ASSESSMENT OF BIODIVERSITY MEASUREMENT APPROACHES FOR BUSINESSES AND FINANCIAL INSTITUTIONS

EU Business @ Biodiversity Platform

UPDATE REPORT 3

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CONTENTS

READER'S GUIDE

This Update Report 3 is the third update of the series "Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions" started by the European Business and Biodiversity Platform (EU B@B Platform) in 2018. Previous versions (2018, 2019) can be found on the website of the EU B@B Platform[1].

These Update Reports reflect evolutions in the development of biodiversity assessment approaches for businesses and financial institutions and therefore the structure and content might change from report to report.

The Update Report 3 has two distinctive features:

- It marks the launch of the **Biodiversity Measurement Navigation Wheel**, a pragmatic decision framework to select the most suitable measurement approaches for a specific business context. The Biodiversity Measurement Navigation Wheel is underpinned by concise tables providing relevant information on measurement approaches. This decision framework is informed by (1) the assessment and comparison of 16 case studies developed by tools and metrics developers; (2) updated methodological information on the different measurement approaches; (3) new information on the costs and level of efforts associated with the application of each measurement approach. The Biodiversity Guidance Navigation Tool, soon to be launched by the Cambridge Conservation Initiative and Capitals Coalition, has integrated the information and approach provided by the Biodiversity Measurement Navigation Wheel.

- It is largely centred around **case studies**, i.e. real-life applications of biodiversity measurement approaches by businesses and financial institutions. The case study analysis provides useful additional insights in the strengths and weaknesses of the available measurement approaches. The case study analysis is built on the increasing number of pilots being organised by metrics and tools developers. A structured process was installed to harmonise the case study descriptions according to an agreed template. Each case study was then assessed by an independent quality review panel. Whereas previous assessment reports were solely based on the methodological features of each approach, this report includes 16 uniform and quality reviewed case study descriptions and has less extensive information on the measurement approaches as such.

This report is another step in refining the findings and solving some of the challenges identified by the Aligning Biodiversity Measures for Business (ABMB) Initiative, which were extensively described in the Update Report 2 published in 2019. ABMB aims to achieve common ground between biodiversity tools for business and was a joint work of the EU B@B Platform and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) which will be continued under the recently launched ALIGN project (Aligning biodiversity metrics for business and support for developing generally accepted accounting principles for natural capital) running from 2021 to 2023 and funded by the EC.

This Update Report 3 has the following structure:

- Section 1: The need for measurement tools
- Section 2: The Biodiversity Measurement Navigation Wheel
- Section 3: Case studies
- ANNEX 1: Overview of biodiversity measurement approaches covered by the Biodiversity Measurement Navigation Wheel version 1.0
- ANNEX 2: Detailed comparative tables with information on biodiversity measurement tools
- ANNEX 3: One-pager information sheets for tools
- ANNEX 4: Full versions of case studies

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

The series "Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions" provides period updates. This Update Report is the third of a series of reports prepared on behalf of the EU B@B Platform. Updates might consist of the inclusion of additional approaches in the assessment, adaptations of the assessment methodology to reflect new developments, descriptions of case studies, etc. We welcome new measurement approaches, new case studies and any constructive contribution by members of the EU B@B Platform and beyond with a view to progress the development, alignment and uptake of biodiversity measurement approaches by businesses and financial institutions.

1 THE EVOLVING LANDSCAPE OF BIODIVERSITY MEASUREMENT APPROACHES BY BUSINESS AND FINANCIAL INSTITUTIONS

1.1 The need for biodiversity measurement guidance

Today, a growing number of businesses and financial institutions is committing to ambitious biodiversity targets such as 'becoming nature positive' or 'zero net loss' by a certain timeline e.g. 2030. Other companies are committing to be compliant to science-based targets for nature. This reflects an increased acknowledgement of the importance of nature by the business community, which is also fuelled by initiatives such as the EU taxonomy for sustainable finance[2], the EU Non-Financial Reporting Directive[3] and the EU Green Claims initiative[4].

As a consequence, the private sector is increasingly looking for methodologies, tools and/or metrics to measure its footprint and dependencies on nature and biodiversity in particular in a credible way. However, measuring and valuing natural capital risks and impacts, in particular on biodiversity, is a huge challenge. Businesses are struggling to identify approaches to measure their biodiversity performance that are on the one hand practical and pragmatic and on the other hand meaningful and relevant. This also applies to financial institutions who are looking for suitable ways to assess the biodiversity performance (in terms of impacts and risks) of their portfolio of investments and financing activities.

A recent survey (autumn 2020) by the TRADE Hub[5], the Aligning Biodiversity Measures for Business (ABMB)[6] collaboration and the EU B@B Platform[7] amongst companies with agricultural supply chains once again revealed the overall perception that assessing the biodiversity impact or dependency of a business activity raises many questions e.g. how to measure, where to start, when to combine measurement approaches, how to aggregate results, etc. A recent Swiss Re survey found that investors are struggling to identify and consider biodiversity-linked investment opportunities and that biodiversity needs to be made more digestible and measurable for investor concerns to translate into investment action:

- *"One-quarter of respondents do not know how to take the first steps to make investments supporting biodiversity and 32% feel they lack the knowledge to do so.*
- *70% believe a lack of available data is a key barrier to making investments supporting biodiversity"*[8].

Biodiversity measurement approaches which are suitable for the private sector and guidance on how to select those approaches and metrics depending on specific business context are very much needed. The objective of the series "Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions" is to bring elements of responses to these needs.

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[2] EU taxonomy for sustainable activities (europa.eu)
[3] Non-financial reporting (europa.eu)
[4] Initiative on substantiating green claims - Environment - European Commission (europa.eu)
[5] https://tradehub.earth/
[6] https://www.unep-wcmc.org/featured-projects/corporate-biodiversity-indicators
[7] Report in preparation
[8] 5 facts about biodiversity finance and investing (credit-suisse.com)

1.2 The evolving landscape of biodiversity measurement approaches

Measurement approaches rely on a combination of data collection and measurement and valuation techniques including correct interpretation to make outcomes digestible for decision-making. The landscape, both in terms of biodiversity data sources as in terms of biodiversity measurement methodologies for businesses and financial institutions is rapidly evolving.

Some years ago, approaches were mostly developed by NGOs or government funded research institutions but nowadays a growing number of approaches are being developed by private parties such as consultancies and private businesses. Examples of companies that have developed or have started to develop their own company-specific approach include for example Kering, LafargeHolcim, Repsol, DOW, Friesland Campina, Nestlé. A similar development is going on in the financial sector, with for instance AXA Investment Managers, BNP Paribas Asset Management, Sycomore Asset Management and Mirova having selected a research provider that will develop a tool to allow them to measure the impact of their investments on biodiversity[9]. These examples clearly demonstrate that biodiversity is a material issue for many companies.

A number of approaches are still under development. Other approaches are being piloted by companies and almost all of them are continuously being upgraded in line with new scientific insights or newly available data. On the other hand, more and more descriptions of real-life applications of available tools are being published, which helps knowledge sharing amongst tool developers and users.

Alignment between measurement approaches is increasing too and this is largely due to efforts such as the Common Ground paper on biodiversity footprint methodologies in the finance sector by ASN Bank, CDC Biodiversité, Actiam and Finance in Motion[10] (published in 2018) and the Aligning Biodiversity Measures for Business (ABMB) initiative[11]. These efforts contributed to a relatively common understanding of key concepts such as business applications, organizational focus areas, boundaries of measurement, required data inputs, aggregation potential, etc. This is crucial for understanding the key characteristics of biodiversity measurement tools and for decisions and guidance to select tools which fit best for a company’s particular context.

However, there is still a long way to go in terms of alignment. Remaining issues that need to be tackled are amongst others achieving a common understanding of biodiversity targets such as ‘nature positive’, agreeing on minimum requirements in terms of biodiversity scope (e.g. only measuring habitats and species or also measuring ecosystem services and what defines this scope), agreeing on more standardized approaches for biodiversity accounting, etc. This work will be continued with the recently launched ALIGN project (Aligning biodiversity metrics for business and support for developing generally accepted accounting principles for natural capital)[12], aimed at streamlining and strengthening methods and metrics for measuring the biodiversity impacts and dependencies of businesses and financial institutions.

The landscape of measurement approaches is rapidly evolving into a continuum of data sources, metrics, measurement tools and measurement frameworks. The focus of the Update 1, 2 and 3 Reports so far has always been on measurement and valuation tools and related metrics while data sources have only been assessed as input information for specific measurement tools. As knowledge and

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[9] In September 2020, the French asset managers chose Iceberg Data Lab and I Care & Consult as a consortium, with the companies having joined forces to expand a metric quantifying corporates’ impact on biodiversity across their activities.(see Asset managers progress biodiversity impact measurement plan | News | IPE)

[10] common-ground-report-asn-bank.pdf (crem.nl)

[11] This initiative is led by UNEP-WCMC with support from the Boticário Group Foundation and the EU Business @ Biodiversity Platform. ABMB is a collaboration of over twenty organisations with expertise in corporate biodiversity measurement approaches. It aims to form a common view amongst key stakeholders on the measurement, monitoring and disclosure of corporate biodiversity impact and dependencies and to build on this to help integrate more credible and comprehensive indicators of corporate contribution to global biodiversity goals into corporate reporting and global policy frameworks.

[12] See Projects – Capitals Coalition and https://ec.europa.eu/environment/biodiversity/business/align/index_en.htm

understanding of biodiversity data sources and their applicability by businesses is getting at least as important as knowledge and understanding of measurement approaches themselves, future update reports will also focus on the rapidly expanding field of biodiversity data sources. Some of these data sources (e.g. ENCORE, IBAT) are evolving into important complementary tools to real measurement tools and therefore need to be included in the scope. This also relates to the overall challenge of data collection by businesses and financial institutions. Businesses, in particular in sectors with numerous and often complex supply chains, are facing a real challenge in terms of data. Evolutions in the field of satellite imagery and combining this with environmental metrics are promising. Examples of these developments include Microsoft's Planetary Computer[13] and geoFootprint[14] by Quantis. Data providers to financial institutions are complementing their data with more robust biodiversity data and are developing approaches to calculate biodiversity footprints of corporates and sectors.

Apart from these observations in the field of biodiversity data, the following trends can be observed:

- moving towards more scientifically robust approaches, which is reflected by the fact that some tool developers are looking to present their approaches in scientific papers: this trend will be further enforced by the emerging concept of 'science based targets for nature', as promoted by the Science Based Targets for Nature Network (SBTN);
- being aligned with global biodiversity indicators: apart from the announced SBTN targets, there is much interest in the expected post-2020 CBD biodiversity framework which will include a number of biodiversity targets that might be very relevant for businesses and financial institutions too;
- recognizing that one and only biodiversity indicator towards the acknowledgement that biodiversity is hard to capture by one indicator): the increased interest in exploring how to combine measurement approaches illustrates this trend (e.g. dashboard-type presentations of biodiversity performance with several indicators); tools can be applied sequentially, e.g. from risk screening to more detailed measurements, or in parallel, e.g. for covering site level and supply chain measurements simultaneously;
- growing interest in 'complete solutions': measurement of biodiversity performance in a complex organization requires not only a measurement tool but also an approach to collect data and to engage stakeholders; this can be challenging in companies with diverse supply chains (for instance with many thousands of smallholder farms involved;
- linking risks related to ecosystem degradation with financial risk: the TCFD (Task Force for Climate related Financial Disclosures)[15] and TFND (Task Force for Nature related Financial Disclosures)[16] are exemplary initiatives demonstrating that corporate reporting on financial risks due to climate change and ecosystem degradation is rapidly gaining interest; this will require specific measurement approaches;
- increased interest in natural capital accounting approaches (financial accounting) and thereby including biodiversity measurements; this business interest has been explicitly embedded in the EU Green Deal ('support for businesses and other stakeholders in developing standardized natural capital accounting practices within the EU and internationally') and by the financial support of the Commission to two groundbreaking initiatives, i.e. Transparent and ALIGN.

The Update Reports series of the EU Business @ Biodiversity Platform is closely following these evolutions and will continuously publish on the most relevant developments in the landscape of biodiversity measurement approaches for businesses and financial institutions.

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13 See from page 61 on RE4Mxso (microsoft.com)

14 geoFootprint: satellite imagery and environmental footprinting metrics meet on a world map | Cool Farm Tool

15 Task Force on Climate-Related Financial Disclosures (fsb-tcfd.org)

16 Task Force on Nature-related Financial Disclosures (TNFD) Gathers Momentum - United Nations Environment - Finance Initiative (unepfi.org)

2 THE BIODIVERSITY MEASUREMENT NAVIGATION WHEEL

2.1 Introduction

This chapter presents a **more performant decision framework** for selecting the biodiversity measurement tools and metrics which are **fit for the specific context of a particular business or financial institution.** It goes beyond the criteria for selecting a measurement approach in the previous version of the decision framework (see Update Report 2). Business applications and organisational focus areas are still key criteria, but companies also want to know if for instance selected tools and metrics can cover all material pressures on biodiversity or can be used to measure progress against well-defined targets and ambitions. The costs and level of efforts required for the application of a tool are also important factors for the companies that wish to use them.

All these criteria are now covered by a new 'fast track' decision framework, the **Biodiversity Measurement Navigation Wheel 1.0**[17] (see Figure 1).

Key features of the **Biodiversity Measurement Navigation Wheel 1.0** are the following:

- 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 on specific criteria;
- It brings in **new 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 19 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 Section 3).

A worked example was developed to illustrate how the Biodiversity Measurement Navigation Wheel should be used by businesses. It clarifies the selection process with an accessible **narrative story** reflecting the thinking process of businesses that are facing the challenge of selecting a suitable measurement approach (see 2.5).

The Biodiversity Measurement Navigation Wheel presented in this report is a first draft. 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 we have started from a generic approach and made first steps with regard to an approach which is more adapted to the finance sector (see 2.4).

[17] The presented version is version 1.0. 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.

Finally, it must be emphasized that the development of the Navigation Wheel is part of a coordinated effort as stated in the box below.

The Cambridge Conservation Initiative, Capitals Coalition and the EU Business @ Biodiversity Platform are continuing to work together to support business and financial institutions to select biodiversity measurement approaches suitable for their specific contexts. The Biodiversity Guidance Navigation Tool, developed by the Cambridge Conservation Initiative and Capitals Coalition (launching soon) has integrated the underlying principles and data of the Biodiversity Measurement Navigation Wheel (launched as part of this EU Business @ Biodiversity Platform's Update 3 Report). Future iterations of the EU B@B's Biodiversity Measurement Navigation Wheel will be developed in close consultation with CCI and The Coalition to ensure integration and alignment of these complementary tools.

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 business. The latter is important, as businesses and financial institutions need approaches that can inform various management questions 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.

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[18], the Biodiversity Benchmark[19], and the Biodiversity Check[20]. A number of the 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.
- Approaches that only provide qualitative information on biodiversity risks or dependencies e.g. ENCORE[21].

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.

ANNEX 1 provides an overview of the 19 biodiversity measurement approaches that are covered by the Navigation Wheel 1.0. Each of the 14 approaches in the upper part of the overview is illustrated by at least one quality reviewed case study (see ANNEX 4). ANNEX 1 includes a short description of the tool, information on the developer, the state of the art in terms of development stage and the level of business uptake (with names of companies that applied the tool). ANNEX 3 includes additional but concise information on each of the first 14 tools. A detailed description of most of these tools is included in the Annexes to the Update Report 2.

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18 http://www.europeanbiodiversitystandard.eu/en
19 https://www.wildlifetrusts.org/sites/default/files/2018-06/BBOM4%20Biodiversity%20Benchmark%20Requirements.pdf
20 https://www.business-biodiversity.eu/docs/ebbc_index01.aspx?id=36799&basehrefrequ=true&isalias=true
21 https://encore.naturalcapital.finance/en

Compared to the Update Report 2, the following tools were added in the assessment:

- Corporate Biodiversity Footprint by Iceberg Data Lab;
- A company specific approach by LafargeHolcim, combining Biodiversity Indicator and Reporting System (BIRS) with an ecosystem services measurement and valuation approach;
- Biodiversity Net Gain Calculator, a tool for measuring biodiversity at site level by Arcadis; and,
- Biodiversity Performance Tool by Solagro and Biodiversity Monitoring System by Lake Constance Foundation and Global Nature Fund, two related tools for biodiversity measurement at farm level.

2.3 The Biodiversity Measurement Navigation Wheel 1.0 for Businesses

Any business, whether it is a company 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 must deliver. The costs and level of effort associated with different measurement approaches will also surely impact 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. To reflect this complexity, and offer flexibility in addressing these decision criteria, this report proposes a Biodiversity Measurement Navigation Wheel, which offers multiple entry points for users to follow, rather than a prescribed sequential process that may not fit well with user needs.

How does it work?

The **Biodiversity Measurement Navigation Wheel 1.0 for businesses** presented below is structured around the six 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, as is exemplified in the worked example provided in section 2.5.

Each of the six criteria is briefly introduced below and discussed in more detail in the **Navigation Wheel Support Table**. This Table provides further guidance on how to address each of the six criteria. Sections 2.3.1 to 2.3.6 then go in the details of the six criteria. The six criteria are:

- **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.

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 five selection criteria. Section 2.5 includes a 'worked example' illustrating how businesses should use the Biodiversity Measurement Navigation Wheel 1.0.

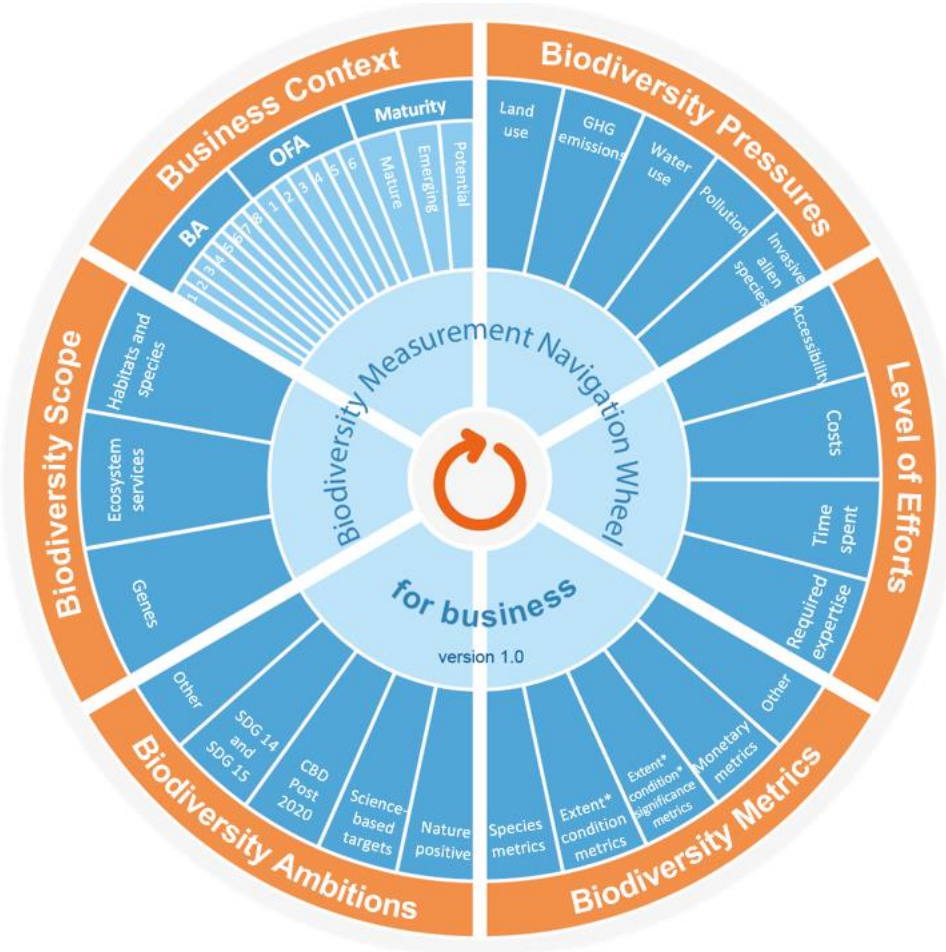

Figure 1: The Biodiversity Measurement Navigation Wheel 1.0 for Business

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 8 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 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, ...)?*	

2.3.1 Business Context

In the majority of cases the combination of **business applications (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[22].

More information on the concept of business applications and the description of the eight 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 as relevant 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.

The Business Context Matrix includes reference to the quality reviewed case studies (see Section 3 and ANNEX 4). As all case studies reflect more than one business application and/or organizational focus area, they appear several times in the matrix.

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[23]);
- 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).

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[22] 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’)

[23] As an example, efforts are ongoing to have biodiversity better integrated in the Product Environmental Footprint (PEF)

Business applications (BA) supported	Product / service	Site / project	Supply chain	Corporate	Portfolio / sector	Country / region
Current performance	ABDi, BFM (3)(4), BPT, PBF (1)(2), ReCiPe	ABD, BD, BFFI (8), BIRS (11), BISI (10), BMS, BNGC (14), BPT, CBF (5), GBS, LIFE (7), PBF, STAR (9)	ABDi, BD, BFM (3)(4), BIM (15), BMS, CBF (5)(6), EP&L, GBS, LIFE, PBF (1)(2), ReCiPe, STAR	ABDi, BD, BFFI (8), BFM, BIM (15), BISI, BMS, CBF (5)(6), EP&L, GBS (12), LIFE, STAR	ABDi, BFFI, BFM (3), BIRS, CBF, GBS (13), LIFE, STAR	ABDi, LIFE, STAR
Future performance	BFM (3)(4), BPT, PBF (1)(2), ReCiPe	BD, BPT, BNGC (14), GBS, LIFE, PBF, STAR (9)	BFM (3)(4), BIM, EP&L, PBF (1)(2), LIFE, STAR	BD, BIM, CBF, EP&L, GBS, LIFE, STAR	BFFI, BFM (3), CBF, GBS, STAR	STAR
Tracking target progress	ABDi, BPT, PBF (1)(2), ReCiPe	ABDi, BD, BFFI (8), BISI (10), BNGC (14), BPT, CBF, LIFE (7), PBF, STAR (9)	ABDi, BD, BIM, BMS, EP&L, LIFE, PBF (1)(2), STAR	ABDi, BD, BFFI (8), BIM, BISI, CBF, EP&L, GBS (12), LIFE, STAR	BFFI, CBF, GBS, STAR	ABDi, STAR
Comparing options	ABDi, BFM (3)(4), BPT, PBF (1)(2), ReCiPe (16)	ABDi, BFFI, BIRS (11), BISI (10), BPT, CBF, GBS, LIFE (7), PBF, STAR	ABDi, BFM (3)(4), BIM (15), BMS, EP&L, GBS, LIFE, PBF (1)(2), ReCiPe (16), STAR	ABDi, BFFI, BFM, BIM, BISI, CBF, EP&L, GBS, LIFE	BFFI, BFM (3), BIRS, CBF, GBS (13), STAR	ABDi, STAR
Third party assessments / ratings		CBF (5), STAR	STAR	CBF (5)(6), GBS, STAR	BFFI, CBF, GBS (13), STAR	
Third party certification		BD, BMS, CBF, LIFE (7), STAR	BD, BMS, STAR	BD, BMS, CBF, STAR	CBF, STAR	
Risk & opportunity assessment	BPT	ABDi, BD, BFFI (8), BISI (10), BNGC (14), BPT, CBF, STAR (9), LIFE	BIM (15), EP&L, STAR	ABDi, BD, BFFI (8), BIM (15), BISI, CBF, EP&L, GBS (12), LIFE	BFFI, CBF, GBS (13), LIFE, STAR	ABDi
Biodiversity accounting		BD, BFFI (8), BIRS (11), BNGC, CBF (6), LIFE (7), STAR	BD, CBF (5)(6), STAR	BD, BFFI (8), CBF (5)(6), GBS (12), STAR	BFFI, BIRS, CBF, GBS (13), STAR	

Organisational Focus Areas (OFA)

BIODIVERSITY MEASUREMENT APPROACHES

PBF: Product Biodiversity Footprint
BFM: Biodiversity Footprint Methodology
CBF: Corporate Biodiversity Footprint
LIFE: LIFE Key
BFFI: Biodiversity Footprint Financial Institutions
STAR: Species Threat Abatement and Restoration metric
BISI: Biodiversity Indicators for Site-based Impacts
GBS: Global Biodiversity Score
GBS BIA: GBS – Biodiversity Impacts Analytics
BNGC: Biodiversity Net Gain Calculator
BIM: Biodiversity Impact Metric
EP&L: Environmental Profit and Loss
LafargeHolcim
ReCiPe

1. PBF Salmon
2. PBF Shower gel
3. BFM Dutch dairy sector
4. BFM Tony's Chocolonely
5. CBF Mining company
6. CBF Portfolio agri-food companies
7. LIFE Posigraf printing company
8. BFFI ASN Bank
9. STAR Bukit Tigapuluh rubber project
10. BISI Anglo American mine
11. LafargeHolcim mine Spain
12. GBS Schneider Electric company
13. GBS BIA application with C4F
14. BNGC Alvance Aluminium site
15. BIM Asda retail company
16. ReCiPe Hand drying systems

Potential
Emerging
Mature

Figure 2 BA - OFA matrix of biodiversity measurement approaches for the business community including the finance sector (updated Nov 2020).

BOX 2: Business applications for the business community excluding financial institutions[24]

The concept of 'business applications' (BAs) in a natural capital context is introduced in the Natural Capital Protocol (2016) [25]. It is defined as "the intended use of the results of your natural capital assessment, to help inform decision making".

In the 2019 Update 2 Report on the Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions[26], **8 different BA** are distinguished (see below). 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.

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).*
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)?*

[24] See BOX 5 with business applications for financial institutions
[25] More specifically, see Table 1.2 in the Natural Capital Protocol
[26] https://ec.europa.eu/environment/biodiversity/business/assets/pdf/European_B@B_platform_report_biodiversity_assessment_2019_FINAL_5Dec2019.pdf

	• *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 (see Box 5)*
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.*
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	*Accounting refers to the process of compiling consistent, comparable and regularly produced data using an accounting approach. Companies may assess biodiversity impacts in the context of a specific accounting framework, such as management accounting (e.g., budget forecast), financial accounting (e.g., biodiversity offset liability) or national accounting (e.g., applying the System of Environmental-Economic Accounting – Experimental Ecosystem Accounting - SEEA EEA). An emerging biodiversity-specific accounting framework, the BD Protocol, which is based on adaptations of double-entry bookkeeping, helps companies produce Statements of Biodiversity Position and Performance using quantitative, non-monetary metrics.*

BOX 3: Organisational focus areas for the business community excluding financial institutions[27]

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[28]
- Corporate level, i.e. covering all activities (value chain, all locations)
- Sector or portfolio level[29] .

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.

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 perspective. 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** 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 Biodiversity Pressures Table under ANNEX 2.

The Biodiversity Pressures Table provides the following insights:

- Apart from the Product Biodiversity Footprint (PBF), there is no other approach that covers all pressures; PBF only covers products and at this stage it must be acknowledged that coverage of overexploitation and invasive alien species has not been widely applied (see case studies on salmon 1 and shower gel and salmon 2)
- All approaches cover land use, while the picture for other pressures is mixed
- Both Global Biodiversity Score (GBS) and Corporate Biodiversity Footprint (CBF) rely on GLOBIO and are very similar in terms of covered pressures

The Biodiversity Pressures Table offers no insight in the level of accuracy of measurement. 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

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[27] See specific BOX 5 with business applications for financial institutions
[28] 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, ….)
[29] 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

is not included in a comprehensive table in this report yet 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 most measurement approaches covered by the Biodiversity Measurement Navigation Wheel 1.0;
- The Biodiversity Metrics Table (see 2.3.5): some metrics are inherently more accurate than others;
- The Effort Table (see 2.3.6): generally, increased accuracy requires increased efforts for data collection.

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor) (*no information received on Agrobiodiversity Index ABDi)

Approaches	Land / sea use change	Direct exploitation[30]		Invasive alien species	Pollution		Climate change	Other
		Biological Resource Use (e.g. overfishing)	Water Use		Atmospheric nitrogen deposition	Nutrient emissions to water		
Biodiversity Footprint Financial Institutions (BFFI)	X	O	X	O	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
Biodiversity Indicators for Site based Impacts (BISI)	X	X	X	X	X	X	O	Noise and light disturbance, hunting
Biodiversity Impact Metric (BIM)	X	O	LUIF	O	O	LUIF	O	O
Global Biodiversity Score (GBS-	X	O	X	O	X	X	X	O
LIFE Methodology	X	O	X	O	X	X	X	Impact of solid waste disposal
Product Biodiversity Footprint (PBF)	X	X	X	X	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
Species Threat Abatement and	X	X	X	X	O	X	X	Geological Events

[30] 'water use' is considered under 'direct exploitation' according to IPBES categorization of drivers of biodiversity loss

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor) (*no information received on Agrobiodiversity Index ABDi)

Approaches	Land / sea use change	Direct exploitation[30]		Invasive alien species	Pollution		Climate change	Other
		Biological Resource Use (e.g. overfishing)	Water Use		Atmospheric nitrogen deposition	Nutrient emissions to water		
Restoration metric (STAR)								
Biodiversity Footprint Methodology (BFM)	X	O	X[31]	O	O	X	X	O
Biodiversity Footprint Calculator (BFC)	X	O	O	O	O	O	X	O
Corporate Biodiversity Footprint (CBF)	X	O	X	O	X	X	X	O
Biodiversity Net Gain Calculator (BNGC)	X	O	X	X	O	X	O	Noise and light disturbance
BIRS and ES assessment LafargeHolcim	X	O	O	X	O	O	O	O
ReCiPe	X	O	X	O	X	X	X	Terrestrial/marine ecotoxicity Terrestrial acidification
Kering's EP&L	X	O	X	O	X	X	X	Impact of solid waste disposal

[31] Only for The Netherlands

BIODIVERSITY PRESSURES TABLE (X: covered; O: not covered; LUIF: indirectly covered through land use intensity factor) (*no information received on Agrobiodiversity Index ABDi)

Approaches	Land / sea use change	Direct exploitation[30]		Invasive alien species	Pollution		Climate change	Other
		Biological Resource Use (e.g. overfishing)	Water Use		Atmospheric nitrogen deposition	Nutrient emissions to water		
Biological Diversity Protocol (BDP)	X	X	O	X	O	O	O	O
Biodiversity Performance Tool (BPT)	X	O	X	X	O	X	O	Erosion, pesticide use
Biodiversity Monitoring System (BMS)	X	O	X	X	O,	X	O	Erosion, pesticide use

(Source: based on recent survey amongst tool developers, autumn 2020)

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'[32] 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 are set out below. A good understanding of these targets will be useful to guide the selection of the appropriate biodiversity measurement tool.

The Biodiversity Ambitions Table provides the following insights:

- At the beginning of 2021 new CBD targets are still under consideration and are expected to be central elements of a Global Biodiversity Framework (GBF) to be agreed under the CBD at COP 15. How businesses will be addressed is yet to be defined. However, that businesses will have to become a key part of the solution to global biodiversity in some form is obvious. In this context the science-based targets for nature network has published initial guidance[33]. More concrete targets will become available soon (announced for 2022). So, 2021 and 2022 will bring more guidance and help corporates to set biodiversity ambitions and targets embedded within internationally accepted frameworks.
- 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 suitable tools are the Biological Diversity Protocol (BD) and the Biodiversity Net Gain Calculator (BNGC).
- Marine biodiversity, covered by SDG 14, is poorly addressed by the assessed biodiversity measurement tools. STAR might be a solution.

[32] See for instance Business for Nature's pledge for 'reversing nature loss by 2030' (Advocate — Business For Nature)
[33] SBTN-Interim-Guidance-executive-summary.pdf (sciencebasedtargetsnetwork.org)

BIODIVERSITY AMBITIONS TABLE

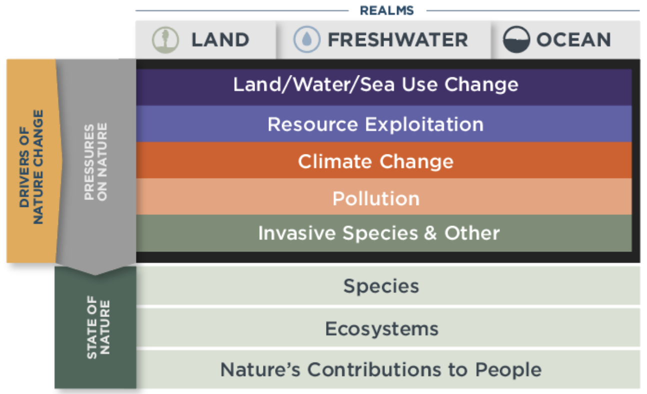
Biodiversity targets	Description	Consequences for tool selection	Suitable tools

CBD post 2020 biodiversity targets	The so-called 'updated zero draft' of August 2020 is the most recent document[34] and includes proposed targets for discussion and approval during the next CBD meeting (postponed from 2020 to 2021 due to Covid). However, these targets are subject to change. Business for Nature has proposed more ambitious targets on many places in the updated zero draft. The below discussion therefore only presents a picture of the way these targets might look like (non-exhaustive overview).
	• *2030 and 2050 will most likely be important milestones in the new biodiversity framework*
	• *The targets for 2030 will probably look like 'reversing biodiversity loss' or 'nature positive' (proposed by Business4Nature and inspired by the 'Nature Positive' ambition[35] which is in line with the Science Based Targets thinking. That means that by 2030, we must have more nature than we do now, through improvements in the health, abundance, diversity and resilience of species, populations and ecosystems)*
	• *Other potential targets relate to halving the production and consumption footprint (proposed by Business4Nature)*
	• *By 2030, ensure active management actions to increase the conservation and restoration of wild species of fauna and flora, natural resources, ecosystems and the ecosystem services they provide by [X%], and reduce human- wildlife conflict by [X%] (proposed by Business4Nature)*
	• *Invest in large scale soil restoration and rehabilitation by ensuring 10% ecological focus areas per km3 for all sourced agricultural inputs ((proposed by Business4Nature – similar to potential target by Science Based Targets for Nature Network, see below)) (proposed by Business4Nature)*
	• *By 2030, achieve reduction of at least [50%] in negative impacts on biodiversity by ensuring production practices and supply chains are sustainable*
	• *Enhancing the effectiveness and efficiency of resource use, including the adoption of mechanisms and quantifiable indicators to value ecosystem services delivery and reward sustainable natural resources management (proposed by Business4Nature)*
	• *Supporting and requiring business to internalize environmental externalities and integrate their impact and dependencies on nature in decision-making, risk management, supply chain management and external disclosure. This will require:*
	  ○ *a) standardizing metrics, tools and guidance to undertake robust corporate natural capital assessments and accounting;*
	  ○ *b) promoting guidance on nature-related financial disclosures; and*
	  ○ *c) providing contextual natural capital data from national statistical systems.*
		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.
		
		It is not entirely clear however, how a 'reversing biodiversity loss' or 'nature positive' target needs to be interpreted at company level. And this has important consequences for tool selection. A few examples of potential confusion:
		• Does it mean that positive impacts on biodiversity in 2030 (e.g. by investing in nature restoration) exceed negative impacts on biodiversity? And over what historical period do these negative impacts apply?
		• Or does it mean that the biodiversity impact in 2030 has improved compared to 2020?
		• Is it similar to Net Gain?
		• Another confusion is embedded in the term 'nature'. Are we talking about biodiversity here (this is what we assume) or do we need to interpret it in line with the thinking of the Science Based Targets Network for Nature, where nature encompasses biodiversity, water, land and climate?
		• And if it's only about biodiversity, does biodiversity include ecosystem services?
		
		Calculating production and consumption footprints will be in favor of LCA approaches.
		
		Measuring and valuing ecosystem services will most probably become more important.
		
		Metrics related to risk identification and interpretation will probably become more important.
			It looks like there will be a huge need to tap from the whole spectrum of biodiversity measurement approaches and related data sources in order to demonstrate compliance with this type of targets if they would be applied at a corporate level.
			
			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
			• Accounting approaches (e.g. Biological Diversity Protocol)
			
			Application of these targets at site level opens the door to more specific site-level measurement tools which also can be combined.

Science Based Targets for Nature	How much should a company contribute to biodiversity conservation? Science-based targets (SBTs) aim to provide a rigorous, objective and transparent process for companies to answer this question and so 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. Initial guidance is now available, with full guidance expected in 2022.	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. The SBTN initial guidance also suggests that material impacts and dependencies on biodiversity	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)

[34] Updated Zero Draft of the Post-2020 Global Biodiversity Framework (cbd.int)
[35] Nature Positive

BIODIVERSITY AMBITIONS TABLE

Biodiversity targets	Description	Consequences for tool selection	Suitable tools
	For climate, global goals can be translated into tonnes of carbon emissions and this can be apportioned across individual companies using a single measure – tCO_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 tCO_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*	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.	• Terrestrial, freshwater and marine biodiversity as far as relevant for the company • Impacts and dependencies. Inspirational: 12 **GBS Schneider Electric case study (12)**
No net loss/ net gain	No net loss or net gain commitments placed 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 developments[36]. Such ambitions might also be included in the CBD post 2020 biodiversity targets (see above)	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 Biological Diversity Protocol All measurement approaches making use of national No Net Loss metrics if available[37] (e.g. DEFRA metrics, Dutch Natuurpunten) Inspirational: 14 **BNGC Alvance Aluminium case study** 8 **BFFI ASN Bank case study**
Sustainable Development Goals	Corporate disclosure of progress against the SDGs is increasing. However, indications are that the biodiversity focused targets (SDG 14,15) are not currently well addressed by companies[38]. It should be noted that these goals are well aligned with Aichi Targets and 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.	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	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

[36] https://deframedia.blog.gov.uk/2019/03/13/government-to-mandate-biodiversity-net-gain/
[37] Not discussed in this report
[38] 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
	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*	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 topics 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.	which are affecting the status of species, application of STAR is worth exploring. ReCiPe-based approaches also cover some marine biodiversity threats (see Pressures Table in ANNEX 3). 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. Inspirational: 9 **STAR Bukit Tigapuluh rubber case study** 14 **BNGC Alvance Aluminium case study** 8 **BISI Anglo American case study**
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. Inspirational: 7 **LIFE Posigraf case study**
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[39] 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. Inspirational: 14 **BNGC Alvance Aluminium case study**

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

BIODIVERSITY AMBITIONS TABLE

Biodiversity targets	Description	Consequences for tool selection	Suitable tools
Voluntary biodiversity assessment and reporting frameworks	Many companies want to demonstrate to stakeholders that they manage biodiversity in a good way. Adopting the Global Reporting Initiative biodiversity indicators is a possible way. Working in line with the steps and principles of the Natural Capital Protocol is another possibility, in particular with the supplementary guidance on biodiversity which will be launched in 2020.	With regard to GRI, tools relying on IBAT as a main data source, might have an advantage, although IBAT can be applied as a standalone data source next to application of one or more biodiversity measurement tools. The Natural Capital Protocol, neither its Biodiversity Guidance, require the application of specific biodiversity measurement approaches. On the contrary, the Biodiversity Guidance Navigation Tool (which is aligned with the Biodiversity Measurement Navigation Wheel in this report – see 2.1) supports companies in selecting a suitable approach.	No preference
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)[40] and on short term the Green Claims initiative stricter obligations under the revised Non-Financial Reporting Directive, 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) Inspirational : 2 **PBF shower gel case study** 1 **PBF salmon case study** 4 **BFM Tony's Chocolonely case study**
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	BISI provides a good solution here, at least as an initial assessment of wildlife related impacts. As IFC 6 also requires investigating ecosystem services additional ES focused approaches will be required too (and this doesn't require monetized outcomes). Inspirational: 10 **BISI Anglo American case study**
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.	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 BISI, BNGC, …

[40] 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
			Inspirational: 15 **BIM Asda case study** 11 **LafargeHolcim case study**
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 CBF and 'GBS for Finance' Inspirational: 6 **CBF portfolio agrifood case study** 13 **GBS BIA with C4F case study** 7 **LIFE Posigraf case study**

2.3.4 Biodiversity Scope

Biodiversity has multiple dimensions and a company will need to decide which dimension(s) is 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** below provides a clear insight on the biodiversity scope covered by the assessed biodiversity measurement approaches. It is clear that the majority of measurement approaches only covers habitats and species. Only four approaches cover ecosystem services too, two of them in a more qualitative way (Agrobiodiversity index and LIFE Methodology) with the other two offering a full monetization approach, i.e. Kering's E P&L approach and LafargeHolcim's approach, not surprisingly approaches developed and applied by businesses who aim to have monetized outcomes. By now, none of the assessed approaches covers genetic biodiversity.

