystem services.

Genetic diversity is also a key aspect of biodiversity but Align does not provide technical criteria for the measurement of genetic diversity.

2.3.5 Biodiversity Metrics

There are different metrics for measuring biodiversity and they all have their pro's and cons. The **Biodiversity Metrics Table** brings clarification and explains which metrics are used by which tools.

The Biodiversity Metrics Table (Table 6) – mainly focused on state indicators for biodiversity – provides the following insights:

- It confirms the perception that biodiversity is hard to express by one single metric suitable for all types of business applications (see Box 2) and/or organizational focus areas (see Box 3);
- Extent, condition and significance are generally accepted elements of an appropriate biodiversity metric, i.e. a metric that reflects the real biodiversity value quite well;
- Model-based approaches (Globio or ReCiPe based) relying on metrics such as MSA (mean species abundance) and PDF (potentially disappeared fraction of species) have the advantage of allowing aggregation of results over different organizational focus areas but they lack the 'local dimension' of biodiversity which is inherent to biodiversity ('biodiversity is location specific') and which is often provided by a significance parameter;
- Approaches heavily relying on 'significance', such as STAR ('threatened species'), also allow aggregation, but they overlook biodiversity values that are not covered by the IUCN Threatened Species List, and which can be very relevant in areas with a smaller amount of species covered by the IUCN Red Lists;
- Financial metrics representing a monetized ecosystem services value of biodiversity measure a completely different dimension of biodiversity;
- There is a large number of thematic metrics in the field of biodiversity, 'deforestation free' and 'palm oil free' being some of the best-known examples.

The choice of the biodiversity metric is very important, as it might have serious consequences for decision making, as illustrated in Box 8 below.

BOX 8: The implication of using different measurement approaches for decision making

Example 1: **a company considers transforming two patches of natural forest into intensive agriculture.** Two patches of forest are considered for development – forest A and forest B. In the example, both are large patches of contiguous intact forest with healthy ecosystems. Forest A hosts a few hundred species and only one endangered species while Forest B hosts a couple of thousands of species and many endangered species. Intactness metrics like MSA and PDF will consider both forests equivalent because they are both undisturbed. So the company might decide to cut down the Forest B. Species-focused metrics like the risk of extinction will value the Forest B more because of its high number of species and in particular endangered species. Results from ecosystem service metrics like the natural capital value will depend on the potential beneficiaries of the services provided by both forests.

Example 2: another company is considering developing an undisturbed grassland with a few dozen species and no endangered species, far from any human activity.
Intactness metrics will warn against the destruction of this undisturbed area. Species-focused metrics will conversely conclude that based on the low number of species losses will be limited. Ecosystem service metrics will similarly consider that given the lack of beneficiaries this ecosystem has a low value. However, the development of such an ecosystem would still lead to the complete loss of ecological functions, and potentially put at risk the survival of species whose habitats would be destroyed.

(*Source: Update 2 Report; box developed by Joshua Berger, CDC Biodiversité*)

In line with the need to combine biodiversity measurement approaches to cover multiple angles of biodiversity measurement (see also Ambitions Table in 2.3.3), there will be an increased need for combining biodiversity metrics. Similar to dashboards full of financial indicators, environmental or biodiversity dashboards can include a suite of indicators ranging from pressure indicators (on biodiversity) to state indicators and even financial indicators.

BOX 9: Biodiversity Metrics in the Align recommendations

In the Align recommendations for a standard on biodiversity measurement and valuation, chapter 3 is dedicated to indicators and metrics for biodiversity. Align provides universal recommendations on indicators and metrics. It does not provide specific technical criteria. Align states that several metrics reflecting the multiple components of biodiversity are needed to understand changes in the state of biodiversity (which may be combined to develop a composite index). It acknowledges that the state of biodiversity cannot be described with one single metric, in contrast to the carbon indicator used for climate assessments. Align provides examples of indicators for various aspects of biodiversity, and recognizes that other indicators will exist for each aspect. This is compatible with the conclusions from the Navigation Wheel. The number of metrics/indicators available is likely to increase as the science and available approaches further develop.

Table 6: Navigation Wheel: Biodiversity metrics table

BIODIVERSITY METRICS TABLE						
Type of metric	**Commonly used metrics**	**Unit of biodiversity**	**Key points**	**Used for**	**Scale of analysis**	**Approaches relying on these metrics**
Species metrics	Number of individuals	Number of individuals of any one species	Enables impacts to any one species to be offset by improving populations of the same species elsewhere; requires precise monitoring of species population numbers	Simple easily communicated compensation for impacts to key species	Project or site scale	• Requires specific species related inventory approaches. • Agrobiodiversity Index (**ABDI**); • Biodiversity Indicators for Site-based Impacts (**BISI**); • **READS**
	STAR (Species Threat Abatement and Restoration metric)	Globally threatened species	Measures opportunity to reduce species extinction risk; based on threats to CR, EN, VU, and NT species. Scores are weighted by threat status and the size of species ranges in a given area.	Compare potential threat abatement and restoration actions, set science-based targets, and track progress over time.	Any scale	• Exploring Natural Capital Opportunities, Risks and Exposure (**ENCORE**) biodiversity module; • **READS**; • Species Threat Abatement and Restoration Metric (**STAR**) **(IBAT)**
Extent * Condition metrics	Habitat hectares; quality hectares	Ecosystems	Compares the condition (or quality) of an ecosystem to a standard reference level	Measuring losses and gains within the same ecosystem type; used by many biodiversity offset schemes (for offsets within the same ecosystem type)	Project or site scale	• **READS**; • Agrobiodiversity Index (**ABDI**)

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
	MSA Mean species abundance	All species	Arithmetic mean of all species abundances; all species weighted equally (so common species increasing can mask other species becoming extinct); based on regressions between the intensity of each pressure and their impacts on species abundances; impact data from a large and growing database of published studies.	Impact assessment and Life Cycle Analysis using GLOBIO model	Product, corporate or global scale	• **B-INTACT**; • Biodiversity Impact Metric (**BIM**); • Biodiversity Footprint Methodology (**BFM**); • Corporate Biodiversity Footprint (**CBF**); • **ENCORE**[32]; • Global Biodiversity Score® (**GBS®**); • Global Impact Database (**GID**)
	PDF Potentially disappeared fraction	All species	Local number of species (does not measure declines in species populations); all species weighted equally; based on regressions between the intensity of each pressure and their impacts on species persistence; impact data from a large and growing database of published studies;	Impact assessment and Life Cycle Analysis using ReCiPe model (e.g. Impact World +;)	Product, corporate or global scale	• Biodiversity Footprint for Financial Institutions (**BFFI**); • Global Impact Database (**GID**); • Product Biodiversity Footprint (**PBF**); • **ReCiPe, BioScope**
Extent (or Area) * Condition (or Quality) *Significance metrics	Biodiversity Intactness Index (BII)	All species	Modelled (or expert-derived) species population densities in different land-use intensities, weighted by species richness for the ecoregion; all species weighted equally (so increased 'weedy' species can lead to a higher score); only terrestrial	Impact assessment and Life Cycle Analysis using PREDICTS model	Product, corporate or global scale	None of the assessed approaches

[32] ENCORE's Biodiversity Module (adjusted using CISL's BIM approach)

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
	Biodiversity Impact Metric (BIM)	All species	Uses MSA for the condition and 'range rarity' by ecoregion for the significance	Supply chain assessments and impact assessments	Product, corporate or global scale	Biodiversity Impact Metric (**BIM**)
	Site Biodiversity Condition Class	Habitats	Based on mapping and classification of habitats in mine areas. Classification based on extent, condition and uniqueness/ecological importance.	Monitoring progress of quarry rehabilitation	Site scale	Biodiversity Indicator and Reporting System (**BIRS**)
	BNGC score	Biodiversity value per m2	Based on field survey, biodiversity value scores are attributed to all polygons of a site. GIS based. Requires knowledge of local biodiversity.	Measuring losses and gains within the same ecosystem type. Can be used to refine modelled MSA scores. Can be used to underpin 'nature positive' investments as offsets for achieving 'no net loss' or 'nature positive' ambitions	Site or project scale	Biodiversity Net Gain Calculator (**BNGC**)

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
	Biodiversity scoring system	Biodiversity units (BU)	Habitats are used as a proxy to describe biodiversity. These habitats are converted into 'biodiversity units'. Biodiversity units are calculated using the size of a parcel of habitat and its quality.	Calculate the losses and gains in biodiversity unit value resulting from changes or actions which affect biodiversity, such as from development or changing the conservation management of a land holding.	Site or project scale	Biodiversity Metric 3.1
Thematic metrics	Examples: deforestation free commodities or supply chains; surface of regenerated or restored land; palm oil free; etc…	km² or %	Measures specific issues of biodiversity	To demonstrate compliance with specific biodiversity targets	Product, supply chain and corporate scale	None of the assessed approaches
	Agrobiodiversity Index (ABDI)	Agro-biodiversity	Measures nutrition, agriculture and genetic resources - not conventional biodiversity	Sustainable agriculture	Site to corporate scale	Agrobiodiversity Index (**ABDI**)

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
Financial metrics	Environmental Profit & Loss accounts (EP&L)	Ecosystem services	Sum of the economic value of ecosystem services; biodiversity not directly included (only by proxies such as land use).	Life cycle analysis (e.g. used by corporates such as Arla and Kering)	Product, site, corporate or global scale	• **EP&L** (product); • **ES Assessment Holcim** (site); • **Ecosystem services measurement approaches** (ESII, Nature Value Explorer, ECOPLAN-SE, TESSA and INVEST) • **READS**[33]
Combined state, pressure and response metrics (dashboard)	No single quantitative metric, with score cards used to identify risk areas. Appreciation of progress (e.g. color codes, arrows, …)	Habitat / species population / biodiversity management unit (BMU)	Measures state (one of above metrics) in combination with pressures and responses and presents this in one dashboard.	Monitoring progress to target	Site and project scale	• Biodiversity Indicators for Site-based Impacts (**BISI**); • **LIFE Methodology**

[33] READS uses financial metrics to assess the loss or gain of Natural Capital at different stages of a project's lifecycle. With its bottom-up approach, it also allows analysis at the corporate level through these same metrics. READS has a module that allows cost-benefit analysis (CBA) of environmental impact mitigation measures, allowing to calculate their effectiveness and financial profitability. This module acts as a financial simulator that identifies which measures are most effective, allowing financial parameters such as discount rates to be changed for NPV calculation. In addition, this module includes a series of KPIs and metrics oriented to relate to the impact on natural capital, the financial and productive balance of the company, and to justify reasonably practicable project alternatives. It is intended for both internal use and external dissemination.

2.3.6 Level of Efforts

There are large differences in terms of the required level of expertise and the accessibility (e.g. open source or not) of the tools and approaches assessed in this report. The cost and level of efforts associated with the application of each tool also vary considerably. Evidently this might be an important selection criterion. Information on these issues was hard to find and required one-on-one conversations with each of the tool developers. This information is brought together in the **Effort Table**, of which a condensed version that serves as a quick guide is presented below. It is strongly advised to also consult the more extensive Effort Table in Annex 2 of Update Report 3[34], which includes the following additional information:

- Contact details shared by the tool developers and links to online resources;
- Details on the type of required expertise according to the tool developers;
- Cost information related to fees for following a training or purchasing a license;
- Estimate of the number of days required to apply the tool, including data collection. This estimate is highly dependent on data availability, activities or sites of company to be covered, location, etc.

The Effort Table (Table 7) should be interpreted as follows:

- **Accessibility** refers to 'open source' or 'commercial': however, cautiousness is required even with 'open source' tools as in some cases external support from the tool developer will still be required despite all technical information being publicly available. This is made clear in the table;

- **Required expertise** refers to the type of technical skills and background knowledge that is needed to apply the measurement approach. In most cases this expertise will not be available in-company and will need to be hired. This is clarified with INT (available within the company) and EXT (not available within the company). Some tool developers offer training allowing the company to apply the tool themselves in future iterations (indicated with EXT – T);

- **Costs** refer to: (1) costs for hiring external expertise, indicated with COST EXT; and (2) to necessary investments in license fees, trainings, etc. (cost for voluntary training is not included here) which is indicated with 'COST Other'. The purchasing of data from data providers (relevant for financial institutions) is another type of 'COST Other'. Costs do not refer to time investment by the company itself (this is covered under the 'efforts' column). The cost level for COST EXT is marked with H (high, i.e. exceeding 20 man days), M (moderate, i.e. between 5 and 20 man days) and L (low, i.e. less than 5 man days) and only applies to the first measurement (costs for follow-up monitoring can be lower). The cost level for COST Other is marked with H (high, i.e. more than EUR 10,000)[35], M (moderate, i.e. between EUR 4,000 and EUR 10,000) and L (low, i.e. less than EUR 4,000);

- **Efforts** refer to the time investment by the company itself and only apply to the first measurement (efforts for follow-up monitoring can be lower); in the table this is marked with H (high, i.e. more than 30 days), M (moderate, i.e. between 10 and 30 days) and L (low, i.e. less than 10 days).

[34] Available at https://ec.europa.eu/environment/biodiversity/business/assets/pdf/EU%20B@B%20Platform%20Update%20Report%203_FINAL_1March2021.pdf

[35] Purchasing of data from data providers by financial institutions is always marked as 'high cost'

Important remarks:

- Costs for hiring external expertise depend on data availability, scope of the assessment, location, size of sites, etc.;
- Efforts are hard to estimate as these mainly depend on the need for company data and the level of effort to collect these data, number of sites or commodities covered by the assessment, etc.;
- Data collection is indeed a key factor affecting both the cost for hiring external expertise and the level of effort required from the company itself. This depends a lot on data availability and the type of data required for the assessment. More information on the type of data required for a number of measurement approaches can be found in the Data Table in Annex 2 of Update Report 3[36].
- When comparing costs and efforts between measurement tools, it should be kept in mind that:
  - measurement tools that cover a wide range of pressures will generally be more expensive and might require more efforts than measurement tools that only cover one pressure;
  - highly accurate measurements might be more expensive than rough estimates;
  - even within one measurement tool, costs and efforts can range from low to high, as this is completely dependent on the level of detail of the measurement as requested by a company (this is why some tools have H/M/L scores in the Efforts Table).

BOX 10: Level of efforts in the Align recommendations

Align provides good and best practice criteria for collecting species and ecosystem data, for site and project level impacts, and for supply chain impacts. In general, complying with best practices requires more efforts than complying with good practices. The best practices imply conformity with the good practices too, furthermore the best practices require a higher accuracy, and spatial precision.

[36] Available at https://ec.europa.eu/environment/biodiversity/business/assets/pdf/EU%20B@B%20Platform%20Update%20Report%203_FINAL_1March2021.pdf

Table 7: Navigation Wheel – Effort table

EFFORT TABLE				
Biodiversity measurement approach	**Accessibility (Full Open Source; Open Source with Support; Commercial)**	**Required expertise (INT = most probably available within the company; EXT = external expertise most probably required; EXT – T: training is possible)**	**Costs (COST EXT H, M, L; COST Other H, M, L; no costs)**	**Efforts (H, M, L)**
Agrobiodiversity Index (ABDI)	Open Source	EXT	COST EXT: H/M COST Other: L	M
B-INTACT	Open Source with Support	INT / EXT-T	COST EXT: M COST OTHER: M	L
Biodiversity Footprint Financial Institutions (BFFI)	Open Source with Support	EXT-T	COST EXT H/M COST Other L	H - M
Biodiversity Footprint Methodology (BFM)	Open Source (with Support)	EXT-T	No costs (COST EXT: M/L)	L
Biodiversity Impact Metric (BIM)	Commercial[37]	EXT	COST EXT H/M/L COST Other M	H - M - L
Biodiversity Indicators for Site-based Impacts (BISI)	Open Source	EXT	COST EXT H/M/L	H – M

[37] Access to IBAT's range rarity layer is needed. Details on the development of this range rarity map are not opensource.

EFFORT TABLE				
Biodiversity measurement approach	**Accessibility (Full Open Source; Open Source with Support; Commercial)**	**Required expertise (INT = most probably available within the company; EXT = external expertise most probably required; EXT – T: training is possible)**	**Costs (COST EXT H, M, L; COST Other H, M, L; no costs)**	**Efforts (H, M, L)**
Biodiversity Metric 3.1	Open Source	EXT	COST EXT M/L No COST Other	L
Biodiversity Monitoring System (BMS)	Open Source	INT/EXT-T	COST EXT: L COST Other: L	L
Biodiversity Net Gain Calculator (BNGC)	Commercial	EXT	COST EXT: M/L	L
Biodiversity Performance Tool (BPT)	Open Source	INT / EXT-T	COST EXT: L COST Other: L	L
BioScope	Open Source	INT	COST EXT: L No COST Other	L
BIRS and ES assessment Holcim	BIRS: Open Source ES assessment: company tool	EXT	COST EXT: H	M
Corporate Biodiversity Footprint (CBF)	Commercial	EXT-T	COST EXT: L Cost Other: H	L

EFFORT TABLE				
Biodiversity measurement approach	**Accessibility (Full Open Source; Open Source with Support; Commercial)**	**Required expertise (INT = most probably available within the company; EXT = external expertise most probably required; EXT – T: training is possible)**	**Costs (COST EXT H, M, L; COST Other H, M, L; no costs)**	**Efforts (H, M, L)**
ECOPLAN scenario evaluator (ECOPLAN-SE)	Open Source	EXT	COST EXT: M	M
Ecosystem Services Identification & Inventory (ESII)	Open Source	EXT-T	COST EXT L	M
Environmental Profit & Loss (EP&L)	Open Source	INT[38]	H	H
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) – both modules	Open Source with Support	EXT-T	L	L
Global Biodiversity Score® (GBS®)	Commercial	EXT-T	COST EXT H COST Other M	H

[38] EP&L is an approach which is only applied by a limited number of companies and these have built up internal expertise. We are not aware of training programs on the EP&L approach. Cost and efforts are marked as high as application of an EP&L approach is demanding

EFFORT TABLE				
Biodiversity measurement approach	**Accessibility (Full Open Source; Open Source with Support; Commercial)**	**Required expertise (INT = most probably available within the company; EXT = external expertise most probably required; EXT – T: training is possible)**	**Costs (COST EXT H, M, L; COST Other H, M, L; no costs)**	**Efforts (H, M, L)**
Global Biodiversity Score® for Financial Institutions (GBS®-FI), including Biodiversity Impact Analytics powered by the GBS® (BIA-GBS®)	Commercial	EXT-T	COST EXT L COST Other H	L
Global Impact Database (GID)	Commercial	EXT	COST EXT: M/L COST Other: H	H – M – L
Integrated Biodiversity Assessment Tool (IBAT)	Commercial	INT/EXT-T	COST Other: H/M/L	M/L
Integrated Valuation of Ecosystem Services and Tradeoffs (INVEST)	Open Source	EXT	COST EXT: H	H
LIFE Methodology	Commercial	EXT-T	COST EXT M COST Other L	H – M
Nature Value Exporer	Open Source	INT/EXT-T	L	L
Product Biodiversity Footprint (PBF)	Commercial	EXT	COST EXT H/M	M

EFFORT TABLE				
Biodiversity measurement approach	**Accessibility (Full Open Source; Open Source with Support; Commercial)**	**Required expertise (INT = most probably available within the company; EXT = external expertise most probably required; EXT – T: training is possible)**	**Costs (COST EXT H, M, L; COST Other H, M, L; no costs)**	**Efforts (H, M, L)**
READS	Commercial	INT / EXT-T	COST EXT: M COST Other: H	M/H
ReCiPe	Open Source	EXT	COST EXT: H/M	L
Species Threat Abatement and Restoration metric (STAR)	Commercial	EXT	COST EXT: H/M/L COST Other: H/M/L	H – M – L
Toolkit for Ecosystem Services Site-Based Assessment (TESSA)	Commercial	INT / EXT-T	COST EXT: M	M

2.3.7 Sector Applicability

Compared to Update Report 3, sector applicability has been added as an additional selection criterion to the Biodiversity Measurement Navigation Wheel. Three frequently occurring sectors can be distinguished, i.e agriculture (agrifood), mining and financial sector (Table 8). The category 'other' indicates whether measurement approaches are applicable to additional, alternative sectors.

Table 8: Navigation Wheel – Sector applicability table

SECTOR APPLICABILITY				
Biodiversity measurement approach	**Agriculture**	**Mining**	**Financial institutions**	**Other**
Agrobiodiversity Index (ABDI)	X			
B-INTACT	X	X	X	X
Biodiversity Footprint Financial Institutions (BFFI)			X	
Biodiversity Footprint Methodology (BFM)	X	X	X	X
Biodiversity Impact Metric (BIM)	X	X	X	X
Biodiversity Indicators for Site-based Impacts (BISI)	X	X		
Biodiversity Metric 3.1	X	X	X (e.g. IFC PS6 assessments)	X
Biodiversity Monitoring System (BMS)	X			
Biodiversity Net Gain Calculator (BNGC)	X	X	X	X
Biodiversity Performance Tool (BPT)	X			
BioScope	X	X	X	X
BIRS and ES assessment Holcim		X		
Corporate Biodiversity Footprint (CBF)	X	X	X	X
Ecosystem Services Measurement Approaches (ESII, Nature Value Explorer, ECOPLAN-SE, TESSA and INVEST)	X	X		X
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)	X	X	X	X
GBS® for financial institutions (GBS®-FI), including Biodiversity Impact Analytics powered by the GBS® (BIA-GBS®)			X	
Global Biodiversity Score® (GBS®)	X	X	X	X
Global Impact Database (GID)	X	X	X	X

SECTOR APPLICABILITY				
Biodiversity measurement approach	**Agriculture**	**Mining**	**Financial institutions**	**Other**
Integrated Biodiversity Assessment Tool (IBAT)	X	X	X	X
Kering Environmental Profit & Loss (EP&L)				
LIFE Methodology	X	X	X	X
Product Biodiversity Footprint (PBF)	X	X	X	X
READS		X		X
ReCiPe	X	X	X	X
Species Threat Abatement and Restoration metric (STAR)	X	X	X	X

BOX 11: Sector approach in the Align recommendations

The Align recommendations are high level and sector agnostic. They are applicable to organizations of all types (public, third sector, and listed and unlisted private), across all sectors, and of any size (such as small and medium sized enterprises and multinational businesses). The current Align recommendations will sit alongside sector specific guidance (high level: only site-based, supply chain and finance guidance) on their practical implementation that is due to be developed in 2023.

3 CONFORMITY WITH ALIGN RECOMMENDATIONS

3.1 General context

The Aligning Accounting Approaches for Nature (Align)[39] project has published recommendations for a standard on measuring and valuing biodiversity impacts and dependencies. It includes principles and technical criteria on 'what' elements of biodiversity should be measured and valued and 'how' this should be done in different decision-making contexts.

The recommendations do not explicitly favor one measurement approach over another, but instead specify which type of approach is applicable for specific business applications, based on standardized and agreed technical criteria. They focus on measuring and valuing the state of biodiversity, drivers of biodiversity loss (impact drivers), dependencies on biodiversity, and biodiversity-related ecosystem services. Align only covers two organizational focus areas:

1. **Site or project level**: site level usually refers to existing sites, while project level usually refers to planned undertakings or initiatives at a specific location; site and project level impacts are directly related to the site or project activities, processes, and incidents and exclude supply chains delivering to the site or project; these are also referred to as 'direct operations'.
2. **Supply chain**: focus is on the upstream parts of the value chain where primary sectors are active (e.g. extraction of raw materials, agriculture, fisheries, forestry).

The Align recommendations provide universal recommendations and technical criteria on how to measure biodiversity in different business contexts. These technical criteria are divided into 'good practices' and 'best practices'. 'Good' practice technical criteria should be followed by every company and are significantly robust. 'Best' practice technical criteria can be followed by any company for all material impacts but should be followed for highly material impacts. They represent a direction of travel for biodiversity measurement, even if not currently deemed feasible by businesses just starting to measure their impacts and dependencies. Conformity with the best practice criteria also implies conformity with the good practices. In the absence of extra best practices, good practice criteria are considered best practice.

In this chapter, the conformity between the Align recommendations and the different existing biodiversity measurement tools and metrics for businesses and financial institutions is discussed. We provide guidance on which tools to use when applying good/best practices from the Align recommendations. The recommendations do not describe individual corporate biodiversity measurement approaches. This is to avoid that the recommendations become outdated as available measurement approaches evolve. As this EU B@B Platform Update Report is regularly updated, we can discuss the currently available tools and metrics in relation to the Align recommendations.

First, we discuss the technical criteria for collecting species and ecosystem data, and which tools and metrics are suitable to comply with the good and best practice technical criteria. Secondly, we discuss the good and best practices for site and project level, followed by the good and best practices for the supply chain level. Next, we discuss the Align recommendations on valuation and which tools/metrics are suitable to measure costs and benefits resulting from biodiversity. Valuation involves understanding of how changes in the state of biodiversity can affect the delivery of ecosystem services and what should be considered when valuing the costs and benefits resulting from these changes in biodiversity. Finally, we move towards accounting. An accounting format can track performance against targets over time. The Align recommendations give a direction of travel from individual measurement of performance to compile robust corporate biodiversity accounts. We discuss which tools are able to track and organize measurements of biodiversity, natural capital stocks and ecosystem flows following the accounting principles (the measurement, processing, and communication of financial and non-financial information about economic entities such as businesses and corporations).

[39] EU B@B Platform – Align

This analysis was supported by individual tool developers who provided feedback about their tool's position in the tables: ABDI, B-INTACT, BPT, CBF, ENCORE, GBS®, GID, IBAT/STAR, BIRS and Holcim, LIFE, and READS.

3.2 Align recommendations on collecting species and ecosystem data

Several tools are available for collecting species and ecosystem data. Table 9 indicates which tools, described in this Update Report 4, are suitable for collecting species and ecosystem data. In order to comply with the good and best practices according to the Align recommendations, it is necessary to include these principles in the process. The use of a tool does not automatically ensure compliance with Align's good and best practices. Attention should be paid to quality control of data sources and the accuracy of the measurements. Whether the data is collected at the appropriate time of the year and on appropriate scale remains the responsibility of the user, not of the tool itself. Quality control is always needed independent from the use of the tool.

We note that some tools can be used for different purposes, therefore tools can fit in more than one column of Table 9. We also note that the presence of a tool in a specific column does not imply that the tool was designed to use this type of data or for the specific purposes described in the column. For example, hardly any tools have been developed to specifically process eDNA data as input. However, nothing prevents a user from including eDNA data in the measurement approach. Often there is the possibility to incorporate the good/best practices when using the tool. In that case, the tool is included in the table. It is possible that additional effort from the user is needed to apply the good or best practice as the tools are not always designed for specifically applying these good/best practices.

Table 9: Good and best practice for collecting species and ecosystem data according to the Align recommendations, and the applicable tools to use.

	SPECIES		ECOSYSTEMS		
	In situ direct population count	**Species threat assessment and range layers**	**In situ habitat and community surveys**	**Spatial overlays with biodiversity data layers**	**Modelled state based on pressures**
	GOOD PRACTICE				
Good practice	Site-based data is collected according to legally and/or generally accepted survey protocols for the species or taxonomic group	Data is used at an appropriate scale based on the resolution of underlying range data	Site-based data is collected according to legally accepted or standardised survey protocols, notably for condition or integrity assessment	Data layer needs to have a temporal component (change over time) to estimate impact	Pressure-response model used to assess biodiversity state or impact, based on peer-reviewed studies.
	Data is collected at the appropriate time of year for the species or taxonomic group	Threat assessments are based on agreed standards such as the international IUCN red list and national or local red lists.	Data is collected at the appropriate time of the year	The resolution of data must be at an appropriate level to attribute change to company operations	'Total footprint' disaggregated into direct and indirect impacts
	Biodiversity data collected undergoes rigorous quality assurance review.		Biodiversity data collected undergoes rigorous quality assurance review		Full transparency is maintained on the pressures included in any estimate of impacts on state, and any uncertainties should be properly disclosed
Applicable tools	BNGC, BISI	BIM, BISI, IBAT, READS	BNGC, BIRS, Biodiversity Metric 3.1, ESII, BISI, BPT	BIRS, Biodiversity Metric 3.1, BNGC, ENCORE, IBAT, STAR, BPT	IBAT, BFM, BIM, GBS®, BFFI, ECOPLAN-SE, Invest, Nature Value Explorer, CBF, ReCiPe, GID, READS, B-INTACT
	BEST PRACTICE				
Best practice	Multiple surveys are completed to accurately reflect species trends and/or presence or absence.		Multiple surveys are completed to accurately reflect ecological trends		Use of primary pressure data leads to a more accurate measurement of impact on state
	Traditional ecological knowledge is embedded within data collection programme.		Use of eDNA and bioacoustics surveys for data collection		Use of a spatially refined model that models regionally specific biodiversity response to pressures
			Traditional ecological knowledge is embedded within data collection programme.		Modelled impacts on biodiversity complemented with primary or secondary in situ biodiversity state data, to interpret potential significance
					All material pressures should be considered by the pressure-response model and known uncertainties should be properly reported
Applicable tools	BNGC, BISI	BIM, BISI, IBAT	BNGC, Biodiversity Metric 3.1, BISI	BIRS, Biodiversity Metric 3.1, BNGC, ENCORE, IBAT, STAR, BPT	GBS®, CBF, GID, PBF

Footnote 1 for Table 9: For the columns 'Species threat assessment and range layers' (species data) and 'Spatial overlays with biodiversity data layers' (ecosystem data) only good practice criteria are defined. As

best practices also include conformity with the good practices, the tools applicable for good practice automatically are applicable for best practice too in these two columns. Therefore the good practice tools are repeated in the best practice row.

Footnote 2 for Table 9 based on feedback of the tool developers:

- BPT: the Biodiversity Performance Tool (BPT) is developed to be applied at farm level. Therefore, this tool is only to a minor extent comparable with tools designed for companies. As the farmer collects data, only sample quality review is done on representative farms. To comply with Align's good practice guidelines, used data should have an appropriate resolution and contain a temporal component.
- IBAT/STAR: STAR is only accessible through IBAT.
- BIM: users need the range rarity layer from IBAT.
- GBS®: the GBS® does not report uncertainties quantitatively, as data quality tiers are used to report the quality of the input data. Other uncertainties are treated and reported qualitatively. In practice, the GBS® is not yet using primary or secondary in situ biodiversity state data. The GBS® has some limitations. For example, it does not cover marine biodiversity. Therefore, the best practice criteria "all material pressures" cannot be evaluated even if this is considered material.
- The ES assessment of Holcim is not listed separately in the tables. As it relies on BIRS, it is applicable where BIRS is listed.
- The LIFE methodology is applicable for the measurement of species and ecosystems but does not comply to all of the criteria in one column.

3.3 Site and project level

Site and project level impacts are directly related to the site or project activities, processes, and incidents and exclude supply chains delivering to the site or project. These are also sometimes known as 'direct operations'. Table 10 is adapted from the Align recommendations and shows the good and best practice measurement criteria and factors to consider when selecting an approach to screen for or measure biodiversity at site and project level. It also includes the applicable tools.

We note that the tools are not always specifically designed for site/project level but can be applied at this level under the right conditions.

Table 10: Good and best practice measurement criteria and factors to consider when selecting an approach to screen for or measure biodiversity at site and project level, from the Align recommendations (2022) with added column describing applicable tools.

Site and project level

Good practice | Best practice

	What to measure	Characteristics of measurement approach	Most applicable methods	Applicable tools
Screen	• Potential presence & proximity to material species & ecosystems • Potential impacts based on **sector-average impact drivers**	• ***Feasibility (screening)*** – **High** (able to apply screening at multiple sites • ***Spatial precision*** – **Medium** • ***Accuracy*** – **Medium** (measures reflect potential presence & impacts on species and ecosystems, but are not ground- truthed)	✓ Spatial overlays with biodiversity data layers (ecosystem extent/condition) ✓ Species threat & range layers ✓ Screening using modelled state based on pressures	✓ Nature Value Explorer, Encore, LIFE ✓ STAR, BIM, IBAT, BIRS ✓ BFM, BIM, Bioscope, ReCiPe, READS, CBF
Measure	• Ecosystem extent & condition indicators; or • Measurement of material impact drivers (at least land use change) • Periodic measurements that start from a baseline & measurements that reflect changes in state resulting from **company-specific impact drivers**	• ***Responsiveness*** - **Medium** able to reflect how changes in pressures affects biodiversity state • ***Spatial precision*** – **Medium** • ***Accuracy*** – **Medium** (measurement reflect potential presence & impact on species and ecosystems, but are not ground- truthed)	✓ Primary data based on surveys ✓ Measuring using responsive biodiversity data layers ✓ Measuring using modelled state based on pressures	✓ Biodiversity Metric, BISI, ESII, BNGC, BIRS, BPT, ABDI ✓ Nature Value Explorer, STAR, LIFE ✓ STAR, BIM, GBS, BFM, ReCiPe, Ecoplan, Bioscope, Invest, BFFI, LIFE, CBF, GID, READS
Screen	• Potential presence & condition of material species & ecosystems, results **ground-truthed** • Species extinction risk indicators • Potential impacts based on **company specific impact drivers**	• ***Feasibility (screening)*** – **High** (for screening, able to apply for screening at multiple sites) • ***Spatial precision*** – **High** (captures species and ecosystems at site level) • ***Accuracy*** – **High** (measures reflect actual, ground- truthed presence of/ impacts on species and ecosystems)	✓ Modelled state based on pressures **(using company specific impact driver data)** for screening only ✓ Species threat & range layers	✓ Bioscope, ReCiPe, READS ✓ BIRS, STAR, Nature Value Explorer, ABDI
Measure	• Ecosystem extent & condition for **individual ecosystem assets** • Species extinction risk indicators • Periodic measurements that start from a baseline & measurements that reflect changes in state resulting from **site-level mitigation measures** • Based on primary data on **material impact drivers**	• ***Responsiveness (measuring impacts)***- reflects effects of site-level mitigation measures • ***Spatial precision*** – **High** (captures species and ecosystems at site level) • ***Accuracy*** – **High** (measures reflect actual, ground- truthed presence of/ impacts on species and ecosystems)	✓ Primary data based on surveys	✓ BISI, BIRS, BNGC, GBS, Biodiversity Metric, Ecoplan, Invest, Nature value explorer, ESII, ABDI, BPT, READS

Footnote for Table 10 based on feedback of the tool developers:

- The BFFI and BFM do not include species threat and BFM does not include surveys.
- In the Biodiversity Metric 3.1, the BNGC and BIRS only one pressure is accounted for (land use). Climate and water are not included.
- ECOPLAN-SE is a tool developed for the Flemish region in Belgium and is less relevant on a global scale.
- ENCORE does not provide any analysis or data interpretation. It relies solely on global, sector average information. It is therefore only suitable for high-level screening.
- GBS®: In principle, the GBS® tool can be used for screening, but because of the needed efforts to understand the tool, it is not included in the 'screening' part of the tables. The GBS® can measure material impact drivers, however not via biodiversity data layers. The tool developer indicates they did a proof of concept for measuring ecosystem extent and condition. They like to evolve towards such accounting in the future.
- B-INTACT's developers indicated that the tool is applicable for site and project screening, however, not all criteria are fulfilled.
- The ES assessment of Holcim is not listed separately in the tables. As it relies on BIRS, it is applicable whenever BIRS is listed.

3.4 Supply chain level

The supply chain level focusses on the upstream parts of the value chain where primary sectors are active, e.g. extraction of raw materials, agriculture, fisheries and forestry.

Table 11 is derived from the Align recommendations and shows the good and best practice measurement criteria and factors to consider when selecting an approach to screen for or measure biodiversity at the supply chain level.

We note that the tools are not always designed specifically for the supply chain level but can be applied at this level under the right conditions.

Table 11: Good and best practice measurement criteria and factors to consider when selecting an approach to screen or measure biodiversity at supply chain level, from the Align recommendations (2022) and including an extra column with applicable tools.

Supply chain level

Good practice | Best practice

	What to measure	Characteristics of measurement approach	Most applicable methods	Applicable tools
Screen	• Ecosystem extend & condition & species extinction risk at broad-scale sourcing regions	• ***Feasibility** (applicable for screening)* – High • ***Spatial precision*** – **Low** (screening can use models based on global data) • ***Accuracy*** – **Low** (e.g., can screen potential impacts based on sector-average impact driver data)	✓ Spatial overlays with biodiversity data layers (ecosystem extent/condition) ✓ Species threat & range layers	✓ ENCORE, PBF, LIFE, BFM, GBS, BIM, ReCiPe, BioScope, CBF, GID, ABDI, ✓ IBAT, STAR, LIFE
Measure	• Potential impacts on ecosystems based on volumes of materials sourced (or revenue) within each **country** sourced from	• ***Responsiveness*** - **Medium** (responsive to changes in impact drivers along supply chain) • ***Spatial precision*** – **Low** (measuring can use models based on global data) • ***Accuracy*** – ***Low*** (e.g., can measure potential impacts based on sector-average impact driver data)	✓ Modelled state based on pressures	✓ BFM, CBF, GBS, BIM, CBF, PBF, GID, LIFE ✓ STAR
Screen	• Ecosystem extent & condition & species extinction risk at broad-scale sourcing regions • Potential impacts on ecosystems based on volumes of materials sourced (or revenue) within each **country** sourced from	• ***Feasibility (screening)*** – **High** • ***Spatial precision*** – **Medium** (reflects differences in potential impact based on sourcing region) • ***Accuracy*** – **Medium** (screens potential impact based on company-specific impact driver data	✓ Modelled state based on pressures, including land use intensity ✓ Spatial overlay with biodiversity data layers (ecosystem extend/condition)	✓ ReCiPe, Bioscope, GID, GBS
Measure	• Measurement of potential impacts reflects differences in biodiversity between sourcing locations and production processes at sourcing locations • Measurement of impact drivers & state at sampled sites using primary data is used to complement full-supply chain measures	• ***Responsiveness*** - **Medium** (reflects changes in production practices at source location) • ***Spatial precision*** – **Medium** (reflects differences in potential impact based on sourcing region) • ***Accuracy*** – **Medium** (measures potential impact based on company-specific impact driver data)	✓ Modelled state based on pressures, including land use intensity ✓ Primary data based on species/habitat surveys for measuring impact at sampled sites	✓ CBF, PBF, GBS

Footnote for Table 11 based on feedback of the tool developers:

- PBF is listed in the table for screening; this is acceptable as – despite the fact that the tool is designed for product level – it reveals much information about supply chain issues.
- ENCORE: plans to add a supply chain view in the coming year. At the moment, users can get a supply chain view if they know which upstream sectors they want to investigate. They can then view the direct potential dependencies and impacts of those sectors individually.
- GBS®: GBS®-FI and BIA-GBS® are applicable for best practice measuring.
- BIRS: BIRS evaluation considers if each habitat is a native habitat type in the country. In case of a positive response, it is necessary to value how widespread it is (from locally to nationally); the degree of threat to this habitat type nationally or in the ecoregion; the intrinsic biodiversity value (endemic, species of regional or national concern); etc.

3.5 Valuation

Valuation involves understanding how changes in the state of biodiversity can affect the delivery of ecosystem services and what should be considered when valuing the costs and benefits resulting from these changes in biodiversity. A few tools allow for the inclusion of ecosystem services.

For example, the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) models use maps as information sources and produce maps as outputs. InVEST returns results in either biophysical terms (e.g., tons of carbon sequestered) or economic terms (e.g., net present value of sequestered carbon). The spatial resolution of analyses is flexible, allowing users to address questions at local, regional, or global scales.

The Align recommendations provide some universal recommendations. For example, it should be clear which types of biodiversity values are assessed and which are omitted. Changes to biodiversity (ecosystems and species) that affect value should be identified and underpin the valuation. The valuation should assess final ecosystem services, not intermediate ecosystem services. Furthermore, qualitative and quantitative factors should be used to acknowledge intrinsic values.

3.6 Accounting

Biodiversity impacts and dependencies can be organized into an accounting format to track performance against targets and over time. The measurement, processing, and communication of financial and non-financial information about economic entities such as businesses and corporations is called accounting, and can be used to organize measurements of biodiversity.

Few organizations are currently using accounting in the context of biodiversity and understanding of corporate biodiversity accounting is relatively limited. The Biological Diversity Protocol can be used to incorporate an accounting approach for biodiversity.

ANNEXES

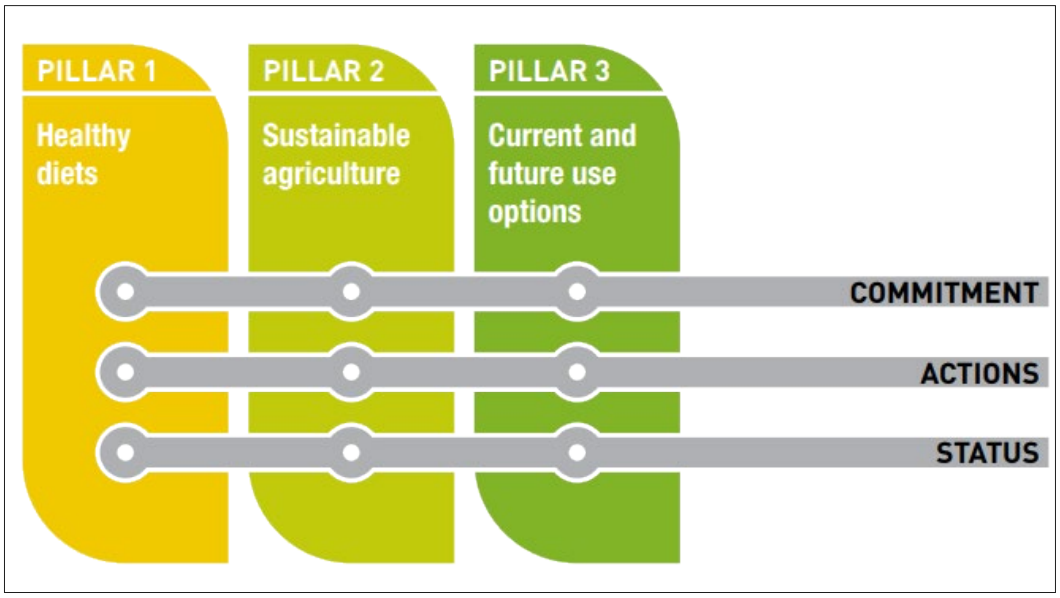
ANNEX 1: SHORT DESCRIPTIONS OF BIODIVERSITY MEASUREMENT APPROACHES

Agrobiodiversity Index (ABDI)

Alliance of Bioversity International and International Centre for Tropical Agriculture (Alliance Bl-CIAT)

The Agrobiodiversity Index measures agrobiodiversity across three 'pillars': 1) consumption and markets, where agrobiodiversity contributes to healthy diets; 2) agricultural production, where agrobiodiversity contributes to sustainable production; and 3) genetic resource conservation, where agrobiodiversity secures current and future use options. Across the three pillars, the Agrobiodiversity Index measures:

1. **Status** – the current state of agrobiodiversity in markets and consumption, in agricultural production, and in genetic resource management.
2. **Actions** – what countries, companies, or projects are concretely doing to increase agrobiodiversity across the food system.
3. **Commitments** – to what extent country, company or project strategies, policies and codes of conduct are contributing to sustainable use and conservation of agrobiodiversity for healthy diets, sustainable agriculture and future use options.



Commitment indicators measure the country, company or project strategies and policies for improving use and management of agrobiodiversity for healthy diets, sustainable agriculture and for future use options.

Action indicators focus on what countries, companies or projects are actually doing to increase agrobiodiversity across the food system, showing the extent to which policies are put into action to achieve what they committed to.

Status indicators measure the actual status of agrobiodiversity in terms of species, varieties, landscape complexity and functional diversity at relevant scales for each of the pillar.

The Agrobiodiversity Index has been designed in three forms, to represent the demand from countries, companies and projects (private, public or mixed). The country, company and project indices share the same architecture, but allow varied input data and different final products. Four specific applications were designed to support different food system actors in making informed decisions in food and agriculture:

- **Risk and resilience assessment**: the Agrobiodiversity Index provides food system actors with insights on their exposure to different risk areas (malnutrition, poverty trap, climate change, land degradation, pests and diseases, and biodiversity loss) when agrobiodiversity is low.
- **Intervention planning**: the Agrobiodiversity Index can be used to plan interventions and formulate evidence-based strategies by comparing the outcomes of different interventions in food markets, supply chains, production, or agricultural genetic resource management on agrobiodiversity.
- **Global policy alignment**: Indicators in the Index are aligned with one or more of the SDG and Aichi targets. Users interested in monitoring progress towards these global targets can use performance on the Index indicators. This also helps identifying if agrobiodiversity is effectively integrated into global policy interventions.
- **Ranking and benchmarking**: the Agrobiodiversity Index scores can be used to compare performance on use and conservation of agrobiodiversity among countries, within a company or among projects. This can stimulate positive behaviour change as part of the 'race to the top' to improve sustainable use and conservation of agrobiodiversity, as well as foster exchange of knowledge and best practices.
- **Leveraging investment in sustainable food systems**: The Agrobiodiversity Index team is also exploring how the different applications of the tool can be used in the financial sector to leverage investments for sustainable and resilient food systems based on agrobiodiversity.

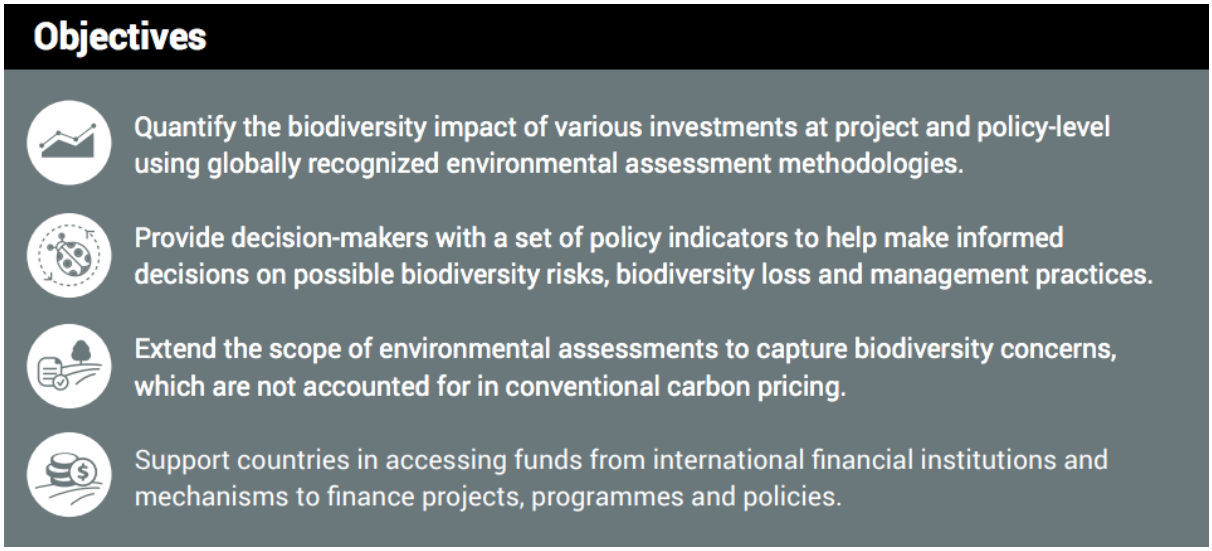
More information on the measurement approach can be found here:

- For a list of indicators and methodological foundations, see: https://www.agrobiodiversityindex.org/index.php/methodology/
- For the scientific basis and a global application, see Jones et al. 2021: https://www.nature.com/articles/s43016-021-00344-3

The Biodiversity Integrated Assessment and Computation Tool (B-INTACT)

Developed by FAO

The B-INTACT tool developed by the FAO is a land-based accounting system that assesses the impacts on biodiversity of projects, programmes and policies implemented in the Agriculture, Forestry and Other Land Use (AFOLU) sector. The tool takes on both a quantitative and a qualitative approach. The quantitative approach assesses the impacts of four anthropogenic pressures on biodiversity. The qualitative approach guides the contextualization of the area and assesses the project's intended impacts on the landscape and on agrobiodiversity.