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

Biodiversity measurement approach	Habitats / Species	Ecosystem Services	Genes
Biodiversity Footprint Financial Institutions (BFFI)	X	O	O
Biodiversity Indicators for Site-based Impacts (BISI)[41]	X	O	O
Biodiversity Impact Metric (BIM)	X	O	O
Global Biodiversity Score® (GBS)	X	O	O
LIFE Methodology (LIFE)	X	(X)	O
Product Biodiversity Footprint (PBF)	X	O	O
Species Threat Abatement and Restoration metric (STAR)	X	O	O
Biodiversity Footprint Methodology and Calculator	X	O	O
Corporate Biodiversity Footprint	X	O	O
Biodiversity Net Gain Calculator	X	O	O

[41] BISI is the new 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**
BIRS and ES assessment (LafargeHolcim)	X	X	O
ReCiPe2016	X	O	O
Agrobiodiversity Index (ABDi)	X	(X)	O
Biological Diversity Protocol (BD Protocol)	X	O	O
Biodiversity Performance Tool for Food sector (BPT)	X	O	O
Biodiversity Monitoring System for the Food Sector (BMS)	X	O	O
Environmental Profit & Loss (EPL)	X	X	O

2.3.5 Biodiversity Metrics

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

The Biodiversity Metrics Table – 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 and are much more accurate, 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 monetized ecosystem services value of biodiversity measure a totally 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 4 below.

BOX 4: 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. There is nothing wrong with it. 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.

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 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.** **BISI might include such approaches if needed**
	STAR Species Threat Abatement and Restoration metric	Globally threatened species	Measures risk of species extinctions; based on threats to each species weighted by its threat status; excludes species listed as 'Least Concern'	Compare potential threat abatement and/or restoration actions	Any scale	**STAR**
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	**None of the assessed approaches**
	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	**Biodiversity Footprint Methodology/Calculator; Global Biodiversity Score; Corporate Biodiversity Footprint**

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
	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	**ReCiPe** **Product Biodiversity Footprint** **Biodiversity Footprint for Financial Institutions**
Extent (or Area) * Condition (or Quality) * Significance metrics	BII Biodiversity Intactness Index	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**
	BIM Biodiversity Impact Metric	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	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
				be used to underpin nature positive investments as offsets for achieving 'no net loss' or 'nature positive' ambitions		
Thematic metrics	Examples: deforestation free commodities or supply chains // surface of regenerated or restored land // palm oil fee // 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**
Other types of biodiversity	Agrobiodiversity Index	Agro-biodiversity	Measures nutrition, agriculture and genetic resources - not conventional biodiversity	Sustainable agriculture	Site to corporate scale	**Agrobiodiversity Index (ABDi)**
Financial metrics	EP&L Environmental Profit & Loss accounts	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	**Kering's E P&L (product), LafargeHolcim's ES valuation (site)**
Combined state, pressure and response metrics (dashboard)	No single quantitative metric, with score cards used to identify risk areas.	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**

BIODIVERSITY METRICS TABLE

Type of metric	Commonly used metrics	Unit of biodiversity	Key points	Used for	Scale of analysis	Approaches relying on these metrics
	Appreciation of progress (e.g. color codes, arrows, …)					

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. For the first time, this information is brought together and presented in the **Effort Table.** Below a condensed version is presented which functions as a quick guide. We strongly advise you to also consult the more extensive version in ANNEX 2. The full version includes the following additional detailed information:

- Contact details shared by the tool developers and links to relevant websites/webpages;
- Details on the type of required expertise according to the tool developers;
- Cost information related to fees for following a training or for example purchasing a license; and
- Estimate of the number of days required to apply the tool, including for data collection, obviously this is very much dependent on data availability, activities or sites of company to be covered, location, etc.

The Effort Table needs to be interpreted as follows:

- **Accessibility** refers to 'open source' or 'commercial' tool: 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)[42], 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).

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

Important remarks:

- Costs for hiring external expertise will dependent on data availability, scope of the assessment, location, size of sites, etc.;
- Efforts are hard to estimate as it mainly depends 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 which are required for a number of these measurement approaches can be found in the Data Table in ANNEX 2.
- When comparing costs and efforts between measurement tools, keep 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; and,
  - 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 totally 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 below).

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 Footprint Financial Institutions (BFFI)	Open Source with Support	EXT-T	COST EXT H/M COST Other L	H - M
Biodiversity Indicators for Site-based Impacts (BISI)[43]	Open Source	EXT	COST EXT H/M/L	H – M
Biodiversity Impact Metric (BIM)	Open Source with Support	EXT	COST EXT H/M/L COST Other M	H - M - L
Global Biodiversity Score® (GBS)	Commercial	EXT-T	COST EXT H COST Other M	H
GBS® for financial institutions	Commercial	EXT	COST EXT L COST Other H	L
LIFE Methodology (LIFE)	Commercial	EXT-T	COST EXT M COST Other L	H – M
Product Biodiversity Footprint (PBF)	Commercial	EXT	COST EXT H/M	M
Species Threat Abatement and Restoration metric (STAR)	Open Source with Support	EXT	COST EXT: H/M/L COST Other: L	L

[43] BISI is the new name for BIE (Biodiversity Impact of Extractive industries)

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 Footprint Methodology	Open Source with Support	EXT-T	COST EXT: M/L	L
Biodiversity Footprint Calculator	Open Source	INT	No costs	L
Corporate Biodiversity Footprint	Commercial	EXT-T	COST EXT: L Cost Other: H	L
Biodiversity Net Gain Calculator	Commercial	EXT	COST EXT: M/L	L
BIRS and ES assessment (LafargeHolcim)	BIRS: Open Source ES assessment: company tool	EXT	COST EXT: H	M
ReCiPe2016	Open Source	EXT	COST EXT: H/M	L
Bioscope	Open Source	INT		L
Agrobiodiversity Index (ABDi)	Commercial	EXT	COST EXT: H/M COST Other: L	M
Biological Diversity Protocol (BD Protocol)	Open Source	EXT-T	COST EXT: L	M/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)
Biodiversity Performance Tool for Food sector (BPT)	Open Source	INT / EXT-T	COST EXT: L COST Other: L	L
Biodiversity Monitoring System for the Food Sector (BMS)	Open Source	INT/EXT-T	COST EXT: L COST Other: L	L
Kering Environmental Profit & Loss (EP&L)	Open Source	INT?		H

2.4 The Biodiversity Measurement Navigation Wheel 1.0 for Financial Institutions

2.4.1 Introduction

A first version of a Biodiversity Measurement Navigation Wheel for financial institutions has been developed in autumn 2020, based on discussions with members of the Finance@Biodiversity Community under Workstream 'Pioneers' of the EU Business @ Biodiversity Platform and tool developers of biodiversity measurement approaches which are suitable for the finance sector.

This Navigation Wheel effort supports the implementation of commitment 3 "Assessing Impact" of the Finance for Biodiversity Pledge[44]. It serves as an additional tool next to the guidance on measurement approaches that will be published as an annex to the measurement page with approaches and examples of the Pledge's more generic Guidance Document.

We are aware that more work is required to refine this decision framework. However, it provides a good idea of how a fully operational and effective biodiversity measurement navigation wheel could look like for financial institutions. The Biodiversity Measurement Navigation Wheel 1.0 for financial institutions is presented in Figure 4.

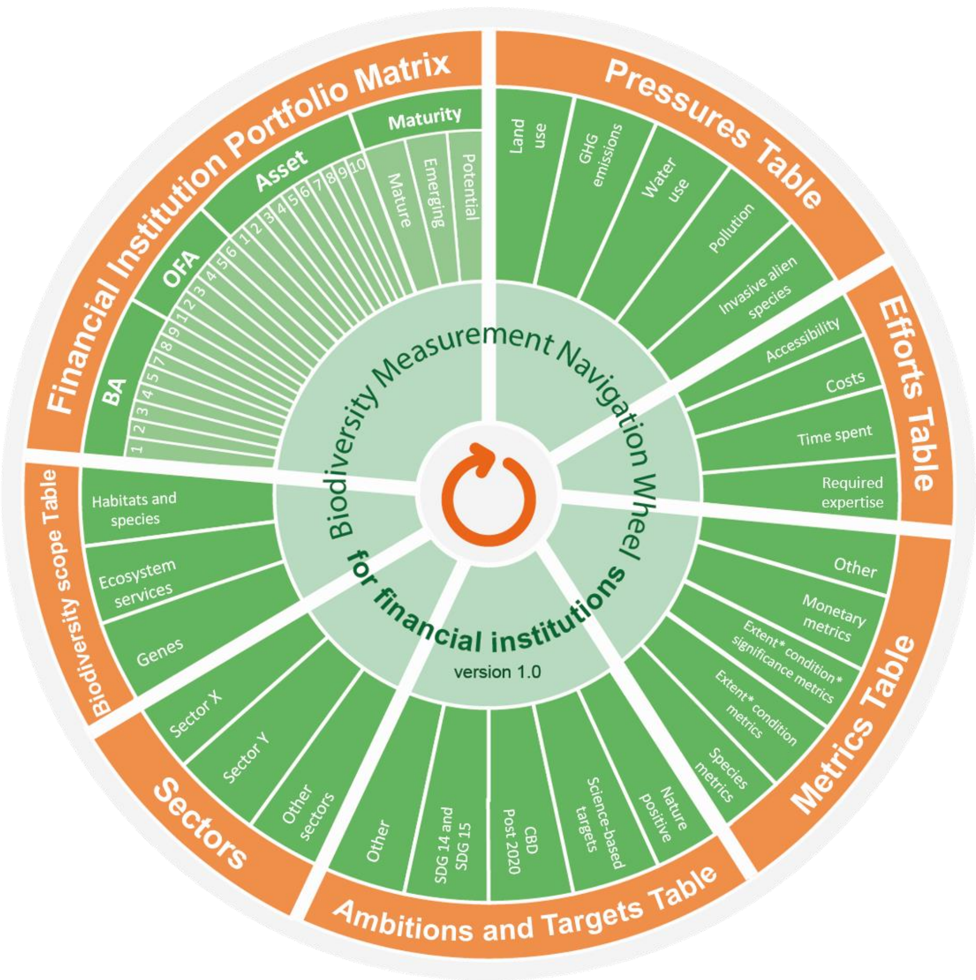


Figure 4: The Biodiversity Measurement Navigation Wheel 1.0 for financial institutions

44 Home - Finance for Biodiversity Pledge

2.4.2 Selection criteria

Figure 4 already reveals that the Navigation Wheel 1.0 for financial institutions has two additional selection criteria compared to the business version (see Figure 1): 'asset categories' and 'sectors'.

The applicability of a measurement approach at asset category level is part of the 'Guidance on measurement approaches for financial institutions which will be published in line with this Update Report 3. The asset category differentiation is largely similar to the Business Context Matrix under the Navigation Wheel for businesses but organizational focus areas are now further subdivided into asset categories and categories and descriptions of the business applications (BA) and the organizational focus areas (OFA) will be adapted accordingly. Box 5 provides an initial clarification on the categories and descriptions of business applications while Box 6 is covering organizational focus areas and asset categories, all through a finance sector lens. However, this will require further development. For now, the business context matrix in section 2.3.1 can be applied by the finance sector too, as it still includes relevant information for the finance sector, including on maturity of tools.

The criteria related to 'pressures', 'efforts', 'metrics', 'ambitions and targets' and 'biodiversity scope' are similar to those of the business version, at least for now. It is possible that next versions will include specific refinements in order to cope better with the needs of the finance sector. A detailed explanation on these criteria can be found in sections 2.3.2 to 2.3.6 of this report.

Additional criteria for the finance sector are still under discussion. These are 'scope' (i.e. 3 scopes of the value chain as applied by GHG Protocol) and 'source data availability' (i.e. primary, secondary or modelled data).

BOX 5: Business applications for the finance sector

See Box 2 in section 2.3.1 for more information on the concept and categories of business applications. Box 2 distinguishes 8 different categories of business applications. Although these have proved to be suitable for the majority of businesses, there is a need to provide a slightly different typology for the financial sector and a more tailor-made definition and explanation for those BA categories that remain in place. The numbering of BAs below follows the original numbering of BAs ('assessment of current performance' is always BA 1, both in a business context as in a FI context) and therefore some numbers will be missing if the respective BAs are not relevant for FI. Key differences with the BA typology for businesses are:

- the removal of BA 6 'Certification by third parties', as this is not a BA to be applied by the financial sector itself; if a FI would be audited by a third party in the context of a 'biodiversity certification', this is covered under BA 6 in Box 2A;
- the inclusion of a new BA 9 'Assessing alignment with internal ESG policy' as this is very specific for FI; it includes engaging with companies aimed at bringing companies in line with the ESG policy of the FI;
- the limitation of BA 7 'Screening risks and opportunities' to only 'Screening opportunities' as 'risk screening' is more covered under BA 1 now.

BA 1: Assessment of current performance	*This is a very common BA. A FI might do this just to demonstrate that its portfolio is doing well in terms of biodiversity performance, or simply to know its current level of performance or to identify 'hotspots', i.e. material biodiversity issues. It also includes the notion of risk assessment, which is very important for FI. One example is the assessment of biodiversity dependencies related to specific asset categories such as commodities trade. Another example is the assessment of biodiversity risks in case of due diligence assessments as part of mergers and acquisitions.*
BA 2: Assessment of future performance	*Scenario-analysis of future biodiversity performance of certain portfolio's, sector or asset categories, e.g. as a result of positive impact actions such as extensive ecosystem restoration actions and/or actions that reduce pressures on biodiversity. Scenario-analysis can also be based on policy scenarios (e.g. changing legislation regarding the use of fossil fuels, or different biodiversity targets at international level). Changes in the composition of the portfolio can also be assessed. It is expected that an increasing number of companies will define biodiversity targets and transparently*

	report on it. This will allow FI to estimate future biodiversity performance of listed equities.
BA 3: Tracking progress to targets	*Some FI have defined specific biodiversity targets at portfolio level (e.g. Net Positive Effect by 2030). Other FI have defined clear ESG targets, either at the level of specific asset categories or at portfolio level. FI 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; specific ambitions related to the finance sector are under development, amongst others by UNEP FI e.g. Nature Positive Finance, 'Deforestation Free', 'Blue Economy').*
BA 4: Comparing options	*FI might want to compare the impact of different investment options on biodiversity. These options can take different forms. Some examples of this BA:* • *Mortgages: which construction techniques or materials have least impact on biodiversity?* • *Which impact funds or green bonds offer the highest return on investment in terms of biodiversity?* • *Which investments in biodiversity conservation or restoration offer the best value for money?* • *Which commodities are riskier from a biodiversity point of view?* • *Which companies within a sector are 'best-in-class'?* • *Which sectors are performing best in terms of biodiversity?* • *Which asset categories score best in the FI's portfolio and offer best possibilities to achieve a portfolio NNL biodiversity target?*
BA 5: Assessment / rating of biodiversity performance by third parties, using external data'	*This is a typical business application in the finance sector; in particular data providers are increasingly looking for improved information on biodiversity performance of listed companies, etc.*
BA 7: Screening and assessment of biodiversity opportunities	*The term 'biodiversity opportunities' in the context of a decision framework for FI needs to be interpreted as 'opportunities for investing in positive biodiversity actions' such as large scale ecosystem restoration either at a project level or at a company level. A FI can do this to achieve a No Net Loss or Net Gain target at portfolio level.*
BA 8: Accounting	*Accounting refers to the process of compiling consistent, comparable and regularly produced data for internal reporting and/or external disclosure using reporting standards (like GRI) and verification by an accountant using an accounting approach. This can also be applied by FI in the field of biodiversity.*
BA 9: ESG screening and engagement	*Assessing compliance of assets to the FI's internal ESG policy and related criteria is a key application for FI. It includes monitoring of company engagement programs to bring companies in line with the FI's ESG criteria.*

BOX 6: Organisational focus areas and asset categories in the finance sector	
Criteria and categories	**Definitions and examples**
Organisational focus area	For financial institutions this is the scope or part of their investment and finance activities they are looking into for measuring the biodiversity impact of that specific part.
Balance-sheet	All the assets, liabilities and shareholders equity of a financial institution together at a specific point in time
Portfolio	A collection of finance activities or investments
Sector	A selection of the economy made up of firms or institutions that share the same or a related product or service
Index level	A method to track or evaluate the price performance of a group of assets in a standardized way, usually stocks, often to use as benchmark
Company	A commercial or industrial enterprise
Project	The funding of a long-term infrastructure, industrial project or public services
Asset categories	Category of assets owned or managed by financial institutions
Corporate loans	Debt-based funding arrangement between a business and a financial institution such as a bank.
Listed equity	Money invested in a company by purchasing its shares on a stock exchange.
Private equity	Money invested in a company by purchasing its shares.
Corporate bonds	Debt-based security issued by publicly held corporations to raise money for expansion or other business needs.
Sovereign bonds	Debt-based security issued by a government of a specific country.
Mortgages and real estate	Debt-based instrument, secured by the collateral of specified real estate property, that the borrower is obliged to pay back with a predetermined set of payments.
Impact funds	Fund with a goal to implement investments that generate a measurable, beneficial environmental (and/or social) impact, in addition to a financial return.
Green bonds	Debt-based instrument to support projects that aim to have a positive impact on climate and/or the environment.
Project finance	Debt-based funding arrangement of long-term infrastructure, industrial projects, and public services using a non-recourse or limited recourse financial structure.
Commodity trade	Trade or purchase of primary goods, such as raw or partly refined materials from the agriculture, energy or metals sector.

In earlier discussions of the Finance@Biodiversity Community, 6 biodiversity measurement approaches have been selected that were deemed to be suitable for the financial sector. Selection criteria were 1°/ tools should be able to measure beyond company level, 2°/ tools should cover all main drivers of biodiversity loss (e.g. not focusing on a single driver, such as deforestation), 3°/ tools should be scientifically robust. On that basis the following tools were selected (some of them are illustrated with a case study in ANNEX 4):

- Biodiversity Footprint Financial Institutions (BFFI) (see case study 8)
- Global Biodiversity Score (GBS) (see case study 12)
- Biodiversity Impact Analysis (BIA) which is a specific application of GBS for the financial sector (see case study 13)
- Corporate Biodiversity Footprint (CBF) (see case studies 5 and 6)
- Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)

- Species Threat Abatement and Restoration (STAR) (see case study 9).

From this list, 5 biodiversity measurement approaches are covered by the Biodiversity Measurement Navigation Wheel 1.0 for finance. In line with the scope definition in this report, ENCORE is excluded as it is considered as a data source, not providing quantified outcomes. However, future iterations of the Navigation Wheel might include highly relevant data sources too.

The limitation to only these 5 or 6 tools should be revised. Given the rapidly evolving biodiversity policy arena with more ambitious biodiversity ambitions and targets being expected over the next few months and years (in particular CBD post 2020 biodiversity framework and Science-Based Targets for Nature, see Biodiversity Ambitions Table in section 2.3.3) which will also trickle down to the private sector, the finance sector will need to consider additional biodiversity measurement approaches (e.g. in the field of ecosystem services and economic valuation). This will go hand in hand with an increased interest in combining approaches and metrics.

As mentioned in the introduction the Biodiversity Measurement Navigation Wheel 1.0 for finance institutions is only a first attempt. In 2021 a version 2.0 is being expected.

2.5 Worked example

This section brings the Biodiversity Measurement Navigation Wheel to live. It provides a narrative from the perspective of a 'dummy case' on how to select suitable tools and metrics. Although this dummy case is only representative for a small fraction of the variety and diversity of business contexts, it illustrates the many possible measurement routes a company can take, each with its pros and cons. It also shows that in practice, the selection of a suitable measurement approach for biodiversity is not just a technical issue, but requires a solid understanding of how companies are structured, how they work with their suppliers, how they want to present outcomes, etc.

The worked example is meant to be inspirational for those who want to start a similar journey.

In this worked example it was not possible to refer to the whole spectrum of assessed tools. The tools referred to are only illustrative for this specific work example and should not be interpreted as tools we are 'promoting'. In future update reports, we will aim to add other work examples based on additional case studies.

The following worked example is presented: **a multinational energy company transitioning from conventional fossil-based energy sources to renewables.**

2.5.1 Company description

The company is gradually switching its focus from fossil-based energy sources (oil and gas) to renewable energy sources. Renewables encompass offshore and onshore wind energy, solar energy and bioenergy. It is a multinational company with hundreds of sites. They have measured biodiversity on many sites, either as part of obligatory environmental impact assessments (EIA) or IFC 6 assessments but have no information on the biodiversity value or restoration potential on many other sites. The company is considering setting a target at corporate level to reverse biodiversity loss by 2030. As they are already investing in large scale afforestation programs as part of their climate mitigation program (carbon sequestration), they want to include these investments as part of their actions to restore biodiversity. A remaining concern of the company is how to bring together into one corporate figure detailed biodiversity information from in-depth site level studies such as EIA and BAP (biodiversity action plans), all covering a broad range of biodiversity taxa, with less accurate outcomes for other sites (e.g. modelled data expressed in MSA) that never have been subject to such detailed studies.

2.5.2 Applying the Biodiversity Measurement Navigation Wheel 1.0 for businesses

The company carefully considered each of the main selection criteria and ranked them as follow based following internal discussion:

- Business applications and organisational focus area
- Biodiversity ambition
- Biodiversity scope
- Pressures covered
- Choice of metric
- Level of effort

This is visualized in Figure 5 and further explained in Table 1 below.

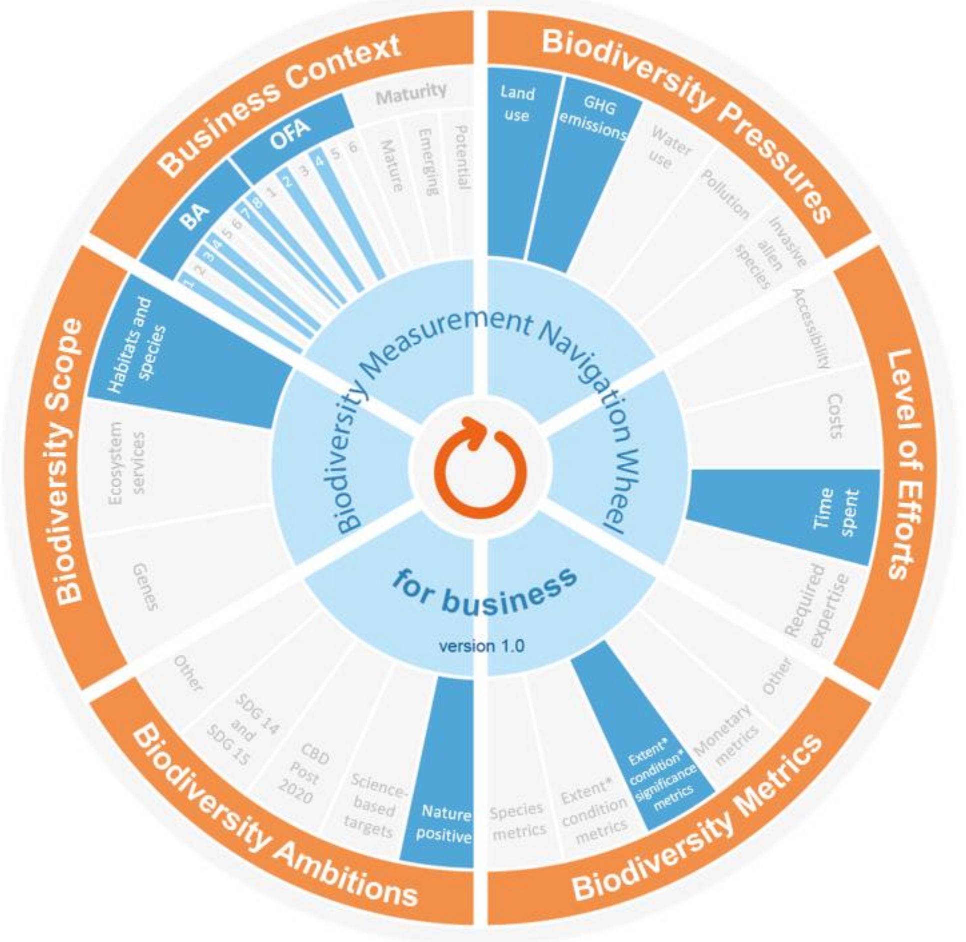


Figure 5: Main selection criteria for the energy company in worked example

Table 1 Illustration of selection process by the energy company

Criteria	Justification of company decision on selection criteria
STEP 1: Potential tools based on [Business Context Matrix](#)	**Business applications** As a first step, they want to measure current biodiversity performance (BA 1) and identify their most material biodiversity issues (BA 7 'screening **risks** and opportunities'). Secondly, they are interested to know which actions will provide a maximum return on investment in terms of biodiversity (BA 4 'comparing options') (BA 7 'screening risks and **opportunities'**) and finally they are looking for a suitable monitoring approach and bookkeeping system (BA 8 'accounting') for measuring progress to target (BA 3). **Organisational focus areas** As the energy company is considering a biodiversity target at **corporate level**, all activities of the company are within the scope of the assessment. These activities are typically **site and project level**. The company decides to apply a **cradle-to-gate approach** in line with its climate mitigation program (or scope 1, 2 and 3 upstream, excluding scope 3 downstream or the consumption phase). **Maturity** The company is aware that biodiversity measurement approaches for the private sector are still very much an innovative area and is happy to experiment with approaches. As a result, the level of maturity of the tools is not a dominant selection criterion.
DECISION	Ideally, the energy company is able to identify one biodiversity measurement approach that supports all business applications mentioned above, both at site level and corporate level: • BA1: measuring current biodiversity performance • BA3: monitoring progress to target • BA4: comparing options • BA7: screening risks and opportunities • BA8: accounting From the **BUSINESS CONTEXT MATRIX** in Figure 2 it is clear that: • the following **tools can be excluded**: PBF and ReCiPe (product level approaches). Further analysis with regard to the sector focus of tools leads to the exclusion of 5 other tools: BPT and BMS (farm level), ABDi (agrifood), BFFI ad CBF (finance sector). • none of the remaining approaches covers all business applications, neither at site level nor at corporate level; this means that **measurement approaches will need to be combined**. But which tools to combine? An analysis of how remaining tools fulfill the other selection criteria will lead to exclusion of an additional number of tools.
STEP 2: Potential tools based on biodiversity ambition and scope	The biodiversity ambition 'reversing biodiversity loss by 2030' requires a common understanding amongst the internal and external stakeholders of the company. According to the **AMBITIONS TABLE** there are multiple interpretations on what it exactly means. Given generally accepted principles or a standard on biodiversity measurement by businesses and associated targets is currently lacking[45], the company has decided to interpret the above target as follows: • positive impacts over the period 2020 to 2030 exceed negative impacts over the period 2020 - 2030 • impacts will be quantified but not monetized; ecosystem services are not included in the biodiversity scope • a **No Net Loss approach**, relying on the mitigation hierarchy, will be applied as part of the 'reversing biodiversity loss' ambition; compensations for remaining impacts will only be implemented after taking measures to avoid and reduce negative impacts.

[45] This gap will be filled by the ALIGN project

Criteria	Justification of company decision on selection criteria
	As the company is comparing outcomes over one decade, they will install a biodiversity accounting system to carefully monitor accumulated biodiversity gains and losses between 2020 and 2030.
DECISION	The biodiversity ambition 'reversing biodiversity loss by 2030' does not lead to the exclusion of one of the tools, but the limitation of the biodiversity scope (no ecosystem services) leads to **exclusion of 2 additional approaches:** the E P&L approach and the ecosystem services valuation part of the LafargeHolcim approach. Furthermore, the emphasis on having a solid biodiversity accounting system might **favor specific approaches such as the Biological Diversity Protocol (BD)**. As a next step, the company is discussing which pressures they want to cover.
STEP 3: Potential tools based on pressures	The company has identified the following pressures as relevant and material for most sites: GHG emissions, land use (including habitat destruction and fragmentation), water extraction and water pollution. Locally, specific additional pressures might be material e.g. noise and light disturbance, underwater noise for sea mammals (construction of offshore devices and windfarms), collision risk of bats and birds (windfarms). The company is aware that those specific pressures require a more tailored measurement approach e.g. Environmental Impact Assessment (EIA) and for all windfarms the information on biodiversity impacts due to these specific pressures is available within the company. Next to pressures the company also wants to measure the positive biodiversity impacts by its investments in large scale afforestation programs as part of their climate mitigation program (carbon sequestration). In a first stage, the company decides to **only focus on land use and GHG emissions**. Later on, they will gradually expand the coverage of pressures.
DECISION	Based on the **PRESSURES TABLE** all tools can measure land use impacts. Amongst the remaining tools (i.e. not eliminated yet), biodiversity loss caused by GHG emissions is **only covered by GBS, LIFE, STAR and BFM/BFC**. However, tools specifically addressing biodiversity measurement related to land use, should **remain in the scope** too as they might be more accurate and can probably be combined with the abovementioned tools that also cover GHG emissions. These tools are **BIRS, BNGC, BISI and BD**. It should be noted at this stage that the aggregation of outcomes from site level EIA with outcomes from generic site level biodiversity measurement tools remains a challenge that has not been addressed to date. As a next step, the company is considering which metrics might be most suitable.
STEP 4: Potential tools based on metrics	The company has no idea which biodiversity metrics to use. The **METRICS TABLE** provides more insights. As the target of 'reversing biodiversity loss by 2030' applies at corporate level, a metric which allows aggregation from site (and country) level to corporate level is preferred. In that case MSA, PDF and STAR scores are suitable metrics. Amongst the remaining tools, GBS (case study 12), LIFE (case study 7) and BFM/BFC (case study 4) rely on MSA (mean species abundance), while – obviously – STAR scores (based on threatened species) are applied in STAR (case study 9). However, for site level assessments MSA is not very accurate. MSA does not take into account the significance of biodiversity (e.g. protected/rare/threatened species and habitats). On the other hand, MSA-based approaches rely on GLOBIO and this model allows translating

Criteria	Justification of company decision on selection criteria

GHG emissions into MSA footprints which is interesting for aggregating biodiversity footprints caused by different pressures. A negative point for an energy company with many offshore activities is that MSA-based approaches fail to cover the marine environment. STAR is more accurate and includes the marine environment but it only measures impacts on IUCN Red List species which might be a limitation in areas with less or no IUCN Red List species. All remaining tools are suitable for measuring positive biodiversity impacts related to afforestation investments.

As an alternative, tailormade No Net Loss metrics based on the extent and condition of habitats can be developed and applied to each site. These allow a much more accurate assessment of biodiversity gains and losses per site. Even though the specific metrics cannot be aggregated (as different scores and weights across different countries and ecoregions) the outcomes (i.e. No Net Loss achieved or % Net Gain) can be aggregated. A quick comparison of BIRS, BNGC and BISI in the table below might bring clarity. They are compared according to the following criteria:

- compatibility with MSA scoring system; compatibility means that the tool can be combined with an MSA based tool (as mentioned above) which allows comparing land use biodiversity footprints and GHG emissions biodiversity footprints
- coverage of marine environment
- suitability of approach for accounting purposes (BA 8) and – related to this application – for demonstrating No Net Loss compliance (this requires an accounting approach)
- suitability of approach for alignment with EIA based biodiversity information.

For each of these tools aggregation of outcomes over different sites is challenging as biodiversity data are site specific and difficult to compare over different ecoregions. For the same reason it might be difficult to include investments in large scale biodiversity offsets in such NNL calculations as it might be hard to compare biodiversity values in these offset areas with biodiversity values on the company's sites.

Approach	Compatibility MSA	Coverage marine	Accounting and NNL compliance	Alignment EIA data
BD (relies on extent and condition data of biodiversity in relation to land use)	Does not work with similar scale as MSA and therefore is not very compatible with MSA based tools.	Yes, on condition that data on marine habitat extent and marine species populations are available	Very well suited for accounting purposes and for demonstrating NNL compliance	Less suitable for integrating EIA based data as these are rarely or at least not consistently expressed in terms of extent of habitats and population size of species
BNGC (relies on extent, condition and significance data of biodiversity in relation to land use)	Ability to MSA based biodiversity footprints for land use, by applying site surveys with a similar scoring scale: BNGC also applies a score ranging between 0 and 1 and might be implemented	No coverage of marine sites	Very well suited for accounting purposes and for demonstrating NNL compliance	Less suitable for integrating EIA data (as these are not expressed in score 0 to 1)

Criteria	Justification of company decision on selection criteria				
		to refine MSA scores (see case study 14)			
	BIRS (relies on extent, condition and significance data of biodiversity in relation to land use)	BIRS does not work with similar scale as MSA and therefore is not very compatible with MSA based tools.	Might be difficult to apply to marine sites	Well suited for accounting purposes and for demonstrating NNL compliance	Less suitable for integrating EIA data as BIRS is more suitable for monitoring progress of biodiversity restoration (e.g. mine rehabilitation) (case study 11)
	BISI (BISI works with scorecards to monitor evolution of pressures, state and response over time (see case study 10).	BISI does not work with similar scale as MSA and therefore is not very compatible with MSA based tools.	Can be applied to marine sites	Less suitable for accounting purposes and for demonstrating NNL compliance	Site specific metrics as applied by the BISI approach are compatible with those applied in EIA, so alignment with EIA based biodiversity data is possible.

DECISION

The energy company decides to explore several approaches on a small number of sites in order to better understand the type of outcomes of different approaches. Interesting paths to explore for them are:

- integrating EIA and BAP outcomes of many sites in a BISI dashboard approach (progress of pressures, state, response) and experiment with aggregation over multiple sites, and/or
- an MSA based approach that also allows measuring biodiversity footprints caused by GHG emissions, and measuring positive biodiversity impacts by large scale afforestation, and/or
- application of a NNL based approach (either BD, BNGC or BIRS), and/or
- parallel road-testing of STAR.

The company does a final check on efforts related to the use of remaining tools.

STEP 5: Potential tools based on efforts

The **EFFORT TABLE** provides information on accessibility, required expertise, costs and own time efforts related to the use of each tool.

The cost and time effort on a site level basis differs between model-based approaches and approaches relying on field surveys. Although own time investments for collection of data might be quite limited, the cost for external support can be substantial. Therefore, the company wants to prioritize their sites, differentiating between sites with high biodiversity value or potential and other sites. A higher cost and time investment is acceptable at high-priority sites.

DECISION

The company decides to start prioritizing sites according to biodiversity value or potential. Efforts for biodiversity measurement will vary accordingly. Both STAR and BISI are useful

Criteria	Justification of company decision on selection criteria
	tools to support this prioritization process as both are making use of IBAT[46], an IUCN managed data source of protected areas, key biodiversity areas and Red List species globally. The company discovers that **BFC** is a handy online tool that produces good insights in land use biodiversity footprint and GHG emissions related biodiversity footprint, at almost no cost. Therefore, they decide to start with applying BFC.

[46] Integrated Biodiversity Assessment Tool (IBAT) (ibat-alliance.org)

3 CASE STUDIES

3.1 Introduction

Since 2018 the number of real-life applications of biodiversity measurement approaches for businesses and financial institutions is rapidly increasing. As these real-life applications (= case studies) offer an excellent source of information on how biodiversity measurement approaches work in practice, the EU Business @ Biodiversity Platform's Workstream on Methods started a parallel assessment, i.e. an independent assessment of these case studies next to the ongoing assessment of the measurement approaches. After all, the proof of the pudding is in the eating. The objectives of the case studies assessment can be summarized as follows:

- Sharing practical experience by businesses and FI with others and serving as a source of inspiration for businesses aiming to start measuring biodiversity performance
- Validation of business applications and organizational focus areas where the approach can provide added value
- Identification of remaining challenges which will be topics for future research by the Platform and related EU funded projects (e.g. ALIGN)
- Feeding the further development of the Biodiversity Measurement Navigation Wheel (decision framework for selecting the appropriate tool(s))
- Supporting the further development and alignment of approaches by elevating the quality level of case study descriptions.

Case studies will not only be presented in these update reports but will brought together on a case study hub page on the Platform's website.

3.2 Methodological approach

For assessing the case studies by the EU B@B Platform:

1. the tool developers were asked to only submit case studies prepared in line with the uniform template to describe the real life application of a method; in order to disseminate case studies covering different measurement approaches in a harmonised format, the Platform – in consultation with the tool developers – has developed such a uniform template for case study description with which all tool developers have applied for including their case studies in this report; a summary of the contents of the template is presented in Box 7 below;
2. an independent panel of experts scrutinised the case studies in a quality review; in 2020 we are grateful for contributions by Annelisa Grigg (GlobalBalance), Anita De Horde (Finance for Biodiversity Pledge), Helen Temple (The Biodiversity Consultancy), Daniel Metzke (Potsdam Institute on Climate) and Serenella Sala (JRC – ISPRA) who have reviewed 16 case studies and provided constructive feedback to tool developers; the aim of the quality review was to eliminate unclarities and inconsistencies and to arrive to real-life stories that can be understood by every interested stakeholder; based on this feedback the tool developers submitted a revised version of their case study.