Quantitative assessment

- The quantitative approach, adapted from the GLOBIO Model Version 3.6 developed by the Netherlands Environmental Assessment Agency (PBL) (Schipper et al., 2016), provides a set of quantitative relationships for four anthropogenic impacts on biodiversity: impacts of land use, disturbance by infrastructure, habitat fragmentation due to land use and human encroachment.
- The quantitative results are expressed using the Mean Species Abundance (MSA) metric. The MSA metric expresses “the mean abundance of original species in disturbed conditions relative to their abundance in an undisturbed habitat. MSA acts as an indicator of the degree to which an ecosystem is intact. It varies between 0 (or 0 percent) for a completely destroyed ecosystem with no original species left and 1 (or 100 percent) for an undisturbed ecosystem where all original species remain.” (FAO, 2021).

To transform the abstract concept of the MSA into more accessible and comprehensible units for decision makers B-INTACT provides three different policy indicators:

1. The Area of biodiversity loss (MSA.ha): Surface area equivalent to the MSA scores which represents the area of biodiversity loss;
2. Added/Lost of social value of biodiversity (SV): Monetary value per hectare to the MSA indicator; and
3. Mean Species Abundance plus (MSA+): MSA factored with the ecological value of each patch.

Qualitative assessment

- The qualitative approach aims at informing, guiding and complementing the quantitative analysis with additional indicators that contextualize the project area, assess possible risks and threats, identify relevant topics on biodiversity and evaluate their level of achievement.
- The qualitative assessment is structured in 4 sections of 16 questions.
  Section 1 addresses the project zone biodiversity sensitivity and corresponds to the description of the area with questions related to Key Biodiversity Areas (KBA), Protected Areas (PA), share of threatened species and water stress. The section 2 accommodates the intended impacts from the projects, policy or investments into these main topics. The sections 3 and 4 focus more on the landscape level and the agricultural aspects (human-wildlife conflict, forest governance and illegal logging) and agrobiodiversity such as crop diversification, conservation agriculture, integrated pest management etc.

More information on the measurement approach can be found here:

- B-INTACT website: https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/b-intact/en/
- B-INTACT guidelines: https://www.fao.org/documents/card/en/c/cb3393en
- B-INTACT flyer: https://www.fao.org/3/ca8242en/CA8242EN.pdf
- B-INTACT registration for accessing the tool: https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/registration/en/
- For more information on GLOBIO, please refer to: www.globio.info
- For more information on ESVD, please refer to: www.esvd.net

Biodiversity Footprint Methodology (BFM)

The Biodiversity Footprint Method is developed by Plansup in collaboration with Wageningen Environmental Research. The method is derived from the GLOBIO model approach, which was developed by The Netherlands Environmental Agency (Planbureau voor de Leefomgeving, PBL) in cooperation with knowledge partners. The GLOBIO methodology comprises two models - one for determining terrestrial biodiversity (GLOBIO3; see Alkemade et al., 2009), and the other for determining the impact on freshwater biodiversity in rivers and lakes (GLOBIO-aquatic, see Janse et al., 2015). The GLOBIO biodiversity model is applied on global, regional and national scale to determine changes in biodiversity due to human impact. Biodiversity is not measured but derived from the impact of a number of pressure factors on biodiversity. For each pressure factor, dose-response relationships have been developed based on meta-analyses of a large number of scientific studies on biodiversity impacts. In general, the greater the pressure, the greater the biodiversity loss.

GLOBIO uses a relative biodiversity indicator, Mean Species Abundance of original species (MSA), representing the natural or original biodiversity of an area in a value in the range of 0 to 1. The MSA has a low value in areas where the pressure of a specific pressure factor is high. The terrestrial GLOBIO3 model includes the following pressure factors: land use, infrastructure, fragmentation, climate change, and nitrogen deposition. The pressure factors in the GLOBIO aquatic model are upstream land use, nitrogen and phosphorus deposition from air and water, dams and water management, climate change, and fishing.

More information on GLOBIO can be found in the Annexes of the Update Report 2[40].

The biodiversity footprint method is based on the GLOBIO model but does not include all pressure factors and is implemented on local scale. It includes currently 3 terrestrial pressures and 1 aquatic pressure: Terrestrial: Land use, climate change (via CO2 equivalent emission), water extraction. Aquatic: Emission of Nitrogen and Phosphor emission to water. In determining the biodiversity footprint, decrease in MSA is combined with the area (ha) on which the company has an impact. In case raw materials or a production process is also used for other products, an economic allocation correction factor is applied. In case land use is very extensive/ semi-natural, a biomass use correction factor is used for the impact calculation of the land use related footprint part.

The equation for determining the biodiversity footprint is:

$$\text{Footprint} = \Sigma(\text{ha area in use } i * [1\text{-MSA\_pressure factor } i])$$

in which i= land use, climate and water use. This equation is used to calculate a biodiversity footprint MSA.ha for a baseline and for different scenarios, enabling comparisons to be made. In addition to land use and climate change, the biodiversity footprint includes the impact of water use and of nitrogen and phosphorus emissions in water. The footprint is calculated for all parts of the production chain: Raw materials, Processing, Transport, Storage, Waste management.

The biodiversity impact is described briefly in the textbox below.

Company MSA and biodiversity footprint
An MSA of 1 indicates that an area is completely in its natural state. The nature is undisturbed and the species composition is similar to that in comparable areas without human interference. The species composition refers to the diversity of species in an area and to the numbers of individual species which is referred to as species abundance.
An MSA of 0.4 means that only 40% of the population remains of the nature in such areas (the natural reference), for example, as a consequence of pressure on nature due to company activities. In this case, company activities have led to a 60% loss of the natural reference, or an impact of 0.6. This is the difference between the MSA in the untouched site (which is always 1) and the MSA in a disturbed site (in this example, 0.4).
The extent of the area of impact (area) is also important. Thus, impact (1 – 0.4 = 0.6) is multiplied by the area (ha) of the impact. If the area is 2 hectares, then the biodiversity footprint is: Area (ha) * (1 – MSA_area) = 2 * 0.6 = 1.2 MSA.ha.
A higher MSA.ha means a larger footprint, for example, because the loss of natural reference species per hectare is high and/or the loss extends over a larger area.
By calculating the footprint for different situations, the impact of company measures can be calculated and compared.

[40] see Critical assessment of biodiversity accounting approaches for businesses (europa.eu)

Biodiversity Footprint Calculator (BFC)

The BFC is a simplified operational webtool of the Full BFM. While the BFM includes the impact calculation of three terrestrial pressures Land use, Climate Change (via GHG) and Extraction of Water, and one (inland) aquatic pressure (N and P to water) for all parts of the production chain, the BFC only includes the two first terrestrial pressure types (land use and GHG) for the impact calculation, and for three parts of the production chain: Raw materials, production process and transport). The reason to simplify the BFC is that these two selected pressures and three parts of the chain are responsible for more than 80% of the impact on terrestrial biodiversity by companies globally and are also relatively simple to calculate. Although not covering all pressure types the BFC is already a very useful open source webtool that can be used by companies themselves to identify which parts of their chain contribute most to the biodiversity footprint of their company or product and to compare the effectiveness of potential company measures. *Note: In case funding will become available the BFC can be extended with the*

Biodiversity Footprint for Financial Institutions (BFFI)

The BFFI was developed by PRé, CREM and ASN Bank and is based on a life cycle assessment (LCA) approach, using an already existing pressure-impact model (ReCiPe) and environmental data from LCA databases like EXIOBASE or ecoinvent. When direct data are available, data from background databases is replaced with site- or company specific data. In the BFFI, species richness is used as an indicator for biodiversity and the damage to diversity can be described as the fraction of species that has been lost in comparison with a natural or undisturbed area.

The BFFI method is comprised of four steps:

1. Understanding system boundaries: In this step, it is determined what economic activities are directly and indirectly linked to a company or project, and what scopes can be included in the analysis. For this, data on total revenue for different companies divided across sectors and geographies is collected from financial database providers and matched with specific sectors in the EXIOBASE database. The result shows to what economic activities a loan or investment is linked.

2. The identification of environmental inputs and outputs linked to the economic activities, i.e. the use of land, water, and other resources (inputs) and emissions (outputs). For this, LCA databases like EXIOBASE are used, unless more specific company or project data are available. In LCA terminology this is referred to as the 'inventory phase'.

3. The translation of emissions, land, water, and resource use into environmental pressures (like climate change resulting from greenhouse gas emissions) using the ReCiPe model, as well as an assessment of how these pressures contribute to biodiversity impact. In LCA terminology this is referred to as 'Life-Cycle Impact Assessment'.

4. Finally, the results are interpreted using both quantitative impact calculations and a qualitative analysis of the case study and the footprint results.

Source for the above information and more information on the approach can be found here:
https://www.government.nl/documents/reports/2021/07/29/biodiversity-footprint-for-financial-institutions

Biodiversity Impact Metric (BIM)

The Biodiversity Impact Metric can be used to assess and track how a business's sourcing affects nature, through the biodiversity lost as a result of land and habitat transformation for agricultural production and the intensity of land use. The metric allows comparison of potential impacts (overall or per unit) across different sourcing locations and between commodities.

For an agricultural commodity sourced from a particular location, the metric assesses impact based on:

- the land area needed for production of the commodity
- the proportion of biodiversity lost when the land is transformed to produce the commodity, related to the type of land use and its intensity; and
- the relative global importance of that biodiversity.

The basic framework for the Biodiversity Impact Metric is shown in the following figure.

A business needs, at a minimum, three pieces of information to calculate the metric: **1) commodity type; 2) sourcing country**; and **3) quantity purchased**. However, the accuracy of the metric improves with greater visibility of sourcing practices.

Calculation of the Biodiversity Impact Metric

The Biodiversity Impact Metric is calculated using a simple multiplication of the three variables: land area, proportion of biodiversity lost and biodiversity importance (see next figure). The unit of the output is 'weighted hectares', i.e. hectares weighted by biodiversity impact. The result can also be divided by the total amount of commodity purchased to give an indicator of impact per unit sourced, which can then be compared with a global average.

More information on the measurement approach can be found here:

https://www.cisl.cam.ac.uk/resources/natural-resource-security-publications/measuring-business-impacts-on-nature

https://www.cisl.cam.ac.uk/resources/publication-pdfs/biodiversity-metric-supplementary-material.pdf

Biodiversity Indicator and Reporting System Holcim

The overall methodology combines an approach for measuring habitats and species condition with an approach for measuring and monetizing ecosystem services. Habitats and species condition is measured by BIRS index (Biodiversity Indicator and Reporting System, developed by IUCN) (see Box 1) and LBI (Long Term Biodiversity index, developed by Lafarge[41], IUCN France and WWF) (see Box 2). The approach for measuring and monetizing ecosystem services is explained in Box 3. Holcim is improving the methodology to assess how habitats (ecosystem assets) and social benefits from restoration evolve over time (ecosystem services flows). A template has been developed to facilitate and harmonize the assessment of natural assets extent and condition, social uses, as well of economic values over time to develop an integrated system of ecosystem services accounts.

Box 1: Biodiversity Indicator and Reporting System (BIRS)

In 2014, IUCN (International Union for Conservation of Nature) created the Biodiversity Indicator and Reporting System (BIRS)[42] to guide companies in the cement and aggregates sector in adopting a standardized system for monitoring biodiversity at their extractive operations, and to encourage regular reporting on biodiversity attributes at the company level.
BIRS is an easy-to-apply system for calculating an annual biodiversity condition index for every active or disused extraction site and reserve landholdings, taking into account (1) the extent of every habitat type found on a site (including operational and rehabilitation areas), (2) the ecological condition of these habitats, especially their suitability for biodiversity and (3) the uniqueness and ecological importance of each habitat in the regional context. BIRS essentially represents a balance sheet of a company's 'biodiversity assets' and summarizes the composite value of its landholdings for supporting biodiversity.
Implementing BIRS involves several steps that ultimately lead to the determination of an overall Site Biodiversity Condition Class for each individual operational site assessed. The first steps involve identifying and delineating the different habitats that make up the site, and then estimating the total area for each habitat type. Next, it is necessary to determine the Habitat Context Factor for each habitat block, based on how widespread it is in the landscape, the intrinsic biodiversity value of the habitat, the degree of threat and its ecological importance. Building on this, the next steps involve assessing the condition of each habitat and assigning each a Habitat Condition Class, based on the potential for enhancements and the level of current threat. The final step of the process combines this information on the extent of each habitat type and their context factor and condition indices, to determine an overall Site Biodiversity Condition Class.

In this overall approach, BIRS outcomes (i.e. condition of habitats; habitats can be considered as ecosystem assets according to UNSEEA EEA[43] terminology) were used as input data for the ecosystem services assessment (see Box 3) and therefore habitat categories in BIRS assessments had to be aligned with ecosystem asset categories that are providing ecosystem services. Also, specific information from BIRS assessments like uniqueness and importance of habitats have been applied to assess a qualitative value for cultural ecosystem services.

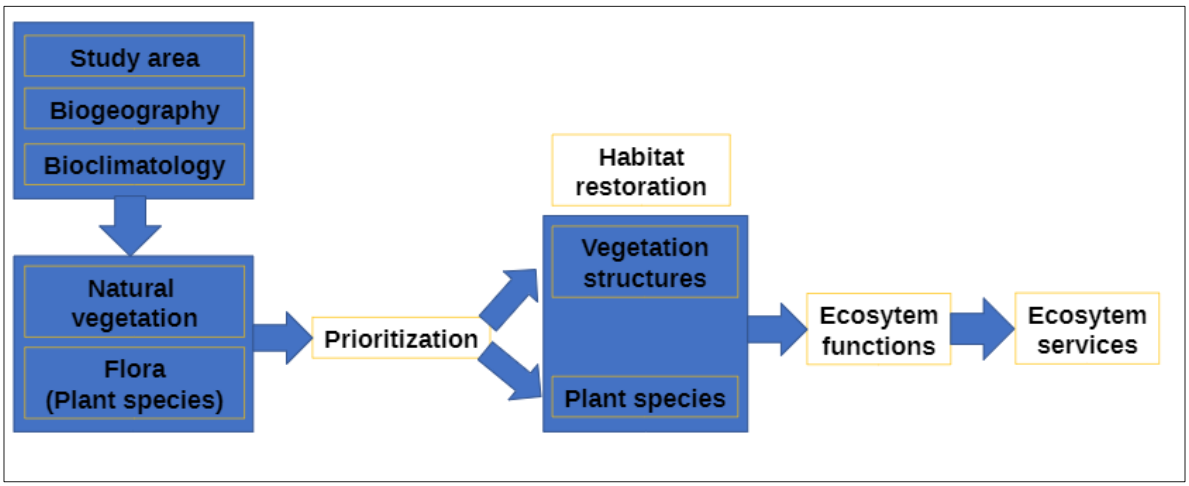
Box 2: Long Term Biodiversity Index (LBI)

The Long-Term Biodiversity Index (LBI) guidance has been developed in 2012 through a partnership between Lafarge (before merger with Holcim), IUCN France and WWF, to update and refine the original methodology, which was issued in 2005.
The Long-term Biodiversity Index (LBI) is an indicator used to assess the biological diversity of a site, and for each habitat identified in the quarry. The assessment focuses on mainly heritage species, i.e. protected and/or endangered species. The rock-type being quarried (igneous, limestone, alluvial, clay etc.) doesn't impact the use of this index. The LBI allows to quantify a site's biodiversity for a given year, and to follow the changes through reassessments every 3 to 5 years. Therefore, it is recommended to periodically recalculate the index in order to follow its evolution and the first LBI has to be calculated as early as possible in the quarry's life cycle. Additionally, the data that is collected to calculate this index can be used in both the creation of environmental management systems and quarry rehabilitation plans.

[41] Before merging with Holcim
[42] https://portals.iucn.org/library/sites/library/files/documents/2014-055.pdf
[43] the UN developed System for Environmental Economic Accounting – Experimental Ecosystem Accounting

Thanks to the implementation of this index Holcim can monitor the natural succession in the restored quarries. Based on succession models of natural recolonization, it also allows to implement a structured decision-making process for defining the best restoration intervention scenario according to prioritization assessment of plant species structures and composition. The future restored ecosystem composition and functions generated in this way will be crucial for defining the type and amount of ecosystem services to society (see following figure). In this way, the information provided by LBI has been very useful to define a context specific qualitative index to assess specific ecosystem services aligned with plant species structures and composition like seed bank provisioning services, regulation of organic material, fire protection, or cultural services.

LBI logical framework:



Box 3: Measuring and valuing ecosystem services

The process of measuring and valuing ecosystem services follows a number of steps defined in the scientific bibliography:

- Step 1: Materiality assessment. Identification of relevant ecosystem services based on stakeholder consultations; classification of ecosystem services is based on CICES 5.1; initially 33 ecosystem services were identified but based on stakeholder input, only 13 were selected as material; provisioning services generated within the rehabilitated quarry and which contributed to improve local economy (such as grazing, agriculture or harvest of wild raw materials) were explicitly excluded; this was also the case for the crops produced in the agricultural area in advance of the mining operations; the reason for this is that Holcim only wants to value ecosystem services related to biodiversity conservation values; the 13 selected ES include pollination, seed bank and seed dispersal, carbon sequestration, fire protection, pest control, pedogenesis and organic material generation, water filtration, regulation of temperature and humidity, active and passive recreation, education and knowledge generation, unique value areas to be conserved for future generations, and preserving biodiversity.
- Step 2: Identifying and mapping ecosystem services. based on the habitats mapping (BIRS) and on the specific locations in the quarry where recreative and educational activities are taking place, ES generation is calculated for every grid of the quarry;
- Step 3: Assessment of ecosystem services, i.e. qualitative, quantitative and monetized assessment; monetization is based on several environmental-economic calculation methods such as market price method, hedonic pricing, avoided costs and travel costs. The general approach for ecosystem services valuation was based on Cambridge University Natural Capital Impact group where the ecosystem services value is determined by qualitative, quantitative and monetary factors. Therefore, on each material ecosystem services category identified in Step 1 a specific valuation approach – based on specific data sources – was applied. For example, pollination values came from pollinators species data from MAES reports, species seed provision is based on transfer values from scientific bibliography data and economic values came from travel cost or hedonic prices approaches.

Biodiversity Indicators for Site-based Impacts (BISI)

Biodiversity Indicators for Site-based Impacts is a methodology for aggregating biodiversity impact and performance data at a site level to provide indicators of biodiversity management performance at corporate level. It has been developed to link to, and be complementary with, existing efforts to identify corporate indicators, in consultation with industry.

The methodology recognises companies may already be required by legislation, as well as reporting standards of financial lending institutions, to disclose their impacts on biodiversity. However, it is not a substitute for these. Instead, it aims to align with these existing requirements and is designed to improve a company's performance in relation to biodiversity.

A three-stage process is outlined:

- **First stage**: screening of the company's portfolio of operations to identify sites with potentially high biodiversity significance . This includes step 1: identify high significance sites based on global datasets, combined with step 2: validation of the results by site managers with locally available datasets;
- **Second stage**: tailoring of site-level biodiversity indicators using the state-pressure-response (SPR) framework (a widely accepted organising framework for site-based biodiversity management and monitoring). This is informed by the stage above and is based upon site-level data and documentation for high significance sites collected as part of an environmental impact assessment and monitoring. This includes step 3: identify site-level metrics against the SPR framework, combined with step 4: calculate scores for the site dashboard; and
- **Third stage** : aggregation of scores for SPR from site level up to business unit, division level and corporate level.

Stages 1 and 2 of this methodology have been piloted by energy and mining companies (IPIECA members and Proteus partners).

More information on the measurement approach can be found here:

https://www2.unep-wcmc.org//system/comfy/cms/files/files/000/001/771/original/Biodiversity_Indicators_for_Site-based_Impacts_Methodology_V3.2_%281%29.pdf

Biodiversity Metric 3.1

Developed by Natural England (updated in April 2022). Biodiversity Metric 3.1 has been extensively tested. Natural England will be recommending to the UK Secretary of State that the Biodiversity Metric 3.1 forms the basis of the statutory biodiversity metric used to underpin future mandatory biodiversity 'net gain' as set out in the UK Environment Act 2021.

The Biodiversity Metric 3.1 is a scoring system which uses habitats and their condition as a proxy to quantify biodiversity. This is a pragmatic, though well-balanced manner to measure and value biodiversity and is thus apt for businesses and developers. Furthermore, the system also incorporates the mitigation hierarchy and offers a framework in case offsetting is needed.

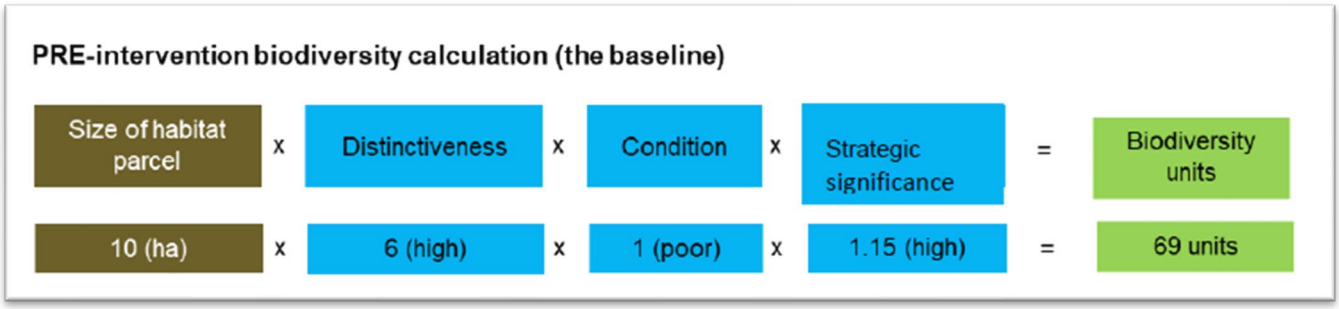
The Biodiversity Metric 3.1 is very well documented with practical user guides and a free Excel tool. Also, a beta version for GIS implementation is available. The documents needed for usage are listed on the webpage of Natural England[44].

Technical use

The first step in the approach consists of measurement of PRE-intervention biodiversity calculation. This is, in other words, a validation of the nature values existing in the baseline situation (a proxy for biodiversity before the start of a development). Four factors are observed and determine the initial "score", expressed in "biodiversity units". These are:

- **Distinctiveness**: habitats that are scarce or declining typically score high. Multipliers that are distinguished are: 0, 2, 4, 6, 8.
- **Condition**: score relative to others of same type. Multipliers: 0, 1, 1.5, 2, 2.5, 3.
- **Strategic significance**: "better" or more "joined-up": habitats sited in an area identified, typically in a relevant local strategy or plan, as being of strategic significance for nature. Multipliers: 1, 1.10 and 1.15.
- **Area** (measured in hectares).