BOX 7: Case study description template	
Elements of case study template	**Clarification**
General information	
Title of case study and **general information** (name of measurement tool, name of company, sector, turnover, measurement period, business applications, organisational focus areas)	On business applications and organizational focus areas, it is requested to be as specific as possible (e.g. if 'tracking progress to targets' is a relevant business application, it is requested to specify exactly which targets need to be monitored (including indicators and target levels).
Description of the case	
Context	Introductory narrative justifying the rationale for applying this biodiversity measurement
Boundaries	It is very important to be clear on the boundaries of the measurement. The following specific questions were asked: • in case of LCA, which are the system boundaries? • value chain focus? (upstream, direct operations, downstream) (scope 1, 2, 3) • organisational structures? (e.g. control (operational and financial), ownership, legal agreements, joint ventures) • direct and indirect impacts? • cumulative impacts?
Location and scale	Request to describe the location, to add a map if useful and to describe the scale of the area (in ha or km2) subject to the measurement
Types of pressures	Table based on IPBES pressure categories and terrestrial, freshwater, marine ecosystems needs to be filled with pressures relevant for the case study; possibility exists to formulate 'pressures' also as 'positive measures' in case biodiversity outcomes of nature positive activities need to be measured;
Collected data on economic activities, pressures, state and impacts	The objective of this information is to describe which particular data sources have been used for this specific case, how accuracy of data has been enhanced (e.g. primary data to replace secondary data which are usually applied in the tool) and which challenges have been faced in the field of data collection, if any. Preformatted table to complete.
Role of qualitative information	Open question allowing for providing information on potential additional steps to interpret collected data
Baseline/reference situation	Request to be clear on eventual baseline and/or reference state, and justification, i.e. how are these defined?
Required efforts for the measurement	Specification on estimated time effort - in man days – for the different tasks under this measurement e.g. including data collection efforts
Required skills to complete this exercise	Clarification regarding required expertise/skills for applying the measurement approach and if this was available in the company or not
Results and application	Possibility to provide +/- 3 visuals (graphics, maps, …) with results. Request to provide textual narrative on how results have been interpreted and how this has influenced decision-making

BOX 7: Case study description template	
Elements of case study template	**Clarification**
Self-assessment on strengths, limitations and opportunities for improvement	
This section focuses on the strengths, limitations (e.g. challenges faced during implementation of the approach) and opportunities for improvement (e.g. lessons learnt) with regard to the applied measurement approach in the context of the specific case study. The self-assessment is based on 8 criteria and should preferably be done jointly by the company and the tool developer.	
Relevance	Is the applied biodiversity measurement useful to the company's target stakeholders, both internal and/or external? Does it capture the relevant parts of the organisation, taking into account the business context (nature of activities/sector, geographic locations, needs of stakeholders and information users)?
Completeness	Does the measurement approach capture all material pressures and all relevant biodiversity taxa (e.g. plants, birds, mammals, …) for the particular question to be answered?
Rigor	Does the described measurement approach rely on technically robust data, methods and information? Does the approach achieve suitable accuracy to enable users to make decisions with reasonable assurance on the quality of information?
Replicability	Is the described measurement approach transparent enough to allow correct interpretation?
Aggregation	Does the measurement approach allow for aggregating outcomes, both horizontally (e.g. over different sites) as vertically (e.g. from site level to corporate level, from one product to a product-portfolio, from one investment to investment portfolio level)?
Communication	Does the measurement approach provide results which can easily be communicated internally and externally? Can results be easily understood and grasped by non-specialists?
User-friendliness	Is the measurement approach user-friendly? This criterion includes elements such as need for specialist skills, training required to use the tool, need for specific software, user friendliness of the software, accessibility to data, etc.)
Investment	Does the application of the biodiversity measurement approach require a reasonable investment in terms of cost and time (data collection, hiring external expertise, etc.)?
Final information	
Authors of case study description and reference to additional information	

This approach, i.e. combination of case study template and independent quality review, is unique. Due to this approach, high quality case study descriptions have now become available for interested businesses and other stakeholders. The full case study description is quite extensive (+/- 10 pages) but due to their uniform structure, readers can easily find the information they are looking for.

New case studies will be published in 2021. As we aim for maximising diversity in case studies, the following conditions will apply to 'new' cases (i.e. eligible for being quality reviewed and published on the Platform's website):

- the case study is either an illustration of a 'new' biodiversity measurement approach, i.e. an approach which is not covered by one of the current 16 cases, or
- the case study is an illustration of new applications of 'existing' approaches (e.g. a BA-OFA combination which was not covered yet), or
- the case study is an illustration of important new functionalities of 'existing' approaches.

3.3 Evaluation of case study assessment approach

Overall, the process for case study assessment has proved to work well. It is quite demanding for applicants to complete the template (first version, second version) as well as for the quality review panel of experts to thoroughly screen the submitted case studies, but the final results are extremely useful for all who are keen to learn more about measuring biodiversity in a business or FI context.

Key findings from the quality review and recommended actions (e.g. need for further research, opportunities for improving the case study template) are presented in the table below.

Table 2: Overview of findings from quality review and related recommendations

Key findings from QR	Recommended actions
It was often difficult to understand the case study without a basic understanding of the biodiversity measurement approach; therefore, for the final version of the case studies tool developers were requested to provide a one-page summary of the measurement approach	Tool developers will need to submit a one-page summary of the biodiversity measurement approach applied in their case studies. These summaries (see ANNEX 3) will not be integrated in the case study descriptions but will be added as standalone documents on the Platform's case studies webpage and made accessible with hyperlinks in the case studies.
The concepts of business applications, organizational focus areas and value chain boundaries are well understood	
Cumulative impacts are not (explicitly) addressed in any of the case studies. Direct and indirect impacts are not interpreted consistently by all tool developers. There is still much confusion on the interpretation of indirect impacts.	Template should request description of direct and indirect impacts (this is not the case yet). Alignment is required on terminology of direct/indirect impacts. Cumulative impacts assessment is complex, even within the framework of in-depth environmental impact assessment studies. None of the case studies has covered cumulative impacts explicitly.
The pressures and data tables have proved to be very useful. The pressures table obliged authors of case studies to think carefully about all potential pressures but it was not always clear if all relevant pressures were mentioned or only those that were covered by the tool. The challenges in the data table are useful.	Template should request to describe all relevant pressures for the case study and which of these pressures were covered by the tool. This difference should be made more explicit.
The self-assessment has proved to be very useful, not at least for the tool developers themselves, as they were forced to present a balanced picture of strengths, limitations and opportunities for improvement. However, applicants did not always stick to the specific case study but started to describe the broad range of functionalities, strengths, limitations, etc. of the tool	Instructions for completing the assessment will need to be more clear on this

ANNEX 1: LIST OF BIODIVERSITY MEASUREMENT APPROACHES

OVERVIEW OF BIODIVERSITY MEASUREMENT APPROACHES *(upper list includes approaches with quality reviewed case study; bottom list includes approaches without quality reviewed case studies)*

	Name of tool/ framework	Developer	Description	Status	Private sector uptake (with case studies marked in bold)
			Approaches with one or more quality reviewed case studies (pink numbers refer to case stdies in Annex 4)		
1	**Biodiversity Footprint Financial Institutions (BFFI)**	ASN Bank (NL) CREM (NL) PRé Sustainability (NL)	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	- **ASN Bank** (full footprint) 8 - Volksbank - Some case studies were done with the **PBAF partners**[47] In 2020, a project started with case studies for six other financial institutions
2	**Biodiversity Indicators for Site-based Impacts (BISI)**[48]	UNEP-WCMC, Conservation International, and Fauna & Flora International (Int)	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 will be piloted in 2021	**Anglo American** 10, BHP, Chevron, ENI, Equinor, Newmont, Total.
3	**Biodiversity Impact Metric (BIM)**	Cambridge Institute for Sustainable Leadership (CISL) (UK)	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	Applied with members of CISL's Natural Capital Impact Group including **Asda** 15 & Kering
4	**Global Biodiversity Score® (GBS)**	CDC Biodiversité (France)	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	BNP Paribas Asset Management, Mirova, EDF, GRT Gaz, L'Oréal, Michelin, **Schneider Electric** 12, Solvay, Suez, Veolia & a luxury goods company. The GBS® has been developed with the Businesses for Positive Biodiversity Club (B4B+), a group of about 10 financial institutions and 25 companies, benefiting from extensive road-testing: 9 case studies and 2 full scale Biodiversity Footprint Assessments. 16 consultants and companies are already trained to use the tool.
	GBS® for financial institutions	CDC Biodiversité (France) & partners	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 several distinct tools, one with each data provider, including the: - Biodiversity Impacts Analytics (BIA) developed with Carbon4 Finance	Developing	CDC Asset Management, BIA (**Carbon4 Finance**) 13
5	**LIFE Key (LIFE)**	LIFE Institute (Brazil)	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 scheduled for January-April 2021	ABN AMRO Bank, Boticário, Catallini C-Pack (3 evaluated business units) Gaia, Silva & Gaede, Itaipu Binacional (Brazil and Paraguay), JTI Tobacco International (8 evaluated business units), Lapinha, Neoenergia Group (2 evaluated business units), **Posigraf** 7, Rocha, SANEPAR, Suzano, UDU Adecoagro (2 evaluated business units), Agricert, Amaggi, JBS, Karanda, Payco Raízen Group (2 evaluated business units), Tamanduá (2 evaluated business units),
,6	**Product Biodiversity Footprint (PBF)**	I CARE – Sayari (France)	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. Already tested in agriculture, food, cosmetics and apparel, electricity and energy sectors, Ongoing tests in all other sectors to be completed in Q1 2021.	**L'Oréal** 2, Kering, Avril, EDF (on going), Primagaz (on-going), Citeo (on-going) **Own case study** 1

[47] https://www.pbafglobal.com/financial-institutions-taking-action
[48] BISI is the new name for BIE (Biodiversity Impact of Extractive industries)

OVERVIEW OF BIODIVERSITY MEASUREMENT APPROACHES *(upper list includes approaches with quality reviewed case study; bottom list includes approaches without quality reviewed case studies)*

	Name of tool/ framework	Developer	Description	Status	Private sector uptake (with case studies marked in bold)
	Approaches with one or more quality reviewed case studies (pink numbers refer to case stdies in Annex 4)				
7	**Species Threat Abatement and Restoration metric (STAR)**	IUCN (Int)	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 under development. Portal for access to STAR data layers in early access programme via the Integrated Biodiversity Assessment Tool (IBAT) under development	18 tests underway or completed: 5 for agricultural products companies (e.g. **rubber case study** 9), 4 finance industry, 2 conservation planning, 2 forest management, 1 extractive industry, 1 private sector advisory services,
8	**Biodiversity Footprint Methodology (BFM) and Calculator (BFC)**	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.	**Dutch dairy sector** 3, **Tony's Chocolonely** 4, Desso Carpets, Foreco, Moyee, Natural Plastics
10	**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 to covering large portfolios with a bottom-up approach covering the most material impacts of constituents throughout their value chain.	Operational	Axa IM, BNPP AM, Mirova, Sycomore **Case studies** 5 and 6
11	**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	**Alvance Aluminium** 14, Brussels Airport Company
12	**BIRS and ES assessment**	LafargeHolcim	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, IUCN France and WWF). LafargeHolcim 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	**LafargeHolcim** 11
13	**ReCiPe2016**	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, we updated the ReCiPe2008 method to its version of 2016. We implemented human health, ecosystem quality and resource scarcity as three areas of protection. 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. We included 17 midpoint impact categories. 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	Operational	a.o. **Dutch government** 16

OVERVIEW OF BIODIVERSITY MEASUREMENT APPROACHES *(upper list includes approaches with quality reviewed case study; bottom list includes approaches without quality reviewed case studies)*

	Name of tool/ framework	Developer	Description	Status	Private sector uptake (with case studies marked in bold)
			Approaches with one or more quality reviewed case studies (pink numbers refer to case stdies in Annex 4)		
			implement characterisation factors at a country and continental scale. We also expanded the number of environmental interventions and added 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 as novel damage pathways.		
			Approaches without quality reviewed case studies		
14	**Agrobiodiversity Index (ABDi)**	Alliance of Bioversity International and CIAT (Int)	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 food and agriculture companies	HowGood & Danone; Olam
15	**Biological Diversity Protocol (BD)**	Endangered Wildlife Trust (South Africa)	This protocol is aligned to the Natural Capital Protocol. It helps provide biodiversity-specific guidance to measuring changes in the state of natural capital (step 6 of the Natural Capital Protocol), by providing guidance on how to measure change(s) in biodiversity components affected by business. It differs from the other measurement approaches in that it offers an accounting framework.	Under development	
16	**Biodiversity Performance Tool (BPT) for Food sector (BPT)**	Solagro (France)	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" aims at proposing a methodology to quite 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.	Online tool tested in Oct – Dec 2019. Available from Oct 2019	Currently 350 users (farmers), but still no longer term case study available
17	**Biodiversity Monitoring System for the Food Sector (BMS)**	Lake Constance Foundation, Global Nature Fund, Germany	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 will be developed in 2021: An In-depth sampling beyond the scope of certification. It monitors mid- and long-term effects of certification on wild biodiversity on the farm and its direct surroundings by selected key indicator species.	Pilots were planned in May – Sept. 2020 but was limited due to Covid19 pandemic. Intensive promotion will happen in 2021. The new German sector initiative "Biodiversity in the Food Sector" agreed on the implementation of the Biodiversity Monitoring SystemAvailable from Sept. 2020	
18	**Environmental Profit & Loss (EPL)**	Kering (France)	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	
19	**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 you to focus on the relevant commodities and suppliers for managing the biodiversity risks and opportunities in your supply chain.	Operational, but not maintained	Sharing case studies not relevant (BioScope only meant for internal use)

Source: information and updates provided by tool developers in autumn 2020 on request by the EU B@B Platform

ANNEX 2: DETAILED COMPARATIVE TABLES

PRESSURES TABLE (full version)

Metric [initiatives using the metric]	Characterisation factors	Land / sea use change	Direct exploitation[49]	Invasive alien species	Pollution	Climate change	Other
Mean species abundance (MSA) [GBS, BIM, BF, BFM, CBF]	GLOBIO's pressure-impact relationships	Land use, Fragmentation, Encroachment, Wetland conversion	Hydrological disturbance	Not covered	Atmospheric nitrogen deposition, Nutrient emissions, Land use change in catchment	Climate change	N&P emission in inland water
Potentially disappeared fraction (PDF) [BFFI, PBF, ReCiPe/Bioscope]	ReCiPe or LC Impact's characterisation factors	Land occupation, Land transformation, (regional) Water scarcity	Not covered	Not covered	Terrestrial ecotoxicity, Terrestrial acidification, Marine ecotoxicity, Marine eutrophication, Freshwater eutrophication, Freshwater ecotoxicity	Climate change	
Risk of extinction unit [STAR]	No characterisation factor but assessment of the level of	Residential & Commercial Development, Agriculture	Biological Resource Use	Invasive & Problematic Species,	Pollution	Climate Change	Geological Events

49 In the assessment conducted within the ABMB project, "direct exploitation" was considered to include only overexploitation of biodiversity (e.g. over-fishing). The assessment will be updated in the future, since the IPBES actually also include the impacts of the exploitation of water, etc. in the "direct exploitation" pressure. Several metrics do take into account the impact on biodiversity of the over-exploitation of water, etc. and should thus not be rated as "Not covered".

PRESSURES TABLE (full version)							
Metric [initiatives using the metric]	**Characterisation factors**	**Land / sea use change**	**Direct exploitation[49]**	**Invasive alien species**	**Pollution**	**Climate change**	**Other**
	pressures through the IUCN Red List	& Aquaculture, Energy Production & Mining, Transportation & Service Corridors, Human Intrusions & Disturbance, Natural System Modifications		Pathogens & Genes			
Biodiversity Pressure index [LIFE]	LIFE evaluation for waste destination impact on biodiversity. LIFE evaluation of energy matrix impact on biodiversity.	Cf. MSA's terrestrial pressures	Not covered directly	Not covered by the biodiversity impact index metric because is not an information applied for all sectors (but assessed as a management indicator for LIFE certified companies)	Emissions	Climate change	
Natural capital value (*e.g.* EUR) [Kering's EP&L]	No characterisation factor	Land use change impact using eco-system services value on top of GHGs, Air pollutants, water use, water pollution, waste production	Not covered	Not covered	GHGs, Air pollutants, water use, water pollution, waste production	Climate change	

PRESSURES TABLE (full version)

Metric [initiatives using the metric]	Characterisation factors	Land / sea use change	Direct exploitation[49]	Invasive alien species	Pollution	Climate change	Other
Qualitative/score card [BISI]	No characterisation factor[50]	Land use, habitat conversion, fragmentation	Water extraction	Covered	Water pollution, soil pollution	Not covered	Noise, dust, light, poaching, hunting, …
Biodiversity Performance Tool (BPT)	Evaluation of strengths and weaknesses based on baseline. A difference matrix to identify the degradation or improvement of basic indicators is proposed when an update of the current report is done.	Land use, habitat protection and creation, quality of habitats, connectivity, buffer zones, Off-site ecosystems loss and degradation related to animal fodder production	Agrobiodiversity, Pesticide management, fertilizer management, erosion, crop rotation, soil management, use of water, livestock density	Covered	Pesticide application including veterinary products, nitrogen application		Only indirectly
Biodiversity Monitoring System (BMS)	No characterization factor	Land use, habitat protection and creation, connectivity, buffer zones, Off-site ecosystems loss and degradation related to animal fodder production	Agricultural practices with impacts on biodiversity	covered	Pesticide application, nitrogen application,		Only indirectly
Biodiversity Net Gain Calculator (BNGC)	No characterization factor (field survey assessment)	Land use, land use fragmentation	Indirectly covered e.g. if excessive water extraction would have visible impacts on habitats and species	Specifically addressed	Indirectly covered e.g. if water or soil pollution would have visible impacts on habitats and species	Not covered	Disturbance (e.g. noise, light) indirectly covered if visible impacts on species

[50] The level of pressure is nonetheless assessed based on site documentation.

DATA TABLE						
Biodiversity measurement approaches	**State**		**Pressure, resources and emissions**		**Economic quantification of activities**	
	User-derived	**External collected**	**User-derived**	**External collected**	**User-derived**	**External collected**
Global Biodiversity Score® (GBS)	Species abundance, species population (number of individuals) from ecological surveys (extremely costly and complicated though).	NA	Company data on land use change, greenhouse gas (GHG) emissions, water withdrawal & consumption, nitrogen, phosphorous and ecotoxic emissions, consumption of commodities, services or refined products inventories, wetland conversions	GLOBIO's scenarios as proxy of current pressures, Food & Agriculture Organisation (FAO) data on yields, crop production and surface harvested, Aqueduct data on water withdrawal & consumption by watershed, US Geological Society data on mines around the world, EXIOBASE data on material consumption, GHG, N, P and ecotoxic emissions	Turnover and purchases by industry and region	Public financial reports, private database on turnover (e.g. FactSet), purchases from EXIOBASE Input-Output model
GBS for financial institutions	NA	NA	NA	Same as GBS + company-level or sector-level data from the data provider (i.e. GHG emissions by Scope)	NA	Same as GBS + company-level or sector-level data from the data provider (i.e. turnover and purchase breakdown by industry and region)
Biodiversity Impact Metric (BIM)	NA	Range rarity values based on IUCN Red List range maps.	Company data on land use type & intensity, yield data where available.	FAO data on yields if company data not available. Land pressures based on GLOBIO & PREDICTS models.	NA	NA

DATA TABLE						
Biodiversity measurement approaches	**State**		**Pressure, resources and emissions**		**Economic quantification of activities**	
	User-derived	**External collected**	**User-derived**	**External collected**	**User-derived**	**External collected**
Biodiversity Indicators for Extractives (BISI)	Company data on species or habitats identified as priority biodiversity features	IUCN Red List data, Global Critical Habitat Screening Layer and protected areas data all from the Integrated Biodiversity Assessment Tool.	Company data on pressures on habitats and species assessed qualitatively based on timing of pressure, proportion of population/habitat affected and severity of pressure	Equivalent data provided from existing sources including sector, national or global averages if company data is unavailable	NA	NA
Product Biodiversity Footprint (PBF)	**Integration of ecological surveys on site or in the supply chain (with different levels of confidence, based on independence / verification level)**	Integration of peer-reviewed specific ecology publications (economic activity x geography), studying the impact of economic activities on biodiversity; Integration of IUCN data and/or GLOBIO results	Company primary data on yields, emissions and resource needed on all stages of the value chain where the company has direct informations and data; localisation information is also needed	**PBF tool assesses the whole value chain pressures through an LCA approach, using LCA databases for background processes (ecoinvent, Agribalyse, …). The LC-Impact model is then used to assess resulting pressures complemented, for key variations, with ecological data from peered reviewed literature and tools.**	NA	NA

DATA TABLE						
Biodiversity measurement approaches	**State**		**Pressure, resources and emissions**		**Economic quantification of activities**	
	User-derived	**External collected**	**User-derived**	**External collected**	**User-derived**	**External collected**
Biodiversity Footprint for Financial Institutions (BFFI)	NA	NA	Company data can be entered at the level of economic activities, or at the level of pressure. We incorporate company data on climate change, data on other pressures are modelled based on revenue per country and sector.	EXIOBASE data on resource (land occupation, water use) and emissions to air, water and soil. Other input-output databases or Life Cycle Inventory databases can also be used.	Turnover and purchases by industry and region	Public financial reports, private database on turnover
Species Threat Abatement and Restoration (STAR) metric	User data on land use, landscape used for verification at the ex-ante baseline and ex-post stage	IUCN Red List and species distribution data	User data on land use, landscape used for verification at the ex-ante baseline and ex-post stage, includes quantitative assessments of how threats would evolve due to actions implemented by the business assessed	Threat assessments from the IUCN Red List	NA	NA
Agrobiodiversity Index (ABDi)	Company data on geospatial location of activities and where available company data on species and varietal diversity in production, consumer products,	Multiple spatial layers (remote sensing & spatial modelling): biodiversity integrity in agricultural landscapes, crop, livestock &	Company data on list of practices that can support biodiversity in agricultural landscapes and food systems	Meta-analyses of effects of agricultural and food system practices on biodiversity and human well-being (livelihood, nutrition, resilience) outcomes in different settings	Under development	Under development

DATA TABLE						
Biodiversity measurement approaches	State		Pressure, resources and emissions		Economic quantification of activities	
	User-derived	External collected	User-derived	External collected	User-derived	External collected
	and genetic resource management	fish diversity, pollinator biodiversity, soil biodiversity				
Biodiversity Performance Tool (BPT)	78 key indicators calculated from a questionnaire with max. 100 questions collected by farm assessor, auditors, farmers. It includes a map module to draw semi-natural habitats.		Farm data on existing habitats, management and potential for creation of habitats, protection of species, agricultural practices with negative impact on biodiversity, agrobiodiversity, capacity building and engagement with local initiatives.			Costs for implementation of certain measures is described
Biodiversity Monitoring System (BMS)	25 key data/indicators collected by farm assessor or auditor		Farm data on existing habitats, management and potential for creation of habitats, protection of species, agricultural practices with negative impact on biodiversity, capacity building and engagement with local initiatives.		N/A	
Biodiversity Footprint	Via pressure intensity / quantity	Existing cause – effect relations	Company data on land use change, GHG emissions,	Various sources can be used to derive productivity per land use type. GHG equivalent	Economic allocation to calculate share	NA

DATA TABLE						
Biodiversity measurement approaches	**State**		**Pressure, resources and emissions**		**Economic quantification of activities**	
	User-derived	**External collected**	**User-derived**	**External collected**	**User-derived**	**External collected**
Methodology & Calculator			N&P to water. Company measures / scenarios	emissions via LCA in case company lacks these data	impact in case of multiple use	
Corporate Biodiversity Footprint (CBF)		Integration of localized environmental data	Company data on land use change, GHG emissions. Company data on asset localization	GLOBIO model on damage functions, emission factors for estimation of pressure levels	Sector-based mapping of economical and physical flows within value chains	Public financial and operational data
LIFE Key (LIFE)	Company data on land use distribution using MSA categories Company data on biodiversity local projects Company data on species and habitats identified as priority	WWF Ecoregions IUCN Protected areas categories IUCN Red List Key Biodiversity Areas* Habitat´s Directive* Red Natura 2000* Local official data of biodiversity priorities Local official data of deforestation rates * Being used in European pilots	Company data on land use change, GHG emissions, water usage, waste generation and destination by hazardouness categories, energy source and consumption * Information on Pesticide use is required for the primary sector (for restrictions and management recommendations).	IPCC information on Global Warming Potential Official data on deforestation rates LIFE ecoregions hierarchy LIFE index on Hydric Balance LIFE index on energy matrix * LIFE information uses regional or national official data, accordingly to: https://institutolife.org/wp-content/uploads/2018/11/LIFE-BR-TG01-Technical_Guide_01-3.2-English.pdf	Annual Turnover	NA
Bioscope	NA	ReCiPe 2008 impact	NA	EXIOBASE data on resource use and emissions	Company specific data on	NA

DATA TABLE						
Biodiversity measurement approaches	**State**		**Pressure, resources and emissions**		**Economic quantification of activities**	
	User-derived	**External collected**	**User-derived**	**External collected**	**User-derived**	**External collected**
		assessment method on climate change; terrestrial acidification; freshwater eutrophication; terrestrial, freshwater and marine ecotoxicity; land occupation; water scarcity.			annual purchases by country and sector	

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
Agrobiodiversity Index (ABDi)	Partly opensource: - Opensource for public sector applications. - For company applications, interested parties should contact ABDi. ABDi has developed several applications for companies, i.e. benchmarking, risk and opportunity assessment, product comparison, traceability, intervention planning & assessment. An interactive interface will be built in 2021: agrobiodiversityindex.org		No costs, except for the application with HowGood where ABDi is integrated into the HowGood Sustainability tool	The required efforts for the company are concentrated in gathering the appropriate data and several dialogues and feedback session(s) with the tool developers. Dependent on the application and complexity of the case, this can vary from 2 weeks to 6 months and can be complemented with on-the-ground field studies.
Arcadis Biodiversity Net Gain Calculator	Commercial (contact: hans.vangossum@arcadis.com)	Field surveys need to be conducted by experienced local ecologists, having a solid understanding of the importance of habitats and related species relative to pristine circumstances	Costs for subcontracting. Dependent on (1) total area to be visited and mapped, (2) required level of detail (low biodiversity areas can be scanned relatively quickly), and (3) frequency of periodic follow up monitoring (annualy, bi-annually, …)	Required efforts for the company are low.
Biodiversity Footprint Financial Institutions (BFFI)	Opensource. - The reports on methodology are published on the ASN Bank website - The input-output database is available on the EXIOBASE website - The impact assessment method can be downloaded from the developers website	All the data is freely available and public, but it will be challenging to do calculations without knowledge of the databases and the impact assessment model. Also you'll need programming skills to do the calculations, or a SimaPro	/	It very much depends on the size of the portfolio and the amount and type of investments. It can take 15 – 50 days to complete a biodiversity footprint of a financial institution.

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
		license to access the database through the tool developers' software. The tool developers can offer tailored trainings on demand. In case you do not want to do the assessment yourself, you can ask us to calculate the impact of your investments and perform the qualitative analysis and interpretation.		- For the calculation of the biodiversity footprint of an investment portfolio, a full balance sheet is needed. - For investments in listed equity, information on the revenue per sector and country, and the market capitalisation is needed. - For project finance, information on the type of project is needed. - For government bonds, information on value and country is needed.
Biodiversity Footprint Methodology (BFM)	Opensource. Excel calculation spreadsheets available on request. http://www.plansup.nl/expertise/biodiversity-footprint/	Existing cause-effect relations for water extraction only available for Dutch landscapes. For impact calculation of N and P emissions to water, data are needed on emission quantity, type of emission (point source or diffuse) and flow, water volume and existing concentration in water body that receives emission. Some training of staff needed. Online manual and help available (www.plansup.nl) or	/	Methodology described in two reports. 1 hour max. required after data on land use and GHG have been inventoried for raw materials, production and transport. More if not in Dutch landscape.

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
		possibility to contact tool developer for advice.		
Biodiversity Footprint Calculator (BFC)	Opensource. Tool accessible through link. http://biodiversity-footprint.herokuapp.com/#/calculator	Information only needed for land use and GHG related to the raw materials, production process and transport. Online manual and help available (www.plansup.nl) or possibility to contact tool developer for advice.	/	1 hour max. required after data on land use and GHG have been inventoried for raw materials, production and transport
Biodiversity Impact Metric (BIM)	Opensource. https://www.cisl.cam.ac.uk/resources/natural-resource-security-publications/measuring-business-impacts-on-nature License through the IBAT platform is needed.	The users will likely need skills in GIS and basic data analysis to undertake the calculations. The users will need to access data available via license through the IBAT platform. The users may need some support in identifying appropriate land-use intensity coefficients, though they can assume 'intense' production if they are uncertain. If a company would like assistance with applying the Biodiversity Impact Metric they are encouraged to contact CISL.	An appropriate licence fee to the IBAT platform for the range rarity data.	The primary effort of the company is concentrated in gathering the appropriate data. Nominally this simply needs to be the amount of a commodity purchased and the country it comes from. Additional effort is required to apply the results to company decision making processes. An initial application of the Biodiversity Impact Metric should take days to weeks depending on the number of commodities and supply chains of interest, the existing information the company can provide, and the scope of the outputs required.

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
				For example, detailed analysis, interpretation and integration into decision making may require additional time as would identifying alternative data sources or assumptions.
Biodiversity Indicators for Site-based Impacts (BISI)	Opensource. https://www.unep-wcmc.org/featured-projects/biodiversity-indicators-for-site-based-impacts Additional resources may aid companies in conducting assessments, for example access to the Integrated Biodiversity Assessment Tool (IBAT) which provides commercial access to biodiversity data relevant to site-level assessments.	The methodology provided clearly lays out the steps needed to apply the approach. This can be conducted by companies themselves or in conjunction with partners (e.g. NGOs, consultants etc).	/	Company effort will vary depending on sites, organizational structure and the potential to engage partners to support the assessment. A key factor in ensuring the process is smooth and efficient is the capacity and buy-in from site-level managers. Current assessments have taken approximately 14 days of time per site spread over several months. However, on-going implementation is demonstrating that the time taken to complete assessments is reduced as a company and its partners become more familiar with the approach.
Biodiversity Monitoring System for the Food sector (BMS)	Registration and confirmation is needed. www.biodiversity-performance.eu	Tool can be used without external support. But project partners are available to	The use of the BMS is free until autumn 2021. Modest user fee from November 2021	Data collection requires 1,5 to 2 hours per farm. 80% of the data requested is data

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
		provide support on quality assurance, evaluation of monitoring results, training.	onwards. Fee depending on size of company/organisation and number of assessments. Additional costs depend on additional services requested from project partners.	required for audits, subventions etc. Monitoring results can by filtered by country, region, production type and are presented in nine clusters. Time for evaluation of results depends on the needs of the company/standard/ cooperative.
Biodiversity Performance Tool for Food sector (BPT)	Registration is necessary. https://bpt.biodiversity-performance.eu/	Tool can be used without external support. But project partners are available to provide support on quality assurance, coordination of pilot projects, training, adaptation of the BPT to specific crops and/or regions	Modest user fee from February 2021 onwards. Fee depending on size of company/organisation and number of assessments. Additional costs depend on additional services requested from project partners.	Baseline assessment requires 3 – 5 hours (depending on data availability of the farmer), additional 2 hours is needed for map module to draw semi-natural habitats. Updates needs less time = 1 – 2 hours.
Biological Diversity Protocol (BD Protocol)	Opensource (publication aims at 1st quarter 2021)	Training may be needed for most to understand the double-entry bookkeeping process.	The tool is opensource, but biodiversity data collection can entail costs if not available yet.	It would vary according to the scope, business and biodiversity context. Pre-existing biodiversity data (e.g. available through EIAs) will help reduce costs and efforts. Assuming all data is available, and a medium size company is involved, a couple of weeks may be needed to compile net biodiversity impact accounts and the associated Statements of Biodiversity

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
				Position and performance as per the BD Protocol. If data is needed on ecosystem extent and condition, surveys on 1 site may take 1 up about 5 days (size dependent); assuming satellite imagery is also used. If data is needed on material species, specific impact assessment protocols may be required. The timing of such assessments can be key (e.g. may need to wait for rains or summer).
BIRS and ES assessment LafargeHolcim	Approach developed for internal company purposes, with support by Ecoacsa. Commercialised by Ecoacsa (contact: davidalvarez@ecoacsa.com).	Profound biodiversity expertise for detailed inventories of habitats and species and for monetization of ecosystem services	Costs for subcontracting e.g. university experts for wildlife inventories, ecosystem services experts.	Own time spent by the company is rather limited
Corporate Biodiversity Footprint (CBF)	Commercial. The CBF developer is a pure data provider working only for financial institutions. They have no advisory business nor sell-side business in order to be free of any conflict of interest when assessing the impact of portfolio's constituents.	A 2h-training is made on the data at the data delivery. No other training is needed to use the dataset. The research team is available for client support in case of questions.	Commercial tool → costs related to performed work	Delivery on demand – bespoke analysis in a 3-weeks' notice period

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
Environmental Profit & Loss (EPL)	Open source, see EP&L: a measurement tool for sustainable Luxury | Kering And https://kering-group.opendatasoft.com/	LCA expertise	No information	No information
Global Biodiversity Score® (GBS)	Commercial. - GBS Presentation - GBS technical update 2019 The GBS® methodology is transparent and its impact factors and the source code of its user interface are available for free for academics for research purposes. Interested companies should contact gbs@cdc-biodiversite.fr. It is recommended to join the B4B+ Club to benefit from the GBS® trademark licence, technical assistance, literature updates, presentations of new updates of the tool, networking meetings, etc.	An assessment with the GBS® must be carried out by an assessor who has followed the level 1 & level 2 trainings (not included in the membership of the B4B+ Club): - GBS® Level 1 Training: to understand and correctly interpret results from corporate biodiversity footprint assessments with the GBS® and learn what data should be collected (1 day – 1600€ excl. VAT) - GBS® Level 2 Training: to be able to lead a GBS®-based biodiversity footprint assessment for internal or commercial purposes (2 days – 3500€ excl. VAT). It is recommended to seek support from a consultant at least for the first year.	The price of the membership of the B4B+ Club is € 6,500 excluding VAT per year. An assessment with the GBS® must be carried out by an assessor who has followed the level 1 & level 2 trainings (not included in the membership of the B4B+ Club): - GBS® Level 1 Training: 1600€ excl. VAT - GBS® Level 2 Training: 3500€ excl. VAT	Collecting the data needed for the assessment constitute an important step of the assessment and requires time and effort, especially since it involves different departments of the company. In line with the ambition to assess the entire biodiversity footprint of the company, the time required by the company is not negligible and exceed 40-60 man-days (time period of 3-6 months).

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
		B4B+ Club Members benefit from technical support from CDC Biodiversité for the use of the GBS® through access to at least 4 technical support webinars each year.		
GBS® for financial institutions	Commercial. The GBS® for financial institutions is actually a handful of distinct biodiversity impact databases and services developed with different partners. Data are purchased as subscription or data sets covering specific universe of financial assets. Interested companies should contact gbs@cdc-biodiversite.fr.	CDC Biodiversité and its partners will provide support on the update and interpretation of corporate biodiversity impacts depending on the level of service purchased. A GBS® Level 1 Training is recommended to understand & correctly interpret impact data calculated with the GBS® for financial institutions (1 day – 1600€ excl. VAT)	Data are purchased as subscription or data sets covering specific universe of financial assets. A GBS® trademark licence fee is included in the subscription or data purchase. There is no additional fee. A GBS® Level 1 Training is recommended to understand & correctly interpret impact data calculated with the GBS® for financial institutions: 1600€ excl. VAT	Impact data are provided entirely calculated, without any effort from the financial institution.
LIFE Key (LIFE)	Methodology is open and available at: https://institutolife.org/o-que-fazemos/desenvolvimento-de-metodologias/documentos-que-dao-suporte-tecnico-a-metodologia/?lang=en LIFE Key software is not opensource. The LIFE Key License must be acquired from LIFE Institute and technical support (1 man-day) is necessary.	To access and use the LIFE key software, it is necessary to download and install the tool with basic technical external support estimated on 1 man-day. Future detailed training or extra support can be estimated considering companies´ specific demands	Free access can be given to download the software in a corporate virtual environment. A fee is required for technical support, and for additional training.	Initial users effort to implement the methodology is estimated between 10 to 100 man-days - depending on the size of the company and the level and organization of internal environmental data. Current users are reporting that 1 man-day is enough for annual updates of the tool

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
				when all the internal information is already updated and well organized. One week is enough to learn the fundamental functionalities of the tool and to enter the company´s basic data for small companies. For a deeply and complete implementation of the methodology for initial users the time may vary between 3 to 10 months - depending on the size of the company and the level and organization of internal environmental data.
Product Biodiversity Footprint (PBF)	Commercial. But information is available on the website http://www.productbiodiversityfootprint.com/ An LCA license and access to LCA databases is necessary.	/	Commercial tool → costs related to the performed man-days (see time spent)	The primary effort of the company is concentrated in gathering the appropriate data on the case study. - One product footprint : 10 to 20 man-days - Comparison of options (2 cases): 15 to 30 man-days
ReCiPe2016	ReCiPe2016 is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long		/	The company is responsible for data collection on its own processes and first tier

EFFORT TABLE (full version)				
Name of tool/ framework	**Accessibility**	**Required expertise**	**Costs**	**Time spent**
	as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. https://www.rivm.nl/bibliotheek/rapporten/2016-0104.pdf			suppliers. This should be possible in a couple of days. Performing an LCA using ReCiPe will take about 15 days for a quick screening LCA and approximately 40 days for an ISO compliant LCA that can be used for comparative assertions to be disclosed to the public.
Bioscope	Opensource. https://bioscope.info/ Disclaimer: This tool gives an approximation of the biodiversity impact resulting from the supply chain of the commodities purchased by businesses. 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.	A quick start guide is available on the website	/	The company is responsible for compiling a complete list of all purchases and their value. The tool can be applied in a couple of hours.
Species Threat Abatement and Restoration metric (STAR)	License through the IBAT platform is needed.		Possibility to contact IBAT to enroll in an early access program. No charge for early access program, but companies are required to complete a feedback form.	Dependent on knowledge of spatial data. Analysis takes hours to days.

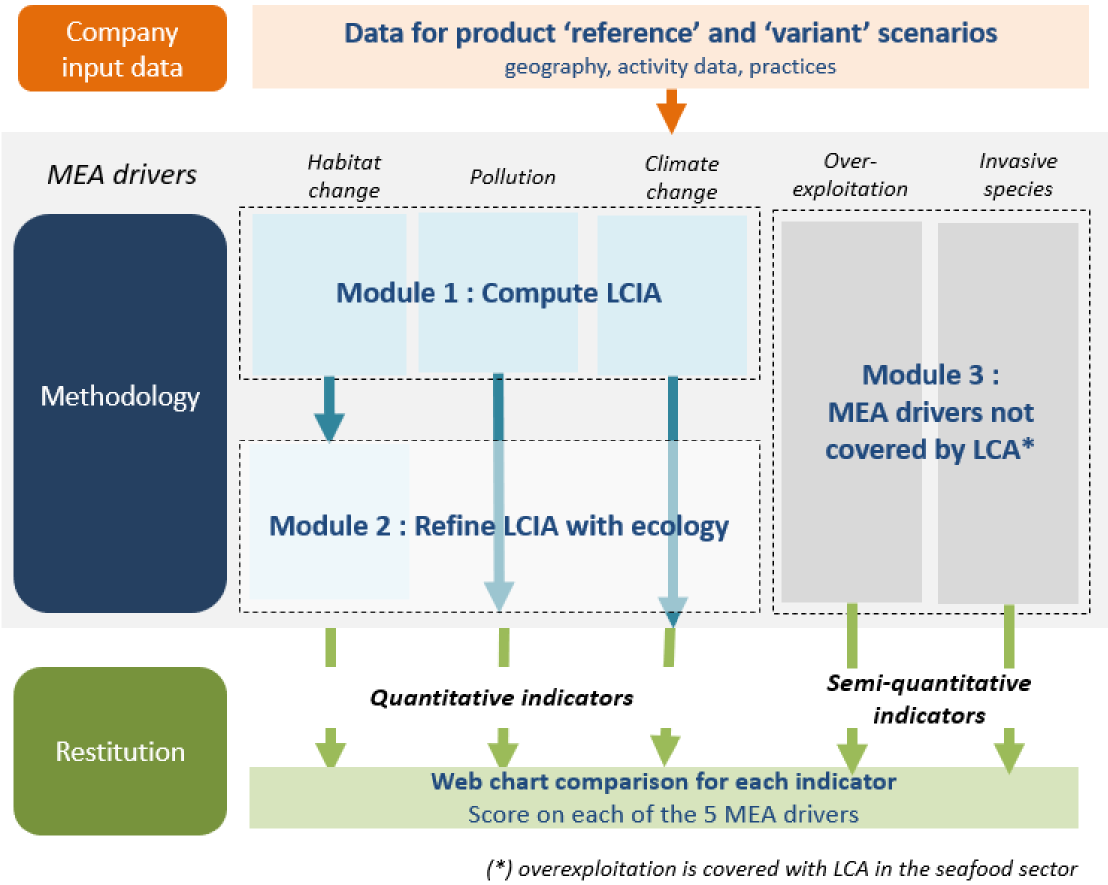
ANNEX 3: SHORT DESCRIPTIONS OF MEASUREMENT APPROACHES

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, fand 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[51] 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

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51 Millenium Ecosystem Assessment, now taken over by IPBES

make refined comparisons between variants for the three MEA drivers ‘habitat change’, ‘pollution’ and ‘climate change’.

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.

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.

Biodiversity Footprint Methodology (BFM)

The Biodiversity Footprint 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[52].

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 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.

The equation for determining the biodiversity footprint is:

Footprint = Σ(ha area in usei * [1-MSA_pressure factori])

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.

[52] 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 other pressure types and parts of the chain.*

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, Nitrogen deposition and the Release of Toxic Waste compounds into Freshwater.

Using pressure-impact relationship functions, those pressures are converted into the metric 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.

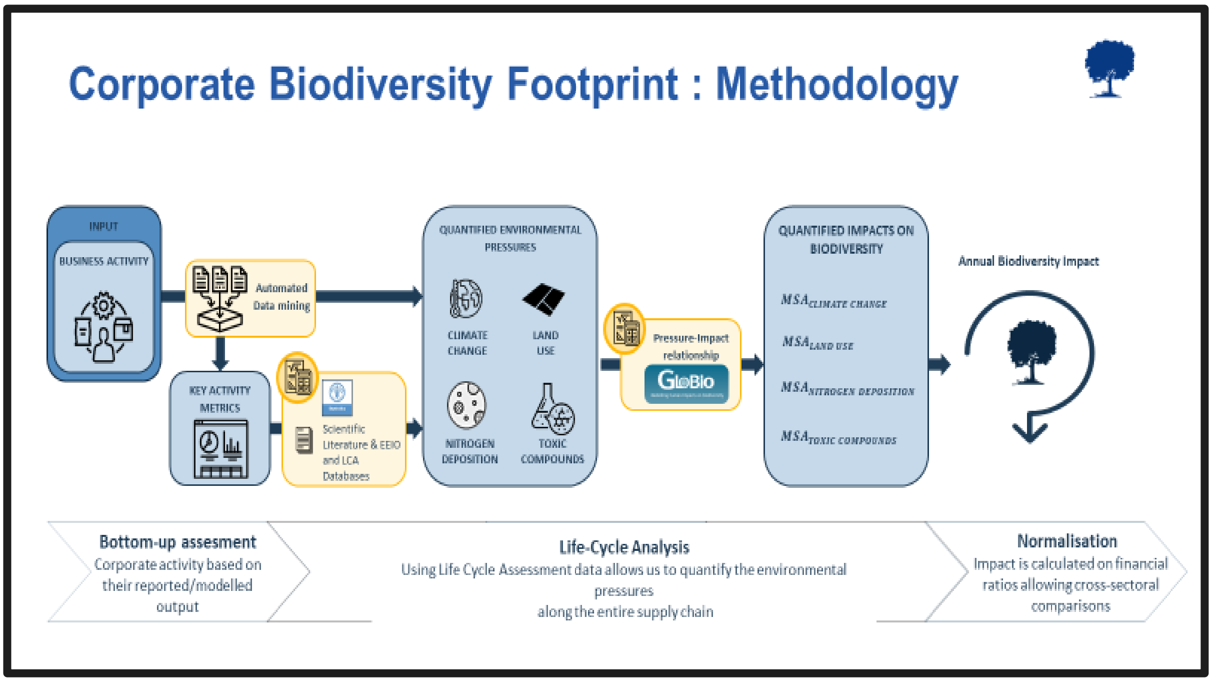
The Mean Species Abundance

The Mean Species Abundance (MSA) is a biodiversity metric which expresses the mean abundance of original species in a 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 and NOx emissions, surface of land use, volumes of toxic compounds released);
3. the pressures are eventually converted into 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. **Land use change**
   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) and land transformation (converting undisturbed land).
2. **Air pollution**
   We consider NOx emissions, which lead to eutrophication and acidification of soils. 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.
4. **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 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 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 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

LIFE Key

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.

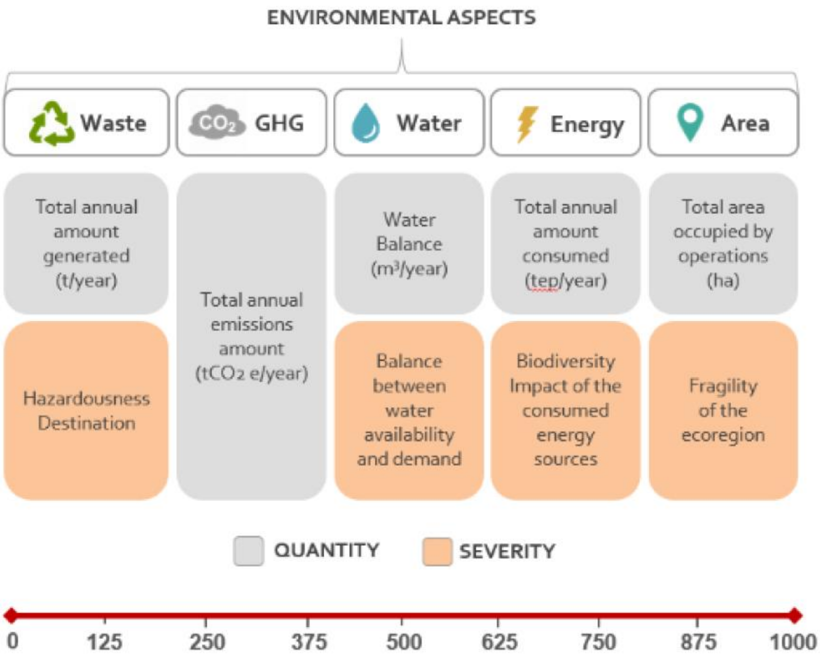
The assessment of the organization's environmental management is performed based on LIFE Standards, which provide management indicators for sustainability. To have access to documents of the Standards and LIFE premises that support them, click here.

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 offset the impact caused by the use of natural resources.

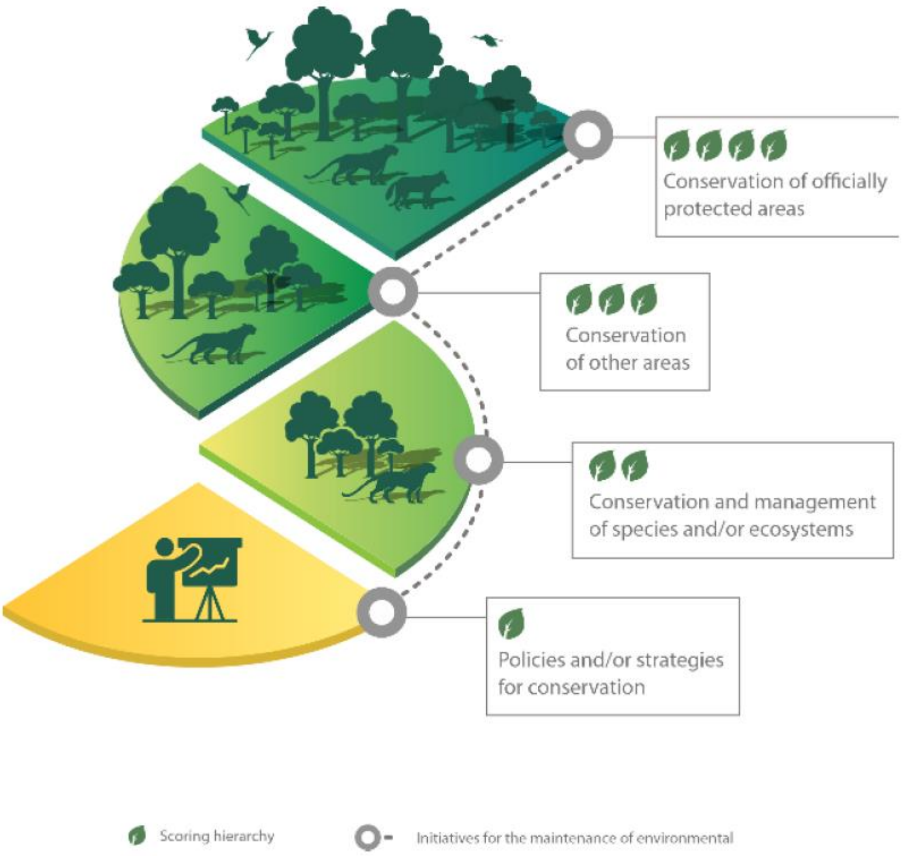
Additionally, at this stage, business' impacts and dependences of biodiversity and ecosystem services are evaluated. This analysis support companies to choose conservation actions and investments directed to business sustainability.

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

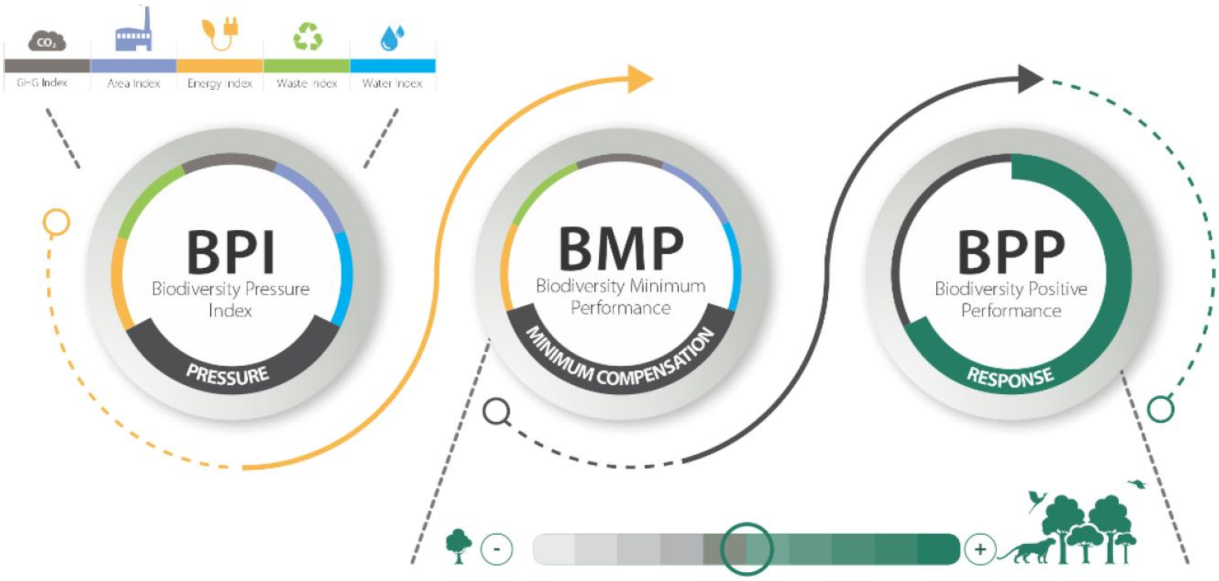
It consists of the evaluation of conservation actions that businesses are already implementing. The rating system follows guidelines regarding both national and international priorities for the conservation of biodiversity as well as the effectiveness of actions performed. Initiatives with greater potential 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 Development organization. Having third-party certification, independent Certifying Bodies accredited by LIFE Institute are responsible for official audits for LIFE Certification.

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^{TM}, 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 Baseline 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 will be added shortly. 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 and approach will be published in February/March 2021- Mair et al. (2021) Nature Ecology & Evolution.

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

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

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 that there are existing requirements placed on companies to disclose performance including those stipulated in national laws and regulations as well as the standards of financial lending institutions' and does not aim to be a substitute for these. Instead, it is an approach designed to provide key information to decision makers at site and corporate levels in order to improve a company's performance in relation to its impact on 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: screen to 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), informed by the stage above and based on site-level data and documentation for high significance sites collected as part of an environmental impact assessment. 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 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:

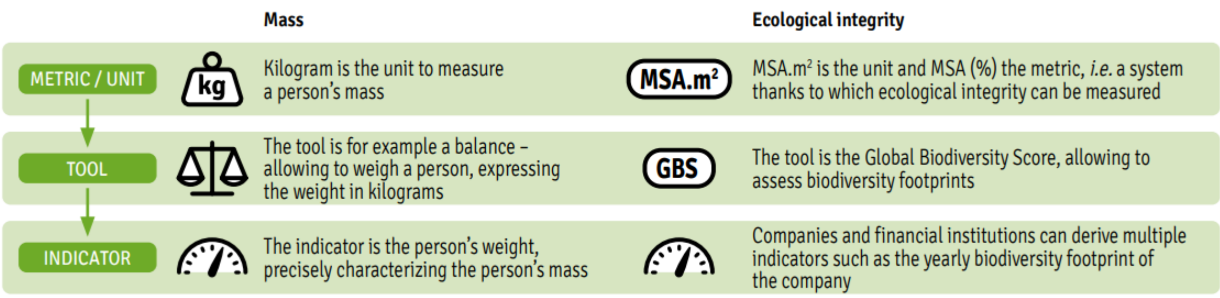
https://www.unep-wcmc.org/featured-projects/biodiversity-indicators-for-site-based-impacts

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:

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

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

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 (see scoring scale in figure below) 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 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.

Biodiversity Impact Metric = Land area x Proportion of biodiversity lost x Biodiversity importance

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

LafargeHolcim

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, IUCN France and WWF) (see Box 2). The approach for measuring and monetizing ecosystem services is explained in Box 3. LafargeHolcim 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.

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)[53] 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[54] 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.

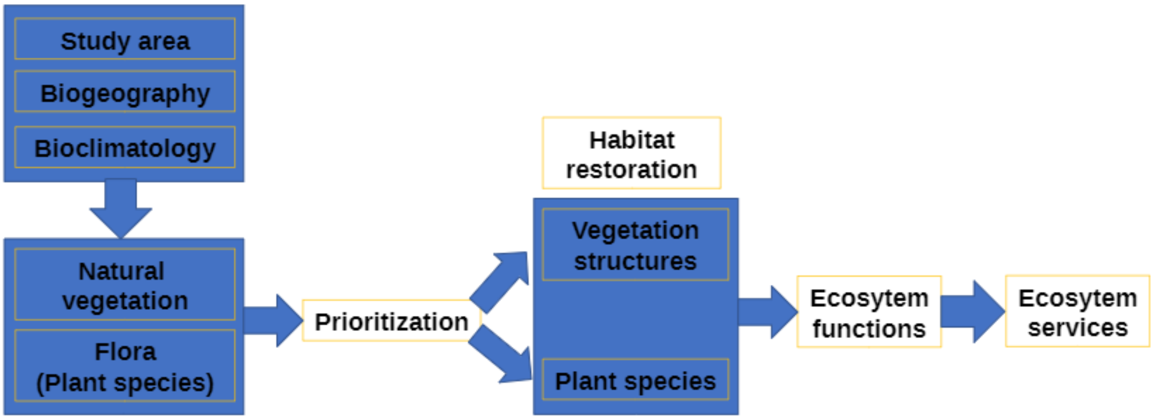
Box 2: Long Term Biodiversity Index (LBI)

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.

[53] https://portals.iucn.org/library/sites/library/files/documents/2014-055.pdf
[54] the UN developed System for Environmental Economic Accounting – Experimental Ecosystem Accounting

Thanks to the implementation of this index LafargeHolcim 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 Figure 1). 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.

Figure 1: 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 Lafarge 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.

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 1). 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 2. Following the example in Figure 2, 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.

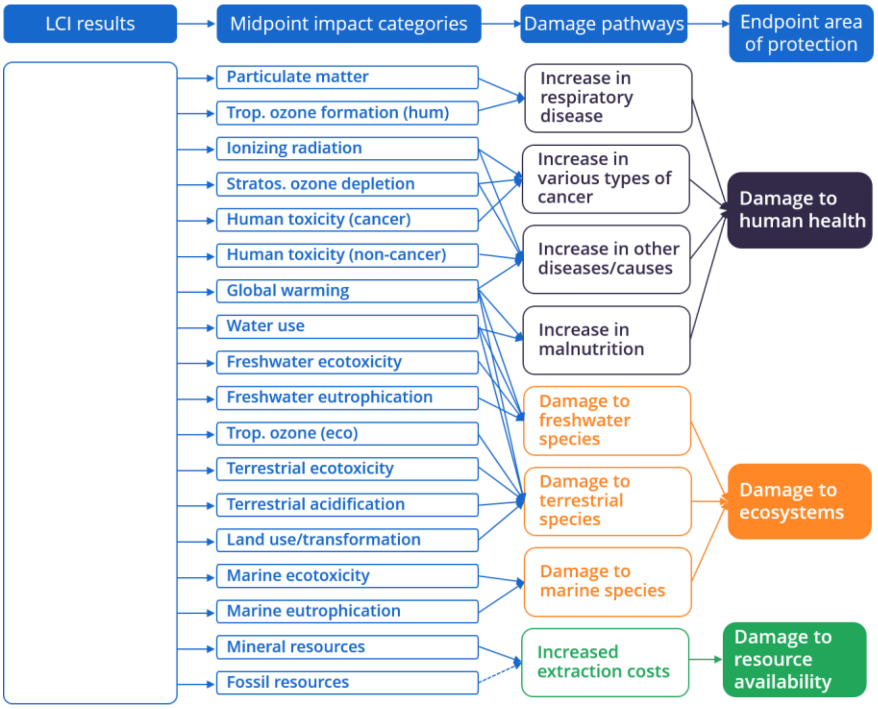


Figure 1. Overview of the impact categories that are covered in the ReCiPe 2016 method and their relation to the areas of protection. The dotted line means there is no constant mid-to-endpoint factor for fossil resources.

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.

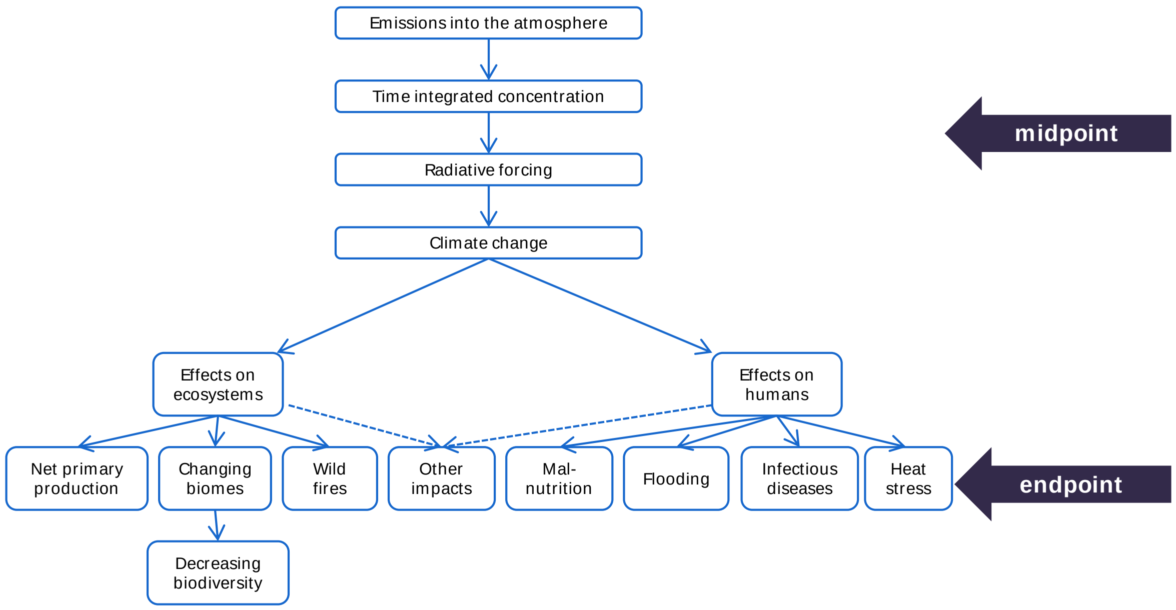


Figure 2. Relation between mid- and endpoint in impact assessment methods

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

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.

ANNEX 4: CASE STUDIES

Case study 1: PBF Salmon

Farmed salmon production: what are the main impacts on biodiversity? A generic case study with the Product Biodiversity Footprint

GENERAL INFORMATION

Biodiversity measurement tool	**Product Biodiversity Footprint**
Company	**None - based on literature**
Sector	Seafood
Turnover	-
Date/Period of measurement (year(s))	2018-2019

Business application(s)

BA 4: Comparing options	Assessment of average farmed salmon. This assessment is compared to wild caught salmon

Organisational Focus Area (site, product, supply chain, …)

OFA 3: Product level	Production of 1kg of liveweight salmon, at harbour gate

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

Introduced as a solution to partially solve the environmental issue linked with meat production, the fish production industry is currently in the spotlight. Wild marine resources are overexploited and threatened; there are numerous calls to keep fishing activities within sustainable boundaries. Wild caught fishing is not sufficient to provide for consumption demand, resulting in a dramatic growth in aquaculture in the last three decades [1, 2].

In order to assess the ecological impacts of fisheries and aquaculture, we conducted a study on the case of Norwegian Atlantic salmon (Salmo salar). This study accounts for the 5 drivers on biodiversity identified by IPBES [3]. We look at a generic case study on salmon aquaculture production in Norway. Our goal with this study is to adapt the PBF framework to aquaculture systems.

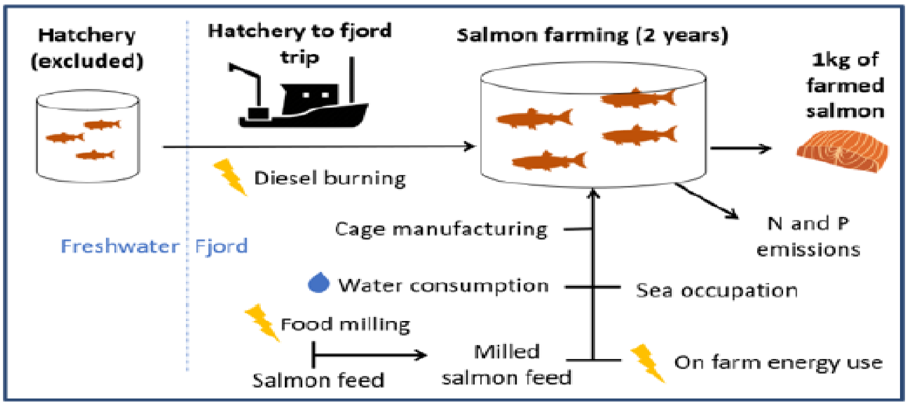
Our case study also includes a benchmark against wild caught salmon, keeping in mind that this limited resource is unable to provide for the total salmon consumption demand.

Boundaries

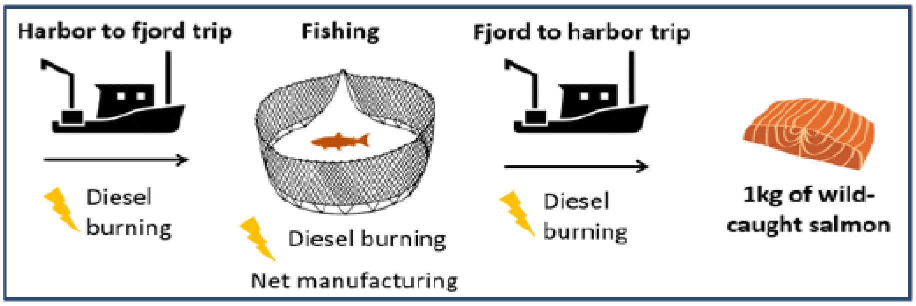
Boundaries are 'cradle to harbour gate', as described in the figures below. Value chain focus is production of liveweight salmon at harbour gate (functional unit). Production of salmon at harbour gate is national average Norway salmon, both for aquaculture and for the fishing benchmark. The upstream value chain is accounted for, and for Norway farmed salmon, part of the salmon feed is coming from Peruvian seas [4]. For farmed salmon, the hatchery phase has been excluded, assuming it is marginal in the overall impacts due to the limited time and feed needed in that phase. Smolders transport to fjord is included.

The three first MEA/IPBES drivers, i.e. habitat change, pollution and climate change, are assessed with the ReCiPe 2016 Life Cycle Impact Assessment method [5], according to current PBF method. ReCiPe enables to aggregate scores on the three drivers into a single score in Potential Disappeared Fraction of species (PDF). With this case study, we have further developed PBF on both other drivers: overexploitation and invasive species. Those developments are based on LCA and ecology literature.

Overexploitation is assessed for two fish stocks of interest in our study: Atlantic salmon in Norwegian Sea and Peruvian anchovy in Peru, as it is the main fish feed of "average" farmed salmon. Invasive species is assessed for escaped farmed salmon.



Farmed salmon



Wild-caught salmon

Location and scale
Aquaculture and fisheries of salmon in Norway

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change			Sea occupation of aquaculture cages in fjords
Climate change	yes	yes	
Pollution	Terrestrial acidification. Tropospheric ozone	Freshwater eutrophication	Marine eutrophication
Direct exploitation			Overfishing of wild salmon and fish feed for farmed fish (Peruvian anchoveta)
Invasive species			Escaped salmon from aquaculture
Other			Disturbance of food webs in case of aquaculture. Antibiotics

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
See footnote [1] Data on fish yields, fuel (and electricity) consumption Data on feed composition and quantity for aquaculture Smolt transport Occupation of cages in fjords	*See footnote* [2] Nitrogen and Phosphorus emissions from farmed fish [6] Boat construction and infrastructure (cages..) : data from ecoinvent [7] Feed production data from ecoinvent [7] and Agribalyse [8]	
Challenges		
Tracing the origin and manufacturing practices for feed production. We use original information when available, otherwise “averages”. For practices, we use average ones as available in secondary database [7], [8]	Alternative feed data such as 'feed from insects' does not currently exist in LCA databases. If needed in ecodesign scenarios, data should be gathered from available literature, or approached by a proxy with data quality to be reported.	
Pressures		
		Cause effect chain models: - Modelled data from LCIA method for climate change, pollution and habitat change pressures. - Overexploitation - Invasive species (qualitative model)
Challenges		
Pressures assessed from literature, no specific company data in this generic case study.		Standard LCIA models are not harmonised in terms of taxa coverage or reference states.
State		
		Current stocks of feed fish used for overexploitation model [9]
Challenges		
No state primary data available for marine products		
Impacts		

[1] This is a generic case study in which only available data from literature have been used. However, this cell has been filled in as if it were from a farmed fish producer perspective.

[2] This is a generic case study in which only available data from literature have been used. However, this cell has been filled in as if it were from a farmed fish producer perspective.

Primary data	Secondary data	Modelled data
		Modelled impact assessment with LCIA method for 3 pressures, looking at 'Ecosystem Quality' endpoint. Modelled impact based on [10] for overexploitation. Proposed new semi quantitative method to assess impact from invasive species (farmed salmon).
Challenges		
		Add up impact of 5 pressures in a single indicator in PDF.

What was the role of qualitative information?

- **Modelling :** Qualitative information is used in the invasive species scoring system. The role is to inform risk matrix.
  Limitation of overexploitation model is also qualitatively reported, as it does not relate to the impact of removing a given fish stock to the entire marine ecosystem quality.
- **Pressure assessment**: Some pressures are not reported quantitatively for the pollution driver, especially pressures from antibiotic application. They are reported qualitatively.
- **Input data:** Qualitative assessment has to be reported.

Baseline/reference situation

For climate change, pollution and habitat change baseline is LCIA model’s and refers to current situation. For overexploitation and invasive species baseline is current situation.

Required efforts for the measurement

This case study is theorical one. In case filled in by farm salmon producer, we expect the company to spend 5-10 man-days (data collection, ...) and the consultant 10-20 days (modelling, report)

Required skills to complete this exercise

LCA and ecology specialists

Results and application

Figure 1a gives a good insight in how the biodiversity footprint of farmed salmon is different from the footprint of wild caught salmon, while Figure 1b shows the dominant influence of feed in the biodiversity footprint of farmed salmon. Figure 2 shows the negative impact on Peruvian anchovy stocks by overexploitation for being used as feed for farmed salmon, while the impact on wild salmon stocks is under control by applying maximum quota. Figure 3 shows the invasive species results (impact of escaped farmed salmon on native ecosystem).

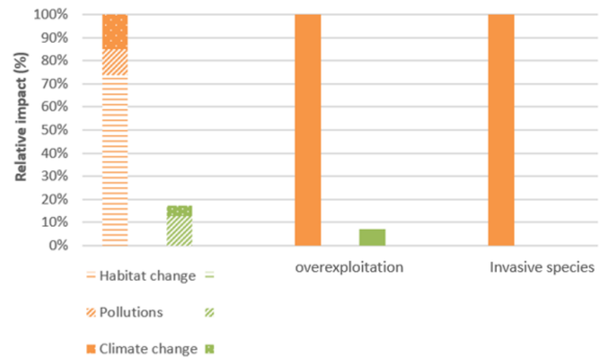


Figure 1a: Relative impact in % of farmed salmon (orange) compared to wild caught salmon (green). LCA method is ReCiPe 2016 (H) endpoint value for 'ecosystem quality'

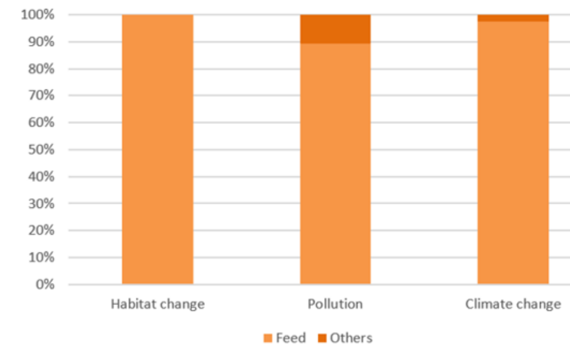


Figure 1b: Share of impacts due to feed for farmed salmon

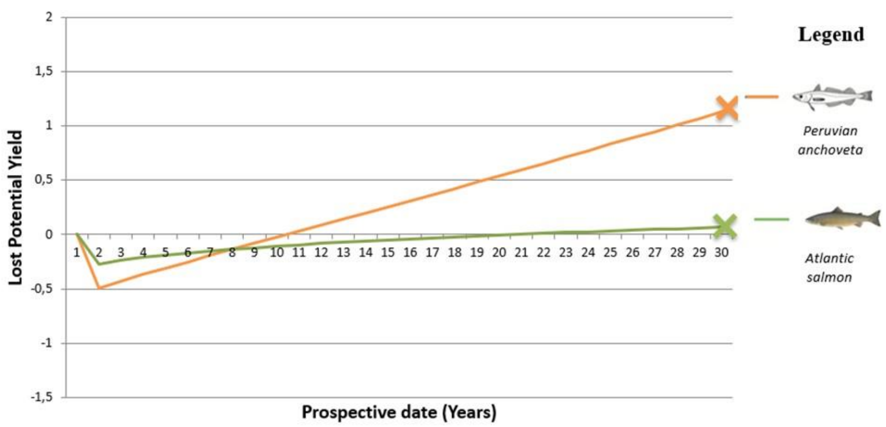


Figure 2 : Lost Potential Yield and vulnerability of fish stocks according to *Emanuelsson et al. (2014).* The X axis represents the prospective date at which the yield is potentially lost. The Y axis represents the value of this lost in proportion of the current catch. Negative LPY values correspond to the period of recovery which is needed to sustainably manage the stock.

Criticality (C)		Behavior								
		-27	-9	-3	0	3	9	27	81	243
Effect	16	-432	-144	-48		48	144	432	1296	3888
	8	-216	-72	-24	0	24	72	216	648	1944
	4	-108	-36	-12		12	36	108	324	972
	2	-54	-18	-6		6	18	54	162	486

Criticality scale		
Positive	-432	-1
Minor	0	36
Serious	37	144
Major	145	486
Disastrous	487	3888

Wild-Caught
Not relevant

Farmed
Invasive species = farmed salmon

Figure 3 : invasive species results. The method assesses the potential behavior of invader (through various pathways : predation, competition for territory and transmission of parasites) with the potential effect on the native ecosystem, and derives a qualitative rating plotted into a criticality matrix. Results for wild-caught salmon are not relevant (assumed to be equal to zero) and are moderate for farmed salmon.

Interpretation of results and impact on decision-making

Results show that farmed salmon has a greater impact on ecosystems than wild caught salmon (see Figure 1a and Figure 1b), mostly linked to feed production. The low impact of overexploitation for wild-caught salmon illustrates the benefits of the recent Norwegian regulation on salmon fishing: catches of wild salmon have reached but do hardly excess Maximum Sustainable Yield (MSY).

There is room for improvement for farmed salmon, with feed production being the major issue, on habitat change, pollution, climate change and overexploitation (of Peruvian Anchoveta) drivers. Further research is needed to look at more sustainable feed also accounting for feed nutrition requirements.
For the invasive species driver, we consider the potential of the escaped seafood to be invading the ecosystem. Indeed, literature highlights the potential of escaped farmed salmon to disrupt local ecosystems, especially through the transmission of sea lice. Our method shows a moderate impact of escaped salmons, aligned with the relatively low invasiveness of escaped salmon compared to other marine invaders (see Figure 3).

This first generic study demonstrates the implementation of PBF on seafood products. It has enabled some specific developments PBF had been adapted to seafood sector, in two major aspects: i) regarding overexploitation of fish resources, entering directly wild caught or entering in the composition of feed for aquaculture and ii) regarding farmed seafood as a potential invasive alien species in the ecosystem.
Based on PBF hotspots, this case study also enables to list data requirements for analysing the aquaculture production. For aquaculture, it shows that feed quantity and composition is crucial for the assessment.

We expect the next iteration in this sector to compare eco-design options in real farming systems.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• It enables to compare biodiversity impacts of seafood products over their value chain, therefore capturing the main impactful steps of the product, to be used for ecodesign purposes of seafood producers. Special focus on overexploitation which is crucial to account for in this sector. Also accounting for escaped farmed seafood as a potential invasive species within the ecosystem, including through disease spreading. • Geographical specificities are captured by looking at the marine biome where the species are fished.
Limitations	• Knowledge on marine ecosystems is less abundant than for terrestrial. It is a challenge in this study, especially for spatialisation.
Opportunities for improvement	• Generic information to be adapted to real business case study. Next iteration to be on comparison of different aquaculture production systems and providing spatialized results on disturbance to marine ecosystems for some pressures (marine eutrophication; seabed occupation ..)
Completeness	
Strengths	• Our study covers the 5 MEA/IPBES drivers over the whole value chain, including overexploitation and invasive species.
Limitations	• Hatchery has been excluded from the boundary of the study. Impacts are assumed to be limited. • By using aggregated characterization factors, the underlying LCA model (ReCiPe) does not provide detailed results on specific taxa. • Model on invasive species is limited (single species) and is new (only model existing to determine the impact on biodiversity from invasive species). • Important pressures are not covered by the measurement approach, mainly related to farmed salmon e.g. disturbance of food webs in case of aquaculture (due to decline of anchovy populations), spreading of antibiotics in freshwater and marine environments, indirect impacts on marine biodiversity due to population decline of anchovy.
Opportunities for improvement	• Include hatchery in the scope and check related contribution on biodiversity. • Improve overexploitation model with upcoming research, potentially enabling to measure it in PDF. • Our model on invasive species might help provide new features to develop the subject. • On-going contribution to international and European Commission efforts on harmonization of biodiversity metrics.
Rigor	
Strengths	• Inclusion of overexploitation, the main driver of biodiversity loss in marine ecosystems [3], is addressed
Limitations	• Overall limited quality of economic data. For farmed salmon, combination of data from different literature sources for e.g. feed composition and emissions from faeces. For wild-caught salmon, proxies are used for fishing distances and related fuel consumption. • For impact assessment, the limits are the same as any LCA modelling, especially on the fact that calculated impacts are most of the time "potential impacts"
Opportunities for improvement	• Currently designing confidence indicators for each pressure's assessment (case study dependent).

Replicability	
Strengths	• Methodology is fully transparent ; initial framework described in Emanuelsson et al. (2014) [11] ; additional impacts are described in upcoming peer-reviewed scientific publications (see below). • Computation of overexploitation indicator is readily available for 70 species.
Limitations	• Technical knowledge of LCA is required. • Technical knowledge of ecology required to assess invasive species indicator. • Some species are missing for easy replicability of overexploitation indicator over the whole spectrum of fished species.
Opportunities for improvement	• Two publications underway (overexploitation and invasive species).
Aggregation	
Strengths	• Aggregation of three of the five pressures is straightforward (habitat change, pollution, climate change) as these are all expressed in PDF.
Limitations	• Scores for overexploitation and invasive species are not expressed in PDF. Aggregation of the five pressures is challenging.
Opportunities for improvement	• Opening for quantifying overexploitation in PDF in an upcoming publication of Helias and Bach [12]
Communication	
Strengths	• Results are mostly presented in a graphical way.
Limitations	• Case study is generic. Therefore, no alignment with PBF communication and no feedback from business at this stage.
Opportunities for improvement	• Expecting real business case study to align and challenge communication.
User friendliness	
Strengths	• Mostly relies on available data or LCA studies. • Approach is familiar to LCA practitioners
Limitations	• Assessment largely facilitated with the use of a LCA software, such as SIMAPRO or openLCA, and background data, such as ecoinvent [7] • Experts are needed to complete assessment, especially for aquaculture systems and the related invasive species indicator.
Opportunities for improvement	• Data collection tool adapted to the sector (especially farmed seafood). • Collection of ecological data for the main farmed species in the various regions of the world could be useful to streamline assessment of invasive species indicator.
Investment	
Strengths	• Open-source data. Reasonable investment of time.
Limitations	• Assessment largely facilitated with the use of a LCA software and background LCA data. • Need for expert knowledge.
Opportunities for improvement	• Has not been tested on a 'real business' case study'. We are currently looking for one.

Overall assessment

PBF method has been refined and adapted for seafood with this case study. Further developments have been conducted on 'overexploitation' and 'invasive species'. Overexploitation, one of the main impact pathways related to marine biodiversity loss is quantitatively assessed, with a promising avenue to be aggregated in the PDF unit based on the upcoming publication of Helias and Bach [12]. We propose a new model on invasive species, based on ecology; it is however limited to the farmed species (single species). Further improvements are needed for aquaculture in addressing missing pressures (e.g. application of antibiotics), and spatialize impacts (e.g. seabed occupation, eutrophication...).

The case study highlights **the need to focus on feed composition and origin** to design better aquaculture farming systems and raises attention on the potential impact of escaped individuals in aquaculture farming systems.