In a flexible manner depending on needs an encroachment factor can be included that reflects the degree of disturbance of a habitat. The calculation is as follows:

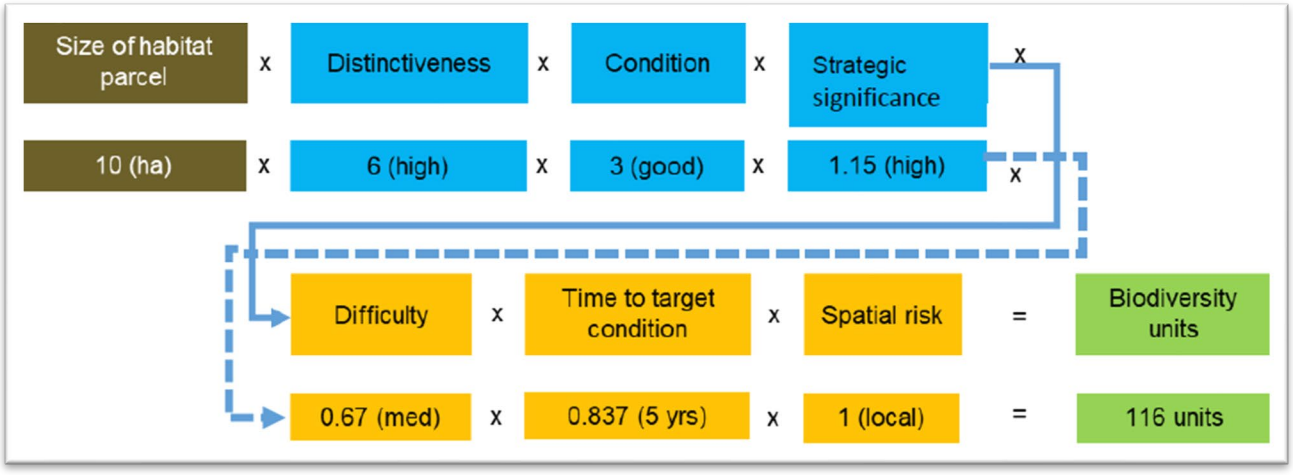


A second step is to calculate the POST-intervention biodiversity value. This means, the newly created or enhanced habitat, either at the project location or due to nature recovery outside of the project location. The calculations thereby include risk factors in creating or enhancing habitats[45]. These risk components are:

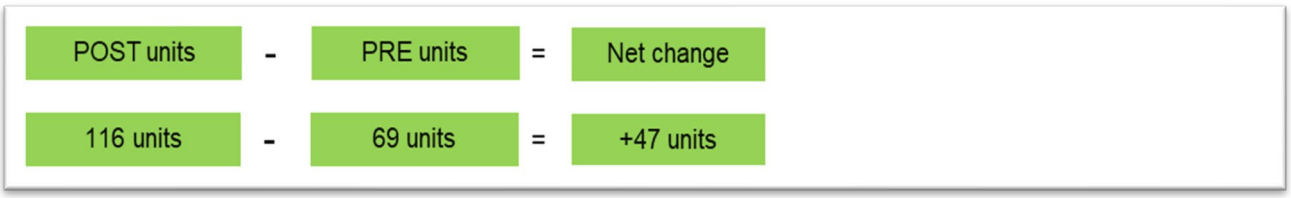
- **Difficulty of creation or enhancing a habitat** (multipliers: 0.1, 0.33, 0.67,1).
- **Temporal risk**, which covers the time gap between, e.g. the destruction of a habitat, and the end stage in the development of a new habitat. Values are given for a time period of 1 to 30 years (multiplier 1 to 0.32). For habitat types which require a development of more than 30 years (e.g. several forest types), a fixed value of 0.32 is given.
- **Spatial risk:** creating habitats nearby habitats that are destructed offers more possibilities for survival of local populations than creating new nature values on long distance. This is accounted for by the factor "spatial risk".

[44] http://publications.naturalengland.org.uk/publication/6049804846366720
[45] Biodiversity Metric 3.1 User Guide.

The following figure shows how these factors are used in the calculation of the biodiversity units for newly created or enhanced habitats.



The next figure shows how the net effect of an intervention (or a series of interventions) is calculated. Pre-intervention units are subtracted from post-intervention units. When the ambition is set to use 'no net loss', the net change should be zero units (0). When ambitions are to obtain net biodiversity gain, the net change should be positive (+). The determination of how positive this value should be, is the subject of other parts within this report.



Biodiversity Net Gain Calculator (BNGC)

The Biodiversity Net Gain Calculator (BNGC) has been developed by Arcadis to provide insight in the land use related biodiversity value on operational sites of a company. The main purpose of the BNGC is to provide insight in the actual and potential biodiversity value of the different spatial units of the site by means of a metric built on extent, condition and significance.

The approach works as follows:

- Based on satellite imagery and infrared maps (to distinguish built and green areas) a workable map of the site is developed, with different polygons for every spatial unit that needs to be differentiated. In GIS, the boundaries around contiguous green areas are created automatically but further differentiation can be applied in a pragmatic way. As such, they can reflect for example different uses, different habitats, different owners if needed, etc. The spatial units (or "polygons") each get a unique code, to which can be referred in the documentation (photos, calculator, report).
- Based on a field survey by an experienced ecologist quality scores for the biodiversity value (ranging between 0 and 1) are attributed to every single polygon, based on expert judgement. The unit of the "score" is expressed in terms of biodiversity value per square meter. Field survey can range between rapid screening and more intensive field observations (eventually supported by more sophisticated monitoring techniques such as bat detector, camera traps, etc.), but this is highly dependent on the biodiversity value of the site and the level of information which is available. High end scores (0 and 1) can be interpreted equally for each situation, i.e. a score of 1 represents a high quality habitat with a very rich biodiversity comparable to totally undisturbed nature (comparable to 'pristine', for example a well-developed Natura 2000 area in favorable conservation status) and 0 represents complete surface hardening (absence of biodiversity value). In between scores are tailored to each situation and dependent on the local context and site constraints of each site. A score of 0,4 in a high biodiversity value area (e.g. abandoned land on an industrial estate and connected to a nearby nature reserve) might have a real biodiversity value which is higher than a habitat patch with a 0,4 score in an intensively used industrial site completely surrounded by built areas). This is deemed acceptable as the tool wants to provide a practical scoring approach for site level assessments and not for comparing sites. For each site where the BNGC is applied, Arcadis develops clear instructions on how to score the biodiversity value in the different plots of the site. As an example, scores are set for amongst others species-poor lawn, extensively mown grassland with limited presence of insect fauna, extensively mown grassland with many herb species and abundant soil life etc. Results of in-depth inventories (e.g. inventory of ants and grasshoppers in grassland habitats by a local NGO) can be taken into account in the scoring system. This way, more detailed info regarding (protected) species can also be summarized in the tool. Also, the potential of vegetations for being upgraded is noted briefly in the calculator, as well as described in the documentation provided together with the calculator. The presence of invasive alien species is noted as well. Observations are documented with photos.
- Quality scores and codes are both presented by means of maps and tables.
- A total quality score is calculated (summation of scores of all polygons with surface of polygons accounted in).
- An excel calculation sheet is developed allowing for visualizing the impact of additional pressures (e.g. new building on the site) or biodiversity restoration/enhancement measures, for tracking progress over time and for defining the need for either on-site or off-site actions needed for maintaining biodiversity 'no net loss' or achieving 'net gain'.

The scoring in the BNGC is aligned with how MSA is scored in GLOBIO with BNGC only focusing on land use. It also provides a quality score between 0 and 1 but while the MSA.km2 metric is reflecting a combination of extent and condition, the BNGC scores which are attributed to each green ('unbuilt') zone of the site are also reflecting significance, i.e. they take into account the presence of rare or protected species and habitats. Moreover, as this is based on a site visit by a biodiversity expert, the BNGC provides a high resolution and accuracy.

More information on the measurement approach: Please contact hans.vangossum@arcadis.com

Biodiversity Monitoring System (BMS)

The Global Nature Fund, Lake Constance Foundation, Agentur AUF! (Germany), the Fundación Global Nature (Spain), Solagro and agoodforgood (France), and Instituto Superior Técnico (Portugal) have initiated the EU LIFE Project "Biodiversity in Standards and Labels for the Food Industry". The main objective is to improve the biodiversity performance of standards and labels within the food sector by supporting standard organizations to include efficient biodiversity criteria into their schemes and motivating food processing companies and retailers to include biodiversity criteria into their sourcing guidelines.

The Biodiversity Monitoring System shall enable the monitoring of impacts on biodiversity that are achieved through certification of standards and labels for the food sector. The focus thereby lies on monitoring:

- Reductions of negative impacts on biodiversity;
- Creation of potentials for more biodiversity on the farm and its surrounding

as a result of improved agricultural practices in support of biodiversity.

The aim of the Biodiversity Monitoring System is to enable detecting changes towards favourable conditions for biodiversity as a consequence of implementation of sound biodiversity management and very good agricultural practices. The development of agricultural practices with relevance for biodiversity is recorded with help of a dedicated indicator set. With these indicators, the Biodiversity Monitoring System generates a data basis for decision-making that -hopefully- helps to induce the following positive changes:

- The creation of potentials for biodiversity;
- A reduction of the direct pressures on biodiversity by implementation of very good agricultural practice;
- The identification and reduction of further risks for biodiversity loss and degradation;
- The creation and protection of habitats;
- The increase of agrobiodiversity.

A structured overview and visualisation of the data facilitate an evaluation of agricultural practices with the aim of drawing conclusions regarding the development of the potentials for biodiversity. A baseline is established by the initial data collection that describes the current state of the farms. Changes are monitored by subsequent data collection in replicated time series i.e. if the key data of the Biodiversity Monitoring indicators are gathered again after a certain time span (every 1-3 years).

Beside the Biodiversity Monitoring System, the Biodiversity Performance Tool was developed in the EU LIFE project. It is closely related to the Biodiversity Monitoring system and aims at identifying and assessing the state of the potential for biodiversity on a farm. The further objective is to propose an action plan comprised of sustainable actions to reduce impacts on, preserve and promote biodiversity into the system of production. The Biodiversity Monitoring System of the EU LIFE Food & Biodiversity project is designed in a way that it can interact closely with the Biodiversity Performance Tool but is also applicable as a stand-alone, independent monitoring system. The Biodiversity Monitoring System uses several key data and indicators that are also relevant for the Biodiversity Performance Tool. If a farm already uses the Biodiversity Performance Tool, only few more data need to be gathered in order to implement the Biodiversity Monitoring. More information about the Biodiversity Performance Tool can be found in the corresponding short description in the appendix to this report.

The web-address of the Biodiversity Monitoring-System is: https://bms.biodiversity-performance.eu/

Biodiversity Performance Tool

- Assessing potential for biodiversity at farm level
- Supports farmers and assessors in biodiversity management and the elaboration of a sound Biodiversity Action Plan
- Collects information on farm environment, farm practises and cooperation (78 indicators with relevance for biodiversity)
- Evaluates the baseline of the farm: strengths, weaknesses and opportunities
- Recommends measures to improve biodiversity performance = input for the Biodiversity Action Plan
- By updating the baseline, the BPT provides an overview on the development of biodiversity on the farm (monitoring)

Biodiversity Monitoring-System

- Comparing biodiversity performance trends in the long-term
- Compiling 25 biodiversity performance indicators within a timespan or within sectors
- Focused on users such as standard organizations, food companies with many suppliers or agricultural cooperatives with many members
- Delivers information on 2 levels:
  - Level 1: System wide monitoring. Data collected for every certified farm /supplying farm through certification applications (e.g. information self-reported by producers), audits and/or the Biodiversity Performance Tool. Collection and evaluation of 25 indicators.
  - Level 2: In-depth sampled monitoring beyond the scope of the certification audit by data generated on selected farms (different geographical settings, different type of crops). Monitoring of few key indicator species. Level 2 monitoring will presumably be available in 2021.

Source for the above information and more information on the approach: https://www.business-biodiversity.eu/bausteine.net/f/9642/Biodiversity_Monitoring_Handbook_EN_StandardCompany.pdf?fd=0

Biodiversity Performance Tool (BPT)

Developed within the EU LIFE Initiative "Biodiversity in Standards and Labels for the Food Sector" by a consortium of Global Nature Fund, Lake Constance Foundation, Agentur AUF! (Germany), Fundación Global Nature (Spain), Solagro and agoodforgood (France) and Instituto Superior Técnico (Portugal).

The BPT facilitates the assessment of the potential for functional biodiversity at farm level. The tool supports farmers and farm assessors to identify the current situation regarding biodiversity on the farm, to evaluate basic indicators and to select effective measures for a Biodiversity Action Plan (BAP). These measures are described in detail on the website https://insect-responsible.org/.

The **BPT Insects** has an additional focus on insect protection with specific indicators and protection measures. The indicators of the BPT Insects also cover all criteria of the Basis-Set of Biodiversity Criteria agreed by the German Association "Food for Biodiversity".

The BPT helps to assess the quality of implementation of measures as well as monitoring of the whole Biodiversity Action Plan. Therefore, the outputs of the BPT are not only useful for farmers, but also interesting for certifiers as well as product and quality managers of food companies. They will get a simple but meaningful overview regarding the quality of the BAP and the biodiversity performance on the farm.

Aims

- Identify the state of potential for biodiversity in general and for insects in particular on a farm and assess strengths and weaknesses. Provide the basis for the elaboration of a sound Biodiversity Action Plan (BAP).
- Quantify each type of semi-natural habitats at farm level
- Support farmers in the elaboration of a Biodiversity Action Plan (BAP) with recommendations for effective measures to reduce impacts on biodiversity and preserve and promote biodiversity and insects in the production system and beyond. The BAP takes into account the current socio-economic as well as technical context of the farm.
- Monitor the implementation of the BAP and illustrate continuous improvement of biodiversity performance (or not).
- Raise farmers' awareness on the potential for biodiversity and insects on the farm and how to use this potential to increase performance. Deploy this learning process to the whole food chain including quality and product manager as well as sourcing manager of food companies.

Target groups

- BPT Insects helps farmers and farm advisors to elaborate and implement sound Biodiversity Action Plans which contribute substantially to a better biodiversity performance on farm level. A special focus is on insect protection.
- The tool supports auditors and certifiers of standards as well as product, quality and sourcing managers of food companies to better assess the conservation and restoration as well as management of biodiversity at farm level.

The BPT is available on www.biodiversity-performance.eu.

Members of the sector initiative "Food for Biodiversity" can use the BPT for free. Other users would need to pay a small user fee. Please contact Saskia.wolf@bodensee-stiftung.org

More information on the measurement approach can be found here: www.biodiversity-performance.eu

BioScope

BioScope is a tool which uses the previous version of EXIOBASE (v2) and ReCiPe (2008) to screen a company supply chain on impact on biodiversity. The results brought by BioScope are aimed at helping you to formulate meaningful actions to further assess and reduce the impact of your business on biodiversity. It not only indicates the potential impact of the commodity you purchase, but also of the upstream supply chain of these commodities. Examples of questions which can be answered with BioScope are:

- Which of the commodities purchased by my business could be the largest cause of impact on biodiversity?
- What could the new purchasing strategy of my business mean for our impact on biodiversity?
- What commodity purchased by my business do we need to focus on if we want to make a meaningful contribution to conservation of biodiversity?

Use cases are products, supply chain, and corporate. Supported business applications are current performance and comparing options.

Corporate Biodiversity Footprint (CBF)

Developed by Iceberg Data Lab (IDL)

A Sectoral Approach

The intensity of environmental pressures on biodiversity is sector specific. For each economic sector, the main drivers of biodiversity loss are selected based on available scientific literature. The most important pressures on biodiversity included in the Corporate Biodiversity Footprint's scope are the Change of Land Use, Climate change, Air pollution (Nitrogen and Sulfur deposition) and Water pollution through the release of toxic compounds into freshwater (Freshwater ecotoxicity).

Using pressure-impact relationships and damage functions, those pressures are converted into the unit km².MSA which measures the overall biodiversity impact of an issuer.

We calculate a company's direct biodiversity impact (Scope 1), the impact of its electricity suppliers (Scope 2) and its upstream and downstream impacts (Scope 3), adopting the taxonomy of the GHG protocol.

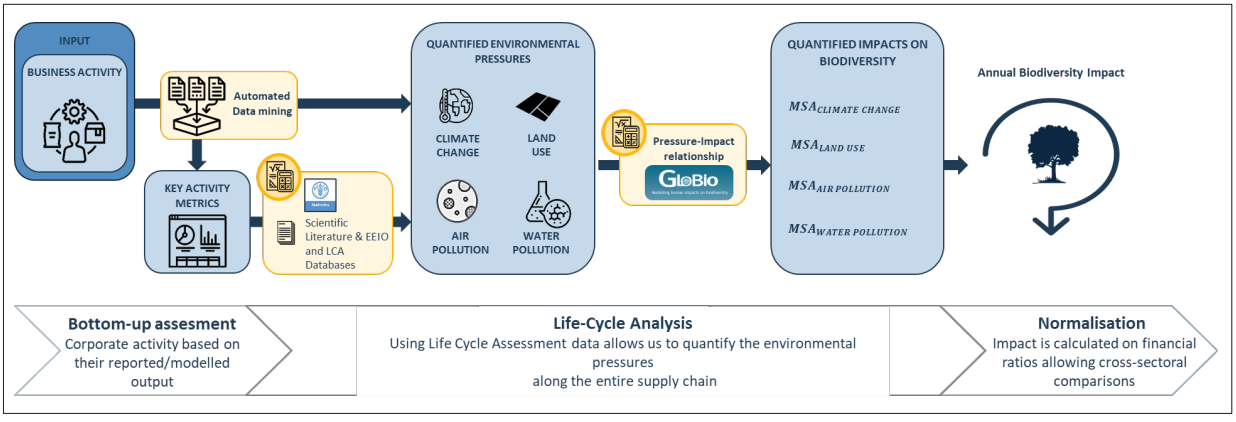
The Mean Species Abundance

The Mean Species Abundance (MSA) is a biodiversity metric which expresses the mean abundance of original species in an habitat compared to their abundance in an undisturbed habitat, measuring to which extent an ecosystem is intact. The MSA is endorsed by the international scientific community, used by the IPBES and the IPPC in their reports and one of the most widely used indicators in biodiversity accounting. The km² MSA enables to aggregate footprinting results. For instance, 1 km² MSA corresponds to the value of biodiversity contained in 1 km² of tropical forests undisturbed by human activities.

Overview of the Corporate Biodiversity Footprint

The calculation of IDL's Corporate Biodiversity Footprint (CBF) follows three successive steps:

1. the company's financial and operational metrics are collected;
2. the company's metrics are used to estimate its specific environmental pressures (GHG emissions, Sox and NOx emissions, surface of land used, volumes of toxic compounds released (Tox));
3. the pressures are eventually converted into absolute impact and converted in the km2.MSA unit. The impact from all pressures is then computed into the overall Corporate Biodiversity Footprint.



To date, the methodology takes into account four different biodiversity pressures:

1. **Change of land-use**
   Land use and land cover change is seen by leading scientists as the first driver of global biodiversity loss. We assess land occupation (maintaining land in an disturbed state), land transformation (converting undisturbed land) and land encroachment.

2. **Air pollution**
   We consider NOx and Sox emissions, which lead to eutrophication and acidification of soils. Terrestrial acidification and eutrophication disturb the living conditions of flora and fauna, leading to changing ecosystems.
3. **Climate Change**
   A lot of species are highly sensitive to change of temperature. Due to the pace of the ongoing climate change, species will not be capable of adapting and are at risk of disappearance. We consider damage functions linking GHG emissions to biodiversity loss.
4. **Water pollution (freshwater ecotoxicity)**
   Certain pollutants are especially hazardous to water and species living in freshwater. Pollutants can either be directly toxic to species or bioaccumulate in aquatic organisms and therefore possibly affect regeneration.

A calculation of the impact throughout the value chain

IDL estimates the biodiversity impact of the corporates throughout their value chain (Scope 1, 2, 3 upstream and downstream) factoring the impact of a company's supply chain (material in the Agri-Food sector for instance) and of its products (material for car manufacturers for instance). Life-cycle analysis reference emission factors are used in the CBF computation.

The assessment incorporates data reported by the company. A Disclosure Quality Level (DQL) indicator is attached to each data point and shows in a transparent manner the uncertainty level relative to each data point. The corporate data collected and used come from available public sources, like their annual or sustainability reports.

An approach applicable to all asset classes

The underlying environmental impact of a company's product or processes is calculated. Our model then allocates this environmental impact to the capital provided, which allows to model the impact of every kind of asset and to compute the overall impact at a portfolio level for a multi-asset investor.

Iceberg Data Lab Research team compiles a database comprised of several thousand issuers, indexed by broadly available unique ID or by their listed financial instruments (stocks, bonds).

A comprehensive quality review assesses the company's results along the "4-eyes" principle and an internal quality indicator monitors the evolution of the quality of our dataset.

More information on the measurement approach can be found here: contact@icebergdatalab.com

Environmental Profit & Loss (EP&L)

Kering has developed an innovative tool for measuring and quantifying the environmental impact of its activities. The Environmental Profit & Loss (EP&L) account is a key enabler of a sustainable business model, and one that Kering wishes to share with its peers in the Luxury industry and other sectors. Because the EP&L is a tool for the greater good, Kering is sharing its methodology with other companies, in its own industry and beyond, to encourage a general movement toward greater sustainability.

An Environmental Profit and Loss account is a business management tool providing an in-depth analysis of the resulting impacts a company's activities have on the environment, which also helps decision makers consider this valuable information alongside traditional financial metrics. Kering's pioneering EP&L measures and values in economic terms the environmental impacts across our own operations and the entire supply chain. In doing so it helps us:

- Translate environmental impacts into a language business understands;
- Compare between different types of impact;
- Facilitates comparison between brands and business units.

As a result, we can:

- Identify the most significant drivers of impacts in our business;
- Understand the impact of every day decisions;
- Develop more robust business policies to address the risks and opportunities presented by environmental challenges;
- Implement targeted projects concerning choice of materials, or development of new manufacturing processes, for example;
- Monitor progress of our sustainability strategy, while forecasting and preparing for the future;
- Be transparent with our stakeholders.

The EP&L approach measures carbon emissions, water consumption, air and water pollution, land use, and waste production along the entire supply chain, thereby making the various environmental impacts of the Group's activities visible, quantifiable, and comparable. These impacts are then converted into monetary values to quantify the use of natural resources. Kering can thus use the EP&L to guide its sustainability strategy, improve its processes and supply sources, and choose the best-adapted technologies.
The methodology is continually evolving to take into account the lessons of previous years. The EP&L features a "scenario" modeling tool with dynamic visualization of results so that the impact of a potential decision or future project on the EP&L footprint is immediately known, in real-time. Adding to the efficiency of the EP&L methodology are lifecycle inventories and the inclusion of the Kering Standards, which were first published in 2018.

The basic steps of the EP&L approach are:

1. Decide what to measure
2. Map the supply chain
3. Identify priority data
4. Collect primary data
5. Collect secondary data
6. Determine the monetary value of the data
7. Calculate and analyse the results

For more details on each of the steps, see https://www.kering.com/en/sustainability/measuring-our-impact/our-ep-l/methodology/.

Source for the above information and more information on the approach can be found here:

- https://www.kering.com/en/sustainability/measuring-our-impact/our-ep-l/
- https://keringcorporate.dam.kering.com/m/4b93719b3980f5b0/original/kering_2017_epl_report.pdf

Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)

Developed by (company): ENCORE was developed by the Natural Capital Finance Alliance, a collaboration between Global Canopy, UNEP Finance Initiative (UNEP FI) and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC).