The next step for PBF would be to **compare different seafood farming systems based on industry data**. This will enable to **close gaps in the method,** and further proof-test it with business; this would also contribute to enhance communication and user-friendliness.

Case study description and self-assessment carried out by

Anne Asselin, Aurore Wermeille (Sayari)

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.

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Case study 2: PBF Shower Gel

Measuring the impact of sustainable ingredients on the biodiversity footprint of shower gel with the Product Biodiversity Footprint

GENERAL INFORMATION

Biodiversity measurement tool	**PBF - Product Biodiversity Footprint**
Company	**L'Oréal**
Sector	Cosmetics
Turnover	Product turnover not communicated
Date/Period of measurement (year(s))	2017

Business application(s)

BA 4: Comparing options	Comparison of shower gel with ingredients from standard agricultural practices vs. shower gel with ingredients from sustainable agricultural practices

Organisational Focus Area (site, product, supply chain, …)

OFA 3: Product level	Production of shower gel (quantity for 15 body washes), including its packaging

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

Biodiversity is a complex topic with multiple dimensions (genes, species and ecosystems) and is becoming a key topic to be addressed by companies.

Cosmetic companies use ingredients partly derived from natural resources. Thus, the purpose of this study is to assess how the improvement of agricultural practices can change the impact on biodiversity of the cosmetic product. The case study is based on the SPOTS project which is a multi-partners project for sustainable palm oil production, regrouping 500 small producers in Malaysia, with social and environmental monitoring, targeting zero deforestation and RSPO[1] certification. This case study includes the following sustainable practices (not exhaustive list): no deforestation, lower yield, no irrigation, no pesticides, reduction of fertilizers, maintenance of soil fertility, plan for endangered species, plan against invasive alien species, …

Boundaries

This study is a cradle-to-gate LCA, from cradle to final product processing gate, covering the following life cycle stages:

1. raw material production, including agricultural phase of bio-based chemicals;
2. raw material transformation into chemical derivatives;
3. raw material packaging, including transportation to bottling plant;
4. shower gel components transport to bottling site in France;
5. shower gel manufacturing and bottling.

Location and scale

The methodology was applied to compare two scenarios of a shower gel made with derivatives from palm oil from Malaysia. The shower gel is then considered to be used in France.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land occupation and land transformation	Water stress	
Climate change	Through increase in global mean temperature, leading to change in biome distribution	Through increase in global mean temperature, leading to change in river discharge	
Pollution	Terrestrial acidification and photochemical ozone formation (leading to plant uptake of ozone and disappearance of plant species)	Freshwater eutrophication	
Direct exploitation	On-site management of species		
Invasive species	Spreading of terrestrial invasive species		
Other			

[1] Roundtable for Sustainable Palm Oil

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Ingredient formulation, packaging composition, logistics data, palm oil agricultural yield for variant case (SPOTS project), geographical origins	Palm oil agricultural yield for reference case, energy production	
Challenges		
Primary data are average data over several growing areas and may represent variable contexts		
Pressures		
• Pollutant emissions from manufacturing plant • Land occupation and transformation at field • Pesticides and fertilization data at field • Water use at field, • Species management action plan as well as alien species action plan		Pressures modelled within Ecoinvent (GHG, pollutants emissions at field, ...)
Challenges		
State		
	Literature study on evolution of biodiversity state within palm oil plantations in Malaysia	
Challenges		
Impacts		
	Literature study on different biodiversity impact as a result of different agricultural practices for palm oil in Malaysia	Modelled impacts with PBF methodology (LC Impact + literature study + invasive species and species management questionnaires for assessing the pressures)
Challenges		
	Matching conditions of literature study with specific practices of company suppliers	

What was the role of qualitative information?

Qualitative information has been mostly used in Module 3 (see summary description of tool), in order to evaluate the impact of exploitation of species and of invasive alien species

Baseline/reference situation

A baseline / reference product has been defined with same ingredient formulation and product characteristics, but with standard agricultural practices, and therefore standard characterization factors coming from LC impact methodology

Required efforts for the measurement

Company: 5-10 man days (data collection, ...)
Consultant: 10-20 days (modelling, report)

Required skills to complete this exercise

LCA expertise and ecology engineering

Results and application

Figure 1 shows the relative differences in biodiversity footprint between the reference (i.e. standard agricultural practices) and the variant (i.e. sustainable agricultural practices) for each MEA/IPBES driver.

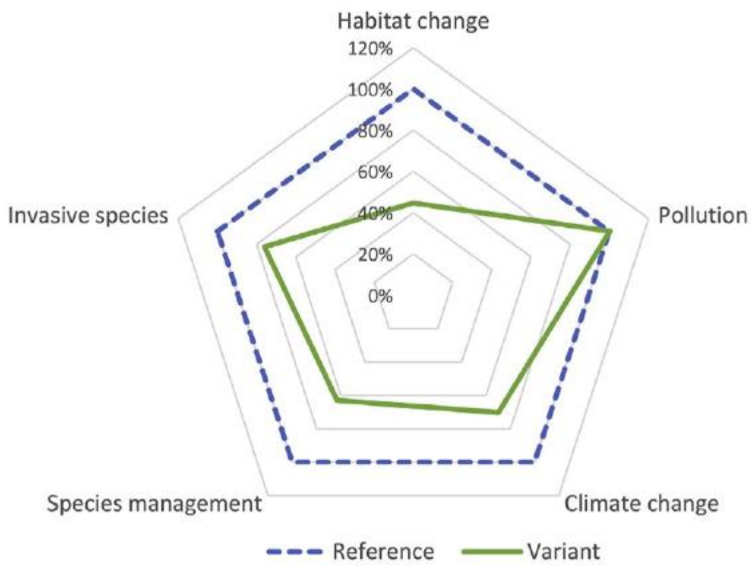

Figure 1: Reference and variant systems (i.e. agricultural practices) evaluated with the PBF methodology (cradle to gate, Module 1 + Module 2 + Moule 3) per MEA/IPBES driver

Interpretation of results and impact on decision-making

As shown in the figure above, the results have been assessed per MEA/IPBES driver. Overall, the impact of the "sustainable variant" is significantly lower than the reference case for 4 of the 5 drivers (habitat change, climate change, species management, invasive species) and almost equivalent for the driver 'pollution'.

"Habitat change" is an addition of quantified impacts of land occupation, land transformation and water stress on biodiversity that are expressed in the same unit. The difference between both scenarios for habitat change is largely due to the absence of land transformation in the variant scenario. Regarding land occupation, applying module 1 (LCA only), it appeared that the reference system is less impacting than the variant system: 100% vs 167%. After combination with module 2 (accounting for practices and relating them to ecological literature), the reference system was still less impacting than the variant system, but to a lesser degree (100% versus 132%), showing the positive impacts of the SPOTS practices. Reference and variant land occupation results differed when ecological data for the palm agricultural phase was applied: with module 1, the difference was due to the yield effect; combination with module 2 enabled to mitigate this yield-effect.

"Pollution" is the combination of terrestrial acidification, eutrophication, and photochemical ozone formation that are expressed in the same unit. Freshwater ecotoxicity is not included in this analysis (developed in 2020). Despite the reduction in pesticides and fertilizer mix, the impact is limited on these indicators as the agricultural phase represents a limited share of the impact of the "cradle to gate" shower gel on these indicators. A Freshwater Ecotocicity indicator would have captured the pesticide improvement.

The climate change impact is lower in the variant case, mostly due to the absence of land transformation in the agricultural phase of palm oil, which induces no conversion from forest to permanent crops and hence no CO2 emissions from soil carbon stored in forests. Less mechanisation in the variant case is also limiting climate change impact.

For module 3 (overexploitation and invasive alien species), it appeared that the variant production system is less impacting than the reference system with a score of 63/100 for Species Management and 76/100 for Invasive Alien Species, 100 being the score of the reference product. This is mainly due to the difference in agricultural practices: the variant production system follows the RSPO principles and criteria (e.g. identification of threatened species and operation to maintain them, management plan for water and soils, integrated pest management techniques).

These results showed the interest of having a biodiversity impact assessment on the 5 drivers of biodiversity loss, going beyond the impact of land occupation, to take into account the other drivers of habitat change, the pollution, the climate change but also the on site management of species and the invasive species issue. Regarding land occupation, the results show the interest of balancing the negative impact of yield degradation (more land occupation) with the positive impact of sustainable agricultural practices (lower intensity of the land occupation).

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• It enables to compare biodiversity impacts of two different products, on all life cycle steps, therefore capturing the main impactful steps of the product. The business context is captured because it is limited to one specific product which is one of the main products of the company. The geographical specificities are captured through LCA spatialization (having different characterization factors by geography) on the most impactful steps (here the agricultural phase).
Limitations	• Qualitative indicators (species management and invasive species are limited to a specific life cycle phase: agricultural stage for species management and transportation for invasive species)
Opportunities for improvement	• Our model on species management and invasive species might evolve, from a qualitative to a quantitative and systematic model
Completeness	
Strengths	• The 5 MEA drivers are considered in this study through the PBF methodology. The underlying LC Impact methodology is supposed to consider the most relevant taxa.

Limitations	• Ecotoxicity has not been integrated in this case study. By using aggregated characterization factors, the underlying model (LC Impact) does not provide detailed results on specific taxa
Opportunities for improvement	• Integrate ecotoxicity in the pollution pressures. (ongoing)
Rigor	
Strengths	• It relies on LCIA modelling criteria with the use of significant primary data. The use of specific ecology literature adapted to the biodiversity main impact is a way to improve modelization and close the gap between potential impact and impact on the field. • Confidence indicators for each pressures assessment have been developed (case study dependent), in order to be transparent on quality of data and modelization..
Limitations	• The limits are the same as any LCIA modelling, especially on the fact that calculated impacts are most of the time "potential impacts"
Opportunities for improvement	
Replicability	
Strengths	• Peer-reviewed publication is available, giving insight on the main hypothesis used.
Limitations	• Technical knowledge of LCA is required.
Opportunities for improvement	
Aggregation	
Strengths	• Aggregation is done (as usually in LCA) for the three LCA modelized group of pressures (habitat change, climate change, pollutions).
Limitations	• Scores for overexploitation and invasive species are different from scores for the three others pressures.
Opportunities for improvement	• Definition of a unique impact score, aggregating the 5 pressures (ongoing).
Communication	
Strengths	• Results are mainly presented in a relative way to make them comprehensible.
Limitations	• The unit "PDF.yr"does not directly speak beyond the LCA community.
Opportunities for improvement	• Conversion in m2 artificialization equivalent pdf (using artificialization impact as the reference of comparison for impact of other pressures, ongoing)
User friendliness	
Strengths	• It relies on usual data for LCIA and ecological studies
Limitations	• It may be easier to perform LCA using an LCA software
Opportunities for improvement	• Training of clients
Investment	
Strengths	• Data collection was carried out in collaboration with the company, which facilitated the work. Some time was necessary to model the specific data.
Limitations	• LCIA is easier with a LCA software
Opportunities for improvement	

Overall assessment

The PBF method at product level enables to address the 5 MEA/IPBES drivers on biodiversity, to cover the value chain and to allow comparisons of product variants. It has also helped to quantify the positive outcomes of field-projects such as SPOTS.

Case study description and self-assessment carried out by

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More information on the measurement approach can be found here:

Asselin, A., et al. (2019). "Product Biodiversity Footprint–A novel approach to compare the impact of products on biodiversity combining Life Cycle Assessment and Ecology." Journal of Cleaner Production 248: 119262.

Case study 3: BFM Dutch Dairy Sector

Application of the Biodiversity Footprint Methodology for the Dutch dairy sector

GENERAL INFORMATION

Biodiversity measurement tool	**Biodiversity Footprint Methodology & Calculator Tool**
Company	**Dutch dairy sector**
Sector	Dutch dairy sector
Turnover	+/- 50 billion euro
Date/Period of measurement (year(s))	Assessment took place in 2016 based on data from 2011

Business application(s)

BA1: Assessment of current biodiversity performance	Biodiversity footprint for total milk production in the Netherlands. Calculated based on figures for 80% of the dairy farms
BA 4: Comparing options	Footprint calculation for land use, GHG and emission to water for current situation and 2 scenarios (conversion to nature friendly and organic farming systems)

Organisational Focus Area (site, product, supply chain, …)

PRODUCT LEVEL	Footprint calculated for the production, processing and transport of milk
SUPPLY CHAIN LEVEL	Raw materials, production farm, production plant
SECTOR LEVEL	For entire dairy sector in The Netherlands

DESCRIPTION OF THE CASE

See summary description of Biodiversity Footprint Methodology and Calculator here

Context of case study

This case study has been requested by the Dutch government as one of the pilot cases for demonstrating the possibilities of the methodology.

The potential impact of the Dutch milk production on biodiversity was assessed as the dairy farms occupy a large part of the land in the Netherlands. The impact of three management systems was estimated for the same total milk production:

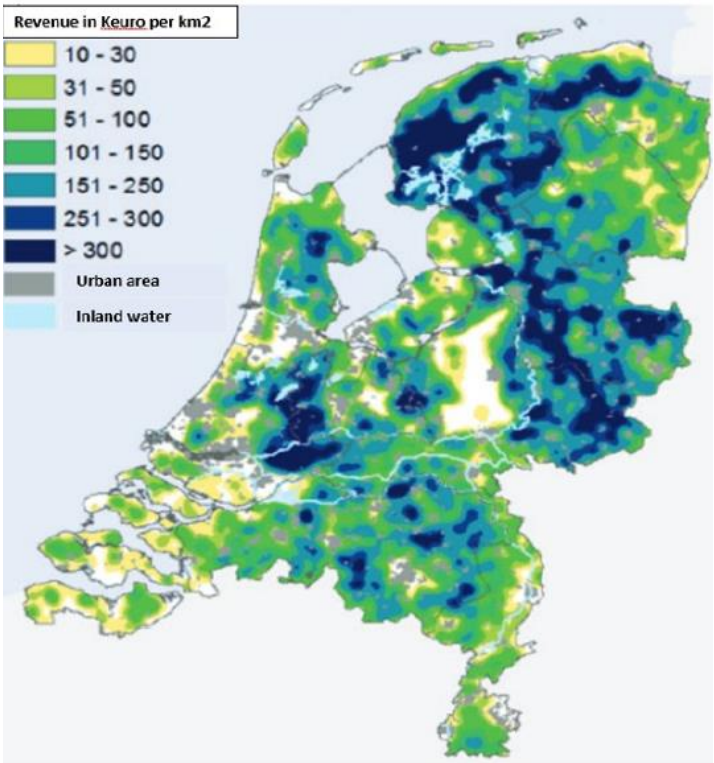
- regular production: few nature friendly measures, standard fertilizer application, soya concentrate and pesticides;
- nature friendly production: same fertilizer application (for obtaining the same production per hectare as under regular production), less pesticide use, consideration of the birds breeding season (more adjusted mowing regime), inclusion of herbs in the grass mix, maintenance of hedgerows;
- biological (or organic) production: no use of artificial fertilizers and pesticides.

Boundaries

The footprint is calculated for the milk production related land use, GHG and emission to water. We included emissions for the production of the raw materials (partly foreign), for the milk production on the farms, for the milk processing facility, storage and for waste processing. Transport emissions for the raw materials are included and also for milk transport from farms to the processing facility.

Emission data between organic and regular dairy farms are derived from the study *Thomassen et al 2008 LCA of conventional and organic milk production in the Netherlands. Agricultural Systems 96.* Scope 2 energy data are included in these data.

Location and scale



The total area of regular dairy farmland in The Netherlands (see Figure 1) was +/- 700.000 hectares in 2011. The organic farm area amounted to +/- 19.000 hectares. The land for the production of corn feed was +/- 160.000 hectares, and other land use related to the farms was +/- 100.000 hectares.

The area for the production of soy from abroad amounted to +/- 80.000 hectares and area needed for the production process and storage was relatively small (less than 200 hectares). The GHG emission is calculated for the off farm raw materials, production on farm, milk processing, storage and waste processing.

Figure 1:Distribution of dairy farms in The Netherlands in 2013 (Wegeningen Livestock Research 2018)

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
LAND USE CHANGE	Land use type and intensity	Water flow, depth and N and P content	
CLIMATE CHANGE	CO2 equivalent values per GHG emission		
POLLUTION	Indirect via land use type and intensity	Eutrophication via concentration of N and P in inland water bodies	
DIRECT EXPLOITATION	Grassland, corn, soy		
INVASIVE SPECIES			
OTHER			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Turnover in relation to milk production to calculate allocation factor for e.g. meat production (*1)		
Challenges		
Economic allocation extensive land use (*2)		
Pressures		
Land use area, GHG, etc information from sectoral reports. N&P emission from WUR		GLOBIO dose-response relations for land use, climate change and N and P to water
Challenges		
State		
		MSA from GLOBIO 3 and GLOBIO_aquatic
Challenges		
Impacts		
Indirect impact via dose response relations pressure / MSA (GLOBIO)		For comparison impact is also calculated with ReCiPe (*3)
Challenges		

(*1) The allocation factor between milk and meat depends on the milk production figures per farm. Some milk cows produce 20,000 liters per year, others less than 10,000. Some live only 4 years, others 5 years or longer. The meat price of older milk cows is low and therefore less relevant compared to the price of the liters milk produced. In this assessment we therefore did not include an allocation factor to correct the footprint for the meat production. Note that the absolute footprint measures are considered less important than the relative differences between different scenarios and between different parts of the chain. Most of the 9 case study companies involved in the road-testing of the Biodiversity Footprint Methodology mentioned that they did not want to use the outcomes to compare their footprint with other companies but merely to see impact differences between potential measures per part of the value chain.

(*2) The area of land used for a product affects the footprint. In general, the more land is used the larger the footprint will be. In intensive agricultural systems in general 100% of the land is used for the production of a product. E.g. all grass is consumed by the cows and the land is only used for the milk production. But this is not the case when for instance a few cows or sheep are grazing in large nature areas. One has to correct for the extensive use of the land. One way is to use for instance the biomass consumption. In intensive systems 100% of the biomass is used for the cattle, but in semi-natural systems only x%.

(*3) ReCiPe was used in parallel to investigate if differences would be large. Trends were more or less similar (the share of the footprint for land use and GHG emission was in ReCiPe resp 53% and 47% and for the Globio based footprint 55% and 45%), but results are difficult to compare as the indicators differ significantly. As the ReCiPe method is more generic and does not differentiate in location and intensity of land use, which are by far the most important contribution factors of the footprint we did not include them here. There is a figure with ReCiPe results for the milk sector case in the full report on www.plansup.nl ('Biodiversiteitsvoetafdruk koploperbedrijven', 2016)

What was the role of qualitative information?

A qualitative interpretation was needed for classification of land use and type of energy used. Land use, differentiated by land use intensity, appears to be the most important pressure type on biodiversity for cases that include organic production of raw materials. Omission of land use intensity factors will result in inaccurate biodiversity footprint results. It is therefore essential to differentiate between organic or extensive agriculture production (in this case for production of milk, and raw feed soy, rapeseed and corn).

Baseline/reference situation

The baseline in this assessment is the current conventional farming system to which two other farming scenarios are compared.
The metric which is applied (MSA, Mean Species Abundance) comes from GLOBIO and measures biodiversity against the reference of a primary untouched ecosystem. MSA is an indicator for naturalness / intactness. The less intact and the higher the use intensity, the lower the MSA.

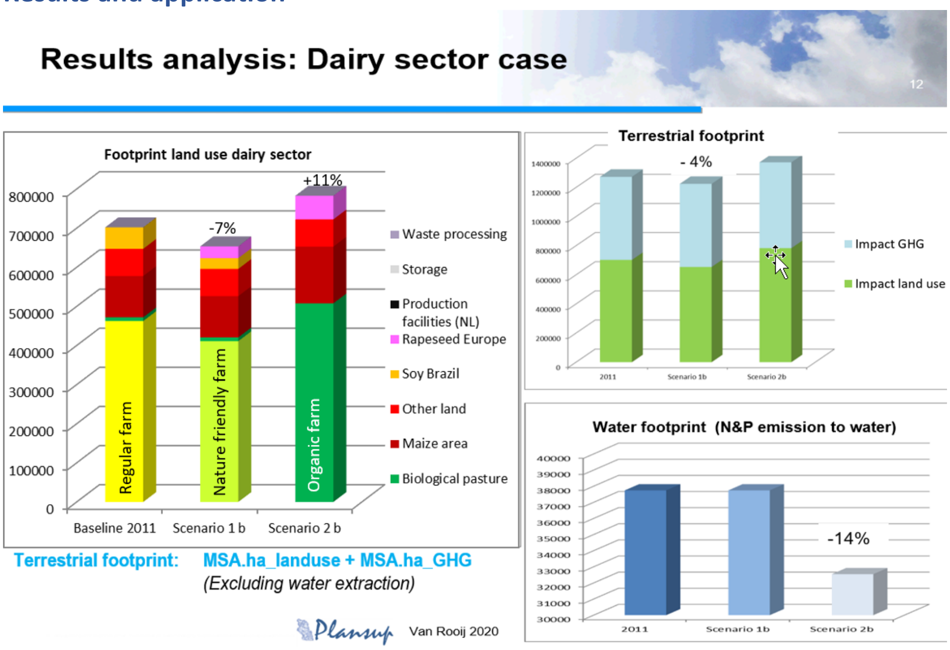
Required efforts for the measurement

Depends on the availability of data for the product / sector. Once suppliers provide information on land use (type, location and area) and its intensity, like is done for CO2 equivalent reporting, hardly any time is needed to collect these data. But even studying some literature for average production information took much less than a day. Implementing the data in the method, e.g. in the Calculator takes a few minutes. When using the full methodology, first some training is needed on how to work with the dose response equations in an Excel spreadsheet. After that, an analysis can be made within 1 day.

Required skills to complete this exercise

The classification of the involved land use type and intensity requires some knowledge about GLOBIO and ecosystems

Results and application



The figure on the left presents the different land use types for the baseline scenario and both alternative scenarios. The upper right figure presents the total terrestrial footprint, which is composed by land use and GHG emissions. The bottom right figure shows the aquatic footprint related to N and P pollution (eutrophication).

- In the baseline scenario (regular farming) land use is the dominant factor throughout the milk production chain and accounts for 55% of the total biodiversity footprint. Greenhouse gas emissions accounted for the remaining 45%.
- If milk production becomes more nature friendly, including replacing half of the soy with rapeseed, the land related footprint reduces by 7%. The greenhouse gas-related footprint remains the same. The latter assumes that no deforestation is taking place for producing the soy. MSA does not differentiate between active deforestation or deforestation earlier. It simply considers land used for human use as being 'non natural land' with a lower biodiversity.
- In scientific literature GHG emission of biological dairy farms is reported to be higher than that of regular dairy farms. There are two main reasons for it (*Thomassen et al 2008 LCA of conventional and organic milk production in the Netherlands. Agricultural Systems 96*[1]):
    - As the organic content is lower in rapeseed than in soy, more land is needed and land use related GHG are also higher. The same is valid for the pasture area: 38% more land is needed for biological farms to produce the same amount of milk per ha. Also, because of the higher protein level in soy, more land is needed if soy is replaced by another crop, such as rapeseed. In addition, the greenhouse gas- related footprint would increase by 3%, partly because methane emissions per liter milk produced are higher in biological milk production.
    - The land use related biodiversity footprint increases with a switch from regular to biological milk production. Under biological milk production, the biodiversity of the extensively managed pastures is higher but milk production per hectare is lower, thus requiring more land to achieve the same production. A switch to biological production without imported soy in the Netherlands would result in a 11% increase of the land related footprint.
    - As there is less land available for nature, more species are threatened. This trade-off between area and quality can be calculated using the MSA footprint indicator. In general, biodiversity value can increase threefold from 10 % (MSA = 0.1) original biodiversity on regular intensive farms to 30% on organic farms (MSA = 0.3). For a nature friendly farm, a MSA of 0.2 is used. So, the local biodiversity increases a lot with a conversion from intensive to extensive production but there is a trade-off caused by the lower productivity. Assuming that consumption patterns do not change, more land is needed to compensate for the lower productivity. This required extra land will most probably come from countries where the pressure on natural lands is already large. That is one of the main reasons for the ongoing biodiversity loss. Conversion of the regular farmlands in Europe to organic farming might be beneficial for local biodiversity, but not for global biodiversity.
- The aquatic footprint resulting from nitrogen and phosphorus emissions (expressed in MSA/ha) decreases with the switch to biological milk production by 14% compared to the baseline. The aquatic footprint has not been added to the terrestrial footprint, because the surface water area is relatively small compared with the land area for grass production, and the impact depends on aquatic characteristics, such as depth and flow.

Interpretation of results and impact on decision-making

This case study was developed on behalf of the Dutch government to demonstrate the possibilities of the Biodiversity Footprint Methodology on the one hand and to assess how the biodiversity footprint evolves by switching from regular to alternative farming practices. Agro commodity firms and suppliers of dairy products can use the method to assess the biodiversity impact of different farming practices.
As this study assessed the impact of an entire sector, no feedback has been received from individual dairy farmers or from the milk factories. But the method has also been applied for several individual company products. Their conclusion was that the biodiversity footprint methodology has helped them to:

- Gain insight into the pressure factors and company processes that make the largest contribution to their biodiversity footprint taking into account local conditions;
- Determine the difference in footprint between the present and an alternative or future situation;
- Calculate the effectiveness of biodiversity friendly measures.

The main result of the case study is the larger biodiversity footprint of the organic farming scenario in case of similar production volumes. However, results need to be interpreted with care:

- First of all, the increased land use required for organic farming is hypothetical as this land won't be available. Businesses introducing organic farming will have a lower biodiversity footprint due to reduced pressures on biodiversity. Lower production may be acknowledged by price premium for the farmer.

[1] Life cycle assessment of conventional and organic milk production in the Netherlands - ScienceDirect

- Secondly, the application of MSA doesn't sufficiently take into account that extensive farming will have beneficial impacts on biodiversity. MSA scores are not refined enough yet for providing a sufficient level of specification for different sets of farming practices.
- Finally, the dose-response relationships in GLOBIO (which are the basis for the Biodiversity Footprint Methodology) are based on global averages but might overlook specific local characteristics. As an example, GHG emissions due to drainage of peat meadows in conventional farming in The Netherlands appear to be a substantial issue. This is not taken into account in this measurement.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• Application of the Biodiversity Footprint Methodology provides comprehensive information – although rough estimates - about the potential biodiversity impact of an agricultural commodity and in particular in relation to the way it is produced (farming practices, sourcing location of raw products).
Limitations	• MSA (Mean Species Abundance) is not sufficiently refined yet to accurately reflect the real biodiversity footprint related to different farming practices
Opportunities for improvement	• Development of more refined MSA metric scale which reflects much better the actual biodiversity footprint of different agricultural practices.
Completeness	
Strengths	• The cause - effect relations from GLOBIO are based on impact measurements for a representative set of animal and plant species. The three major pressure types are included (Land use, GHG and N&P emission to water)
Limitations	• The impact of Infrastructure, fragmentation, Invasive species and nitrogen deposition is not included in the methodology.
Opportunities for improvement	• Expand methodology (GLOBIO) with other relevant pressures.
Rigor	
Strengths	• GLOBIO is accepted on a global level and the use of its dose response relations is quite straightforward
Limitations	• The current dose response relations are based on global models. They could be refined for more local situations
Opportunities for improvement	• There is currently no certification yet for the method. This would certainly help the credibility of the footprint calculation outcome
Replicability	
Strengths	• Information on the footprint methodology is open and freely available. The method can be replicated by anyone without the need for expensive software or databases.
Limitations	• Some basic GLOBIO and ecology skills are needed to make the correct decisions what type and intensity of land use should be used for the calculations
Opportunities for improvement	
Aggregation	
Strengths	• The Biodiversity footprint methodology uses the same indicator (MSA.ha) for each pressure type and results can therefore be aggregated both horizontally (i.e. over different pressures) and vertically (e.g. from company to sector level)
Limitations	• The biodiversity impact on water can be expressed in MSA.ha but due to the different aspects of biodiversity in running water (3D) compared to biodiversity on a land surface (2D) it is not recommended to add these into one MSA.ha footprint
Opportunities for improvement	• Correction factors should be used for the calculation of the biodiversity footprint of extensive land use, similar to the use of economic allocation factors to correct for multiple use of land (other than for the production of the assessed product).

Communication	
Strengths	• Naturalness in terms of area and quality is a concept that can be easily communicated
Limitations	• The definition of the used indicator Mean Species Abundance is a bit more difficult to communicate.
Opportunities for improvement	• The absolute MSA.ha figures could be used for benchmarking, but companies involved indicated that it can better be used for internal communication and assessments of the • effectiveness of planned and taken biodiversity friendly measures.
User friendliness	
Strengths	• The complete Biodiversity Footprint Methodology can be found online and no special software is needed. Required data related to the pressures can be collected either by the companies or suppliers. The Biodiversity Footprint Calculator is a simplified tool that does not require the user to know what and how equations should be used. A few days training will be needed for the full methodology. The Biodiversity footprint calculator can be applied without training in case the user has some understanding of ecosystems.
Limitations	• The concepts of MSA and using the correct land use type and intensity need to be understood
Opportunities for improvement	• Data on land use should preferably be provided by the suppliers, analogue to information on GHG
Investment	
Strengths	• A short training of own dedicated staff will be sufficient and there are no costs involved in using the methodology or calculator tool
Limitations	• External expertise is needed when there is no staff available who understands the concepts of sustainability and ecology
Opportunities for improvement	

Overall assessment

This assessment of the dairy sector has successfully shown which parts of the production chain has the highest impact on biodiversity. It also shows that there is an important trade off as a result of lowering the productivity on land while the consumption remains the same. Conversion from regular farming to organic farming with a lower productivity will lead to a higher local biodiversity but also to an increased pressure on land elsewhere.

Case study description and self-assessment carried out by

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More information on the measurement approach can be found here:

www.plansup.nl

Case study 4: BFM Tony’s Chocolonely

Application of the Biodiversity Footprint Methodology for the production of a chocolate bar of Tony's Chocolonely

GENERAL INFORMATION

Biodiversity measurement tool	**Biodiversity Footprint Methodology & Calculator Tool**
Company	**Tony's Chocolonely**
Sector	Food sector
Turnover	Approx. 264 million euro for 2018 / 2019 (Year report)
Date/Period of measurement (year(s))	Measurement took place in 2016 based on data from 2014 / 2015

Business application(s)

BA 1: Assessment of current biodiversity performance	Biodiversity footprint per 180g chocolate bar (Pure and milk) in 2014
BA 2: Assessment of future biodiversity performance	Assumed that cacao productivity will increase in the future
BA 4: Comparing options	Comparing between milk and pure chocolate bar and between low and high productivity of cocoa production

Organisational Focus Area (site, product, supply chain, …):

OFA 3: Product level	Footprint calculated for the production of 180g chocolate bar (pure and milk)
OFA 4: Supply chain level	Raw materials (cacao, sugar, milk, raw feed), chocolate processing, paper and aluminium package,

DESCRIPTION OF THE CASE

See summary description of Biodiversity Footprint Methodology and Calculator here

Context

The company Tony's Chocolonely was interested to participate in a research case study about the biodiversity footprint of their chocolate. Tony's Chocolonely (TC) sells 'slave-free' chocolate bars based on cocoa beans produced in Ghana and Ivory Coast. Tony's social mission comprises five principles of cooperation:

1. Pay a fair price
2. Follow the cocoa bean
3. Improve quality and productivity together
4. Farmers stand strong together
5. In for the long haul

Natural capital is second priority to this mission. In this case, the difference in the footprint of milk (32% cocoa) versus pure chocolate (70% cocoa) is investigated in two cocoa bean productivity systems, i.e. a low productive and a high productive system. The more productive system is the current system of an existing cooperative plantation. The low productivity system is a system by farmers that were not part of the cooperative but produce cocoa by themselves. The cooperative uses more fertilizers and some pesticides and other management practices that are common for intensive plantations. The independent farmers used very little or no fertilizers as those are expensive.

Boundaries

The footprint is calculated for the chocolate production related land use, GHG and emission to water, including quantification of these three pressure types for the production of the raw materials, the farms and processing and storage facilities. The footprint of the paper and aluminum wrapping is not included because it is the same for both bars. Transport emissions were included for transport (data from True Price LCA).

Location and scale

The cocoa production takes place in Ivory Coast and Ghana. Cocoa is transported to Antwerp in Belgium where it is processed to chocolate. Beet sugar is extracted from Western Europe and cane sugar from Mauritius. Milk via milk powder is extracted from Germany.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land use type and intensity	Water flow, depth and N and P content	
Climate change	CO2 equivalent values per GHG emission	Eutrophication via concentration of N and P in inland water bodies	
Pollution	Indirect via land use type and intensity		
Direct exploitation	Cocoa field, Grassland, Sugar beet		
Invasive species			
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Income related to cocoa production and other side products (honey, meat) produced on cocoa production area. Allocation correction needed for contribution cocoa production only.		
Challenges		
Income side products difficult to get as it is traded partly informal or for own consumption.		
Pressures		
Land use area, GHG, etc information were partly available from LCA report produced for Tony's Chocolonely. N&P emission mainly for milk production and derived from WUR.		GLOBIO dose-response relations for land use, climate change and N and P to water
Challenges		
Water use for chocolate processing in Belgium was not available. Impact of intensification cocoa production is assumed not to have consequences on water use and N and P emission to water (*1).		
State		
		MSA from GLOBIO 3 and GLOBIO aquatic
Challenges		
Impacts		
		Indirect impact via dose response relations pressure / MSA (GLOBIO). For comparison impact is also calculated with ReCiPe (*2)
Challenges		
Impact other pressure types such as Impact Infrastructure, fragmentation and Nitrogen deposition on land not included		

(*1) Water is not an issue for the cocoa production in this humid production area. They extracted water from the adjacent river which has no impact on the river itself due to the relative small amounts extracted and high flow of the river. The lack of information on water use by the processing facility is merely due to time constraint. However, because the processing footprint is expected to be much smaller than the impact of the production of raw materials, the analysis was focused on the most important parts of the value chain and did not inventorize additional data from the corporate company Callebout. Of course there will be some impact but in comparison it will be insignificant. Focus on the main pressures and parts of the value chain is the approach of our Biodiversity Footprint Methodology.

(*2) ReCiPe was used in parallel to investigate if differences would be large. Trends were more or less similar, but results are difficult to compare as the indicators differ significantly. As the ReCiPe method is more generic and does not differentiate in location and intensity of land use, which are by far the most important contribution factors of the footprint we did not include them here. There is a figure with ReCiPe results for the milk sector case in the full report on www.plansup.nl ('Biodiversiteitsvoetafdruk koploperbedrijven', 2016)

What was the role of qualitative information?

A qualitative interpretation was needed for classification of land use and type of energy used. Land use, differentiated by land use intensity, appears to be the most important pressure type on biodiversity for cases that include organic production of raw materials. Omission of land use intensity factors will result in inaccurate biodiversity footprint results. It is therefore essential to differentiate between organic or extensive agriculture production (in this case for production of cocoa, sugar and milk).

Baseline/reference situation

The baseline in this assessment is the current low productive farming system to which a high productive farming system is compared.

The metric which is applied (MSA, Mean Species Abundance) comes from GLOBIO and measures biodiversity against the reference of a primary untouched ecosystem. MSA is an indicator for naturalness / intactness. The less intact and the higher the use intensity, the lower the MSA.

Required efforts for the measurement

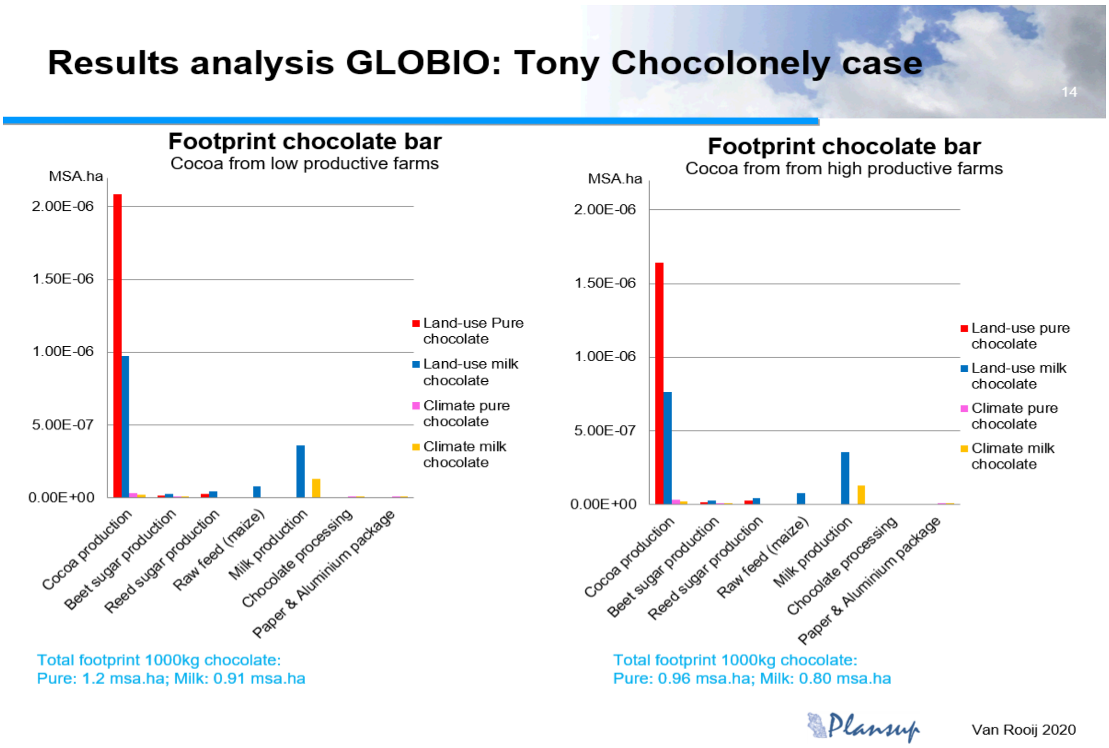
Depends on the availability of data for the product / sector. Once suppliers provide information on land use (type, location and area) and its intensity, like is done for CO2 equivalent reporting, hardly any time is needed to collect these data. But even studying some literature for average production information took much less than a day. Implementing the data in the method, e.g. in the Calculator takes a few minutes. When using the full methodology, first some training is needed on how to work with the dose response equations in an Excel spreadsheet. After that, an analysis can be made within 1 day.

For Tony's Chocolonely, some figures on land use and GHG emission were available from the existing LCA study. However, average production figures can also be extracted per organic product per region from scientific literature. It is assumed that this information can also be requested directly from suppliers in the near future.

Required skills to complete this exercise

The classification of the involved land use type and intensity requires some knowledge about GLOBIO and ecosystems. However, in case of monoculture agriculture, this is straightforward.

Results and application



Detailed results are available in the full report on www.plansup.nl ('Biodiversiteitsvoetafdruk koploperbedrijven', 2016). This case study only provides some main results.

The estimated footprints are calculated for the current mean productivity of cocoa producers (low productivity) and for the situation in which farmers produce under more or less ideal circumstances with the right knowledge and production means (high productivity). While current productivity is on average 450 kg/ha/y Tony's expectation is that cocoa bean productivity could increase to 800 kg/ha/y. The functional unit is the production of 180 g chocolate bar. The area in m2 and CO_2 equivalent in kg is calculated for each ingredient in a bar.

Main results:

- From the graphics it is obvious that land use for cocoa production has the highest impact. As low productivity farmers produce less cocoa per ha, more land is needed to produce a chocolate bar than for cocoa from high productivity farmers. For the calculation, it is assumed that half of the required sugar is cane sugar from Mauritius and half is beet sugar from the Netherlands and Germany. Because of the higher productivity, beet sugar production requires less land area than required for cane sugar production. In the production of milk chocolate bars, grassland in Germany is also required for the production of milk powder.
- Greenhouse gas emissions are based on information from an LCA conducted by True Price. Emissions are given for cocoa cultivation, sugar production, milk production and for chocolate manufacture. While the greenhouse gas emissions comprise only a small proportion of the total footprint, CO_2 emissions were 350% higher for a milk chocolate bar than for a pure chocolate bar. The climate impact of efficient cocoa production is probably higher due to the use of fertilizers and pesticides.
- As cocoa is grown in high rainfall areas with an abundance of water, water use for cocoa cultivation is not a pressure factor. Water is required for washing the beans and to a lesser extent in processing the liquid chocolate in Belgium. But as sufficient data were not available, the impact is not included in the calculation of the biodiversity footprint.
- Further, little fertiliser is used by the farmers. The low productivity farmers sometimes use manure from their cattle on their cocoa tree plantations. As these are small quantities, it is assumed that the impact of nitrogen and phosphorus emissions in the surrounding water is also limited.
- Overall, a milk chocolate bar made of cocoa from high productive farmers has the smallest footprint and the pure chocolate bar made of cocoa from low productive farmers has the largest footprint. The impact of climate is relatively small because land use is by far the largest contributing factor to the footprint of both types of chocolate bars. More efficient cocoa production reduces the relative impact of land use but increases that of climate. Although climate impact on biodiversity is relatively low, it may be a goal to reduce the company's carbon footprint. Training of low productivity farmers directed to increasing their productivity has the largest positive impact on the footprint. Further, the higher the cocoa content in a chocolate bar, the higher the biodiversity footprint. In addition, use of more beet sugar instead of cane sugar would have a slightly positive impact on the footprint.

Interpretation of results and impact on decision-making

This study brings clarity in how environmental pressures individually and collectively could affect biodiversity and gives insights into their relative impacts.

For Tony's Chocolonely the wellbeing of the cocoa farmers has the highest priority. With some training the smallholders can increase their cocoa productivity which will have a positive impact both for income and biodiversity. Tony's mentioned that they were also thinking of using alternatives for milk in their milk bars to reduce the biodiversity footprint that can be related to the production of milk chocolate bars.

It was concluded that the MSA based methodology for biodiversity footprint calculation enabled the company to test relatively easily the effectiveness of potential measures designed to reduce the future impact on biodiversity. The potential impact as a result of different scenarios can be compared which is helpful for decision making aimed at decreasing a company's biodiversity footprint.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• Application of the Biodiversity Footprint Methodology provides comprehensive information – although rough estimates - about the potential biodiversity impact of an agricultural commodity and in particular in relation to the way it is produced (farming practices, sourcing location of raw products). • Application of the Biodiversity Footprint Methodology or Calculator (the latter inly for land use and GHG emissions) provides comprehensive information about the biodiversity impact of a product, company or sector and a rapid insight in where in the value chain the highest pressure(s) can be identified and what measures have the highest effectiveness.
Limitations	• MSA (Mean Species Abundance) is not sufficiently refined yet to accurately reflect the real biodiversity footprint related to different farming practices
Opportunities for improvement	• Development of more refined MSA metric scale which reflects much better the actual biodiversity footprint of different agricultural practices.
Completeness	
Strengths	• The cause - effect relations from GLOBIO are based on impact measurements for a representative set of animal and plant species. The three major pressure types are included (Land use, GHG and N&P emission to water)
Limitations	• The impact of Infrastructure, fragmentation, Invasive species and nitrogen deposition is not included in the methodology.
Opportunities for improvement	• For Tony's Chocolonely social aspects of producers are a key focus area. It might be useful to develop footprint approaches that combine social and natural capital aspects. • Furthermore, expand methodology (GLOBIO) with other relevant pressures.
Rigor	
Strengths	• GLOBIO is accepted on a global level and the use of its dose response relations is quite straightforward
Limitations	• The current dose response relations are based on global models. They could be refined for more local situations
Opportunities for improvement	• There is currently no certification yet for the method. This would certainly help the credibility of the footprint calculation outcome
Replicability	
Strengths	• Information on the footprint methodology is open and freely available. The method can be replicated by anyone without the need for expensive software or data bases.
Limitations	• Some basic GLOBIO and ecology skills are needed to make the correct decisions what type and intensity of land use should be used for the calculations.
Opportunities for improvement	
Aggregation	
Strengths	• The Biodiversity Footprint Methodology uses the same indicator (MSA.ha) for each pressure type and results can therefore well be aggregated both horizontally (i.e. over different pressures) and vertically (e.g. from company to sector level)
Limitations	

Opportunities for improvement	• Correction factors should be used for the calculation of the biodiversity footprint of extensive land use, similar to the use of economic allocation factors to correct for multiple use of land (other than for the production of the assessed product).
Communication	
Strengths	• Naturalness in terms of area and quality is an concept that can be easily be communicated
Limitations	• The definition of the used indicator Mean Species Abundance is a bit more difficult to communicate.
Opportunities for improvement	• The absolute MSA.ha figures could be used for benchmarking, but companies involved indicated that it can better be used for internal communication and assessments of the effectiveness of planned and taken biodiversity friendly measures. In that case, a more refined MSA scale needs to be elaborated allowing measurement of progress due to specific biodiversity friendly farming practices.
User friendliness	
Strengths	• The complete Biodiversity Footprint Methodology can be found online and no special software is needed. Required data related to the pressures can be collected either by the companies or suppliers. The Biodiversity Footprint Calculator is a simplified tool that does not require the user to know what and how equations should be used. A few days training will be needed for the full methodology. The Biodiversity footprint calculator can be applied without training in case the user has some understanding of ecosystems.
Limitations	• The concepts of MSA and using the correct land use type and intensity needs to be understood
Opportunities for improvement	• Data on land use should preferably be provided by the suppliers, analogue to information on GHG
Investment	
Strengths	• A short training of own dedicated staff will be sufficient and there are no costs involved in using the methodology or calculator tool
Limitations	• External expertise is needed when there is no staff available who understands the concepts of sustainability and ecology
Opportunities for improvement	

Overall assessment

This assessment of the footprint assessment for the production of chocolate bars has successfully shown which parts of the production chain has the highest impact on biodiversity. It also shows that increasing the productivity, especially for cocoa, leads to a strong decrease in the biodiversity footprint.

The conclusion of Tony's Chocolonely was that the biodiversity footprint methodology has helped them to:

- Gain insight into the pressure factors and company processes that make the largest contribution to their biodiversity footprint taking into account local conditions;
- Determine the difference in footprint between the present and an alternative or future situation;
- Calculate the effectiveness of biodiversity friendly measures.

Case study description and self-assessment carried out by

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www.plansup.nl

Case study 5: CBF Mining Company

Corporate Biodiversity Footprint applied to a Mining company

GENERAL INFORMATION

Biodiversity measurement tool	**CORPORATE BIODIVERSITY FOOTPRINT** **Commercial tool by Iceberg Data Lab (IDL)**
Company	**ANONYMIZED**
Sector	MINING
Turnover	> €40Bn
Date/Period of measurement (year(s))	01/01/19-31/12/19

Business application(s)

BA5: Assessment / rating of biodiversity performance by third parties, using external data	Assessment of the potential biodiversity impact of the corporate based on external data published by the company
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Our calculation applies set of rules replicated on similar companies in a same sector, allowing to use in external reporting and benchmarking

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	Calculation made in parallel on several locations operated by the company (one example provided in this case study) and at corporate level
OFA 5: Corporate level	The company's assessment is based on corporate-level reported figures

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

Financial institutions need biodiversity data solutions allowing to report and manage their impact on biodiversity. These solutions need to be (i) quantitative, (ii) based on scientific approaches (iii) focused on the most material issues, (iv) based on available information (v) allowing to identify best performers or laggards in a sector (comparing corporates within a same sector, allowing a financial institution to make financing decisions or engage based on their performance).

Iceberg Data Lab is a data provider to financial institutions. We calculate the Corporate Biodiversity Footprint on several hundreds of corporates allowing financial institutions to calculate the overall footprint of their impact on biodiversity.

The company evaluated here is a major issuer of financial instruments and the counterpart of many major banks financing its mining operations. The Mining & Metals sector is a major consumer of financing solutions due the front-ended capital needed to develop the mining operations. Iceberg Data Lab's clients (responsible investors) were therefore interested to understand its key impact on biodiversity, position it against its peers and then engage with it. In addition, they also wanted to identify the most material biodiversity issues in the company's assets portfolio, i.e. most material sites and activities.

Boundaries

This case study does not include the full assessment of the company's pressures but only the following ones throughout the company's value chain:

- scope 1 for the change of land use for the quarries,
- scope 1, 2 and scope 3 downstream for the air pollution, water pollution and climate change impact of the ore refining activities and downstream steel manufacturing and aluminium activities.

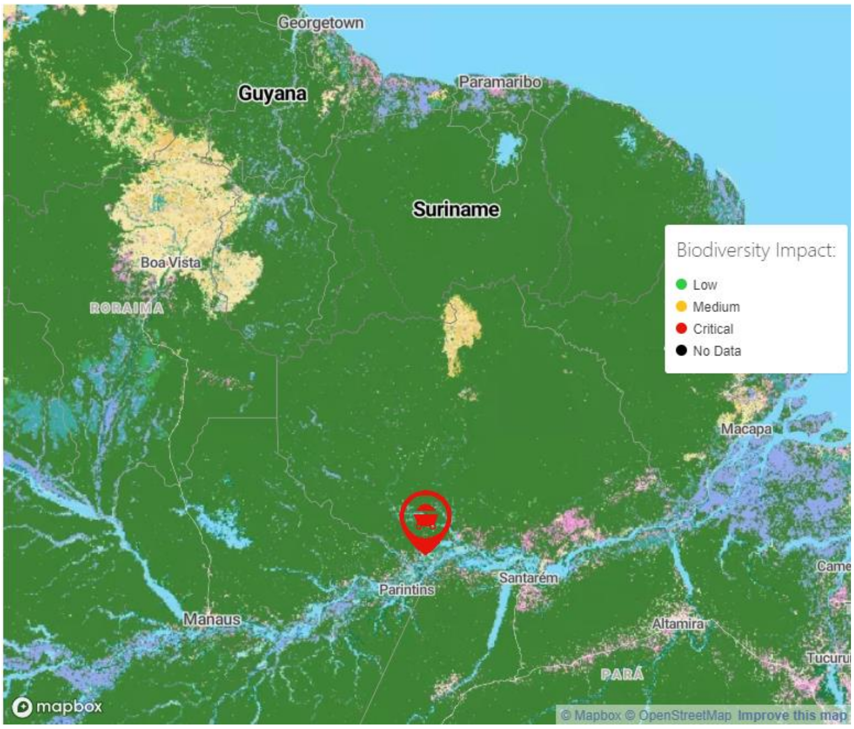
It does not include the use of these products (Steel, Aluminium).

IDL has elaborated this case study as part of an initial 'proof of concept' earlier in 2020 and prioritized the most material impacts in the value chain. At that time, IDL did not factor in scope 2 nor direct emissions for the quarries, but this is done now since they started documenting the mining sector in a systematic manner.

All pressures throughout the value chain are routinely covered in the assessment performed on Metals & Mining companies. The case study covers all the scope of operations consolidated in the company, i.e. the review was not limited to a specific business of the group (geography, product, etc.).

The assessment is performed on the activity of the company in FY 2019. Consequences of past emissions are not included.

Location and scale



The impact of one mine partially owned by the company is disclosed in this case study (all having been reviewed). The asset-level impacts are assessed separately and in addition to the broader asset-level review. The asset selected here is an iron ore mine operated in Brazil, which is the most sensitive (in terms of biodiversity) asset operated by the company.

Screenshot of the asset-level assessment

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
LAND USE CHANGE	• Occupational land use (i.e. all occupied land in supply chains excluding the changes in 2019) • Transformational land use due to the operation of the company in 2019 • Transformational land use due to the growth in company's operation in 2019		
CLIMATE CHANGE	• Release of GHG due to the transformation of the company's iron ore output in metals by the company's clients.		
POLLUTION	• Release of NOx due to the transformation of the company's iron ore output in metals by the company's clients.	• Release of toxic pollutants in the course of the company's mining operations	
DIRECT EXPLOITATION			
INVASIVE SPECIES			
OTHER			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
The sales of the company are published business unit by business unit. No data is available at asset level		
Challenges		
The company has a broad scope of operations, so deriving operational data from the financial one may create bias due to the different grade/cost of production of the products		
Pressures		
The pressures are not comprehensively published by the company (not for Land Use and Ecotoxicity for instance). They were calculated on its output, which is available by products through various sources, structured or unstructured in the company's publications.		Downstream emissions due to the transformation of the company's products is available through our internal emission factors database (*1).
Challenges		
Limited challenges, we have a high disclosure quality level and were able to rely on the multiple reports of the company's production flows, reducing the uncertainty on its impact assessment.		The downstream emissions are modelled on "average" steel-making operations and therefore are not reflecting the real emissions of the company's clients
State		
	We used abundance inventories as published by the EU (GLC dataset) as recorded on the location of the company's assets	At corporate level, the assessment of the company is based on "normative" MSA assumptions determined from reference scientific sources (GLOBIO model) (*2)
Challenges		
	Abundance data are not reported in real time and sufficiently granular	The impact will be identical for another mining company with the same distribution of activities (when relying on normative assumptions at corporate level, the distinguishing factor between companies is their mix of products and reported emissions and not the impact on a specific biome)
Impacts		
		We use damage functions published by reference sources (GLOBIO among others). The damage functions are based on meta-analysis of several papers which are a proxy of the impact a company would really have.

Primary data	Secondary data	Modelled data
Challenges		
		Some damage functions are forward-looking on a long-term impact (climate change) and therefore, their uncertainty level is higher.

(*1) Emission factor database is IDL's internal database of emission factors (based on internal expertise, external sources, reliable reported sources), accessible for clients and scientific partners

(*2) At this point, we feel that we cannot yet calculate only a bottom-up MSA aggregating the asset-level impact of all assets of a company. Until we are comfortable enough with the fact that this review is comprehensive, we will continue calculating corporate-level assesment using normative assumptions.

What was the role of qualitative information?

It is important to complement purely quantitative calculations with qualitative assessment related to relevant pressures or mitigation actions which could not be included in the model. We especially focused this qualitative information on the company's water impact and its land rehabilitation actions.

Baseline/reference situation

At the asset-level (mining operations), it is based on the localization of the asset and abundance data available on these specific areas.
At the corporate level, regarding the change of Land Use, we take conservative normative assumptions of a mining operation's impact starting from an undisturbed state and leading to an artificialized land.
The company's biodiversity footprint is calculated each year, allowing to monitor its impact's evolution over time.

Required efforts for the measurement

The data collection itself requested several hours. The development of the value chain model and calculation tool cumulates several man-years already and is continuously improved. The dataset is available in IDL database and can be used by a Financial Institutions right away, training materials are available. So, users only pay for the data and don't need to spend time in collecting data.

Required skills to complete this exercise

Users of the data need no specific skills to use the dataset, training is provided by Iceberg Data Lab. The analysts who performed this assessment are environmental experts (engineering/economist degree).

Results and application

The first step is the assessment of the business diversification of the company, which revealed evenly spread activities between mining of iron ores and non-ferrous metal ores. This is used for the analysis at corporate level (see Figure 1).

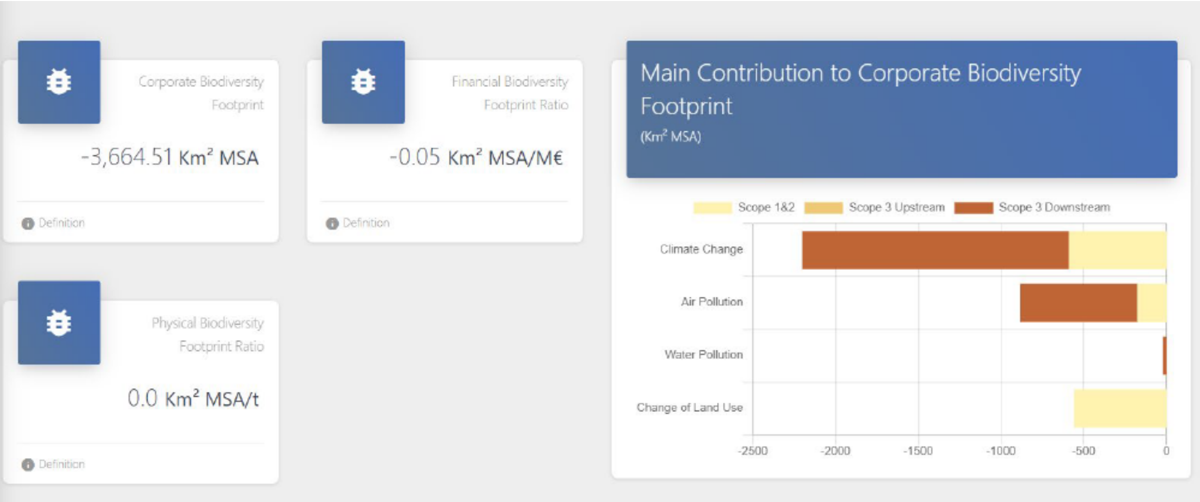


Figure 1: Key KPI's at corporate level

Figure 1 shows that the absolute MSA impact of the company at corporate level is 3,666 km2.MSA, one of the highest footprints Iceberg Data Lab has assessed so far. However, this is partly explained by the size of the company, which recorded €40bn of sales in 2019. We then divide this absolute result by a financial indicator (here capital employed). The resulting financial ratio (-0,05 km2MSA/M€) allows benchmarking corporates of various size.
The Corporate Biodiversity Footprint of the company is among the highest calculated in our Database. That means that the company has a strong impact on biodiversity and should be prioritized for engagement by investors and lenders. The key contributors of the company's biodiversity impact come from its downstream impact (GHG and NOx emissions), which is due to the transformation of raw materials into steel and aluminium.

It is important to complement purely quantitative calculations with more qualitative assessment to capture a broader picture of the biodiversity impact of the company (see Figure 2). We especially focused on mitigation actions. They do not reduce its calculated direct impacts but reflect positive initiatives taken by the company which should be factored by investors in their appraisal . For instance, the company is taking several land rehabilitation actions to compensate its land use impact and has set related targets. A land rehabilitation plan will be earmarked in the qualitative assesment, distinguishing companies with strong impact and identified actions from comparable ones. Over time, land rehabilitated will reduce the negative "Change of Land Use" impact.

Figure 2: More detailed qualitative assessment

Figure 3 provides a focus on the commodity flows of the company and calculates their absolute and relative impacts on biodiversity. Iron ore is the main output of the company (85% of its volumes) and, logically, its main contributor to its biodiversity footprint (>90% of its impact on biodiversity). Expressed in relative terms, gold has a disproportionate impact, reflecting the very low yield of gold mining operations. That distribution of the biodiversity footprint on the company's physical output allows for a more focused assessment of its mining assets.

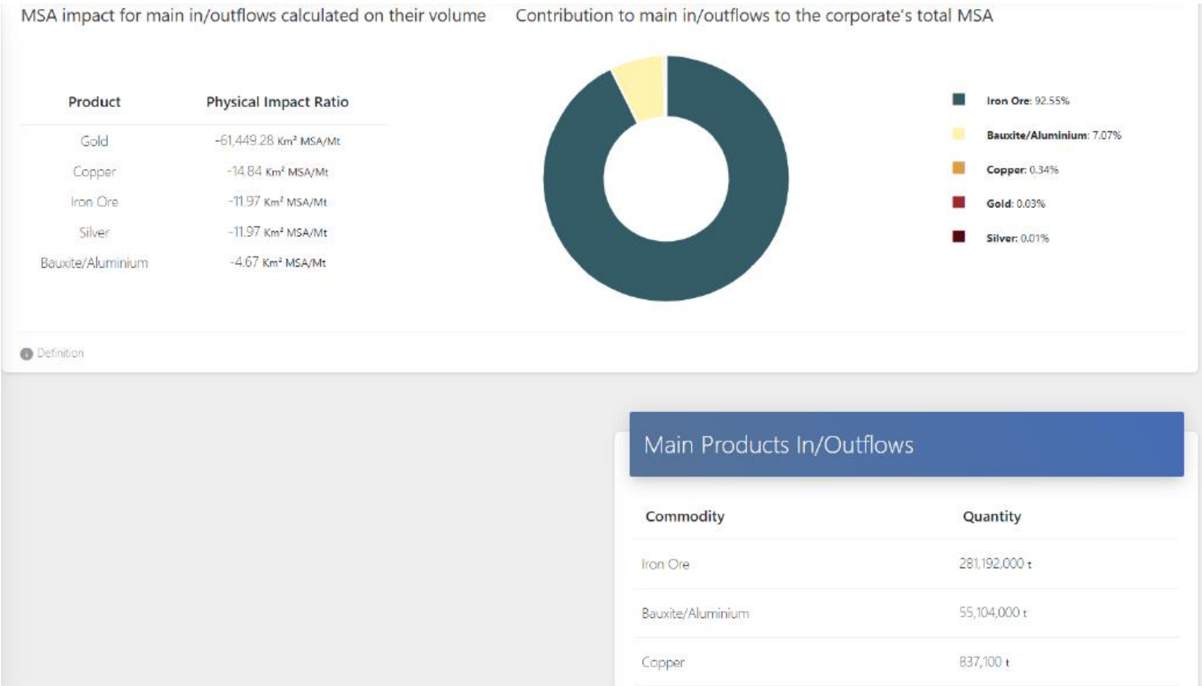


Figure 3: Product-level analysis

Finally, an asset-level analysis was carried out (see Figure 4), i.e. a calculation of the asset-level impact of mining operations factoring their location, businesses and activity level. The local richness of the area impacted by the mining operations is assessed, based on ecological richness maps. This bottom-up evaluation allows to identify material biodiversity issues (in red) in the company's portfolio, due to their activity, size or location and which are a key source of environmental liability risks (or of reputation risks).

Figure 4: Asset level analysis (names of specific mines are anonymized)

The overall conclusion of the assessment is that the company has a large and intensive biodiversity footprint due to 3 main pressures: change of land use due of its mining activities, air and water pollution due to its ore refining activities and GHG emissions of downstream steel manufacturing and aluminium activities. The estimated biodiversity impact intensity per mineral category is contrasted: it is much higher for gold and silver than for iron ore, bauxite and copper. The company has 3 main levers to reduce its impact on biodiversity:

- Rehabilitation of mining areas, through careful reconstitution of initial ecosystems

- Optimized tailing management system to reduce impact of mineral waste
- Reduction of its GHG emissions on its operations, mainly at ore refining and aluminium processing (through setting ambitious targets)

Interpretation of results and impact on decision-making

This corporate biodiversity impact assessment is part of a broader sample allowing our clients to:

- have an aggregated reporting of the impact on biodiversity of their financings.
- select best in class within the sector, depending on their impact on biodiversity
- help identifying potentially sensitive assets within the company's portfolio to engage with it to evaluate its mitigation/remediation actions.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The analysis captures the most material impact of the company on biodiversity (land use, GHG emissions)
Limitations	• The approach is based on the impact of normative process (mining operations, metal production), because we lack of site-specific information, especially for air emissions and ecotoxicity
Opportunities for improvement	• Using normative assumptions is fine as long as it does weigh negatively on the most transparent players, so the calibration of the normative model will be revised on a regular basis to control that bias (eg non-transparency brings a malus).
Completeness	
Strengths	• The approach assesses the most material impact in the sector (land use and GHG for mining operations ; GHG emissions for metals).
Limitations	• The consumption of resources (e.g. water) is not computed in our calculation, which is a limitation for a raw material company. • The impact on biodiversity is expressed in Mean Species Abundance. Additional biodiversity features such as significance (e.g. risk of extinction of species) are not included in the approach.
Opportunities for improvement	• We will work with scientific partners over the coming years to model the impact of the resources' consumption on biodiversity.
Rigor	
Strengths	• The calculation is based on reported volumes; pressures and impacts are based on external scientific sources representing the state-of -art in terms of modelling.
Limitations	• Evaluating of the biodiversity impact of a corporate through the lens of a single metric, regardless of its merits, is a limited approach of the reality. Is should be complemented with engagement with the company and qualitative evaluations of its actions and mitigation initiatives. Use of corporate-level assessment is relevant for screening impacts and does not substitute to site-level due diligence.
Opportunities for improvement	• Development of qualitative indicators in addition to our score.

Replicability	
Strengths	• Methodological guide and sectoral booklet are available to our clients to the database users help user understand the approach
Limitations	• Few investors know the Mean Species Abundance (MSA) concept and the km2.MSA metric. Accelerating the learning curve of Financial Institutions on biodiversity impact measurements is a collective challenge.
Opportunities for improvement	• Organize training with experts on our solutions • Our methodological guide and sectoral booklets will be published and open for review in 2021.
Aggregation	
Strengths	• The metric and model are designed to allow for aggregation from site level to corporate level.
Limitations	• The share of ownership of mining operation are not similar in the company's portfolio, creating a bias between the view at consolidated level and at the asset level
Opportunities for improvement	• Allow the user to custom the aggregation of the results
Communication	
Strengths	• The metric is relatively simple to understand and interpret once the concept of MSA is understood.
Limitations	• Biodiversity has many facets. Therefore, it is challenging to communicate an impact using one metric.
Opportunities for improvement	• Work with partners in multilateral forums to reach a global consensus on a common view on the metrics to be used at least to report the impact on biodiversity.
User friendliness	
Strengths	• The appraisal of this company is displayed through a website providing a structured view of the results.
Limitations	• Contrasted level of expertise within our clients on the metrics
Opportunities for improvement	• We organize webinars at the client's onboarding to walk them through the tool
Investment	
Strengths	• Users of our database only pay for it and are just required to invest time to understand the methodology and interpret the results. They do not have to calculate the impacts. The calculation cost is spread over all our users.
Limitations	• Important cost to constitute the database
Opportunities for improvement	• Reduce the dataset acquisition costs (time spent by company).

Overall assessment

We are comfortable on the fact that the Corporate Biodiversity Footprint can be applied in a consistent manner at site or corporate level and covers the most material impact of the issuers on biodiversity.

This assessment reflects this company's most material impacts. It helped our client to design its engagement strategy and detect the company's most sensitive operations.
Efforts in the future should aim at extending the quantitative metric to the resources' consumption impact.

Case study description and self-assessment carried out by

ICEBERG DATA LAB - Matthieu Maurin, CEO

More information on the measurement approach can be found here:

contact@icebergdatalab.com

Case study 6: CBF Portfolio agri-food companies

Corporate Biodiversity Footprint applied to a portfolio of Agri-Food companies

GENERAL INFORMATION

Biodiversity measurement tool	**CORPORATE BIODIVERSITY FOOTPRINT**
Company	**Portfolio of 30 Agri-Food companies**
Sector	Agri-Food
Turnover	NA
Date/Period of measurement (year(s))	Reported financial year (FY) 2019 – all companies

Business application(s)

BA 5: Assessment / rating of biodiversity performance by third parties, using external data	Assessment of the impact of the company's operations based on its reported environmental, operational, and financial data
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Our calculation applies set of rules replicated on similar companies in a same sector, allowing to use in external reporting and benchmarking

Organisational Focus Area (site, product, supply chain, …)

OFA 4: Supply chain level	The calculation factors the upstream impact of the company's business (soft commodities)
OFA 6: Portfolio / sector level	The assessment focuses on a portfolio of listed corporates in the agri-food sector

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

Financial institutions need biodiversity data solutions allowing to report and manage their impact on biodiversity. These solutions need to (i) be quantitative, (ii) be based on scientific approaches (iii) be focused on the most material issues, (iv) be based on available information (v) allow to distinguish best and worst performers, based on their Biodiversity impact (comparing corporates within a same sector, allowing a financial institution to make financing decisions or engage based on their performance).

The companies evaluated in this case study are a sectorial portion of the investment universe of a major asset manager. Agri-Food players, and in particular those involved in meat production, are amongst the actors with the most material impacts on biodiversity due to the combined impact of land use (change) and climate change of the upstream intensive agricultural activities and the breeding of animals.

BoundariesThe boundaries assessed for the constituents of that portfolio are the companies' scope of operation (scope 1 and 2) and their upstream scope 3 impact (supply chain). In the Agri-Food sector, the most material pressures are located in the upstream part of the value chain (raw materials, agricultural sector impact).

It covers all consolidated scope of the companies (i.e. controlled subsidiaries).

The assessment is performed on the activity of the companies in FY 2019.

Location and scale

Not Applicable for a portfolio analysis

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	• Occupational land use (i.e. all occupied land in supply chains excluding the changes in 2019) • Transformational land use due to the sales or purchases of soft commodities by the companies • Transformational Land Use due to the growth in companies' sales or purchases in 2019 (allocated on a country basis)		
Climate change	• Release of GHG due to the breeding of animals in the supply chain of the Agri-Food companies with meat in their product mix are a major contributor. • Scope 1 & 2 are also included but fairly marginal in terms of impact.		
Pollution	• Release of NOx due to the agricultural business of the company.	• Release of toxic pollutants (especially pesticides) by the companies' suppliers.	
Direct exploitation			

Pressures	Terrestrial	Freshwater	Marine
Invasive species			
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
The sales of the companies are published business unit by business unit along with supply/output data in some cases		
Challenges		
Most companies publish volume data only on their main supply/purchase mix, which means that we had to model missing data. As a result, our calculation includes a mixed set of inputs (modelled/reported data).		
Pressures		
		Upstream emissions due to the production of the company's raw materials is available through our internal emission factors database (*1).
Challenges		
It is very uncommon to find an estimation of the pressures in the company's reports.		We had to assume in most of the case a normative distribution of the supply countries due to the lack of available reporting on that point in the companies' reports.
State		
		At corporate level, the assessment of the company's impact (change of land use) is based on normative undisturbed state
Challenges		
		A comprehensive assessment should include asset by asset review of the change of state for each asset operated or impacted by the company's supply chain.
Impacts		
		We use pressure-impact relationship models (not open source) published by reference sources (GLOBIO among others). The damage functions are based on the meta-analysis of several papers which are a proxy of the impact a company would really have.

Primary data	Secondary data	Modelled data
Challenges		
		Some damage functions are forward-looking on a long-term impact (climate change) and therefore, the uncertainty level of their impact is higher.

(*1) Emission factor database is IDL's internal database of emission factors (based on internal expertise, external sources, reliable reported sources), accessible for clients and scientific partners

What was the role of qualitative information?

Qualitative information is provided to identify a corporate's specific business and to complement pressures in the calculation scope with other ones.

Baseline/reference situation

We have a normative assumption of the reference state (undisturbed) for the change of Land use impact. The overall impact of the companies will be calculated and updated on a yearly basis, allowing to monitor the evolution of their impact over time.

Required efforts for the measurement

If the constituents are in the database, the calculation takes a couple of minutes. A corporate review takes a couple of hours for our Research team. Users only pay for the data and don't need to spend time in collecting data.

Required skills to complete this exercise

Users of the data need no specific skills to use the dataset, training is provided by Iceberg Data Lab. The analysts who performed this assessment are environmental experts (with either an engineering or an economist degree)

Results and application

The graphic in Figure 1 shows a ranking of selected companies in a subsector ('meat production') of the broader agri-food sector, according to their biodiversity footprint related to land use change. The portfolio is an Agri-Food Fund that invested in 30 large corporates throughout the value chain in all countries.

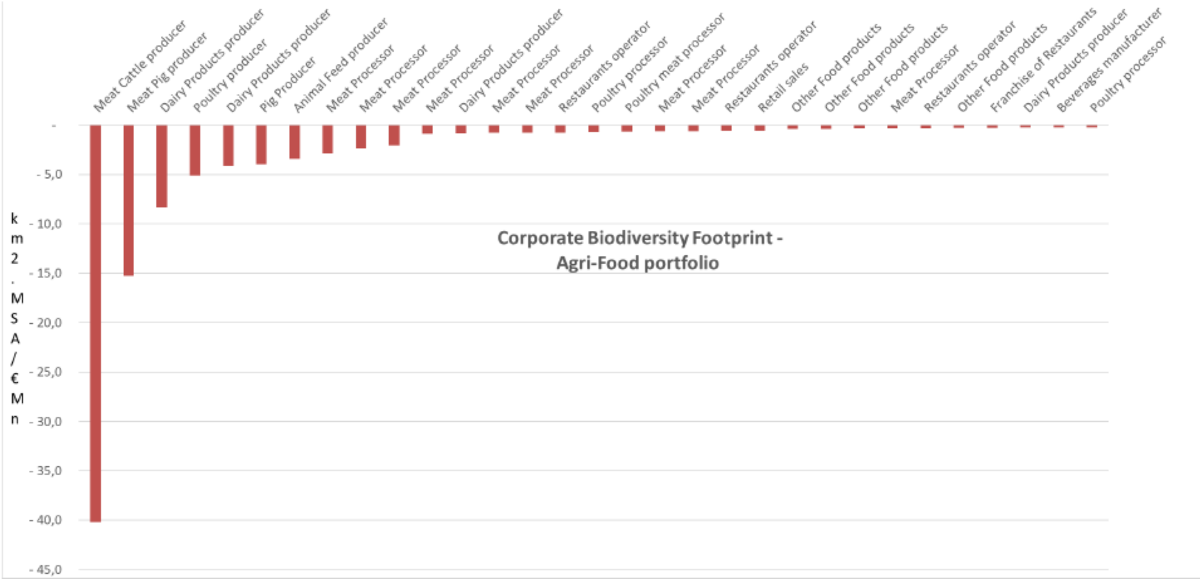


Figure 1: Agrifood sector analysis based on corporate biodiversity footprint of selected companies

The assessment factors in the supply chain impact of the companies, which is their main contributor to their total biodiversity impact in the agri-food sector. The corporates are ranked along their Corporate Biodiversity Footprint expressed in a financial ratio. The results are expressed in km2.MSA/€Mn, which is the ratio of the absolute biodiversity impact of each corporate (km2.MSA) and its capital employed (in €Mn). It expresses the negative impact of each million Euros invested in the company on biodiversity, using the MSA concept.

The calculation includes all pressures but, in that sector, land use change is the main contributor to the companies' impact. It includes the occupational and the transformational land use (eg factoring the impact of the company's growing demand).

The CBF shows a strong dispersion of the results, reflecting a strong dependency of the land use change impact on the various product/country supply mix of the constituents. The players' ranking is different if we only factor the climate change impact of the constituents, stressing the importance of adding specific biodiversity-related impact measurement on top of the more usual climate metrics already used by financial institutions.

Through selection of best-in class constituents in each subsector, the client was able to shrink the biodiversity footprint of its portfolio by circa 66% without changing its sectoral allocation between the Agri, Food and Retail/Restaurants segments. As the transformation of the Agri-Food sector towards more sustainable practices is recognized as a critical issue for the years to come, providing relevant signal to drive investment-making decision will enable driving the capital flows towards the most sustainable players.

Interpretation of results and impact on decision-making

This portfolio analysis allowed our clients to:

- have an aggregated reporting of the potential impact on biodiversity of their financings
- select best in class within the sector, depending on their impact on biodiversity, and to
- either divest (removing worst performers from investment portfolio) or identify the most sensitive constituents to begin an engagement strategy with them and evaluate their remediation/mitigation actions

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• This portfolio analysis allows asset managers to have a comprehensive insight in the potential biodiversity impact of their investments, to select best in class within the sector (in terms of biodiversity impact) and identify sensitive constituents to start an engagement strategy
Limitations	• The approach uses in most case a normative distribution of the supply mix (relying on sector averages), due to the lack of information on the specific geographical distribution of the companies' supply chain. • Use of MSA global values helps to screen impacts but site-specific assessments will have a higher relevance in terms of accuracy of impacts
Opportunities for improvement	• Using normative assumptions is fine as long as it does not give transparent players an unfair disadvantage, so the calibration of the normative model will be revised on a regular basis to validate it
Completeness	
Strengths	• The approach assesses some of the most material impacts in the sector (notably Change of Land Use), as documented by scientific literature
Limitations	• The consumption of resources (e.g. water) is not covered as of today in the approach. For some commodities, this is an important limitation. • The impact on biodiversity is expressed in Mean Species Abundance. Additional biodiversity features such as significance (e.g. risk of extinction of species) are not included in the approach.
Opportunities for improvement	• We will work with scientific partners over the coming years to model the impact of the consumption of resources on biodiversity.
Rigor	
Strengths	• Pressures and impacts are based on external scientific sources representing the state-of -art in terms of modelling so we estimate that it can be deemed as being technically robust.
Limitations	• Evaluating of the biodiversity impact of a corporate through the lens of a single metric, regardless of its merits, is a limited approach of the reality. Is should be complemented with engagement with the company, qualitative evaluations of its actions and mitigation initiatives. Use of corporate-level assessment is relevant for screening impacts and does not substitute to site-level due diligence.
Opportunities for improvement	• Development of qualitative indicators in addition to our score.
Replicability	
Strengths	• Methodological guide and sectoral booklet are available to our clients to the database users help user understand the approach
Limitations	• Few investors are familiar with the Mean Species Abundance (MSA) concept and the km2.MSA metric. Accelerating the learning curve of Financial Institutions on biodiversity impact measurements is a collective challenge.
Opportunities for improvement	• Our methodological guide and sectoral booklets will be published and open for review in 2021.

Aggregation	
Strengths	• The metric and model are designed to be aggregated at two levels: from sites to the corporate level, between several corporates at portfolio level for an investor. It also allows to calculate ratios and compare corporates from various size. The ratios calculated are financial ones (km2.SA/€Mn) or physical ones (km.MSA/tons).
Limitations	• The most material impacts are in the scope of the evaluation. However, some pressures are not evaluated yet (like the invasive species impact). If they do not have a similar impact across the sector, this may change the merit order of the corporates from a biodiversity impact standpoint.
Opportunities for improvement	• We will expand the scope of pressures assessed to reduce the impact of that bias.
Communication	
Strengths	• The metric is relatively simple to understand and interpret once the concept of MSA is understood.
Limitations	• Biodiversity has many facets. Therefore, it is challenging to communicate an impact using one metric.
Opportunities for improvement	• Work with partners in multilateral forums to reach a global consensus on a common view on the metrics to be used to measure the impact on biodiversity.
User friendliness	
Strengths	• Having a quantitative metric brings a toolbox familiar to portfolio managers and allows the implementation of stock-picking, exclusion and filtering strategies.
Limitations	• The method is not freely available for financial institutions. We provide users with training material to help them understand and interpret the results
Opportunities for improvement	• We will organize webinars to maintain the knowledge of our customers
Investment	
Strengths	• Users of our database only pay for it and are just required to invest time to understand the methodology and interpret the results. They do not have to calculate the impacts. The calculation cost is spread over all our users.
Limitations	• Expanding the database is expensive
Opportunities for improvement	• Reduce the dataset acquisition costs (time spent by company).