ENCORE was initially funded by the Swiss State Secretariat for Economic Affairs (SECO) and the MAVA Foundation. An additional phase of work was funded by the Swiss Federal Office for the Environment (FOEN) in 2021.

Summary description:

The first part of Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) enables users to visualise how the economy potentially depends on and impacts nature and how environmental change creates risks for businesses. This is made available within its module titled 'Visualise links between the economy and nature' (hereafter referred to as the 'nature capital module'). Starting from a business sector, ecosystem service, impact driver, or natural capital asset, ENCORE's natural capital module can be used to start exploring natural capital risks. These risks can be explored further to understand location-specific risks with maps of natural capital assets, drivers of environmental change, and impact drivers.

Recent developments of ENCORE have resulted in the addition of a further module, titled 'Explore potential portfolio alignment with biodiversity goals' (hereafter referred to as the 'biodiversity module'). This new module within ENCORE enables users to explore the potential alignment of financial activities in selected sectors with a 'nature positive' future. Due to their high material impacts and dependencies on nature, mining and agriculture have been selected as the two initial priority sectors in the module. Further developments to the biodiversity module are planned for 2022.

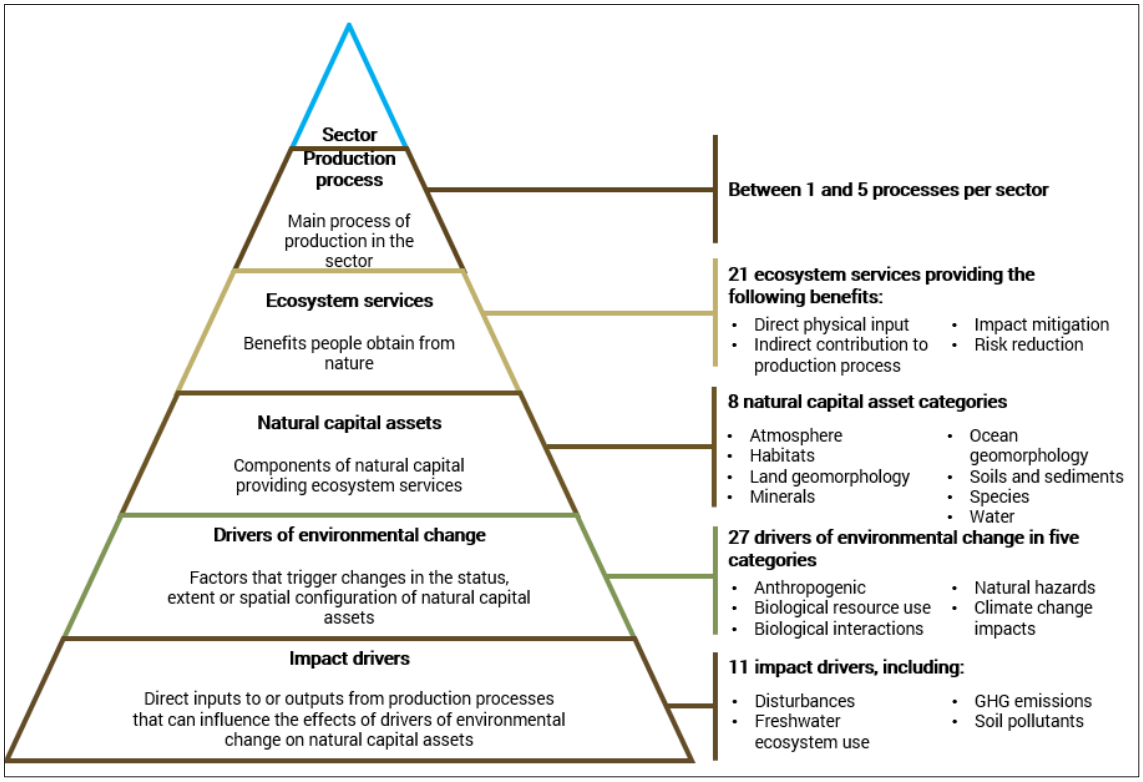
ENCORE can be used for three main purposes: 1) risk management, 2) communication and stakeholder engagement, and 3) biodiversity target setting and portfolio alignment:

- **Risk management** – By identifying potentially material ecosystem services, natural capital assets, and impact drivers for different sectors; identifying important drivers of environmental change that could affect a company/portfolio; assessing the potential risk of disruption to activities in specific locations; exploring potential exposure to nature-related risks in specific areas based on global datasets and sectoral averages.
- **Communication and stakeholder engagement** – ENCORE provides the basic knowledge for financial institutions to understand and communicate potential nature-related risks associated with their portfolios. This can inform the next steps financial institutions need to take to address these risks. Additionally, by clarifying the links between economic activities and natural capital (be it through dependencies or impacts), ENCORE helps integrate natural capital into existing risk management frameworks to institutionalise the management of nature-related risks.
- **Biodiversity target setting and portfolio alignment** – The new ENCORE biodiversity module can help financial institutions understand how much their agriculture and mining portfolios might currently be aligned with a 'nature positive' future, how this might evolve in the future (for mining) and the associated biodiversity risks/opportunities, and what actions financial institutions can take now to ensure greatest alignment with a 'nature positive' future.

What does ENCORE provide within the natural capital module?

ENCORE provides users with a view of how economic activities (referred to as 'production processes') might depend on or impact natural capital. The tool also provides qualitative materiality ratings for dependencies and impacts, which help users understand which dependencies and impacts might warrant the most immediate attention. The information in ENCORE is based on a large body of scientific and grey literature supplemented with input from experts within the scientific and conservation community, and industry. The sectors and sub-industries are based on the Global Industry Classification Standard, GICS. The knowledge base in ENCORE is structured as indicated in the figure below.

ENCORE's natural capital knowledge base:



What does ENCORE provide within the biodiversity module?

The ENCORE biodiversity module (released in 2021) focuses on agriculture and mining initially and combines finance sector user inputs (e.g., area of agricultural land, mining companies) with underlying modelled biodiversity data to provide portfolio level current exposure results for two goal-relevant metrics: species extinction risk and ecological integrity risk. These two metrics relate to two key components that are expected to be included in the Convention on Biological Diversity's Post-2020 Global Biodiversity Framework, expected to be agreed in 2022. This will be accompanied by sector-level future scenarios to indicate potential future risks, as well as guidance on how financial institutions can work with clients/customers to increase their alignment with global biodiversity goals.

Strengths and limitations

Main strengths:

- Accessible to all audiences, as it requires very little prior knowledge of natural capital, ecosystem services, and dependencies and impacts.
- The ENCORE knowledge base draws on a vast body of scientific and grey literature and has been through extensive review processes.
- It comprehensively covers all impacts and dependencies, aligned with authoritative approaches (e.g., the Natural Capital Protocol and the IUCN's Threats Classification).
- The natural capital information in ENCORE can easily be linked to users' own financial data to support economic analyses at varying levels.
- Includes spatial data from existing third-party sources, which allows users to get a quick sense of potential natural capital-related risks in specific locations.

- ENCORE is also a useful tool to implement initial steps contained in guidance (e.g. Science Based Targets Network) by delivering sector materiality assessments, risks and opportunities based on an assessment of nature-related dependencies and impacts.

Main limitations:

- ENCORE's materiality ratings for dependencies and impacts only indicate potential dependencies and impacts, based on generic global and sectoral averages. This is appropriate to inform initial screening, but should be followed by spatially explicit and company-specific assessments to inform on location-specific dependencies and impacts.
- While the natural capital knowledge base is built on the best available scientific and grey literature, some dependency and/or impact links may be missing due to lack of sufficient robust literature.
- The information in ENCORE considers present-day technologies and industry norms, it does not account for future developments by industries to reduce dependencies and impacts.
- Only direct impacts and dependencies are covered. Users cannot explore impacts and dependencies across the full value chain of a production process (e.g., the dependencies listed for the 'Production of paper products' process exclude the dependencies related to growing and harvesting wood products, which are covered under forestry-related processes).
- ENCORE provides no coverage of cultural ecosystem services as these are deemed to be important for all industries (e.g., to maintain health and mental wellbeing of workforces). Also, no coverage of nutrition under provisioning ecosystem services as it is assumed that all industries depend on their customers and staff being able to access food.

More information on the measurement approach can be found here:

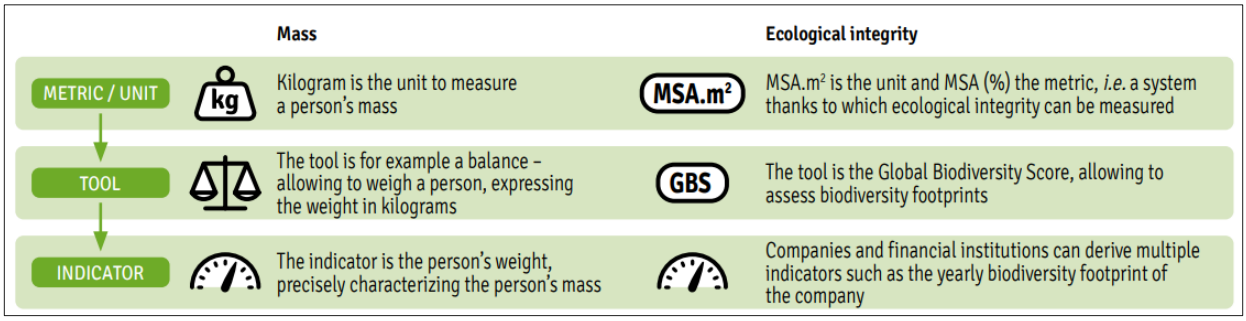
- ENCORE website. Natural Capital Finance Alliance (Global Canopy, UNEP FI, and UNEP-WCMC).
- Demo video of the natural capital functionalities available in ENCORE. 2021, Natural Capital Finance Alliance (Global Canopy, UNEP FI, and UNEP-WCMC).
- Exploring Natural Capital Opportunities, Risks and Exposure: A practical guide for financial institutions. 2018, Natural Capital Finance Alliance and UN Environment World Conservation Monitoring Centre
- Integrating Natural Capital in Risk Assessments: A step-by-step guide for banks. 2018, Natural Capital Finance Alliance and PricewaterhouseCoopers.
- Beyond 'Business as Usual': Biodiversity targets and finance. Managing biodiversity risks across business sectors. 2020, UN Environment Programme, UNEP Finance Initiative and Global Canopy. UNEP-WCMC, Cambridge, UK, 42 pp.
- How to use the ENCORE biodiversity module. 2021, Natural Capital Finance Alliance (Global Canopy, UNEP FI, and UNEP-WCMC).

Global Biodiversity Score® (GBS®)

Developed by CDC Biodiversité

The GBS® is a corporate biodiversity footprint assessment tool: it can be used to evaluate the impact or footprint of companies and investments on biodiversity. The results of assessments conducted with the GBS® are expressed in the MSA.km2 unit where MSA is the Mean Species Abundance, a metric expressed in % characterising the intactness of ecosystems. MSA values range from 0% to 100%, where 100% represents an undisturbed pristine ecosystem. Stakeholders can then build indicators based on GBS® assessment results, for instance Key Performance Indicators (KPI) against which to measure corporate performance. Those differences are illustrated in the figure below. In order to break down impacts across the value chain and provide ways to avoid double-counting, the GBS® uses the concept of Scope, or value chain boundary. Scope 1 covers direct operations. Impacts occurring upstream are broken down into non-fuel energy generation which falls within Scope 2, and other purchases which fall within upstream Scope 3. Finally, downstream impacts belong to downstream Scope 3. To account for impacts lasting beyond the period assessed, GBS® results are further split into dynamic – occurring within the period assessed, future – which will occur in the future - and static - persistent - impacts.

In order to assess corporate biodiversity footprint, the main approach of the GBS® is to link data on economic activity to pressures on biodiversity and to translate these pressures into biodiversity impacts. A hybrid approach is used to take advantage of data available at each step of the assessment. BFAs use company specific data on purchases or related to pressures (such as land use changes or greenhouse gas emissions). In the absence of precise data, a default calculation assesses impacts based on financial turnover data. To link activity, pressures and impacts, the GBS® uses peer-reviewed tools such as EXIOBASE, an environmentally extended multi-regional input-output model, or GLOBIO, a model assessing the impact of various pressures on biodiversity intactness. Its underlying assumptions are transparent. In short, the GBS® uses environmental flows of EXIOBASE (GHG emissions, pollutants emissions and raw material) combined with in-house associated impact factors, which are used to feed models to estimate the impact of e.g. 1 tonne of a given commodity produced in a given country. In the long run, the aim of the GBS® is to cover all biodiversity impacts across the value chain (including both upstream and downstream impacts). It currently covers direct operations and upstream impacts (cradle to gate) on terrestrial and aquatic (freshwater) biodiversity. The pressures covered are land use, fragmentation of natural ecosystems, human encroachment, atmospheric nitrogen deposition, climate change, hydrological disturbance, wetland conversion, freshwater eutrophication, land use in catchment, ecotoxicity (experimental).



More information on the measurement approach can be found here:

2021 technical update: https://www.mission-economie-biodiversite.com/wp-content/uploads/2022/02/N18-TRAVAUX-DU-CLUB-B4B-GBS-UK-MD-WEB.pdf

2019 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2020/09/N15-TRAVAUX-DU-CLUB-B4B-GBS-UK-MD-WEB.pdf

2018 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2019/05/N14-TRAVAUX-DU-CLUB-B4B-GBS-UK-WEB.pdf

2017 technical update: http://www.mission-economie-biodiversite.com/downloads/biodiv2050-outlook-no-11/

GBS® for financial institutions (GBS®-FI)

Developed by CDC Biodiversité

The Global Biodiversity Score® for Financial Institutions (GBS®-FI) is based on the GBS®, a tool which provides an overall and synthetic vision of the biodiversity footprint of economic activities. It is measured by the Mean Species Abundance (ratio between the observed biodiversity and the biodiversity in its pristine state). Calculation of the Mean Species Abundance is based on PBL Netherlands Environmental Assessment Agency's GLOBIO model of five terrestrial pressures (land use, nitrogen deposition, climate change, fragmentation, and infrastructure/ encroachment) and five aquatic pressures, and their impacts on biodiversity.

The GBS® is deployed for two main uses: biodiversity assessment for companies (GBS®) and for financial institutions (GBS®-FI). The methodological grounds are identical for both, but the operational frameworks differ considering the differences in terms of coverage (one company versus multiple financial assets) and data availability (comprehensive company data versus scarce publicly available data). Footprints are estimated in a two-step process. First, pressures caused by specific economic activities on biodiversity are quantitatively assessed. Then, the impacts of these pressures on ecosystems are estimated. This last step relies on the GLOBIO model which is based on pressure-impact relationships.

The GBS®-FI is suitable for calculating the footprint of a financial asset portfolio. Its ability to produce results for investment decisions is conditioned by the underlying data availability which varies depending on the asset type. For listed assets (equity and corporate bonds) an integrated solution, the Biodiversity Impact Analytics (BIA), has been developed. In that case, limited data from users will be necessary (only underlying company identification number). For other asset types, at first GBS®-FI will remain a tailor-made approach that can only be used if a minimum data is provided by the financial institution (it can either be its own data, data purchased from third-party data providers or a mix of both).

More information on the measurement approach can be found here:

2021 technical update: https://www.mission-economie-biodiversite.com/wp-content/uploads/2022/02/N18-TRAVAUX-DU-CLUB-B4B-GBS-UK-MD-WEB.pdf

2019 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2020/09/N15-TRAVAUX-DU-CLUB-B4B-GBS-UK-MD-WEB.pdf

2018 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2019/05/N14-TRAVAUX-DU-CLUB-B4B-GBS-UK-WEB.pdf

Technical update 2017: http://www.mission-economie-biodiversite.com/downloads/biodiv2050-outlook-no-11/

Global Impact Database (GID)

Developed by Impact Institute

What is GID

Global Impact Database (GID) quantitatively describes environmental, social and economic impact estimates for countries and sectors in the global economy, for the purpose of impact reporting and impact management.

Economic activity causes impacts throughout the interconnected economy. GID estimates this impact with input-output analysis based on data on trade between industries in various countries and their environmental, social and economic performance.

GID includes positive and negative metrics for impact themes such as climate change, human health, human rights and more. It covers companies' own operations, upstream and downstream value chain, without double counting, thanks to an innovative attribution approach in line with the Impact-Weighted Accounts Framework. Impact estimates are available in monetary units to facilitate comparison across impact themes. It is applicable for multiple asset classes.

GID Biodiversity impact data

GID includes a biodiversity impact dataset. It can be used to assess the biodiversity impact of investment portfolios and funds, through application to different financial asset classes, as well as B2B interactions, large supply chains, regions, countries and sectors.

The main questions GID answers are the following:

- What biodiversity loss is linked to economic activity, including up- and downstream value chains?
- What is the monetary value of this biodiversity impact?

Distinctive features of the GID include a large granularity of countries and sectors covered, the coverage of up- and downstream value chain without double counting, monetary valuation of impacts, and the combination of input-output analysis with a GIS model.

Methodology

At the time of writing, GID estimates the impact on biodiversity by modelling the pressures of land occupation, contribution to climate change, air pollution and water pollution:

Impact	Indicator
Land use	Land occupation
Contribution to climate change	Contribution to climate change
Air pollution	Terrestrial acidification
	Terrestrial, fresh-, marine water ecotoxicity from emissions to air
Water pollution	Freshwater eutrophication
	Marine eutrophication

GID

The Global Impact Database is built on publicly available and proprietary data sources. Data is sourced from leading academic institutions and private data suppliers. The main data sources used include company reported data, trade data, economic data, environmental and social impact indicators, and impact valuation factors, including Exiobase, GTAP, Eora, FAOSTAT and more.

The GID provides underlying estimates of intensity of these pressures for companies and economic activity in countries and sectors of the global economy by combining data on GHG and other air and water emissions, as well as land use by different crops, pastures and forestry.

These are then used to model biodiversity impact using GLOBIO and ReCiPe, resulting in one of these two metrics: Potentially Disappeared Fractions (PDF) and Mean Species Abundance (MSA) loss. PDF captures the fraction of species that has a high probability of no occurrence in a region due to unfavourable conditions caused by various environmental problems. MSA, on the other hand, is the percentage of biodiversity lost under current usage compared to a natural ecosystem, in terms both of species number and species abundance. Both can be used to approximatively represent: the relative loss of pristine biodiversity. When integrated of area and time, they are used to model biodiversity loss expressed as loss of hectares of natural ecosystem (biodiversity ha) for a year.

In the attribution step, biodiversity impacts of companies, countries or sectors is attributed through value chains, using trade data from the GTAP model (Global Trade Analysis Project) and input-output analysis. Thanks to the GID's innovative approach, it is possible to estimate how economic activity creates biodiversity effects both up- and downstream, without double counting when aggregating a large number of estimates, like you would do for an investment portfolio or a large supply chain.

Impact valuation is also possible with GID, as translation between biodiversity metrics and monetary value is possible, using the True Price methodology, which uses the lens of ecosystem services.

More information on the measurement approach can be found here:

- https://www.impactinstitute.com/products/global-impact-database/gid-biodiversity-impact-data/
- https://www.impactinstitute.com/products/global-impact-database/
- ABN AMRO's Impact on Biodiversity
- Monetisation Factors for True Pricing

Integrated Biodiversity Assessment Tool (IBAT)

Developed by UNEP-WCMC, IUCN, BirdLife International, Conservation International

IBAT is a biodiversity data provider licencing commercial access to global biodiversity datasets and derived data layers consisting of the **World Database on Protected Areas (WDPA),** the **World Database of Key Biodiversity Areas (WDKBA)** and the **IUCN Red List of Threatened Species™.**

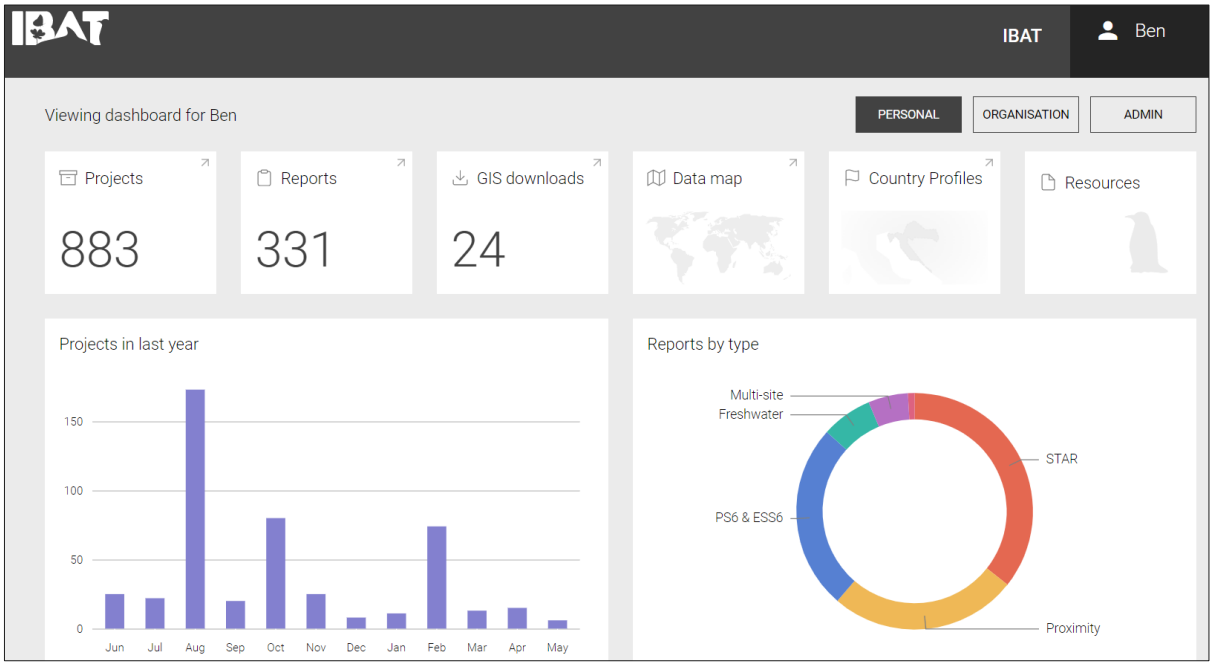
IBAT also provides access to biodiversity reports that offer fast, easy and web-based methods of querying these global datasets to gain site-specific insights on biodiversity risk and opportunities. IBAT Reports include a Proximity Analysis, IFC & World Bank PS6/ESS6 Report on Critical Habitat, Freshwater Report, Multi-site Analysis and Species Threat Abatement and Restoration Metric Report (examples of each here).

The Species Threat Abatement and Restoration Metric (STAR) was incorporated into IBAT in September 2021 and is available to access through bespoke reports for individual Areas of Interest, through IBAT's Multi-site Report and through GIS data downloads of the raster layer.

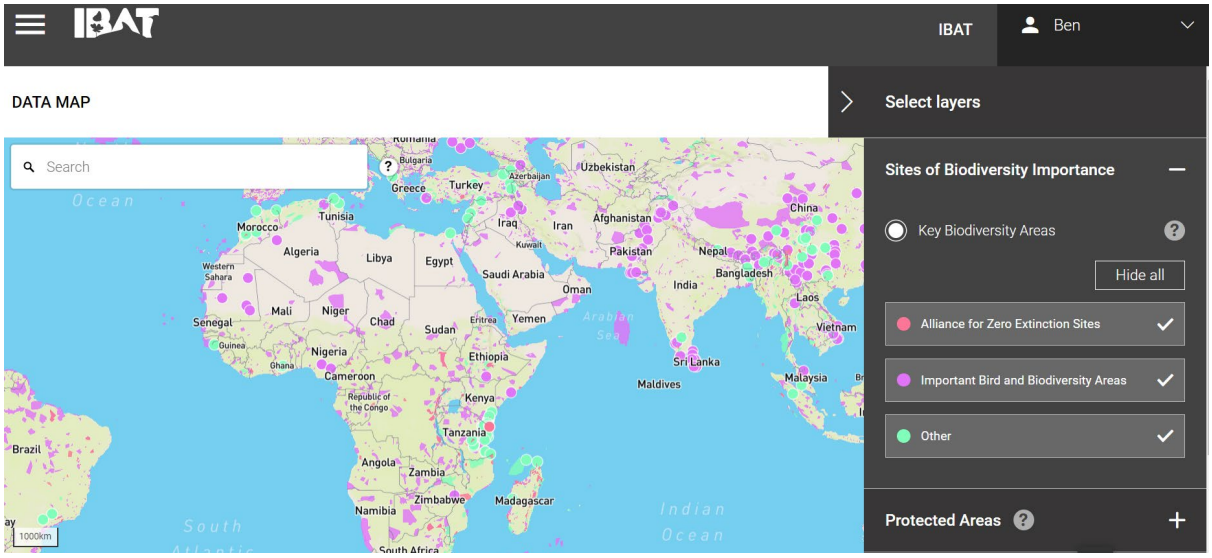
IBAT was originally conceived in 2005 by staff across the Alliance organisations and launched at IUCN World Conservation Congress in 2008. IBAT worked closely with commercial organisations from the start (e.g., The World Bank, Inter-American Development Bank, BP etc.) to ensure the tool was fit for purpose and met the needs of their users. IBAT has seen rapid growth in interest since 2020 and currently supports >12,500 users from over 150 companies - user stories from a selection of IBAT subscribers can be read here.

IBAT is delivered by the IBAT Secretariat, a team of 6 full time staff hosted by UNEP-WCMC, BirdLife International and IUCN. More information on the composition of the teams behind IBAT can be found here.

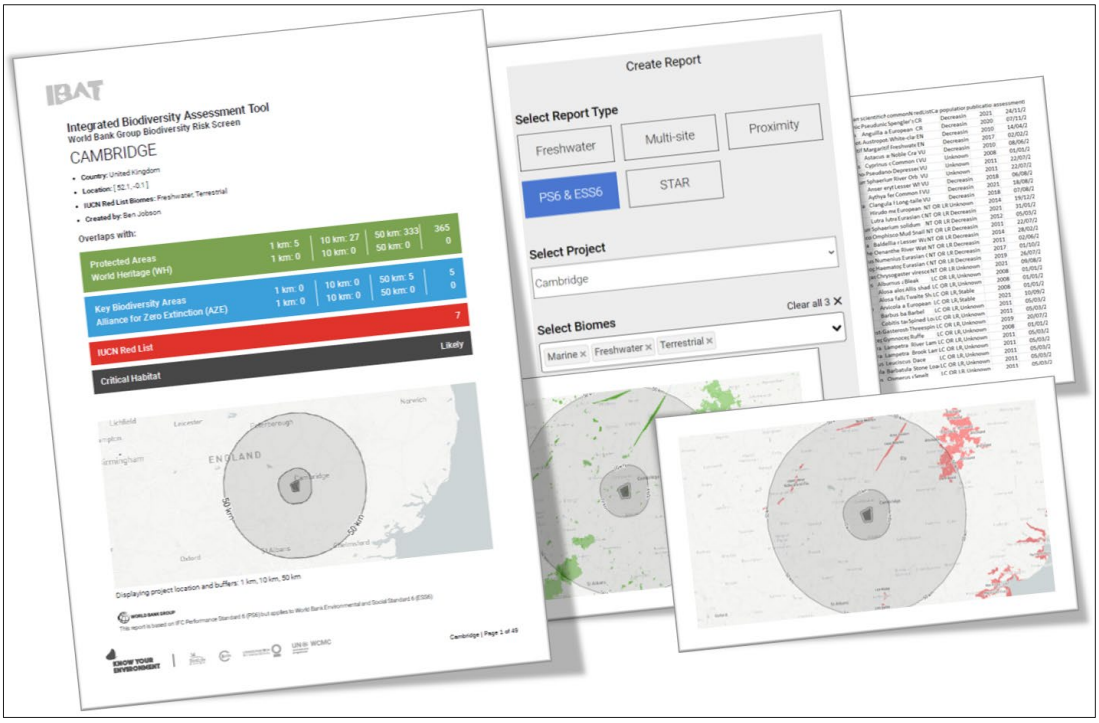
Integrated Biodiversity Assessment Tool



IBAT Dashboard - Individual View



IBAT Data Map showing Key Biodiversity Areas



Example IBAT Performance Standard 6 Report

Access to IBAT Datasets and Reports is arranged through a subscription or Pay As You Go downloadv, which automatically includes a licence to use the data for commercial purposes: *i.e. (a) any use by, on behalf of, or to inform or assist the activities of, a commercial entity (an entity that operates 'for profit') or (b) use by any individual or non-profit entity for the purposes of revenue generation*. The revenue from IBAT licencing is passed back to IBAT Alliance partners to help update and maintain the datasets (cost of which is estimated at $6.5 million p/a).

More information on the measurement approach can be found online (https://www.ibat-alliance.org/subscriptions) and by contacting ibat@ibat-alliance.org.

LIFE Methodology (LIFE)

LIFE Methodology enables organizations to quantify objectively their impact on natural resources. It also provides strategic guidance to organizations to guarantee the effectiveness of their conservation actions.

Thus, the organizational management for sustainability must necessarily incorporate actions that contribute to improve environmental management, to measure and reduce the company's pressures and to conserve biodiversity and ecosystems services.

LIFE Methodology for companies presents three steps that are interconnected: state, pressure, and response.

1. STATE

A general overview of business' operations and management system is provided. Followed by the characterization of landscape, including the ecoregion in which the company is located, local conservation priorities, and threatened species, among others.

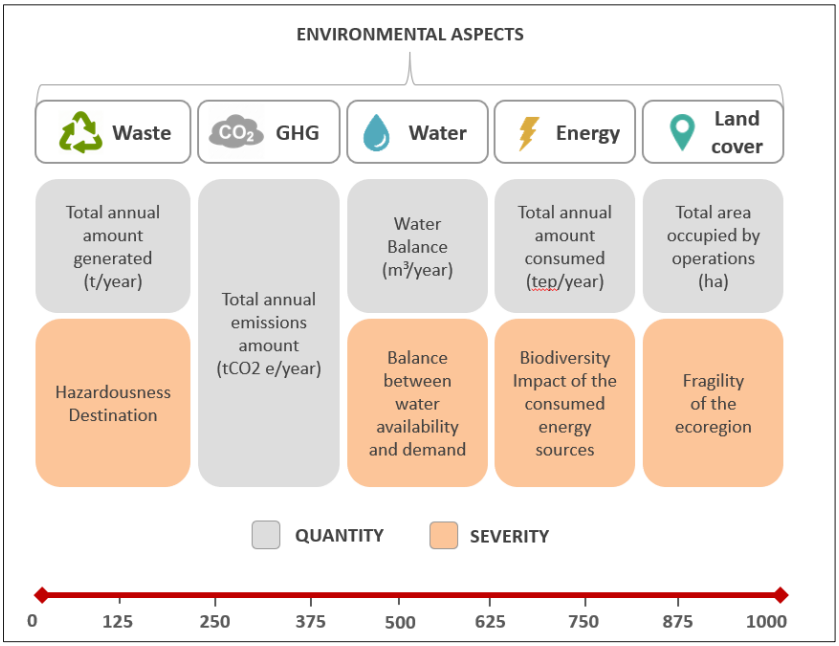
The assessment of the organization's environmental management is performed based on LIFE Standards, which provide management indicators for sustainability. To have access to documents of the Standards and LIFE premises that support them, click here.

2. PRESSURE

Through Biodiversity Pressure Index (BPI) businesses can calculate and monitor through time the pressure that business' activities put on biodiversity. Measurements reflects five important environmental aspects, considering their quantity and severity (chart bellow).

BIODIVERSITY PRESSURE INDEX – BPI

To calculate the organization's pressure on biodiversity, environmental aspects are considered, such as the consumption of energy and water, waste generation, emissions of greenhouse gases and area occupation, considering both their quantity and their severity. More details on BPI calculation are available here. BPI metric will figure in a scale from 0 to 1,000.



BIODIVERSITY MINIMUM PERFORMANCE - BMP

After measuring BPI, the methodology calculates the minimum positive performance required on conservation in order to compensate the impact caused by the use of natural resources.

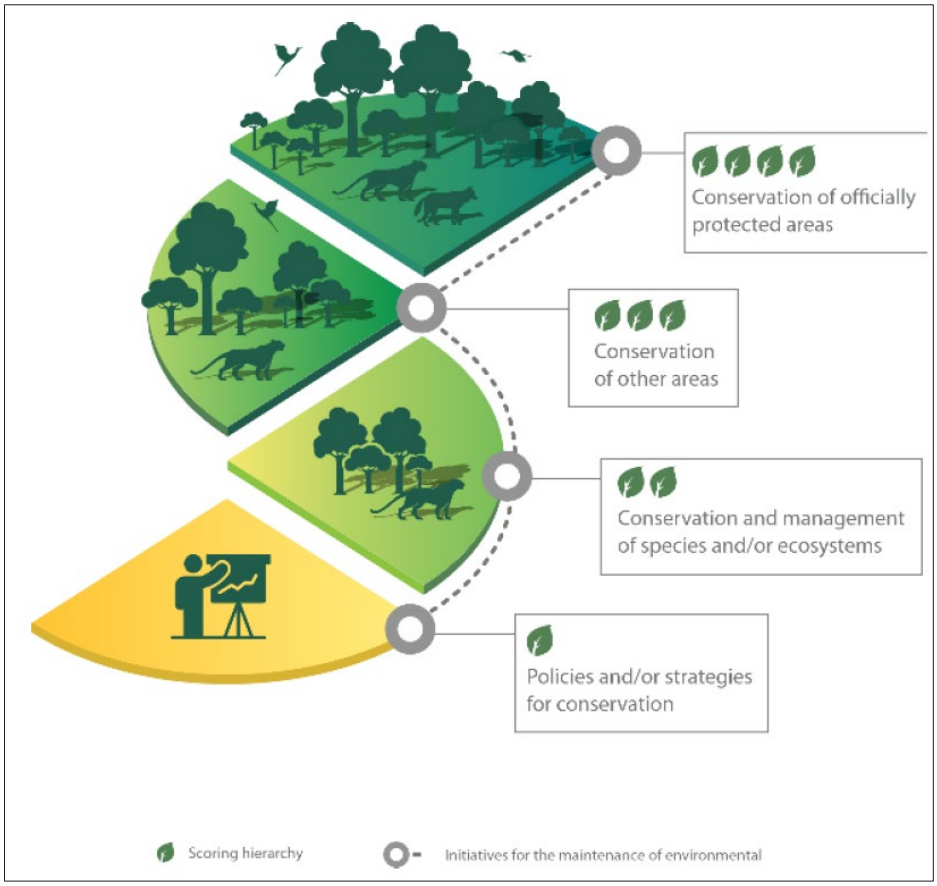
Additionally, at this stage, business' impacts and dependences of biodiversity and ecosystem services are evaluated through LIFE BES (Biodiversity and Ecosystem Services) Matrix tool. This analysis support companies to choose conservation actions and investments directed to business sustainability.

3. RESPONSE

Conservation actions implemented by businesses are evaluated, categorized, and scored. Considering scientific data and international, regional, and local conservation priorities it is possible to strategically assess the results of investments effort in different projects. LIFE Methodology supports elaboration of a Biodiversity Action Plan, calculating the positive performance (BPP) expected from conservation projects, offering improvements, and including conservation performance indicators. It also establishes guidelines for evaluating business' supply chain.

BIODIVERSITY POSITIVE PERFORMANCE – BPP

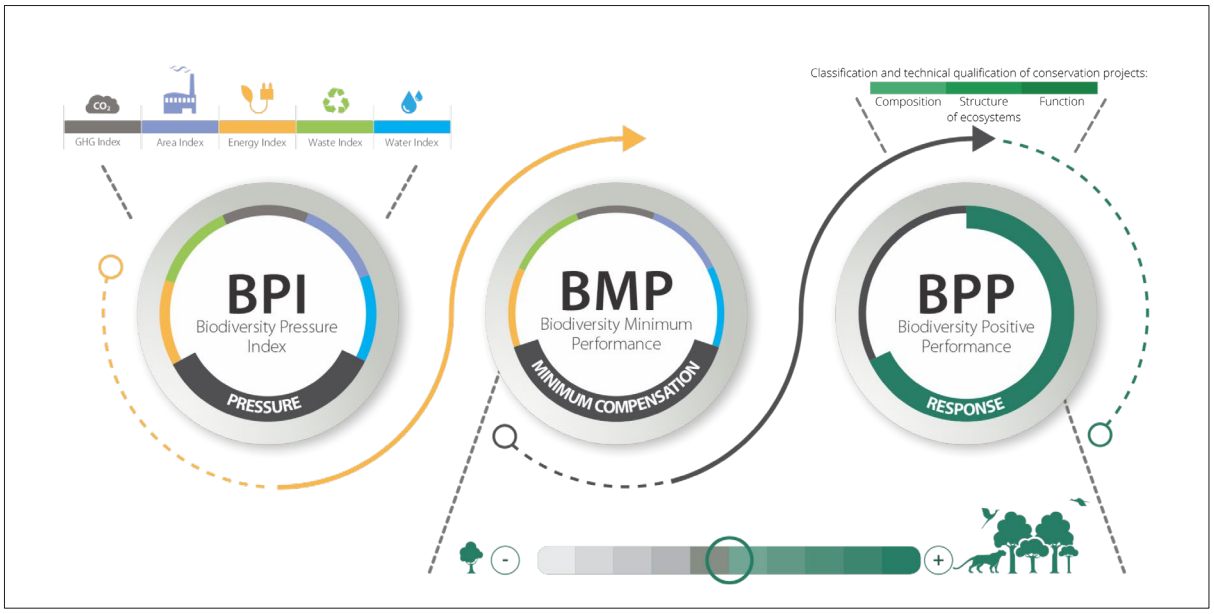
It consists of the evaluation of conservation actions that businesses are already implementing. The rating system follows guidelines regarding both national and international priorities for the conservation of biodiversity as well as the effectiveness of actions performed. Initiatives with greater potential for the maintenance of ecosystem services and the conservation of biodiversity in a shortest time are prioritized. For example, actions for creation and protection of legally protected areas guarantee a direct and effective return for the maintenance of ecosystems' services, so they rate higher than actions carried out focusing on the protection of a single species. Full details about this rating system can be found here.



Supply chain evaluation

Businesses' supply chain is evaluated by LIFE management indicators. They indicate business must identify 100% of suppliers, classify the risks to biodiversity from direct suppliers, establish minimum criteria for the approval of risk suppliers and criteria for continuous suppliers' risks evaluation.

LIFE METHODOLOGY METRICS



LIFE CERTIFICATION

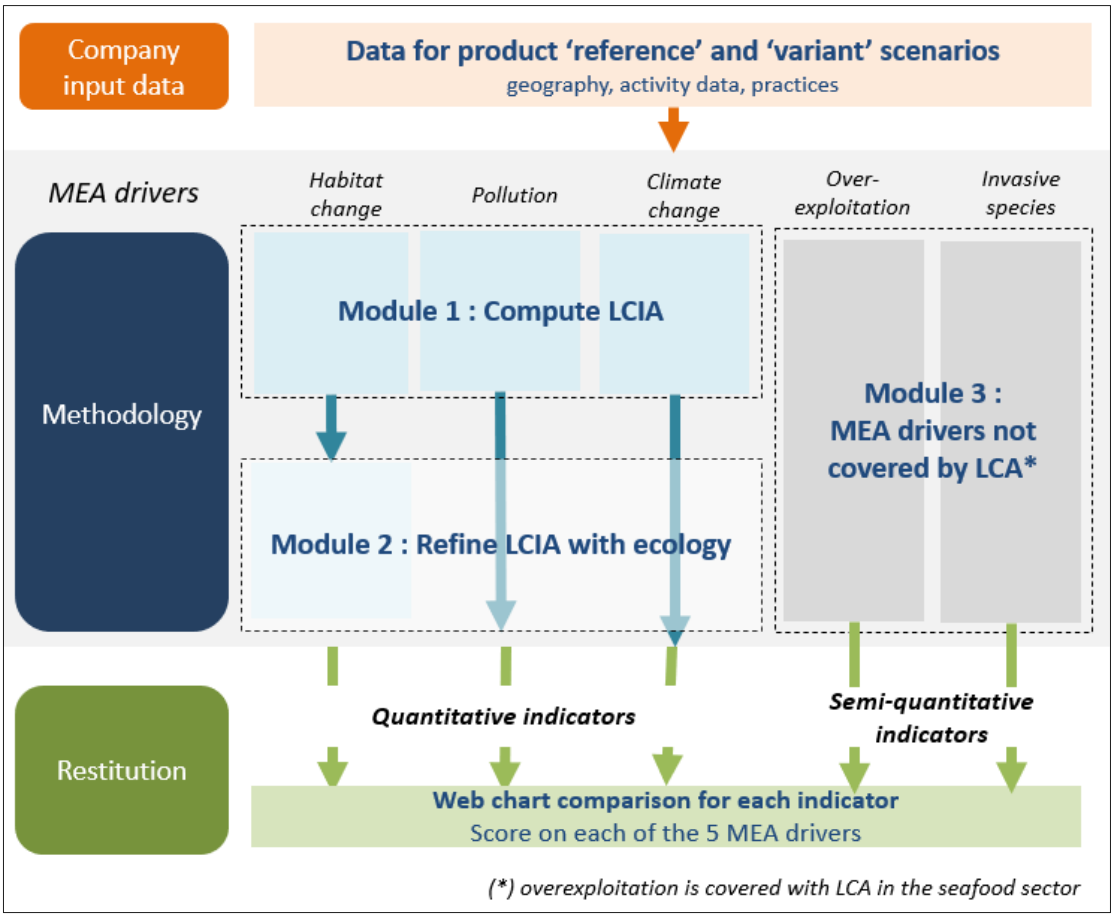
Any organization that complies all steps of LIFE Methodology and reaches its Biodiversity Minimum Performance (BMP) can require a third part audit to apply for LIFE Certification. LIFE is a Standard setting organization. Having third-party certification, independent Certifying Bodies accredited by LIFE Institute are responsible for official audits for LIFE Certification.

Product Biodiversity Footprint (PBF)

The Product Biodiversity Footprint (PBF) is a public private research and development partnership initiated in 2017 by I-Care & Consult and codeveloped by I-Care & Consult and Sayari, partially funded (for its first phase of development) by the PIA (French Program for Future Investment – Biodiversity Program).

Its objective is to guide decision making in product design with a focus on biodiversity. The PBF aims at addressing and providing indicators for each of the five drivers of biodiversity as defined by the MEA[46] throughout the value chain. Priority is given to providing quantitative indicators based on cause-effect chains, similarly to the LCA approach; when LCA indicators are not precise enough to distinguish between practices, the indicators are refined with ecological data and literature. For some MEA drivers that are not (yet) operationally covered by LCA, a qualitative or semi-quantitative approach is provided.

The PBF method encompasses three modules, as described in the figure below.



Module 1 computes LCIA. It addresses three of the five MEA drivers: 'habitat change', 'pollution' and 'climate change'; for those it discloses the hotspots of the product along the value chain and guides the decision-maker towards the priority(ies) for products within the value chain. Spatialized LCIA CFs are used for the hotspot's stages of the product.

Module 2 refines the quantification of the pressure from 'habitat change', using specific information on practices, including ecological data for the hotspots phase(s), enabling update of Module 1. Results of Module 2, combined with results of Module 1, enable the user to address the value chain of the product and make refined comparisons between variants for the three MEA drivers 'habitat change', 'pollution' and 'climate change'.

[46] Millenium Ecosystem Assessment, now taken over by IPBES

Module 3 assesses the two remaining MEA drivers, namely 'invasive species' and 'overexploitation' in a semi quantitative way. The PBF displays two indicators: 'invasive species' and 'species management'. The second one goes beyond the MEA driver 'overexploitation', as it also encompasses positive actions (e.g. installation of pollinators, use of various breeds, follow-up of endangered species…). For the marine sector, a quantitative assessment is done based on current research of fish overexploitation in LCA.

PBF has been successfully tested on production from marine systems, such as fisheries and aquaculture.

Initially developed at product level, PBF has also been applied successfully at project / site level, and then "renamed" SBF, standing for Site Biodiversity Footprint. The PBF methodology favours the integration of local ecological data whenever possible, which is easier at site level. The quantification of pressures such as Habitat change, Pollution, Overexploitation of species and Invasive Alien Species can then be fed by data such as Species inventories or measured pollution.

Initially quantified in pdf, the native unit of LC Impact, PBF and SBF now propose also a quantification **in km² eq pdf**, based on the equivalent of the impact of artificialization of 1 km² forest.

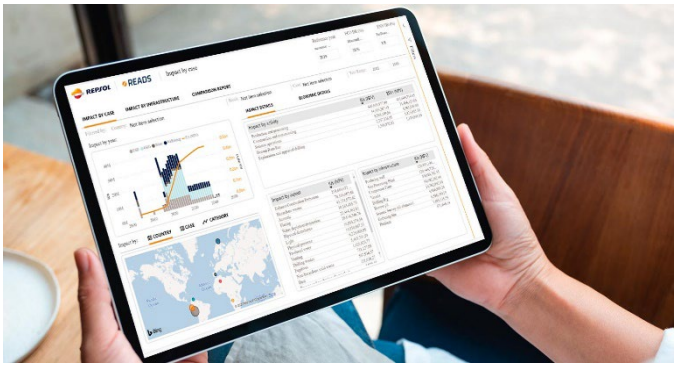
More information on the measurement approach can be found here:

A. Asselin et al., « Product Biodiversity Footprint – A novel approach to compare the impact of products on biodiversity combining Life Cycle Assessment and Ecology », Journal of Cleaner Production, 2019, doi: 10.1016/j.jclepro.2019.119262.

Gaillet, Grégoire, Anne Asselin-Balençon, et Aurore Wermeille. 2022. « Sustainable fisheries: towards operationalization of decision-making accounting for biodiversity ». Journal of Cleaner Production. https://doi.org/10.1016/j.jclepro.2022.132103

READS

Developed by: Repsol



Intended use

Repsol has developed a Natural Capital valuation and accounting approach for the comprehensive assessment of environmental impacts of projects and operations at a global level: READS.

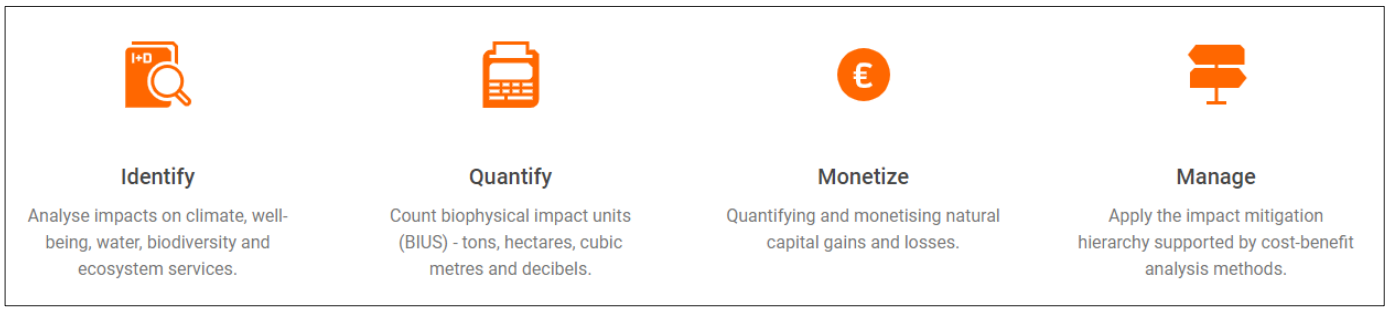
READS is based on the analysis of the relationship between the components of natural capital stocks (plants, animals, air, water, etc.) and the ecosystem services they provide, with the activities carried out by the Energy Industry.