Overall assessment

The Corporate Biodiversity Footprint can be applied in a consistent manner at corporate level and portfolio level and covers the most material impact of the issuers on biodiversity. The tool developer observes in the most extensively documented sectors (c.300 lines for the Agri-Food one) a broad dispersion of results, with consistent rankings of best players and laggards between the results and what was expected based on literature and expert judgement (processor of meat food having the highest impact, impacts of the downstream player more limited due to a more diversified business mix -for instance diversified retail).

Efforts in the future should aim at extending our sectoral coverage and the approach to all source of impact on biodiversity (e.g. water consumption and propagation of invasive species). We are comfortable with the assessment performed on the client's portfolio. The ranking of corporates in terms of biodiversity impact is consistent with our expectations and correctly reflects its most material impacts. It helped our client starting an engagement strategy focused on the most concerning players in the Agri-Food sector, which is centric in its sustainability strategy.

Case study description and self-assessment carried out by
ICEBERG DATA LAB - Matthieu Maurin, CEO

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

Case study 7: LIFE Posigraf printing company

Application of LIFE Methodology on POSIGRAF - Printing Company - Brazil.

GENERAL INFORMATION

Biodiversity measurement tool	**LIFE Methodology**
Company	**Posigraf**
Sector	Printing Company
Turnover	U$ 54 million
Date/Period of measurement (year(s))	2019

Business application(s)

BA 1: Assessment of current biodiversity performance	Measurement of pressures on biodiversity (Biodiversity Pressure Index BPI) and biodiversity performance (Biodiversity Positive Performance BPP)
BA 3: Tracking progress to targets	Annual target of reducing Biodiversity Pressure Index (BPI) and improving Biodiversity Positive Performance (BPP).
BA 4: Comparing options	Metrics allow to select the site which offers least harm to biodiversity values (e.g. less fragile ecoregions). Biodiversity Pressure Index (BPI) allows to compare different production processes Biodiversity Pressure Index (BPI) allows to evaluate which mitigation measures offer best result in terms of both ecological and economic terms.

	Through Biodiversity Positive Performance (BPP) company can select investments in biodiversity with best "investment/biodiversity score". Through Biodiversity Pressure Index (BPI) companies can compare different business units and better guide the investments for biodiversity conservation
BA 6: Certification by third parties	LIFE Methodology allows third party certification based on auditing of a clearly established methodological approach. LIFE Institute has already accredited the certifying bodies: Control Union and TECPAR (Indexes disclosure available at: https://www.tecparcert.com.br/en/life/).
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Biodiversity accounting from LIFE Methodology and Certification refers to the process of compiling consistent, comparable and annual produced data. Certified companies must assess biodiversity pressures in the context of LIFE framework, such as biodiversity management, biodiversity pressure and biodiversity positive performance. LIFE Key reports (Technical and Executive Summary) are used both for internal reporting and external disclosure. Certification report and disclosure available at: https://www.tecparcert.com.br/en/life/

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	Business Unit: Gráfica e Editora Positivo S.A. https://posigraf.gupy.io/

DESCRIPTION OF THE CASE

See summary description of methodology here

Any organization is dependent on biodiversity resources, regardless of its sector or activity size. However, both sector and size, influence the quantity and severity of organization's negative impacts on biodiversity, having to be compensated proportionality. Thus, LIFE Methodology considers a mixed approach, comprised by both a qualitative and a quantitative phase.

The qualitative approach is based on the LIFE Standards, their Principles and Criteria herein presented, and refers to the requirements of organizational management related to biodiversity. All the indicators are presented in the document LIFE-CS.

The quantitative approach is applied in parallel to the assessment of these Standards and it sets the minimum performance to be achieved in conservation actions, and the different alternatives for the organization to provide evidence of this performance. The metrics that come from the quantitative approach are:

- BPI – Biodiversity Pressure Index (LIFE-TG01)
- BMP – Biodiversity Minimum Performance (LIFE-TG01)
- BPP – Biodiversity Positive Performance (LIFE-TG02)

Their application is detailed in the documents LIFE-TG01 and LIFE-TG02.

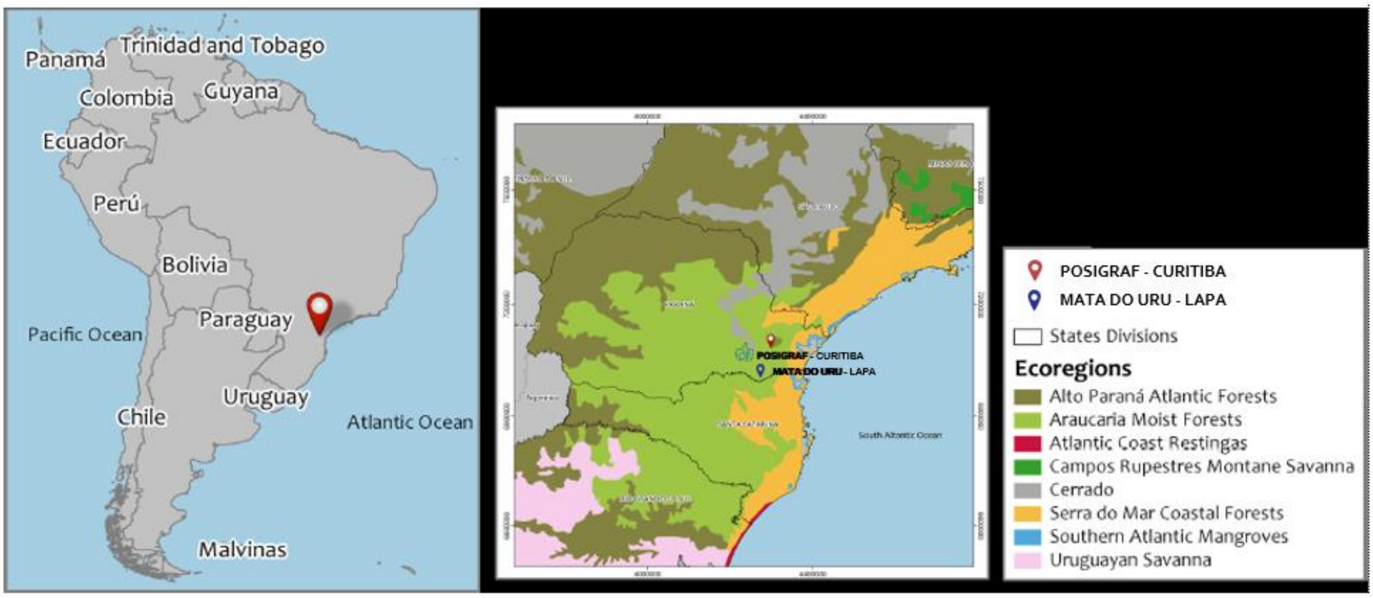
Context

In 16 years Posigraf, a printing company, has already invested almost US$ 365,000 (about E 300,000) in biodiversity conservation, through the maintenance and management of a reserve. Within the company, there has always been a concern to know their pressures on biodiversity so they could work on reducing these pressures and on investing in nature restoration. The LIFE Methodology allows them to compare their biodiversity pressures with the positive biodiversity outcomes of their nature restoration investments.

Boundaries

This case study refers to an operational level analysis. The operational level analysed includes the Manufacturing Unit/Finishing Center and the Distribution Center of the company both located in Curitiba, South Brazil. The supply chain is assessed using management indicators (e.g. requiring FSC certification for paper supply) which are part of LIFE Standards applied by all companies that use the Methodology. Additionally, companies can measure the BPI of their supply chain – which was not done yet by Posigraf.

Location and scale



The Biodiversity Pressure Index was calculated for the Posigraf Business Unit located at Curitiba, Paraná State (Brazil), while the Biodiversity Positive Performance (BPP) was calculated for projects developed in the Uru Reserve located at Lapa Municipality, Parana State. The municipality of Lapa is located near Curitiba and it is in the same ecoregion.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land cover per ecoregion Land use conversion per ecoregion Biodiversity Positive Performance (BPP) evaluated through conservation actions in Uru Reserve - Lapa Municipality.		
Climate change	GHG emissions		
Pollution	Waste generation Waste destination		
Direct exploitation			

Invasive species	Control of invasive species as a requirement of management indicators) in LIFE Methodology. In this case the FSC certification helps to guarantee the control of invasive species in the planted forests (impact of Posigraf supply chain).		
Other	Energy matrix (*1)	Water consumption Posigraf: Energy from Brazilian National Interconnected System	

(* 1: energy matrix as a set of the different sources of energy used by the company. Its pressure is evaluated considering thus study: https://institutolife.org/wp-content/uploads/2018/11/Energia-EN.pdf

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Gross revenue is used to stablish the Minimum Biodiversity Performance (BMP) for each business unit		
Challenges		
Pressures		
For BPI: Land cover; GHG emissions; Energy usage; water consumption; waste generated. For BPP: priority classification for conservation of the Uru Reserve.		Biodiversity Pressure Index modelled by LIFE Institute.
Challenges		
For BPI: Environmental data must be organized by the company.		Modelled data used for index calculations, provided by LIFE Institute, must be continuously studied and improved as any other models.
State		
For BPI: ecoregion fragility, water scarcity. For BPP: Projects data on: size of the forest reserve; status of the conserved area, priority classification for conservation of the Uru Reserve, status of the species, duration of the projects developed on the reserve; carbon storage in the reserve, projects terms; projects results (species identification, species threaten classification). Given the need to guide organizations on the way of evaluating the effectiveness of biodiversity conservation actions, LIFE Institute has identified objective criteria that allow monitoring results in conservation. Classes of Conservation Result Indicators (CRI) have been refined in order to	Maps and reports made available by governments and other environmental agencies.	

Primary data	Secondary data	Modelled data
evaluate information from the genetic diversity of species to the integrity of ecosystem functions. In each class, minimal variables are suggested that are passive or measuring and can generate clear result indicators both in the medium and long terms.		
Challenges		
Obtain standardized information on results for all projects. This information is needed to evaluate the results of the companies efforts considering this guidance: https://institutolife.org/wp-content/uploads/2018/11/Conservation-EN.pdf . Posigraf already has the information of the scoring on BPP (efforts on conservation actions) and is working on the evidence to get the extra score for the results on biodiversity conservation.		
Impacts		
Challenges		
For BPI: Better understand the relation between pressures evaluated and their direct and indirect impacts (*1).	Better understand the relation between pressures evaluated and their direct and indirect impacts.	

(*1): indirect impacts are interpreted by the LIFE Methodology tool developers as impacts on biodiversity due to e.g. GHG emissions (e.g. how to evaluate the loss of a species somewhere related to the contribution of the diffuse impact of GHG emission in Lapa Municipality, Paraná, Brazil for the climate change).

What was the role of qualitative information?

Qualitative information was used to evaluate biodiversity management indicators (see summary sheet on methodology).

Baseline/reference situation

The baseline for Posigraf is 2019 (first measurement).

Required efforts for the measurement

In the first year, as the team were still learning about the methodology, the software and identifying the information needed, it took one week to fulfil all the information. This time may be longer if the company has not an environmental management system well implemented. The time for annual updates on the Life Key platform is 1 manday.

Required skills to complete this exercise

Posigraf has employees trained in environmental management, who have the necessary skills to carry out the activities. However, the software is user friendly and no specific knowledge is required for its application.

Results and application

<u>IMPORTANT</u>: The documents available at LIFE website and related to LIFE Methodology mention the terms “Biodiversity Impact Index – BII” and “Biodiversity Conservation Actions – BCA”. Documents launched after June/2020 mention these same metrics as “Biodiversity Pressure Index – BPI” and “Biodiversity Performance – BP.” More specifically: Minimum Biodiversity Performance (MBP – former “BCAmin”) and Biodiversity Positive Performance (BPP – former “BCA achieved”). The changes in the terminology and abbreviations, which are currently being used, do not affect the meaning or the method these metrics are calculated. We emphasize these changes are due to our commitment to continuous improvement and aim to better communicate LIFE Methodology. We would like to inform that new and reviewed documents related to LIFE Methodology will have these terms progressively reviewed and will be updated on our website. If you have any questions, please contact the LIFE Institute team.

Figure 1 presents the Posigraf Biodiversity Pressure Index and Posigraf LIFE Metrics. The Biodiversity Pressure Index (BPI) was calculated based on 5 environmental aspects: waste generation, gas emissions, water consumption, energy consumption and land cover. The results are established on a scale of 0-1000 and correspond to the company's BPI. Posigraf has a BPI of 6.538.
The BPI is obtained through information relative to the quantity and severity relating to these 5 selected environmental aspects. Information on the quantity of environmental aspects assessed, or “Quantity Value”, refers to a direct relationship between the data of the organization/producer compared to official data for this aspect in the country. This comparison generates a quantity value of pressure for each environmental aspect referring to its contribution to the national total. Information on severity, or “Severity Value”, considers specific information for each environmental aspect, which allows to define their criticality: water availability in the region, potential for global warming from the gases emitted, pressure of the energy sources used, health hazard, the disposal of waste generated by the activities, and national fragility of the ecoregion occupied by the enterprise. This information, although qualitative, is quantitatively represented by the severity values, which range between 0 and 1 and may be called severity factors. By multiplying the quantity values of pressure by their severity factors, “Pressure Values” are generated for each environmental aspect. For comparison purposes, these pressure values are transformed into “Pressure Indexes”, with the purpose of being mathematically distributed on the same scale, from zero to one thousand. This distribution has as reference the value of greatest pressure known in the country for each environmental aspect. The simple average of the Pressure Indexes for each one of the environmental aspects, results in the Biodiversity Pressure Index (BPI).

The Pressure Values are transformed into Pressure Indexes, which allow the representation of the pressure of each environmental aspect on the same scale, dimensionless, ranging from zero to 1,000.

The Biodiversity Pressure Index is obtained by the simple arithmetic average of the Pressure Indexes (PI) of the five environmental aspects assessed.

Each environmental aspect has a specific calibration factor that allow the distribution of the values in the scale. The calibration factors are determined nationally (for Europe they were established regionally), aiming the distribution of the pressures in a scale. The scale is referenced by the higher values for each environmental aspect in the business unit level in the country/region. In each country/region, the factor is set so that the maximum value observed for the environmental aspect is equivalent to the value of 950 in a scale from 0 to 1,000.

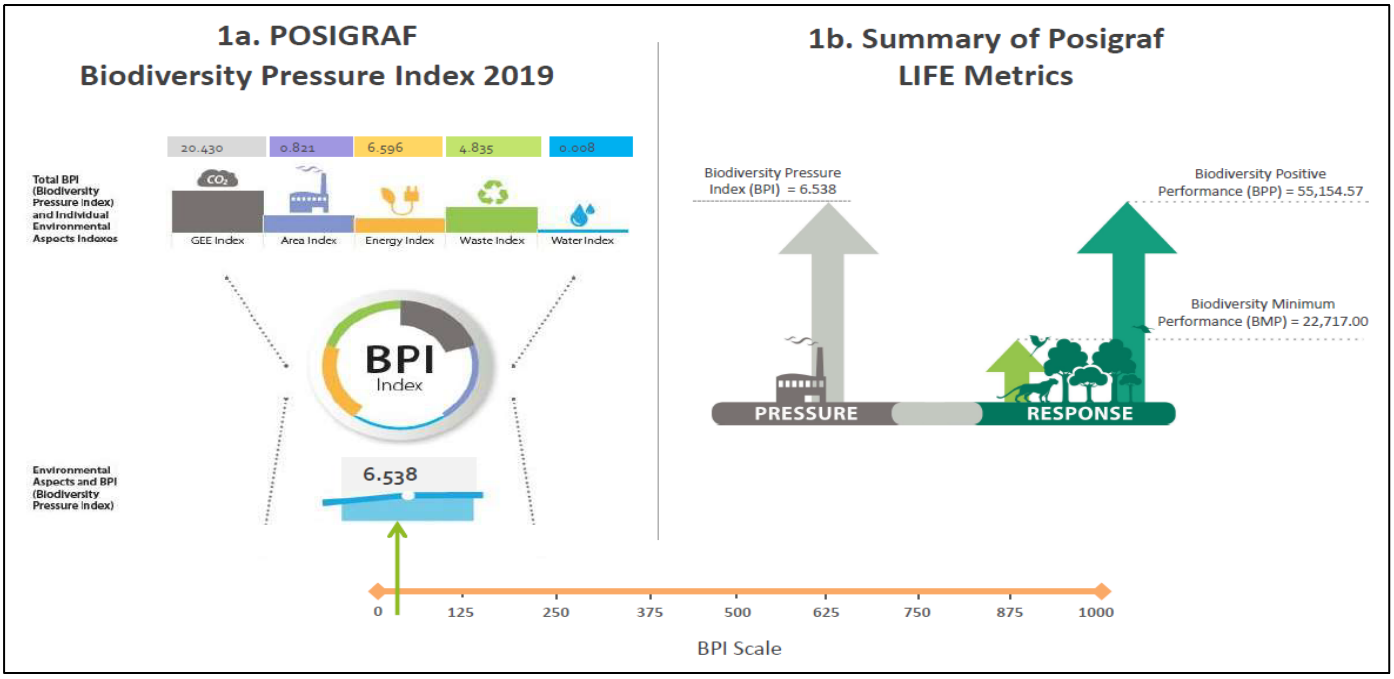


Figure 1: Posigraf Biodiversity Pressure Index and Posigraf LIFE Metrics

Based on BPI, the Biodiversity Minimum Performance (BMP) that the organization must compensate for the pressure was determined. Posigraf has a BMP equal to 22,700.00. The BMP (BCAmin in Figure 2) is obtained from an equation adjusted for the country's/region´s conservation performance according to the current practices of organizations, so that all enterprises seek to achieve the best practices. For this calibration, current practices of organizations in conservation are researched and assessed by local experts.

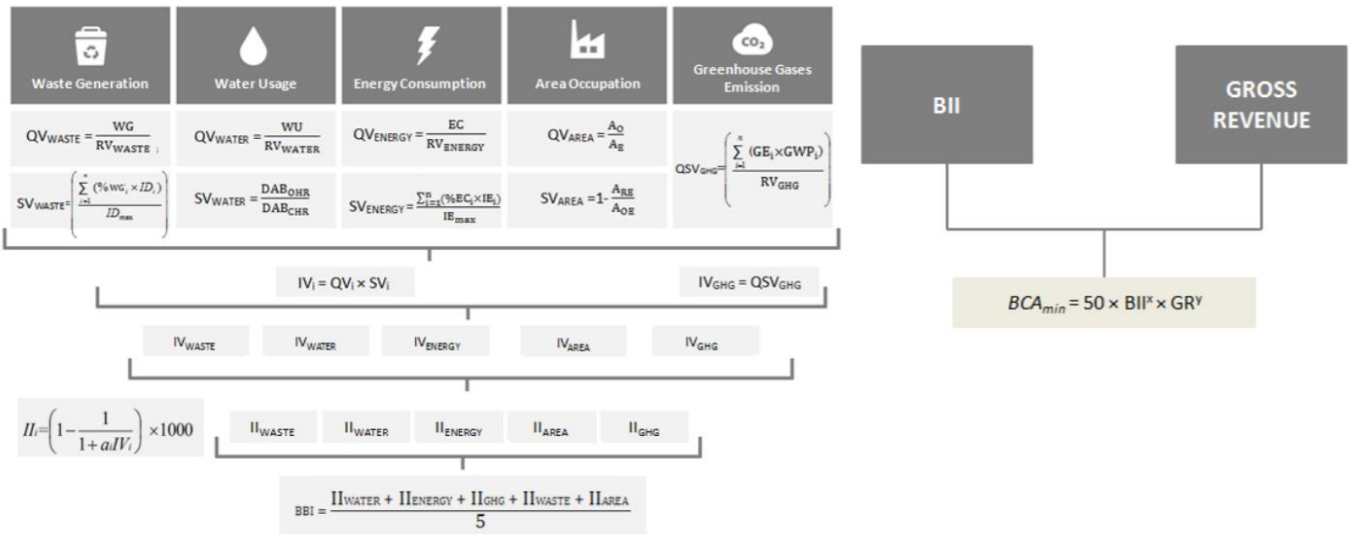


Figure 2: Equation for calculating the Minimum Biodiversity Performance (BMP)

Knowing its pressure, Posigraf performs several conservation actions and projects that exceed its Biodiversity Minimum Performance (BMP) required by the LIFE Methodology.

The LIFE Methodology considers that real engagement with biodiversity conservation can be evaluated in complementary ways, considering the inclusion of biodiversity all over the organizations´ environmental management (LIFE Standard for Business and Biodiversity) and the undertaking of direct and effective actions for conservation, through an Action Plan for Biodiversity and Ecosystem Services (APBE). An organization can obtain LIFE Certification whenever the score obtained for the APBE meets the minimum performance required. This minimum biodiversity performance is calculated considering the size of the organization and its Biodiversity Pressure Index (BPI), as described in the LIFE Technical Guide 01 (LIFE-TG01). The LIFE-TG02 is the technical guide for the LIFE Certification Methodology used to describe the way to classify the company´s efforts and score the Biodiversity Positive Performance (BPP). BPP refers to the total score achieved by the effort to conserve biodiversity presented in the company´s APBE.
By evaluating, scoring, highlighting, publicizing and recognizing the company´s efforts to conserve biodiversity, LIFE Methodology encourages the maintenance of the values associated with the composition, structure and function of the ecosystem services, contributing to the promotion of the well-being of humanity as a whole, and in particular to that of those communities which depend directly on these resources for their survival.

The actions carried out in Uru Forest, supported by the company, represent the Biodiversity Positive Performance (BPP). Posigraf BPP was calculated according to the metrics and represents 55,100 points (see Figure 3).

Posigraf BPP score of 55.100 was obtained using LIFE Key software which classifies, evaluate technical evidences and score each action in each project implemented by Posigraf.

A public summary of Posigraf actions, their classification and scoring are available at https://www.tecparcert.com.br/life/Resumo_Publico_Posigraf.pdf
(page 6). The classification of each action used LIFE Methodology - Evaluation of Performance in Biodiversity Conservation Actions - LIFE Technical Guidance 02 (https://institutolife.org/wp-content/uploads/2018/11/LIFE-BR-TG02-Technical_Guide_02-3.1-English.pdf).

Project	Actions	Score	Voluntary
URU Forest	Inspection and protection actions in the area	4,903.04	Yes
URU Forest	Adoption of 129 hectares	15,572.17	Yes
URU Forest	Hiring employees to carry out the actions	4,903.04	Yes
URU Forest	Control and monitoring of invasive exotic species	213.58	Yes
URU Forest	Support and funding for NGOs	457.60	Yes
URU Forest	Demarcation of the area (landmarks and signboards)	4,903.04	Yes
URU Forest	Area delimitation infrastructure	4,903.04	Yes
URU Forest	Monitoring of fauna and flora	1,128.52	Yes
URU Forest	Forest fire fighting plan	6,436.56	Yes
URU Forest	Uru Forest Management Plan (Lapa / PR), approved by the environmental authority	6,436.56	Yes
URU Forest	Environmental education program	394.40	Yes
URU Forest	Implementation of basic sanitation in the area	4,903.04	Yes
Total score for voluntary actions			**55,154.57**
Total score of actions for LIFE Certification			**55,154.57**

Figure 3: Posigraf Biodiversity Positive Performance (BPP)

The actions carried out by Posigraf in Uru Forest were classified and scored according to the LIFE Methodology and verified by the independent certifying body responsible for the LIFE Certification audit. As the Biodiversity Positive Performance (BPP = 55,154.57) is higher than the minimum performance (BMP = 22.700), Posigraf obtained LIFE Certification. Independent audits are undertaken annually. The results presented here in this document refer to the last audit undertaken by the Certifying body TECPAR. Company is certified since 2014 and has maintained this positive results until now.

The last column of this table refers to volunteer actions or not. When the actions are not volunteer they can also be listed in the software so the company can also score them using the software LIFE Key in order to know their importance ("credit") for biodiversity. However, they are not included in the total scoring used for Certification purposes. The table was extracted from LIFE Key software. Last column is useful to specify which an action is additional to legislation or not.

The main action of the company was the adoption of 129 hectares of Araucaria Forest in an advanced stage of conservation and fauna and flora species monitoring activities.

Finally, Figure 4 presents the qualitative part of the approach. Business and biodiversity management indicators are part of the LIFE Standards for LIFE Certification. LIFE indicators for Biodiversity and Business Management are available in the document **LIFE Certification Standards (LIFE-CS)**. This document applies to industry, services, and the primary sector (farming areas: agriculture, forestry, animal production, and aquaculture), whereas it does not apply to extractive activities.

LIFE Standards present Principles, Criteria, Indicators and Verifiers of LIFE Methodology:

- Principle: a fundamental issue underlying the concepts of LIFE Certification according to its Premises;
- Criterion: description of a procedure to comply with a Principle;
- Indicator: information related to the compliance of a Criterion;
- Verifier: examples of records of the compliance of an indicator.

A Principle is considered fulfilled when all Criteria applicable to the organization are met. A Criterion is considered fulfilled when the applicable indicators are met.

The 8 Principles* of LIFE methodology, that drive all the indicators are:

- Principle 1: Common, but differentiated responsibility
- Principle 2: Compliance with legislation, agreements, treaties, and international programs
- Principle 3: Conservation of biodiversity and ecosystem services as an additionality action

- Principle 4: Interaction among biodiversity, ecosystem services, human welfare, and business
- Principle 5: Priority and complementarity between environmental management and compensation for the negative impacts on biodiversity and ecosystem services
- Principle 6: Science and traditional knowledge
- Principle 7: Sharing of benefits derived from access to genetic resources from biodiversity and/or associated traditional knowledge
- Principle 8: Monitoring and continuous improvement.

* The LIFE Standards are under review. A new version with a specific Principle to deal with Natural Capital shall be launched after European pilots.

Compliance with LIFE Standards refers to compliance with all Principles, Criteria, and indicators that are applicable to the assessed organization, wherein compliance with a minimum of 70% on Year Zero (start of the certification process) of the Certification is allowed, as long as 100% of essential indicators are met.

For Year 1 (1 year after the certification process had begun), compliance with 100% of all applicable indicators is already mandatory. However, all the indicators highlighted in the boxes of the document are considered essential and their compliance is mandatory since the first year (Information available at Audit Guide: LIFE-INMP02 – this document can be found here: https://institutolife.org/o-que-fazemos/organismo-normalizador/documentos-adicionais/?lang=en).

Posigraf has achieved all applicable indicators to its business application since the 1st certification in 2014.

Figure 4 shows that Posigraf covered 28 general indicators + 16 essential indicators, totalizing 46 biodiversity management indicators accomplished. From the total of LIFE indicators 20 general indicators + 10 essential were considered by the auditors as non-applicable to Posigraf.

The main improvements in biodiversity management were development of a technical Biodiversity Action Plan (BAP); supply chain evaluation of biodiversity impacts[1]; refinement of environmental data collection and control to monitor GHG emissions and analysis of company´s role in the implementation of biodiversity international agreements.

The details of Posigraf processes and attendance to the indicators are a confidential information included in the detailed report fulfilled by third-party evaluation that company can automatically extracted from LIFE Key. Also the company and the independent auditors have access to Posigraf information through LIFE Key Platform.

Public information of LIFE certified companies is available at the websites of their respective Certifying Bodies and involve:

- Metrics:
    - BPI: Biodiversity Pressure Index
    - Environmental Pressure Index: water, land, waste, energy, emissions
    - BMP: Biodiversity Minimum Performance
    - BPP: Biodiversity Positive Performance
- Biodiversity Conservation Actions implemented and monitored by company
- Indicators attendance status

[1] All companies that apply the LIFE Methodology have to evaluate minimum criteria related to biodiversity risks of the supply chain; however, it is the decision of each company to calculate the BPI for all the suppliers. Posigraf does not calculate or monitors the BPI for its suppliers

How this has influenced decision-making

Posigraf uses Biodiversity Pressure Index (BPI) to define and monitor environmental targets. Working with this information and proving that responses exceeded pressures allowed Posigraf to obtain LIFE Certification. Posigraf was the first printing company to achieve LIFE Certification.

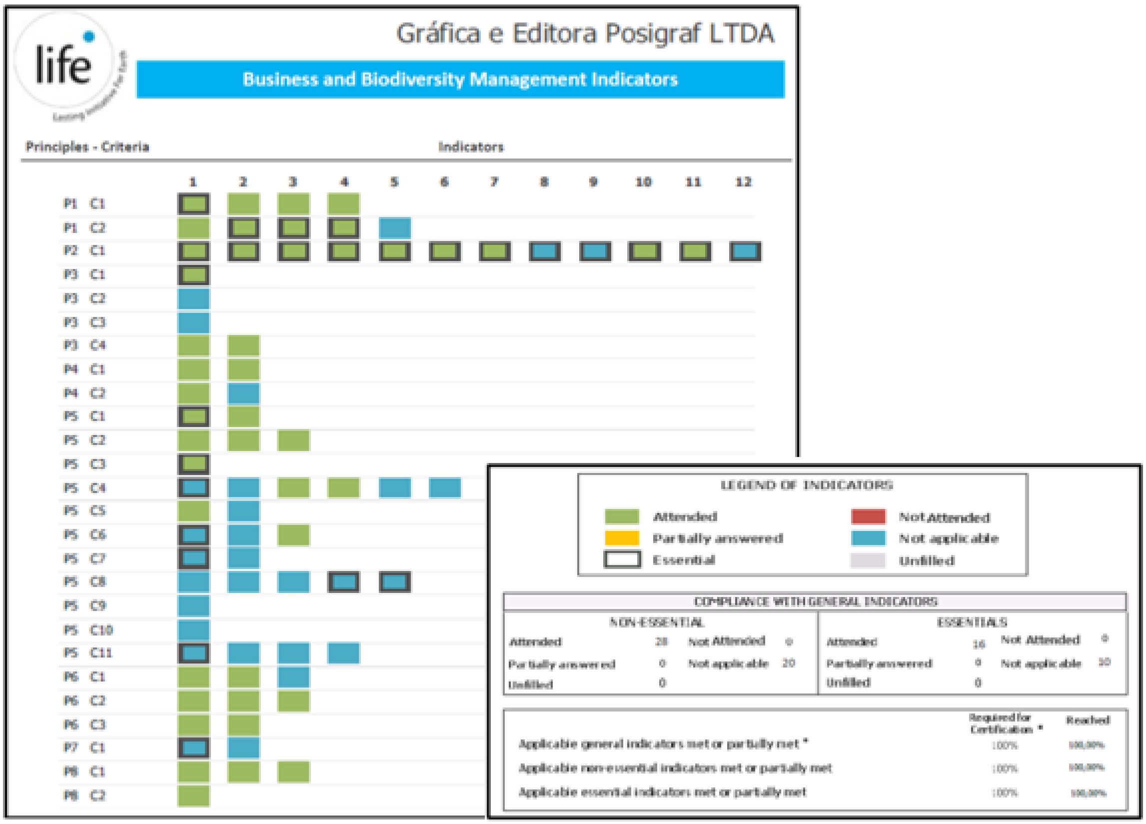


Figure 4: Business and Biodiversity Management Indicators

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The approach has proved to be very relevant for Posigraf's sustainability ambitions (see 'Overall assessment' below). it captures the main biodiversity pressures for the organization allowing to plan concrete actions to improve biodiversity gains.
Limitations	• Identification of relevant pressures will benefit from more widespread use of the tool, as more technical results will become available.
Opportunities for improvement	• Methodology could allow the possibility for compensation local BPI with BPP being developed abroad. For example, BPI in Europe being compensated with BPP in Latin America or Africa.
Completeness	
Strengths	• Main material pressures are captured.
Limitations	• Specific types of pressures (e.g. noise disturbance) are not considered for the BPI. As a universal index the quantity of environmental aspects that can be equally applied among companies is limited.
Opportunities for improvement	• Some relations between biodiversity conservation and ecosystem services could be more clear.
Rigor	
Strengths	• Posigraf has selected LIFE methodology because it is supported by robust data and it helps the company in decision making process.
Limitations	• The rigor of local technical data depends on national or local information available. Often, they are different among countries. • Severity of pressures is related to national or regional information and not to specific local biodiversity context.
Opportunities for improvement	• Standardize the detailed technical information on LIFE Key among countries.
Replicability	
Strengths	• Methodology and results are very transparent • Being developed as a universal methodology, LIFE is replicable to any country and sector, providing comparison among business units.
Limitations	• LIFE Methodology is operational to Brazil and Paraguay, with a pilot in Europe under development. But, it could be adapted for all Latin and North America. There are no technical limitations for replicability as the Methodology was designed to be replicable.
Opportunities for improvement	• Software available for all countries could be available.

Aggregation	
Strengths	• Aggregation factors allow BPI to consider different environmental aspects together which facilitate company´s monitoring and managing biodiversity data among business units.
Limitations	• Aggregation factors need more efforts in the communication process in order not to be confusing for the company or the society.
Opportunities for improvement	• Diferentiate the weighting of the 5 “pressures”, unrelated to their actual contribution to biodiversity loss, means optimising the biodiversity pressure index (BPI) could lead to a focus on “pressures” with a large impact on biodiversity.
Communication	
Strengths	• LIFE outcomes can easily be communicated and easily understood by non specialists. Mainly the quantitative information. As long as only high level results are communicated (i.e. not detailed scores for BPI, BMP, BPP)
Limitations	• Understanding the logical relations between BPI, BMP and BPP requires efforts
Opportunities for improvement	
User friendliness	
Strengths	• Data required by LIFE Key software are information commonly prepared by the company, so it can be fulfilled by anyone of the Posigraf team.
Limitations	
Opportunities for improvement	
Investment	
Strengths	• Information required was data already prepared by the company, so it could be easily fulfilled.
Limitations	• As it happens to all metrics/methodologies, small companies may have to hire external consultants to help with data organization.
Opportunities for improvement	

Overall assessment

Our main challenge in Posigraf is reducing our BPI (Biodiversity Pressure Index). This involves financial investments and raising people's awareness. Companies in general have the “culture change” as a main challenge. Another challenge for Posigraf is mobilizing the supply chain and we hope to see a major shift in this direction in the coming years. The main lesson learned is that biodiversity conservation should be understood as a strategy for maintaining business. It goes beyond a conservationist perception and achieving the needs for a long-term survival. Resources may continue to exist in the long term and a shortage may represent an increase in the cost of accessing these resources making the business less competitive or unfeasible. In this sense, LIFE Methodology and consequent LIFE Certification contributed to the organization's strategic planning, helping to quantify and value the efforts that are already being done by the company and making clear to the board the importance of committing to resources conservation.

Case study description and self-assessment carried out by

Regiane Borsato - LIFE Institute
Andrea Luiza da Silva Santos – Posigraf
Regiane Salata – LIFE Institute

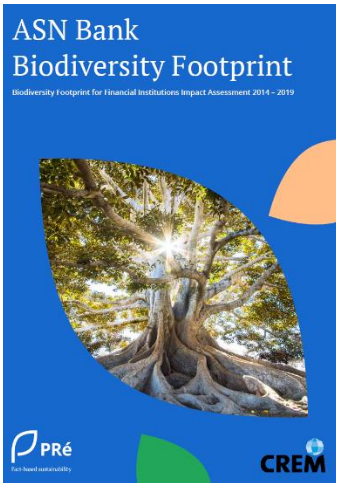
More information on the measurement approach can be found here:
https://institutolife.org/o-que-fazemos/desenvolvimento-de-metodologias/documentos-que-dao-suporte-tecnico-a-metodologia/?lang=en
All the equations and information used to calculate BPI are available at: https://institutolife.org/wp-content/uploads/2018/11/LIFE-BR-TG01-Technical_Guide_01-3.2-English.pdf (attention for the clarification about the terminology in the box under 'Results and application").

Despite the fact that all the equations are the same, the local references need to be adapted to each country or region. Detailed documents with local technical data are available for Brazil and Paraguay. A European Technical Guide 01 is being piloted among some business units from different companies in the first semester of 2021. Version being adapted for Europe available here: https://institutolife.org/wp-content/uploads/2021/01/LIFE-EU-TG01-Technical_Guide_01-00-English.pdf

The positive performance of each company is evaluated using the Methodology described in the LIFE Technical Guidance 02 (https://institutolife.org/wp-content/uploads/2018/11/LIFE-BR-TG02-Technical_Guide_02-3.1-English.pdf). The version being adapted, tested and improved for Europe available here: https://institutolife.org/o-que-fazemos/desenvolvimento-de-metodologias/documentos-que-dao-suporte-tecnico-a-metodologia/?lang=en

Case study 8: BFFI ASN Bank

ASN Bank Biodiversity Footprint 2014 - 2018 with the Biodiversity Footprint for Financial Institutions



GENERAL INFORMATION

Name of biodiversity measurement tool	**Biodiversity Footprint for Financial Institutions (BFFI)**
Name of company	**ASN Bank**
Sector	Financial
Turnover	13 336 Million USD
Date/Period of measurement (year(s))	2014-2018

Business application(s)

BA 1: Assessment of current biodiversity performance	
BA 3: Tracking progress to targets	ASN Bank aims to have a net positive gain on biodiversity with all loans and investments by 2030
BA 7: Screening and assessment of biodiversity risks and Opportunities	If the BFFI is used to scan an entire bank balance, it serves as a screening tool. Zooming in on individual investments is also possible
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	

Organisational Focus Area (site, product, supply chain, …)

OFA 2: Project level	Analysis of project finance is done for renewable energy projects and (agro)forestry.
OFA 5: Corporate level	We use a simplified corporate footprint method to assess listed equity. More detailed analysis is also possible when direct data is available.
OFA 7: Other	The results are reported at portfolio level, asset class level and balance sheet level. These results are compiled from the calculations for individual investments in a company (listed equity), (government) bond, mortgage, or project.

DESCRIPTION OF THE CASE

BFFI summary description of methodology:

- Summary description not available yet
- See extensive description in Annexes of Update 2 Report (https://ec.europa.eu/environment/biodiversity/business/assets/pdf/EU_B@B_Platform_Report_Biodiversity_Assessment_2019_Annexes_Final_5Dec2019.pdf)

Figure 1 provides a basic insight in the 4 steps of the BFFI methodology.