This relationship is measured in two ways:

1. In economic terms, allowing to understand the materiality and importance of impacts, making them comparable. Results are expressed in Net Present Value (NPV) so that the valuation considers the time value of money and better informs decision-making.
2. In dimensionless (no unit) Impact Units, allowing to improve the valuation accuracy and representativeness of economic valuations by using local adjustments that cannot be subjected to monetary valuation. This information helps to focus on most material aspects and to simulate mitigation measures with the required degree of BA standpoint.

The READS tool is aligned with the Natural Capital Protocol, the IPIECA guidelines for Ecosystem Services Assessments, the EEA Common International Classification of Ecosystem Services (CICES), and the ISO 14008:2019 for Monetary valuation of environmental impacts and related environmental aspects.

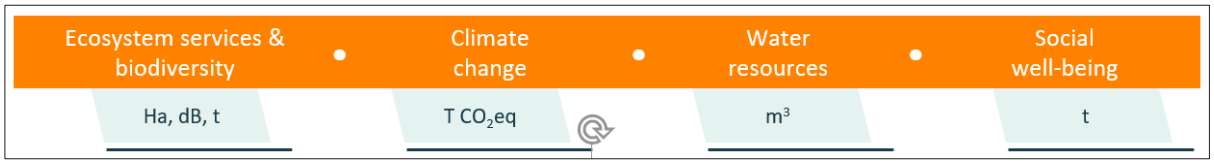
The READS tool requires valuation databases (which can be adjusted if site-specific values are available), screening models and internal calculations to easily obtain net present values of impacts and simulate potential efficiencies of applicable mitigation measures. A simplified version of the natural capital impact assessment process is illustrated in the figure below (steps used to analyse impacts on natural capital):



Assessment of Environmental Impacts

Impacts are quantified in Biophysical Units, which represent the extent to which an ecosystem structure, process or function might be affected. Impacts quantified in Biophysical Units, as shown in the figure below, are valuated in environmental economic terms through Environmental Economic Values and subsequently converted into dimensionless Impact Units using specific modulation factors.

Biophysical Impact Units per impact category:



Not all environmental impacts can be quantified based on the anticipated and estimated changes in Natural Capital; consequently, the methodology proposes the following to evaluate environmental impacts:

- *Ecosystem Services Detraction (ESD)*, used to valuate impacts, refers to the extent to which the provision of an ecosystem service (or several services) is detracted or diminished (compromised) due to an impact on natural capital. To determine the ESD, the Environmental Economic Value (EEV) is applied to changes in the ecosystem service using economic valuation methods following criteria established in ISO 14008:2019. For this valuation, an Ecosystem Services Valuation Database is required to contain global estimates of ecosystem services values expressed in monetary terms per biome. The READS valuation database is adapted from The Economics of Ecosystems and Biodiversity Database reviewed and adjusted by the University of Salamanca. Assumptions and simplifications are necessary to cover all ecosystem services categories across all potential biomes. As such, intra-biome adjustments are included in the GEMI methodology. A materiality assessment is conducted to identify the ecosystem services affected by each impact based on potential receptors, such as flora, fauna, soil and marine water.

  Ecosystem services that might be impacted by a project lifecycle (construction, operation, decommissioning, restoration and offset) were identified using CICES as a reference typology of ecosystem services. After having selected which CICES Ecosystem Services could be relevant for GEMI's application, these were grouped together based on common characteristics such as ecosystem structures and functions underpinning several ecosystem services, or similar human well-being benefits provided by more than one ecosystem service.

- *The valuation of impacts on well-being due to emitted pollutants* from anthropogenic sources cannot be evaluated based on ESD, because some impacts do not directly affect natural capital. The EEVs for such impacts are prices constructed based on the social cost of pollution, such as the loss of wellbeing per unit of pollutant released to the environment, which is expressed in monetary units per amount of emitted pollutant.

- *The valuation of impacts due to greenhouse gas (GHG) emissions,* which have global scope and are independent of the location of the source, considers contributions to Climate Change. The EEV applied to each tonne emitted is based on User's internal carbon pricing per metric t CO_2eq according to any climate change roadmap.

- *The valuation of impacts due to the use of resources that are pivotal to human well-being,* such as the consumption of water, is considered separately due to the high relevance of water resources for human well-being and for the environment. Impacts related to the use of water complements those impacts assessed through ESD by measuring the use and consumption of water during the lifecycle of a project. The EEV should be adjusted to local conditions considering water scarcity/stress by region/basin, local water quality, local population density, ecosystem services underpinned by water, and human health impacts from water pollution.

Once the environmental value associated with each impact is calculated, the Impact Units are obtained to assess and manage the environmental impact. IUs can be calculated by multiplying the EEV of each impact

by the appropriate modulation factor. These modulators improve the assessment by incorporating key features of the local socio-environmental context. The impact on biodiversity is intrinsically related to the Natural Capital impact (biodiversity underpins Natural Capital) and is calculated as a portion of the ecosystem services, climate change and water impact categories.

READS produces biodiversity-inclusive natural capital assessments to avoid that business's impacts on biodiversity are underappreciated and mismanaged. It includes negative and positive impacts.

READS acknowledges that, in general, higher levels of biodiversity generate a greater quantity and quality of goods and services, and more resilience to change. It includes specific biodiversity features to evaluate the condition of the stock, including number of species, threatened species' extinction risk, habitats status and protection categories. READS considers that impacts on ecosystem services, water resources, and climate are intrinsically linked with biodiversity (a direct valuation relationship is established between the impact on ecosystem services, water resources and/or climate).

Management of Environmental Impacts

READS has a specific module for impacts management. This module applies the mitigation hierarchy to manage the identified environmental impacts. This analysis helps to identify suitable mitigation measures, compare mitigation alternatives (cost versus efficiency), verify effectiveness of implemented and project mitigation curves, and establish future targets in the short-, medium- and/or long-term.

Results are graphically presented, and applicable Key Performance Indicators are tailored for each activity. The tool can be used to simulate mitigation measures by estimating their effectiveness and efficiencies (reduced impacts per USD invested in the proposed mitigation).

- Impact value by year
- Impact value by environmental aspects and impacts
- Impact value by infrastructure/activity
- Impact value by ecosystem services
- Impact value to biodiversity
- Impact value by financial metrics (CAPEX, OPEX…)
- Impact value by operational metrics (adapted to each sector)

READS provides a consistent approach to value, account, and mitigate impacts on Natural Capital. The incorporation of natural capital concepts into the decision-making process of a project/company will improve its environmental performance, support the legal and regulatory requirements, and create opportunities to enhance sustainability reporting to stakeholders and financial institutions.

More information on the measurement approach can be found here: repsolsma@repsol.com

ReCiPe

ReCiPe is one of the most recent and updated impact assessment methods available to LCA practitioners. The method addresses a number of environmental concerns at the midpoint level and then aggregates the midpoints into a set of three endpoint categories (see Figure A). Endpoint characterization models the impact on Areas of Protection (i.e., on human health, ecosystems, and resources). In other words, endpoint is a measure of the damage – at the end of the cause-effect chain – caused by a stressor in terms of human life-years lost and the years lived disabled, species disappeared, and resources lost. LCA professionals can choose impact indicators at different stages in the cause-effect pathway, for example the midpoint or endpoint. The relation between midpoint impact categories and their area of protection is shown in Figure B. Following the example in Figure B, global warming is a midpoint category, which through scientifically-proven pathways has impact on human health and ecosystems (endpoint).

A cause-effect pathway shows the causal relationship between the environmental intervention (for instance, the emission of a certain chemical) and its potential impacts. An example of a cause-effect pathway could be the emission of a chemical into air, leading to increased chemical concentrations in freshwater, and subsequent disappearance of species.

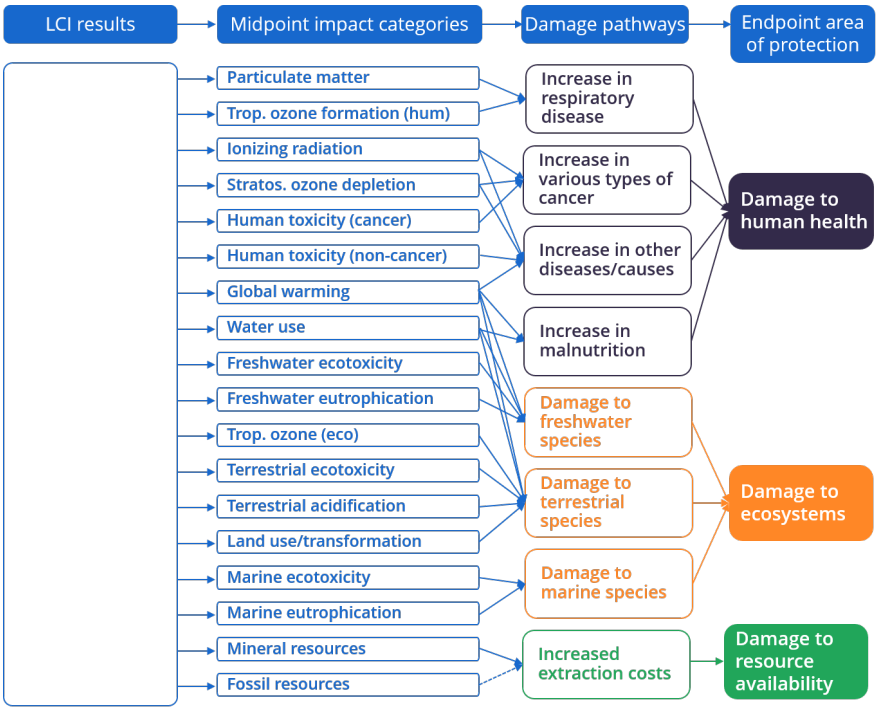


Figure A: Overview of the impact categories that are covered in the ReCiPe 2016 method and their relation to the areas of protection. The dotted line means there is no constant mid-to-endpoint factor for fossil resources. Source: https://pre-sustainability.com/.

While midpoint methods measure an effect before the damage to one of the areas of protection occurred, endpoint methods follow the consequences of certain emission until it causes damage. Midpoint methods have relatively low uncertainty but the results tend to be harder to interpret given the number and complexity of included categories. On the other hand, the additional steps required to convert mid- to endpoint impacts introduce additional uncertainty but make the outcomes more accessible to non-experts. Furthermore, endpoint results can be aggregated, so that a single score expressed all the impacts given product has on environment. That requires normalization and weighting steps, which again increase the uncertainty and – through weighting – introduce subjective choices.

The midpoint impact scores of life cycle assessments are often presented in units that are difficult to grasp, such as kg CO2 equivalents or CTUh. One way to make interpreting such scores easier is to normalize them: dividing your scores by a reference situation's scores. This reference situation could be one person's –

Average world citizen – share of all emission and resource use in the world during one year. Normalization converts complicated units into fractions of an average citizen scores per impact category. ReCiPe offers several normalisation factors. In this case study the impact of an average world citizen was used.

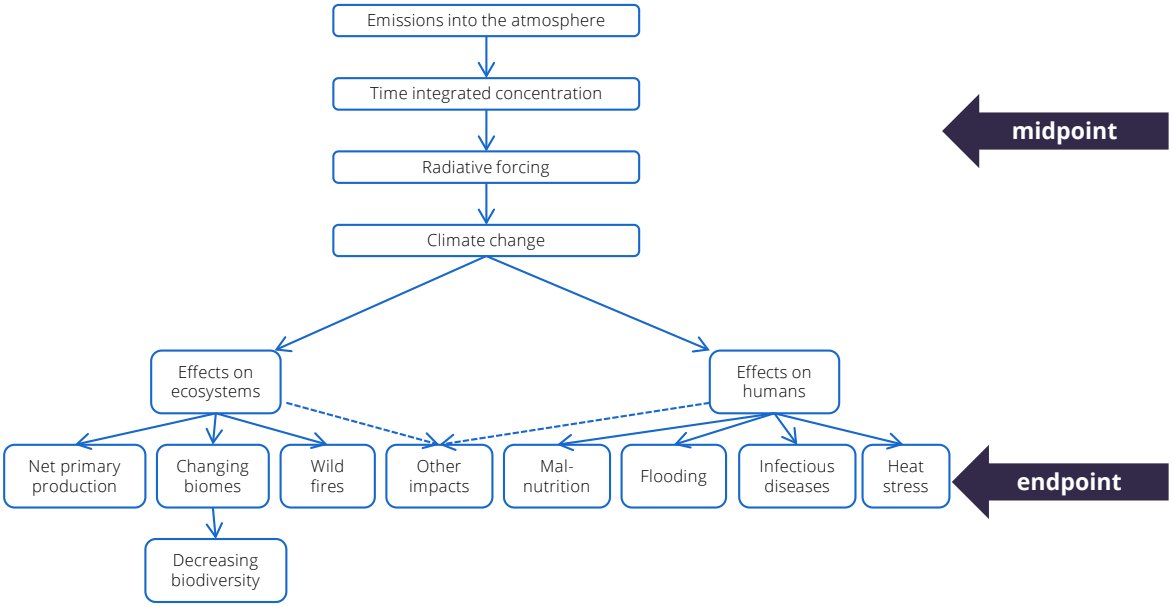


Figure B: Relation between mid- and endpoint in impact assessment methods. Source: https://pre-sustainability.com/.

Weighting is an optional step in Life Cycle Impact Assessment (LCIA). The weighting step is perhaps the most debated. Weighting entails multiplying the normalized results of each of the impact categories with a weighting factor that expresses the relative importance of the impact category. The weighted results all have the same unit and can be added up to create one single score for the environmental impact of a product. ReCiPe offers several weighting sets. In this case study a panel weighting of 40% human health, 40% ecosystems and 20% resource scarcity was used.

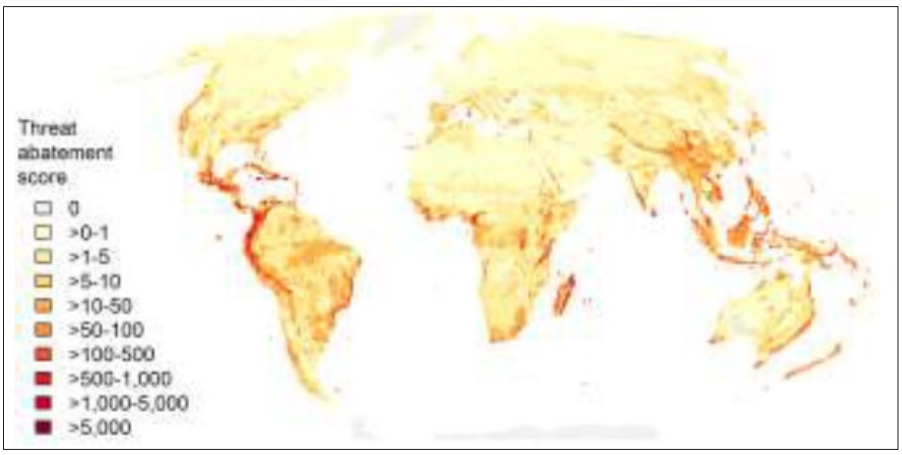
More extensive information on ReCiPe can be found in the Annexes of the Update Report 2, see Critical assessment of biodiversity accounting approaches for businesses (europa.eu) and ReCiPe: https://www.rivm.nl/en/life-cycle-assessment-lca/recipe

Species Threat Abatement and Restoration metric (STAR)

The **Species Threat Abatement and Restoration (STAR) metric** allows business, governments and civil society to quantify their potential contributions to stemming global species loss, and can be used to calculate national, regional, sector-based, or institution-specific targets. STAR is based on the IUCN Red List of Threatened Species™, in a collaboration between 55 organisations. The IUCN Red List is the most comprehensive global assessment of the status of biodiversity.

Because biodiversity is distributed unequally around the world, STAR assesses the potential of specific actions at specific locations to contribute to conservation targets. STAR estimates the contribution of two kinds of action to reduce species extinction risk – **threat abatement and habitat restoration**.

This makes it possible to **compare specific threat abatement and habitat restoration actions** in different places in reducing global species extinction risk, which will help companies, countries and others plan their conservation efforts. It also permits actors to add up their **total contributions**.



Global STAR threat-abatement scores for amphibians, birds and mammals. The darker areas indicate places in which removing threats would contribute most to reversing global biodiversity loss.

Calculating the STAR score

Each species has a global STAR threat-abatement score that varies with species' extinction risk: the higher the extinction risk, the higher the STAR score. Individual species scores are summed to give the total global STAR threatabatement score in a site, corporate footprint or country, which represents the global threat-abatement effort required for all species to become Least Concern.

Setting science-based targets

The STAR threat-abatement score of an individual site, corporate footprint or country depends upon the threatened species present, their risk of extinction, and the extent of their distribution STAR scores show the potential contribution of conservation or restoration actions in that location to reducing the extinction risk for all species globally. STAR can therefore be used to establish science-based targets, that is, contributions from individual actors towards goals under the post-2020 global biodiversity framework.

At a country scale, STAR scores show how governments can plan their policy to deliver on **post-2020 global biodiversity framework commitments**. For example, the total STAR threat-abatement score for Colombia is 85,268, which was calculated based on the presence of 527 species of threatened or Near Threatened amphibians, birds and mammals, 250 of which are endemic to Colombia. Colombia's STAR threat-abatement score contributes 7% to the global total.

To demonstrate its **use by individual institutions**, STAR was used to measure the potential impact of removing threats across an 88,000-hectare commercial rubber company in central Sumatra, Indonesia. By tackling threats such as habitat loss and hunting, the company could report having reduced extinction risk by 0.2% across Sumatra, 0.04% across Indonesia and 0.003% globally. This would be due in part to safeguarding the area's populations of tigers (*Panthera tigris*; Endangered) and Asian elephants (*Elephas*

maximus; Endangered), as well as the leaf-nosed bat *Hipposideros orbiculus*, assessed as Vulnerable on the IUCN Red List and only found in this region.

Application of STAR in measuring impacts

The method described above gives the Estimated STAR score for a site. This value can be revised to Calbirated STAR by on-the-ground verification of threats and species presence, and targets set (for instance to reduce threats by 50% over 5 years). This will enable managers to demonstrate the delivery of Realised STAR values. The methodology for this approach is in testing currently.

Use of STAR can also help governments to fit corporate commitments into their national targets.

Future development

Currently STAR uses extinction risk and threat information on birds, amphibians and mammals. Marine and freshwater species as well as plants and reptiles are currently in the process of being added. In due course, the STAR methodology will be extended to apply to genetic diversity and to ecosystems, the latter likely drawing from the IUCN Red List of Ecosystems.

Where can I get more information?

The STAR metric will be available for use by business in the second quarter of 2021 through the Integrated Biodiversity Assessment Tool (IBAT), and for non-commercial users through IBAT. Availability in IBAT will be accompanied by comprehensive guidance notes. It will also form the basis for a species threat risk layer in the ENCORE risk assessment tool.

The STAR methodology has been published

Mair, L., Bennun, L.A., Brooks, T.M. *et al.* A metric for spatially explicit contributions to science-based species targets. *Nat Ecol Evol* **5,** 836–844 (2021). https://doi.org/10.1038/s41559-021-01432-0

IBAT: https://www.ibat-alliance.org/star

ENCORE : https://encore.naturalcapital.finance/en

ANNEX 2: SHORT DESCRIPTIONS OF ECOSYSTEM SERVICES MEASUREMENT APPROACHES

ECOPLAN scenario evaluator (ECOPLAN-SE)

Developed by research units from several Flemish universities and research institutes: University of Antwerp, Ghent University, KU Leuven, Flemish Institute for Technological Research, Institute for Nature and Forest Research. ECOPLAN-SE was developed as part of the ECOPLAN project, funded by the Flemish agency for Innovation by Science and Technology.

Often, a large number of alternative scenarios are considered for spatial development projects. These scenarios can have unexpected effects on the delivery of ecosystem services. ECOPLAN-SE calculates these effects and presents the results in an understandable way so that they are comparable between different development scenarios. The results can help realize a more multifunctional project design and can support communication to the general public.

The tool consists of 18 ecosystem service models, which are linked in one integrated model. This makes it possible to show the changes in the delivery of a particular ecosystem service when the delivery of another ecosystem service changes (e.g.: water extraction → water table drops → loss of carbon storage → nutrients exemption → effect on biomass). The results are spatially explicit and have a high accuracy. However, the models require detailed input data and use a lot of computing power / data capacity. Outcomes are suitable to assess and compare final development scenarios.

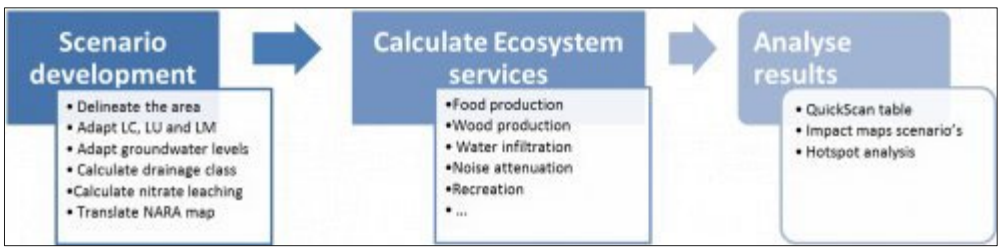
How does ECOPLAN-SE work?

ECOPLAN-SE can calculate and quantitatively evaluate the effects of spatial scenarios on 18 different ecosystem services: 4 producing, 8 regulating, 3 supporting and 3 cultural services. The user can define and evaluate the scenarios using quantitative models, specifically developed for the Flemish Region (data and context).

ECOPLAN-SE is available as a **QGIS plug-in**, including a **comprehensive GIS database on the level of the Flemish Region in Belgium**. The plug-in consists of 3 parts that allow for the full analysis of ecosystem services:

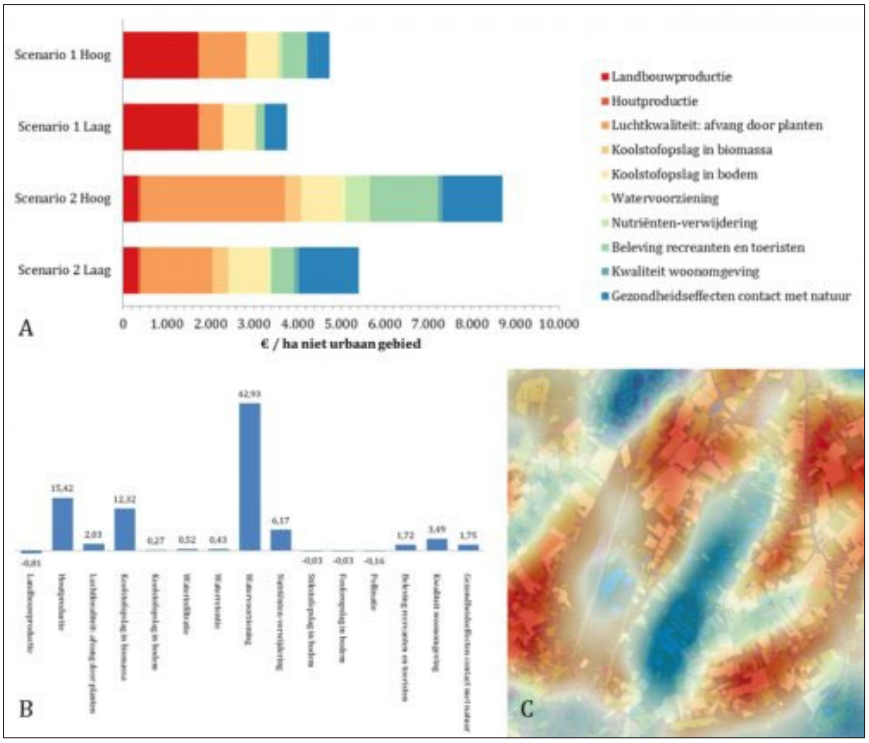
1. Based on changes in land cover/use/management and changes in hydrology, the user can select different spatial scenarios.
2. The tool calculates the effects of the scenario on 18 ecosystem services and presents their delivery in figures and map layers.
3. The tool analyzes the scenarios: **impact maps and tables (changes in ecosystem services supply)** are generated and can be used in ECOPLAN-SE's **QuickScan** module. In addition, there is the option to perform a spatial analysis of multi-functionality in the area: the 18 map layers are then statistically analyzed for co-occurring services, which are **visualized**.

Overview of a scenario analysis with ECOPLAN-SE:

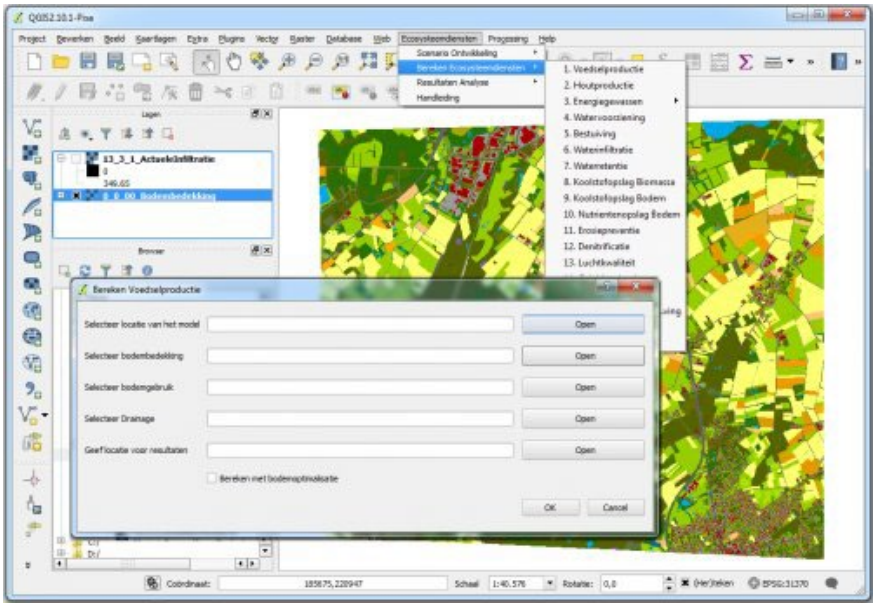


Examples of the analysis results:

A) Yield per hectare for 2 scenarios
B) Difference (%) between 2 scenarios
C) Hotspot (red) – coldspot (blue) mapping for the ecosystem service of water infiltration



Impression of the ECOPLAN-SE plug-in for QGIS. The plug-in consists of a drop-down menu that opens the different models and allows entering input parameters.



When can ECOPLAN-SE be used?

This tool can calculate the ecosystem services delivery in the exploratory phase of a project. Based on the results, it can be determined which areas are important for certain ecosystem services. This information can be one of the starting and discussion points in the development of a regional vision.

ECOPLAN-SE can also be implemented in later stages of plan development to evaluate multiple scenarios. The calculation and analysis tools enable to assess and visualize the positive and negative effects of each scenario. These results may help to further develop the regional vision and to reach a final layout scenario. The calculations provide information on which zones from the layout plan yield the largest ecosystem services benefits. Based on a comprehensive cost-benefit analysis, it can be identified which interventions should get the highest priority during project implementation.

ECOPLAN-SE is developed for spatial planners working for administrations, agencies, and technical offices. This tool consists of a simple, clear software; basic knowledge of QGIS is required.

Source: https://www.uantwerpen.be/en/research-groups/ECOPLAN/

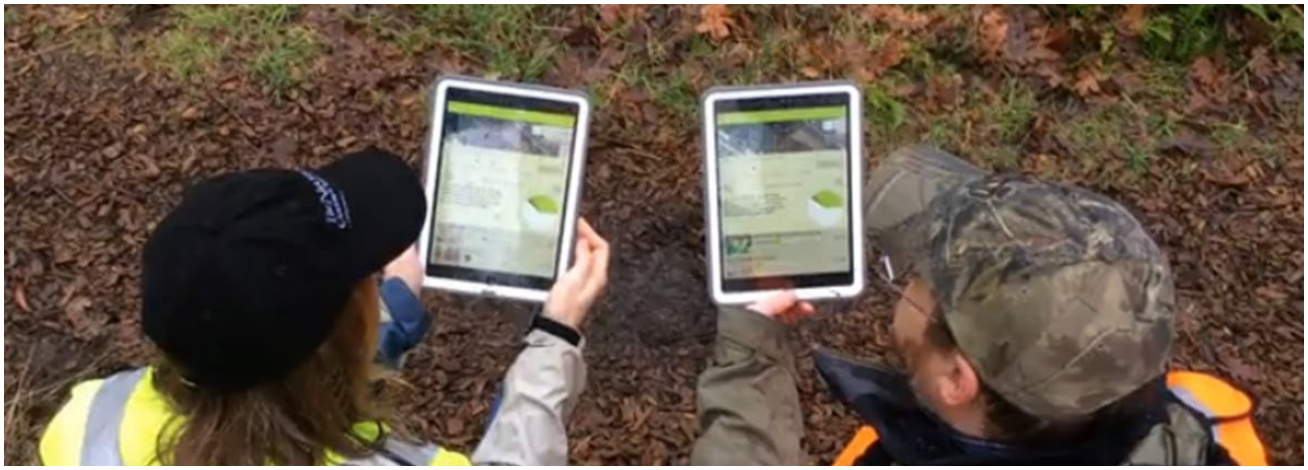
Ecosystem Services Identification & Inventory (ESII)

Developed by: The Nature Conservancy (TNC), The Dow Chemical Company (Dow) and EcoMetrix Solutions Group.

The ESII Tool was developed to help businesses such as Dow incorporate the value of nature into their business processes, strategies, and decisions. As such, the ESII Tool models and outputs were constructed and tested with an engineering and design perspective to facilitate actionable land use and management decisions. The ESII Tool helps non-ecologists make relative comparisons of the expected levels of ecosystem service performance across a given site, under a variety of conditions. As a planning-level tool, it can inform business decisions while enhancing the user's relationship with nature. However, other uses that require ecological models of a higher degree of accuracy and/or precision, expert data collection, extensive sampling, and analysis of ecological relationships are beyond the intended scope of this tool.

Using the ESII Field App, you can download mapping for your property, go into the field and collect spatially-explicit ecological data for your site. In the ESII Project Workspace, you can review and edit the data once you have returned from the field, run the ESII Tool's ecological models, and generate results in a variety of user-friendly formats.

While Version 1 of the ESII Tool was created with Dow's business needs in mind, the Dow–TNC Collaboration is making the ESII Tool freely available to the public to promote more widespread awareness of the value of nature to businesses and communities and to encourage the broad uptake of ESII concepts and the ESII Tool. A community of practitioners, The ESII Tool Commons, is being established to help guide the continued growth and evolution of the Tool. Future versions of the ESII Tool will expand upon the functions and services currently available, as well as add new functions, services, and functionality related to unique geographies and the modeling of benefit flows.



Integrated Valuation of Ecosystem Services and Tradeoffs (INVEST)

Developed by: Stanford and Minnesota Universities, World Wildlife Fund (WWF), and the Nature Conservancy under the Natural Capital Project.

InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a suite of models used to map and value the goods and services from nature that sustain and fulfil human life. It helps explore how changes in ecosystems can lead to changes in the flows of many different benefits to people.

What is InVEST?

InVEST is a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfil human life. If properly managed, ecosystems yield a flow of services that are vital to humanity, including the production of goods (e.g., food), life-support processes (e.g., water purification), and life-fulfilling conditions (e.g., beauty, opportunities for recreation), and the conservation of options (e.g., genetic diversity for future use). Despite its importance, this natural capital is poorly understood, scarcely monitored, and, in many cases, undergoing rapid degradation and depletion.

Governments, non-profits, international lending institutions, and corporations all manage natural resources for multiple uses and inevitably must evaluate tradeoffs among them. The multi-service, modular design of InVEST provides an effective tool for balancing the environmental and economic goals of these diverse entities.

InVEST enables decision makers to assess quantified tradeoffs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. The toolset includes distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems, as well as a number of “helper tools” to assist with locating and processing input data and with understanding and visualizing outputs.

How it works

InVEST models are spatially-explicit, using maps as information sources and producing maps as outputs. InVEST returns results in either biophysical terms (e.g., tons of carbon sequestered) or economic terms (e.g., net present value of that sequestered carbon).

The spatial resolution of analyses is also flexible, allowing users to address questions at local, regional, or global scales.

InVEST models are based on production functions that define how changes in an ecosystem’s structure and function are likely to affect the flows and values of ecosystem services across a land- or a seascape. The models account for both service supply (e.g., living habitats as buffers for storm waves) and the location and activities of people who benefit from services (e.g., location of people and infrastructure potentially affected by coastal storms).

InVEST models are distributed as a standalone application that is independent of a GIS software. You will need a mapping software such as QGIS or ArcGIS to view your results. Running InVEST effectively does not require knowledge of Python programming, but it does require basic to intermediate skills in GIS software.

The tool is modular in the sense that you do not have to model all the ecosystem services listed, but rather can select only those of interest.

Urban InVEST: Designing resilient cities by nature

In a rapidly urbanizing world, the design of cities will determine the health and wellbeing of billions of people. Urban InVEST provides tools to show how incorporating the value of nature into urban design can deliver better outcomes for people and the planet.

Source: https://naturalcapitalproject.stanford.edu/software/invest

Nature Value Explorer

Developed by: VITO, University of Antwerp, University of Liège, Environment Department of the Flemish government.

The nature value explorer is a free web-based tool that makes it possible to calculate the impact of a project in Flanders (Belgium) on ecosystem services in a qualitative, biophysical and monetary way. It quickly assesses the impact and makes it possible to compare scenarios and discuss with stakeholders. The tool is spatially explicit for Flanders, Belgium. The user draws the case study area on a map and draws the different measures that are planned in the scenario. The tool collects the necessary input data from national maps and calculates the supply and value of different ecosystem services. It also translates the results to more comprehensible indicators so the results can be used in the communication to the public.

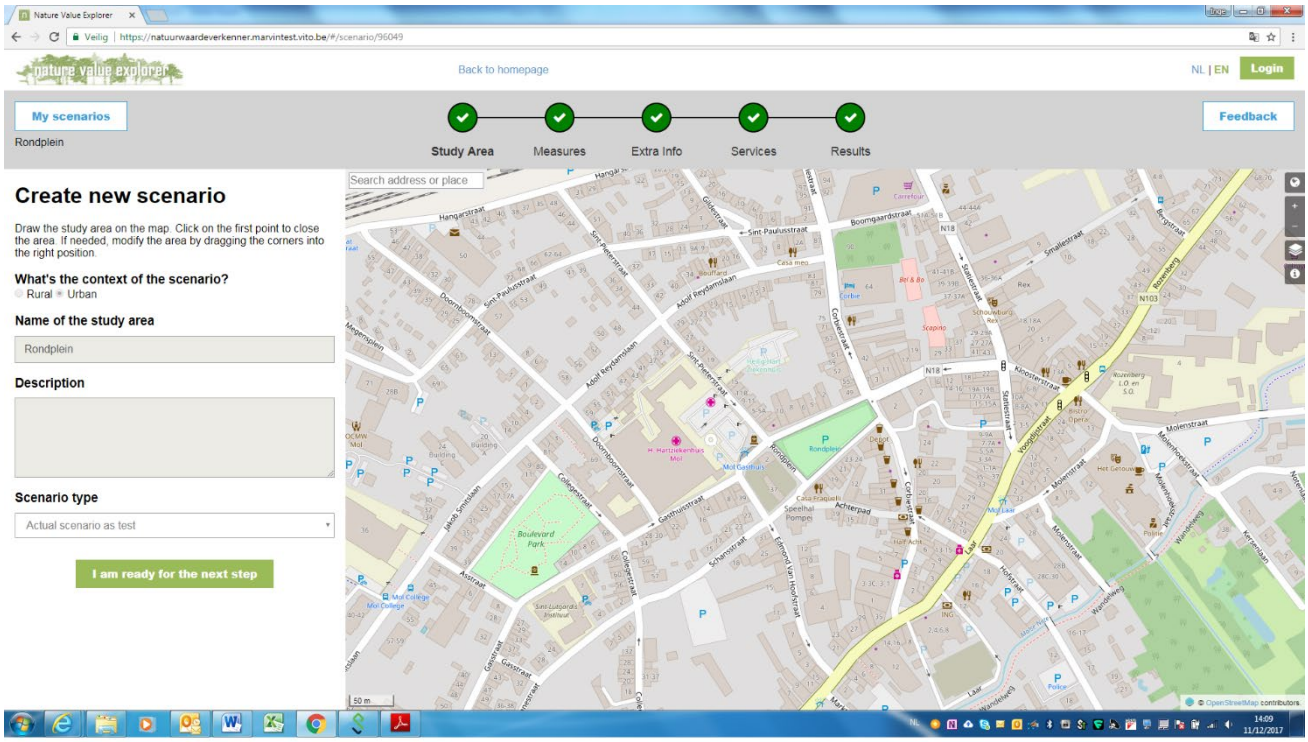
The Nature Value Explorer comes with a guidance that provides methodologies to value the ecosystem goods and services of (semi)-natural land use, including forests and agricultural land use. The guidance discusses qualitative, quantitative and monetary valuation methods for a range of ecosystem services.

For each ecosystem service the data requirements are discussed in the guidance, as are the assumptions made to value ecosystem services, where to find the necessary input data, and finally illustrate the methods with an example. This information is also the basics for a webtool. The tool can be consulted on the internet via www.natuurwaardeverkenner.be. End-users are able to create and save scenarios, share scenarios with other registered users and consult public scenarios. Interactive discussions are stimulated through a discussion forum.

The approach considers the following ecosystems: agriculture, grasslands, forest and woodland, heathland, coastal, inland wetlands and rivers and lakes. Marine ecosystems are not included in the tool. Agricultural land use is divided in cropland, meadows and orchards. Urban land use is a category to be used whenever a part of the case study exists of buildings, roads, residential area, industry…The manual and tool are not intended to value ecosystem services in this urban environment (e.g. green roofs, parks).

- Qualitative scores express the importance of ecosystem services with a score from 1 to 10. These scores can be used for scoping. When the score is high (>6) it means that the case study is an important area for the delivery of that particular ecosystem service. It would be appropriate to look at these ecosystem services more into detail, especially when there is discussion amongst stakeholders.
- Quantification functions express the importance of ecosystem services in physical terms (e.g. tonnes of C sequestration, amount of visits per year, ...). Quantification functions applied here take into account the main driving factors of the underlying ecological processes such as soil texture, groundwater level and vegetation type but still require little computation time. They build on region specific datasets (Flanders - Belgium) and studies (existing land-use/land-cover and soil map classifications) to increase the accuracy and transparency.
- Monetary valuation expresses the importance in monetary terms (€) and makes it able to sum up all individual services to a total economic value. For the monetary valuation we use a range of methods depending on the service. If goods (products) delivered by ecosystems can be sold on a market which is the case for provisioning services as agricultural production and wood production, market prices are used. Regulating services are valued with stated preference methods, revealed preference methods (adjoining markets), marginal damage costs or marginal reduction costs. Cultural services bundle the value people put on nature from a recreational, spiritual or emotional view and can be monetised with revealed or stated preference methods. Supporting services are not valued separately to avoid double counting.

The Nature Value explorer focuses on pragmatic methods that value these ecosystem services and helps planners, land managers and policy makers to map nature's socio-economic importance. Taking this into account may lead to more balanced policy and investment decisions.


Nature Value Explorer
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Back to homepage
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Login
My scenarios
Rondplein
Study Area
Measures
Extra Info
Services
Results
Feedback
Create new scenario
Draw the study area on the map. Click on the first point to close the area. If needed, modify the area by dragging the corners into the right position.
What's the context of the scenario?
Rural
Urban
Name of the study area
Rondplein
Description
Scenario type
Actual scenario as test
I am ready for the next step
Search address or place

Toolkit for Ecosystem Service Site-Based Assessment (TESSA)

The Toolkit for Ecosystem Service Site-based Assessment (TESSA) provides accessible guidance on low-cost methods for how to evaluate the benefits people receive from nature at particular sites in order to generate information that can be used to influence decision making.

TESSA was developed in 2013 by collaborators from: Anglia Ruskin University, BirdLife International, the Royal Society for the Protection of Birds, the Tropcal Biology Association, UNEP-World Conservation Monitoring Centre, the University of Cambridge and University of Southampton. A revised version of the interactive Toolkit was published in 2018.

The methods in the toolkit are designed to be applicable to users from developing and developed countries, and across all terrestrial and wetland habitats (currently excluding marine areas). Current ecosystem services included are: global climate regulation, water services (supply, quality, flood reduction), harvested wild goods, cultivated goods, nature-based recreation, cultural services, pollination services, coastal protection.

A variety of practical resources are included in the toolkit, including detailed interview guides and step-by-step screen guides for online databases and modelling applications. Decision trees help determine which tools to use in a particular case and general guidance is provided on confidence measures of Ecosystem Services estimates (low, medium or high) using different methods. The toolkit includes:

- An overview of ecosystem services, key concepts and caveats
- Guidance on conducting a preliminary scoping appraisal at a site(s) to understand the important services provided by a site and to whom
- Decision trees (flow charts) to lead the user to the most appropriate methods according to the characteristics of the site
- Methods for measuring the ecosystem services listed above
- The valuation of an 'alternative state' in order to compare a current and alternative state of the site and hence estimate the impact of potential or actual changes on the ecosystem services provided
- Worked examples on how to derive a value (quantitative, including potentially economic, and/or qualitative) for each service, including presenting the difference in value between two states of the site
- Guidance on how to synthesise the data for each service into a summary of ecosystem service change at site scale
- Guidance on assessing the how benefits are spread across different beneficiary group.

The approach is relatively low cost compared with many other tools, and does not require advanced technical skills. The toolkit is designed to be used both online and in the field and is provided as an interactive 'user manual' in a simple workbook structure which can be downloaded.

The target users for TESSA are non-experts from an ecosystem services perspective, but technical practitioners who want to better understand and use ecosystem services data for informing site-based decisions. This includes for example: conservation practitioners, land use planners and businesses. TESSA has been applied across the world by practitioners in Africa, Asia, South America, Caribbean and Europe.

Aim of the resource

Increasing demand from decision-makers for information on ecosystem services has prompted efforts to offer guidance on measuring and incorporating ecosystem services into decision-making. To inform local decisions, ecosystem service assessments need to be based on data that are locally appropriate, easy to collect and relatively affordable, and can be used to produce results that are easy to communicate to decision-makers. Existing approaches to measuring ecosystem services do not fully provide for all these needs.

TESSA aims to overcome these challenges by providing relatively accessible methods for identifying which ecosystem services may be important at a site, and for evaluating the magnitude of benefits that people obtain from them currently, compared with those expected after an intervention (for instance under alternative land-uses). It aims to enable stakeholders to obtain robust and locally relevant ecosystem service

information despite limited capacity, time and resources. This site-oriented focus, informed by relatively accessible methods for local data collection involving high levels of stakeholder engagement and underpinned by the consideration of the alternative state, is the 'unique selling point' for TESSA.

Can be used to assess the following ecosystem services:

- Global climate regulation: carbon storage and carbon sequestration
- Water-related services: flood protection services, water supply services, and water-quality improvement services
- Harvested wild goods
- Cultivated goods
- Nature-based recreation
- In Version 2.0 the developers expanded the suite of services to include coastal protection, pollination services and cultural services.

TESSA can help answer questions like:

- Which ES should be assessed for the selected site?
- What data are needed to measure the selected ES?
- What methods and sources of data are appropriate to use for the site context?
- How can the assessment results be best communicated for better biodiversity conservation?

How it is done

Request a copy of TESSA at http://tessa.tools/. The rapid appraisal involves first identifying the most relevant communities of people and stakeholders to engage in the process and then actively working with the stakeholders in workshops or other participatory processes. TESSA provides some guidance on considering social differences among groups and how to go about stratifying stakeholders to address important differences in how ES are understood and used by different groups of people. Multiple workshops and meetings with different groups that may be identified in the process of stratifying stakeholders are then used to identify what will change in terms of ES delivery as a result of a management or policy decisions and what the impact of this would be on different groups of people. Following the rapid appraisal and based on the decision context, determine the potential alternative state of the site (i.e., how the site might look and the ES it might supply under a different development scenario) and proceed with selecting appropriate methods for measuring ES. Some sources of data are supplied and advice is provided on data needs and possible sources for each method. Detailed decision-tree graphics and screen shots of online tools help to make the rapid appraisal approach more accessible. TESSA also provides advice on presenting and communicating the results of the rapid appraisal. Planning communication strategies in advance or keeping them in mind throughout the assessment would be useful and can be facilitated by reading this section of the toolkit in advance.

Optimal use of this approach involves using collaborative, multi-disciplinary teams and effectively engaging stakeholders.

Strengths/advantages

The toolkit is readily available from the www.birdlife.org website. Use of the toolkit requires only limited technical capacity and a relatively small investment of time and money to measure ES at a particular site. Detailed instructions on a variety of methods provide options for producing robust scientific information on ES and for comparing services to those at similar sites that have been altered. Emphasis on the implications of decisions is useful in terms of identifying who stands to gain or lose and for more generally appreciating the value of nature and consequences to humans of ecosystem degradation.

Limitations/disadvantages

Results gained through the approach are not rigorous enough to be used in applying payments for ecosystem services (PES) or Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects. A limited set of ES are included in TESSA.

Efforts

- Expertise: Basic scientific training to understand sampling methods, statistics, and production of graphs; some training in socio-economic methods if looking at distribution of costs and benefits; computer skills and good level of numeracy.
- Time: Estimated minimum time to complete an assessment using TESSA is two months of staff time. If assessment includes socio-economic issues at the local level with primary data collection, then substantially more time required.
- Cost: Undetermined (depends largely on the site). Necessary resources include computer with Internet connection, field equipment, and staff.
- Access to information: Internet access to publicly available databases.

Further information

Peh et al. (2013) TESSA: A toolkit for rapid assessment of ecosystem services at sites of biodiversity conservation importance. Ecosystem Services 5, 51-55

A revised version of the interactive Toolkit was published in 2018.

http://tessa.tools/

Value of Nature to Canadians Study Taskforce. 2017. Completing and Using Ecosystem Service Assessment for Decision-Making: An Interdisciplinary Toolkit for Managers and Analysts. Ottawa, ON: Federal, Provincial, and Territorial Governments of Canada.

COLOPHON

ASSESSMENT OF BIODIVERSITY MEASUREMENT APPROACHES FOR BUSINESSES AND FINANCIAL INSTITUTIONS

UPDATE REPORT 4

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ABOUT THE EU B@B PLATFORM

The EU B@B Platform is a forum for dialogue and policy interface to discuss the links between business and biodiversity at EU level. It was set up by the European Commission with the aim to work with and help businesses integrate natural capital and biodiversity considerations into business practices. The EU B@B Platform focuses its work on three thematic workstreams: Methods, Pioneers and Mainstreaming. ICF is supporting the European Commission in running the EU B@B Platform since 2013. Arcadis is leading the Methods Workstream.