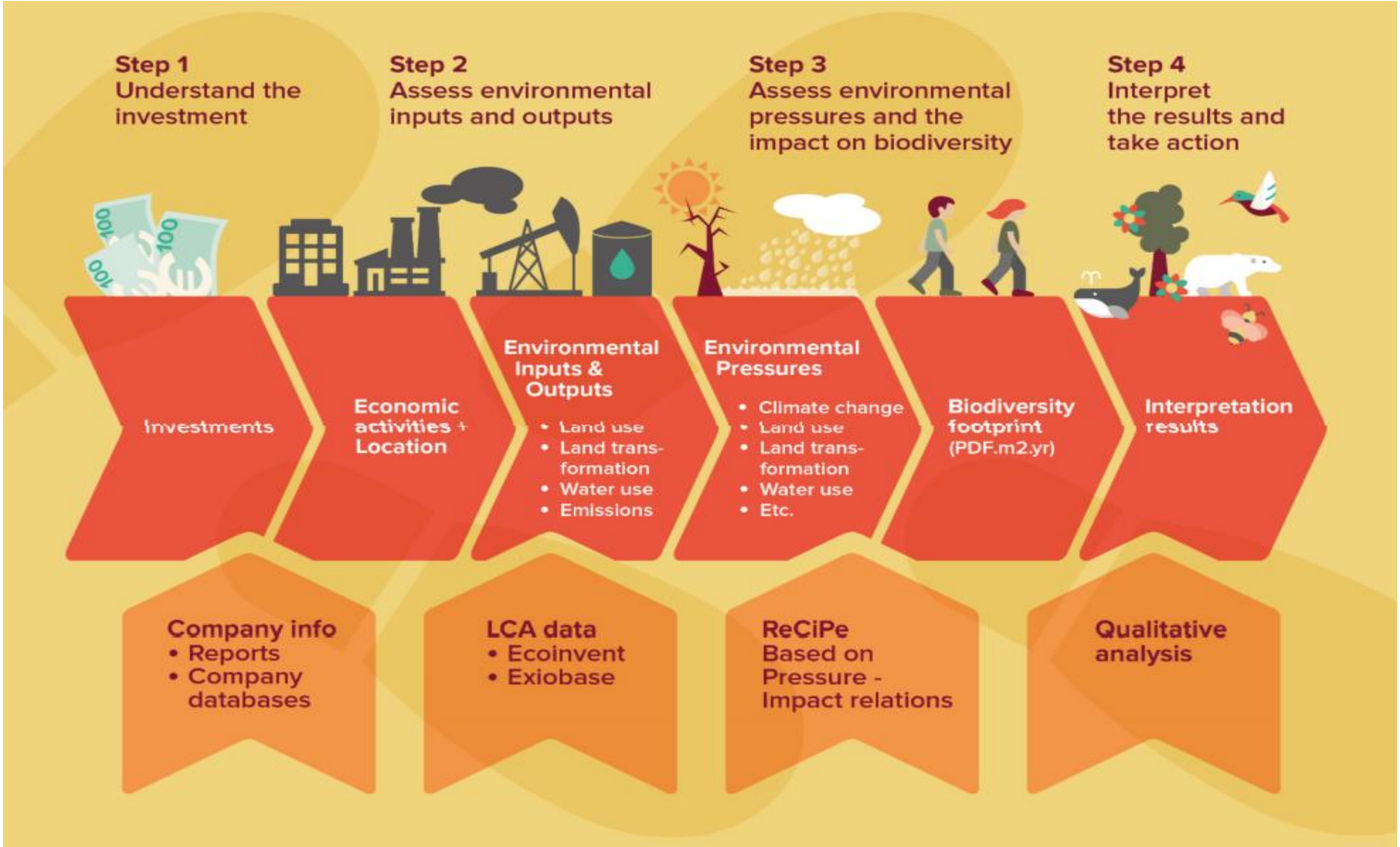


Figure 1: schematic overview of the 4 steps of the BFFI methodology

Context

ASN Bank would like to understand what impacts the bank's investments have on biodiversity: the biodiversity footprint of the investment portfolio. ASN Bank and other financial institutions can use the information from such a footprint analysis to assess their impacts on biodiversity, what steps are needed to minimize negative impacts and increase positive impacts in order to reach a No Net Loss situation or a situation of a net positive contribution.

A point of departure for this approach is the fact that most banks will probably not be interested in a complex assessment, requiring a high input of time and budget. The approach should therefore be pragmatic, sufficiently reliable to point in the right direction and transparent at the same time, allowing for a discussion with stakeholders, and use by different financial institutions. The methodology was developed together with CREM, in close cooperation with ASN Bank, with active support from the Dutch government. ASN Bank is following the mitigation hierarchy. It first seeks to avoid the impact by not investing in most polluting industries, then minimizes the impact by looking for best in class companies. Once this has been done, it invests in rehabilitation/restoration. Once these options are exhausted, ASN Bank can choose to offset.

Boundaries

The approach is both qualitative and quantitative. For most asset classes, the quantitative analysis includes the full value chain (scope 1,2,3) except the use phase.

For investments in renewable energy projects, the use phase is also taken into account, since the environmental gains of renewable energy projects are achieved in the use phase (producing renewable energy instead of fossil based energy). ASN Bank is aware that it would be better to include the use phase for all investments. This is currently not feasible. This is why ASN Bank does not only focus on the quantification of impact, but also on a qualitative analysis to determine investment criteria. So, investments in wind energy should only be done if they are not in or near Natura 2000 areas and if they are located in bird migration routes, measures should be taken to minimize the impact. The effects of these measures are not included in the quantification, but as they are covered in the investment criteria, they are still taken into account.

For the analysis of listed equity, bonds and loans, the share of ASN investments attributed to each investment was calculated as the ASN Bank investment divided by the company's market capitalization in the year of the analysis.

Both direct and indirect impacts are taken into account, but the impacts are usually modeled using background datasets rather than measured throughout the supply chain. The use of background data and expected biodiversity impact is unavoidable because companies generally do not have environmental information available on the impact of their suppliers and that is where most biodiversity impact takes place.

Location and scale

The BFFI measures global biodiversity loss in PDF.m2.yr. This is the potentially disappeared fraction of species in an area with a certain size, during a certain time period.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Included in ReCiPe2016	Not included	Not included
Climate change	Included in ReCiPe2016	Included in ReCiPe2016	Included in ReCiPe2016
Pollution	Included in ReCiPe2016: Acidification Ecotoxicity Ozone formation Ionizing radiation	Included in ReCiPe2016: Eutrophication Ecotoxicity	Included in ReCiPe2016: Ecotoxicity
Direct exploitation	Water consumption	Water consumption To be updated with a new impact pathway towards ecosystem quality in LCA: characterization factors for fisheries from Helias & Bach (2020)	To be updated with a new impact pathway towards ecosystem quality in LCA: characterization factors for fisheries from Helias & Bach (2020)
Invasive species	Included in the qualitative assessment	Included in the qualitative assessment	Included in the qualitative assessment
Other	Included in the qualitative assessment	Included in the qualitative assessment	Included in the qualitative assessment

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Publicly reported revenue data was used. Company specific carbon footprints are included in the analysis.	Background data from EXIOBASE v3.4 with the base year 2011. As of this version, the end years of real data points used are: 2015 for energy, 2019 for all GHG, 2013 for material use, and 2011 for most others, such as land, and water.	
Challenges		
Limited reporting by companies, revenue data is presented in broad regions and sectors	Background data is not always up-to-date and does not distinguish best-in class since sector average data is used.	
Pressures		
Company specific data, if available.	Background data from EXIOBASE	
Challenges		
An assessment on portfolio level will often not allow the input of direct data due to the time needed to gather such data for hundreds of companies.	Background data is not always up-to-date and does not distinguish best-in class since sector average data is used.	
State		
	Data on water scarcity on country level (EXIOBASE for water use & ReCiPe for water scarcity)	
Challenges		
Assessments on portfolio level do not allow for ecological assessments on individual production sites / impact areas.		
Impacts		
		The ReCiPe2016 impact assessment method was enriched with impact factors for forestry management systems (Chaudhary et al.) and agroforestry types
Challenges		
		Some impacts cannot yet be modelled, like impacts from the introduction of invasive species. Such impacts are addressed in the qualitative analysis.

What was the role of qualitative information?

- Showing the value and the limitations of the quantitative information. What can and what cannot be concluded from the calculations?
- Enriching the analysis with information on the drivers that were not included in the quantitative analysis.
- Providing guidance on the interpretation and use of the footprint information in investment decisions, investment criteria and the biodiversity strategy of the financial institution (see example on wind energy in 'boundaries').

Baseline/reference situation

For most investments and loans the reference situation is the situation without the economic activities taking place (zero biodiversity impact). For investments that specifically aim to reduce biodiversity loss, the reference situation is the situation without the investment. For renewable energy we compare the impact of renewable energy with the impact from grey electricity. The negative and the avoided impact from these investments are reported (separately).

Required efforts for the measurement

20 days to calculate the impact on biodiversity on portfolio level (one year)

Required skills to complete this exercise

Knowledge of biodiversity (metrics), LCA, life cycle inventory data and, input-output databases. This knowledge was available within ASN Bank because of the bank's work on climate footprinting.

Results and application

Both 'footprint' diagrams in Figure 2 and Figure 3 summarize the footprint. The columns on the left are in financial value. The middle columns with negative values represent avoided impact (avoided damage to ecosystems). The columns on the right represent biodiversity impact (damage to ecosystems), expressed in ha. ASN Bank has loans and investments on its bank balance and there is a separate entity for the investment funds. Figure 2 shows the total value of the investments on the ASN Bank balance sheet, grouped per asset class and its biodiversity footprint. This figure allows a comparison between the financial value of the investment and the biodiversity impact that is related to investing in these asset classes. Figure 3 shows the total value and the biodiversity footprint of all ASN Banks investment funds (ABB) which mostly consist of investments in listed equity and (government) bonds. Both figures show that the value of the ABB funds is relatively low compared to the total value of assets on the ASN Bank balance sheet. The total impact however is much higher, because the average impact of investments in equity is larger than the average impact of government bonds and mortgages, which make up the largest share of the investments of ASN Bank.

This is also reflected in Figure 4, which gives an overview how ASN Bank's biodiversity footprint has evolved over the period 2014 - 2018.

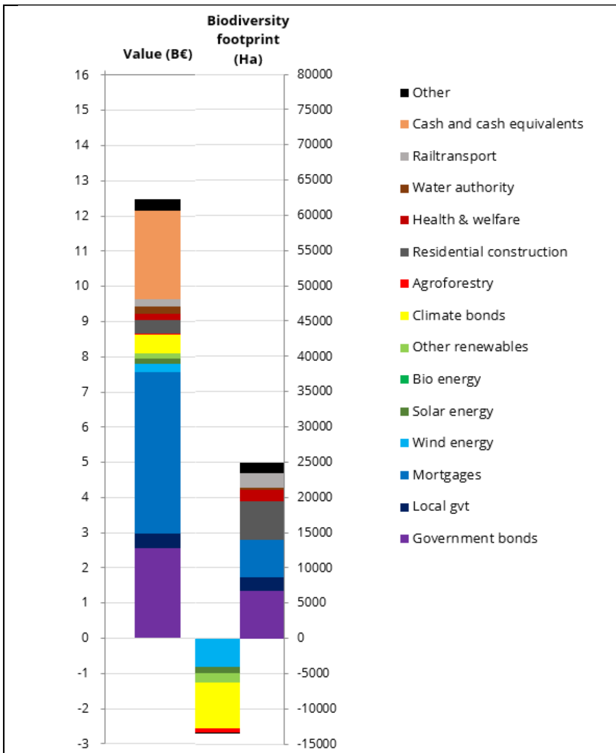


Figure 2: Biodiversity Footprint ASN Bank – total value and total biodiversity impacts of investments on the ASN Bank balance

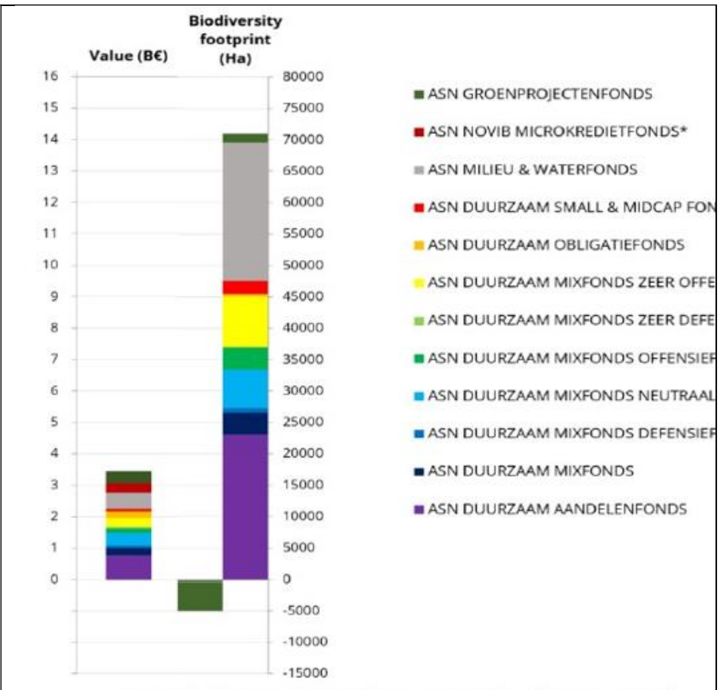


Figure 3: Total value and total biodiversity impact of the ABB investment funds

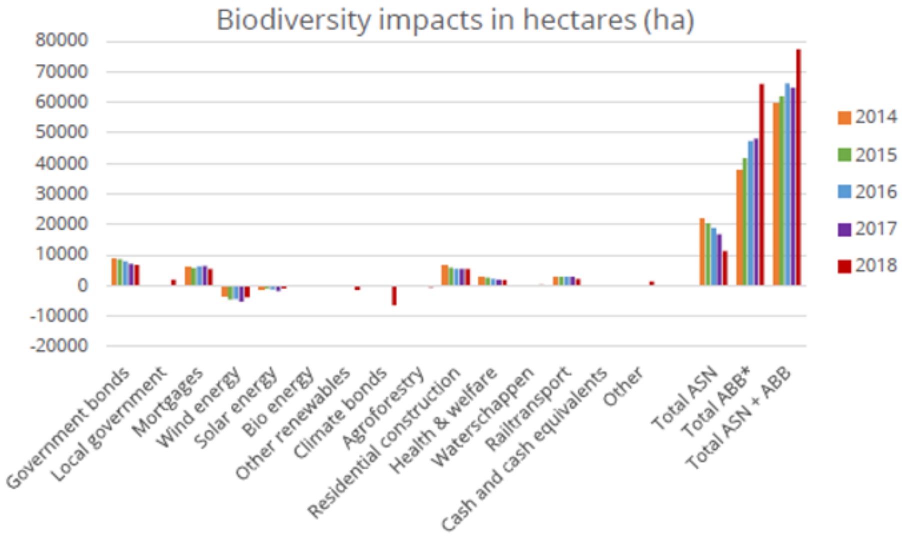


*Figure 4: The biodiversity impacts in hectares per investment category for the period 2014 – 2018 (*ABB was reported as equity in the footprints of previous years)*

Interpretation of results and impact on decision-making

The footprint results have been used by ASN Bank:

- To assess whether reaching a no-net-loss or net-gain on a portfolio level could be possible. This is possible.
- To decide on a net-gain objective on a portfolio level in 2030.
- To integrate the use of a simplified impact assessment tool in the sustainability screening of potential investments. Also a lower return on investment is accepted for investments with a positive effect on the environment
- To reconsider investments in biomass for energy production. The investment criteria were made stricter.
- To expand the work on biodiversity to Volksbank level, the parent company of ASN Bank.
- To start (international) discussions on specific challenges in the biodiversity impact assessment methodology, like the choice of reference situation in case of biodiversity positive investments.
- To start the Partnership for Biodiversity Accounting Financials (PBAF) to support further improvement of biodiversity impact assessment.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• ASN Bank wants to have a footprint of thousands of investments in order to measure and monitor their progress. The BFFI can do this.
Limitations	• Despite BFFI being a measurement approach, it is best to use the results for screening purposes due to the uncertainty in the data. Where needed, the bank can zoom in on investments with the highest potential biodiversity impacts in a second step.
Opportunities for improvement	• The use of a pressure-response model and background dataset that map out international supply chains allows to complete the task set out by ASN Bank
Completeness	
Strengths	• The ReCiPe impact assessment model typically looks at impact on lower level organisms. And although not all species are impacted in the same way, they serve as a good proxy for the health of ecosystems. The unit of ReCiPe is the potentially disappeared fraction of species. For each impact category the relation between the pressure and the species richness is determined. As an example, for land use the midpoint characterization factors (CFs) were derived using the species richness data for several taxonomic groups: plants, vertebrates (mammals and birds) and invertebrates (mainly arthropods) (De Baan et al. 2013, Elshout et al. 2014). These taxonomic groups react differently to land use, given that they generally have varying requirements for food, shelter and breeding or nesting (Elshout et al. 2014). Due to the variety of taxonomic groups included, the CFs are a proxy for the impact of land use on total species richness.
Limitations	• Because we look at the health of ecosystems as a whole, impact on specific (endangered) species is not taken into account. • Not all pressures are included in the ReCiPe model, e.g. invasive species and overexploitation are not yet covered. The same applies for specific biodiversity impacts of renewables such as disturbance by underwater noise to marine mammals during construction of offshore wind farms, cumulative barrier effects to seabirds by numerous offshore windfarms, barotrauma to bats by wind turbines, etc. The implication is that the results of the footprint can be either too low (drivers of biodiversity loss are missing) or too high (investment criteria are in place and the impact can be expected to be lower than the sector average values we are working with). The qualitative analysis in used to provide the background information.
Opportunities for improvement	• Incorporate regional impact factors for the potentially disappeared fraction of species, such as those provided by Chaudhary et al. DOI: 10.1021/acs.est.5b02507 • Incorporation of overexploitation of fish species. Currently, ReCiPe 2016 does not include overexploitation in the pressure response model. Helias and Bach have developed impact factors to include it[1]
Rigor	
Strengths	• The background data from EXIOBASE is developed by renowned research institutes and universities and is fully transparent.
Limitations	• Site specific biodiversity impacts are not assessed, the expected biodiversity impact is modelled using pressure-response models
Opportunities for improvement	• Explore linkages with spatial biodiversity data and other methods such as the STAR methodology.

[1] https://www.researchgate.net/publication/341794046_Biodiversity_impact_of_fisheries

Replicability	
Strengths	• The method, the background data (EXIOBASE) the impact assessment model (ReCiPe2016) and our adaptations are all freely available on the EXIOBASE website, on the RIVM website, and in our reports.
Limitations	• In order to use these databases and make calculations you need SimaPro software, or you need programming skill to import the databases and make calculations with ReCiPe
Opportunities for improvement	• We could build a platform to allow FIs to do these calculations themselves (e.g. for a quick screening of new investments). Possibly an update of the Bioscope platform (https://bioscope.info/) would be suitable for this purpose.
Aggregation	
Strengths	• The total biodiversity impact is calculated using the footprint of the various portfolio's, which in turn is based on the footprint of the individual investments. • The use of PDF.m2.yr allows for aggregation of different drivers of biodiversity loss, leading to in a single score result
Limitations	• In the current version, we are reporting the total net impact. It is more accurate to report the negative impact, the avoided impact and the positive impact separately. This will be included in future reports.
Opportunities for improvement	• Form the 2019 footprint onwards, we will report negative, avoided and positive impact separately. The impact per driver (land use, climate change, water use etc.) will also be reported separately.
Communication	
Strengths	• The PDF.m2.yr unit is simplified to m2 of ha. This should be interpreted as an area where all biodiversity is lost during one year.
Limitations	• This simplification is easier to understand than the original unit, but a part of the nuance of the PFD.m2.yr unit is missing when the results are expressed in m2 or ha.
Opportunities for improvement	•
User friendliness	
Strengths	• All data needed to make the calculations is open source and freely available.
Limitations	• Although the BFFI is open source, it takes an expert to be able to do the modeling and the calculations. Such as knowledge on Life Cycle Assessment, Environmentally extended input output databases (exiobase), and impact assessment methods (ReCiPe). Furthermore, knowledge on LCA software can be useful. If you do not need a user interface and you have the skills to use Matlab, or Octave (freely available), you can do the calculations without LCA software
Opportunities for improvement	• Make the results of the calculations available for other users so they do not have to do the modeling and calculations all over again.
Investment	
Strengths	• With a limited investment of 20 days, the biodiversity footprint of a complete bank balance can be calculated and reported including a qualitative assessment.
Limitations	• The footprint will be based on publicly available revenue data and the footprint will be calculated with sector average environmental data. Use of company specific data is an option when data is available. However, for an analysis on a portfolio level, this will require a high input in time, unless this process can be automated (e.g. together with ESG data providers).
Opportunities for improvement	• The sector average data can be replaced with company specific data once companies start to report on key biodiversity related pressures like land use and water use, including pressures in supply chains. We are already using company specific carbon footprint data.

Overall assessment

The BFFI methodology is fit for purpose in the sense that it offers an overview of biodiversity impact risks within an investment portfolio. It shows where to focus in order to minimise potential negative impacts and where to focus to increase potential positive impacts. In this way, it supports ASN Bank in working towards a net gain on biodiversity on a portfolio level. The application of the methodology over the years also shows that continued development is necessary in order to answer new questions that materialise as a result of the bank's initiatives to work towards its objective. An example of this is the assessment of biodiversity positive impacts (e.g. related to forestry) and the way in which the use of sustainability standards/certifications could be integrated in the footprint.

Case study description and self-assessment carried out by

Wijnand Broer (CREM), Mark Goedkoop (PRé Sustainability), Daniël Kan (PRé Sustainability)

More information on the measurement approach can be found here:
https://www.asnbank.nl/over-asn-bank/duurzaamheid/biodiversiteit/biodiversiteit-in-2030.html
https://pre-sustainability.com/articles/?con=comp_biodiversity-assessment
https://www.rijksoverheid.nl/documenten/rapporten/2019/09/25/report-positive-impacts-in-the-biodiversity-footprint-financial-institutions

Case study 9: STAR Bukit Tigapuluh rubber project

Assessment of potential reduction in risk of species extinctions with STAR in a sustainable commercial rubber project in Sumatra

GENERAL INFORMATION

Biodiversity measurement tool	**Species Threat Abatement and Recovery (STAR) Metric**
Company	**NB Lestari - Bukit Tigapuluh Sustainable Landscape and Livelihoods Project**
Sector	Rubber
Turnover	
Date/Period of measurement (year(s))	Baseline measurement in 2018

Business application(s)

BA 1: Assessment of current biodiversity performance	Assessment of opportunities for conservation outcomes based on current strategies
BA 2: Assessment of future biodiversity performance	Assessment of potential for contributions of species threat abatement through management and restoration
BA 3: Tracking progress to targets	Methodology and approach for definition of numerical targets based on opportunities for reducing species extinction risk
BA 7: Screening and assessment of biodiversity risks and Opportunities	Assessment of threatened species presence in concession area and opportunities for species threat abatement through management and restoration

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	Rubber concession plus 5 km buffer in central Sumatra
OFA 2: Project level	investment project with a range of corporate and finance agencies supporting biodiversity outcomes

DESCRIPTION OF THE CASE

See summary description of methodology here

STAR measures the change in risk of species extinction by measuring the contribution that investments can make to reducing species extinction risk through 1/ mitigating existing risk factors, and 2/ assessing contributions of habitat restoration. It can help countries, the finance industry, civil society and corporates measure conservation outcomes.

Context

The Bukit Tigapuluh Sustainable Landscape and Livelihoods Project is a high climate/environmental/social return landscape programme to develop a commercial sustainable rubber project at scale across 90,000 hectares (70,000 in Jambi) that places half the land area in set-asides for local livelihoods. This would also include wildlife conservation areas and forest/land protection/restoration, where HCS (High Carbon Stock) and HCV (High Conservation Value) areas remain[1]. The two concession areas held by PT. Royal Lestari Utama (RLU) in Jambi, along with two WWF ABT[2] concessions, form a strong and contiguous buffer zone protecting the Bukit Tigapuluh National Park (BTP) (of significant conservation and biodiversity value) from further encroachment, largely from smallholders fueled by capital from land speculators.

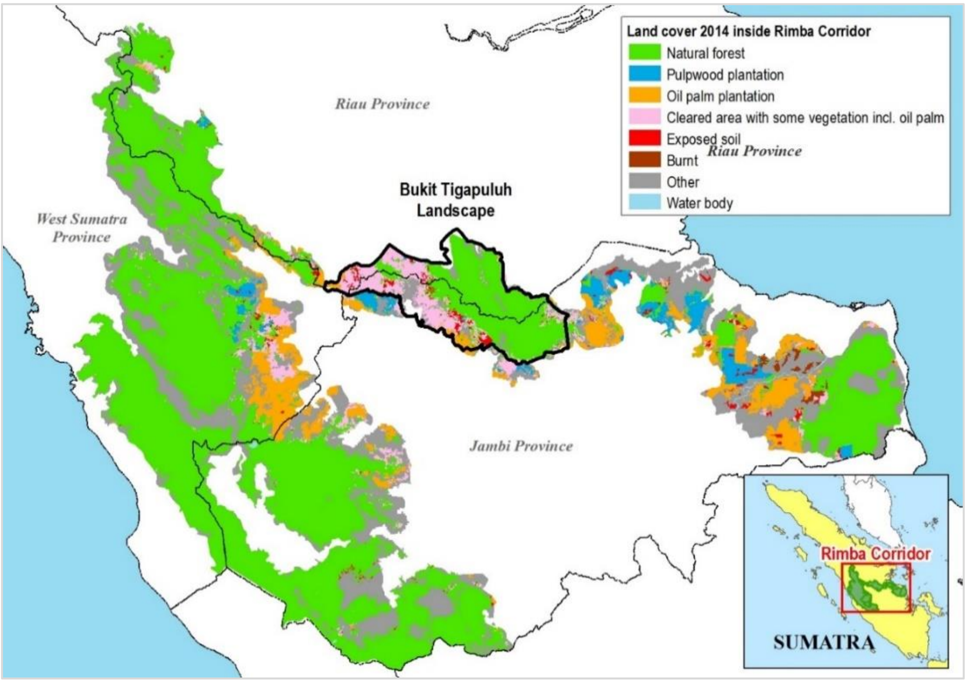
STAR was used to calculate an initial ex-ante conservation assessment value for the project area of Bukit Tigapuluh Sustainable Landscape and Livelihoods Project, and to make management recommendations based on the result of that analysis.

Boundaries

This analysis was predicated on the spatial extent (including a 5km buffer) of the project area described above, in proximity to Bukit Tigapuluh National Park in eastern Sumatra, Indonesia.

Location and scale

The project is located in the heart of Sumatra.



Types of pressures

[1] See Global Land Use ChangeHCS & HCV - Global Land Use Change

[2] ABT stands for PT Alam Bukit Tigapuluh (ABT), which means The Thirty Hills Forest Company

Pressures	Terrestrial	Freshwater	Marine
Land use change	deforestation, subsistence agriculture, industrial agriculture, and other unsustainable resource use		
Climate change			
Pollution			
Direct exploitation	hunting, woodcutting		
Invasive species	introduction of invasive species		
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Challenges		
Pressures		
remotely sensed data of land use change, camera traps for species presence and hunting, targeted interviews with local informants and project staff		
Challenges		
State		
presence of threatened species and threats obtained from local informants and researchers	presence of threatened species and threats to them from IUCN Red List of Species	
Challenges		
Data are limited without effort to conduct further field surveys. Access to some data sources challenging owing to IP issues	Some taxa and threats have poor spatial information	
Impacts		
Remotely sensed data showing potential for restoration and reduction of deforestation.		
Challenges		
Management interventions will take some time to be manifested and only baseline data currently available		

What was the role of qualitative information?

Presence/absence of some threats and species was all that was available prior to fieldwork to establish the baseline.

Baseline/reference situation

The study was aimed to establish an **ex-ante baseline STAR value** of the species extinction risk reduction possible at the site. This involved making an ex-ante estimate from published information on the IUCN Red List of Species, and then verifying the presence of the threatened species at the site and the intensity and distribution of the threats to these species. The **ex-ante estimate STAR value** can be calculated from existing published information. The ex-ante estimate needs ground verification to get to a baseline against which subsequent conservation action can be measured.

We partly achieved the goal of the project, but confirmation of the baseline would require further fieldwork which at the time of the report had not been completed. The components of the baseline still required confirmation of some threatened species presence and confirmation of the spatial distribution and intensity of hunting in particular.

Required efforts for the measurement

Overall analysis took around 1 month, as the process required many new approaches and development of new analysis techniques.

Required skills to complete this exercise

Now an ex-ante estimate of STAR value for a given polygon can be done in ~1 day from Q2 2021, STAR data layers will be available without charge through the Integrated Biodiversity Assessment Tool. Further field work (varying according to the situation) could take 1 week to several months depending on the size of a project and the amount of data available.

Results and application

Figure 1 presents the study area with STAR scores for threat abatement and STAR scores for restoration. The study area (+/- 88.000 ha) includes a 5 km buffer, set aside area to support local livelihoods, wildlife conservation areas and forest protection and restoration, and two ecosystem restoration areas, which form a conservation management zone that protects the Bukit Tigapuluh National Park from encroachment. The total STAR score of the study area represents 0,2% of the STAR score for Sumatra, 0,04% of that for Indonesia and 0,003% of the global STAR score.

Figure 2 presents the threats analysis for the study area. The major threats are from annual and perennial non-timber crops, logging and wood harvesting and collecting terrestrial animals.

Figure 3 shows the areas identified for priority threat abatement and restoration actions. provides recommendations on restoration measures.

Interpretation of results and impact on decision-making

Results have changed the perspective of the project managers in favour of focusing on species for which the possibly of extinction is high, and for which the threat abatement and restoration opportunities in the project area can make significant impact. The company is interested to extend the analysis to other concession sites.

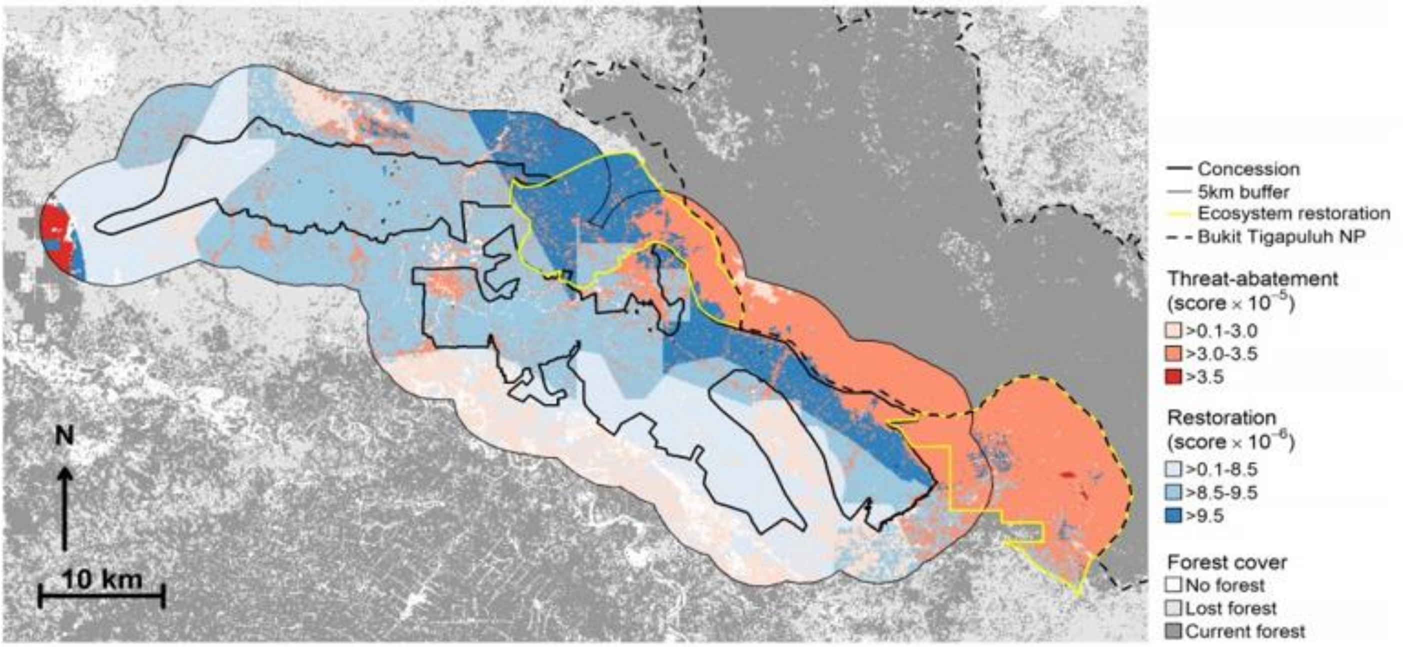


Figure 1: Study area with STAR scores for threat abatement and STAR scores for restoration

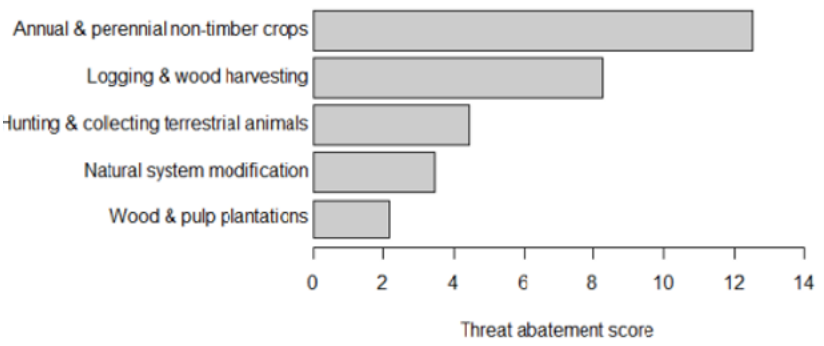


Figure 2: Threats analysis

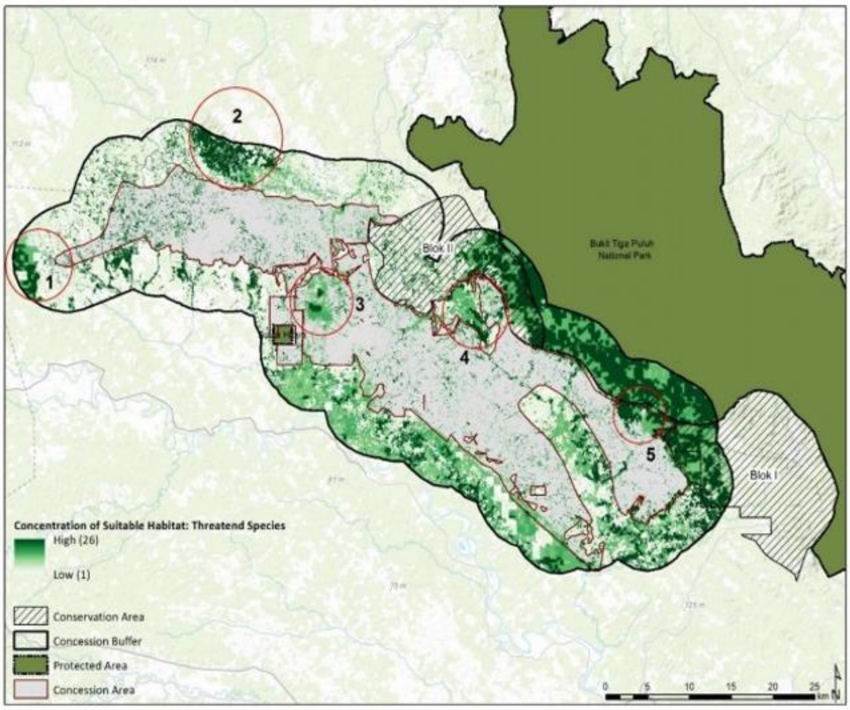


Figure 3: Identified priority areas for threat abatement and restoration actions

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The metric is directly relevant to the company's target stakeholders and focuses on the components of the organisation with significant opportunity to contribute: the site managers. The project is intended to be sustainable and the STAR metric values and recommendations help it to deliver focused outcomes for biodiversity. Even the ex-ante estimate STAR value for a site conveys considerable information about the processes affecting threatened species at a site, that are not easily accessible in any other way. This can allow site managers to formulate initial recommendations that will certainly reduce the likelihood of species extinctions. Further, more measurable progress will require the setting of baselines and targets as described above.

Limitations	• In order for the company to move to delivery of biodiversity targets (of any kind, measured by STAR or not), auditable evidence of impacts on the ground must be presented • The application of STAR is not limited by outdated data, the data in the Red List of Species is usually not sufficiently spatially precise to allow a baseline value to be calculated without field verification • Moving from ex-ante estimate to baseline requires some confirmatory research at the project site. This requires investment on the part of the company. They are looking for investment sources to carry out this work.
Opportunities for improvement	• The project study was an early test of the STAR approach and thus took much longer than expected to complete. We now have a much more refined analysis technique and access to better data.
Completeness	
Strengths	• The STAR metric was applied to all taxa for which there are data available for the site. Significant gaps include for plants and freshwater animals. However, knowledge of these taxa for this part of Sumatra is very poor and any attempt to interpret other data on these taxa would likely have led to significant errors. The taxa used for the analysis (birds, mammals and amphibians) are exposed to most of the threats that would apply to other taxa, so management to reduce threats to these taxa would also benefit other components of biodiversity
Limitations	• It would be desirable to include other taxa in the analysis. However, this would require considerable investment in research and time. Without this, results from any modelling or meta-analysis, when applied to this case, would likely lead to considerable errors.
Opportunities for improvement	• Taxa such as trees, freshwater fish, reptiles and some marine species will be added to STAR in the next couple of years.
Rigor	
Strengths	• STAR is generated from the IUCN Red List of Species, a comprehensive global dataset that uses published scientific methods to assess extinction risk for species. The methodology for calculating STAR is in review in a high-quality scientific journal (Mair et al. in press).
Limitations	• Even for a comprehensive global data set like the Red List of Species, there are gaps in knowledge which need to be filled by fieldwork, which takes time and effort. However, for achieving concrete results at site or landscape level in terms of restoring habitats and threatened species populations this level of accuracy is necessary.
Opportunities for improvement	• For cases such as the Bukit Tigapuluh project, moving from an Ex-Ante Estimated STAR value to a baseline is now the subject of a set of industry guidance notes which will make the use of STAR to deliver verifiable conservation outcomes more efficient. These industry guidance notes will be available in combination with a portal in IBAT that will give access to STAR global data layers (mapped by 5 x 5 km squares, with individual threat layers. These will all be available free of charge during an early access window
Replicability	
Strengths	• The measurement approach is completely transparent, based on scientifically validated data and underpinned by freely available global data layers. The application to real-world management was refined by iteration with project managers to produce management recommendations relevant to field practice, but also generating results that can be compared to other project interventions elsewhere in the world.
Limitations	• The scientific paper describing the approach and methodology (Mair et al. in press) will be published in Nature Ecology and Evolution in February 2021
Opportunities for improvement	• Users of STAR will have access to STAR global heat maps and guidance notes through IBAT in the near future (Q1 2021). This will enable them to generate results that will be • comparable to the results of this pilot study
Aggregation	
Strengths	• STAR values are additive across sites (i.e. a STAR value from one site can be added to a value from another to give a cumulative total, for instance for a company footprint or country target) and also aggregated across product impacts to a portfolio, as long as the site-based impacts of

	each component of the portfolio are known. An explicit strength of STAR is its accuracy, i.e. reflecting real biodiversity risks and conservation benefits. Delivery of reductions in species extinction risk as a result of management actions can be assessed by changes in the intensity of threats at a temporal scale relevant to management (1-5 years)
Limitations	
Opportunities for improvement	
Communication	
Strengths	• STAR provides a scientifically- justified numerical metric of the opportunity to reduce extinction risk at a site. This is an easily-conveyed concept (“*we have the opportunity to help these species that are at risk of extinction*”), and one that can be extended to baseline calculation and target setting that, when attained, will generate clear and auditable reductions in species extinction risk (“*we have made it less likely that these species are at risk of extinction*”). These principles are easily understood and grasped by non-specialists, especially if the species involved are described.
Limitations	• Understanding the technicalities of the STAR score requires some effort.
Opportunities for improvement	• Some people may not understand the concept of species extinction. But when common examples (the dodo, the passenger pigeon, the Tasmanian Tiger) are used, the idea of preventing extinctions is very intuitive.
User friendliness	
Strengths	• The STAR data layers exist as global 5x5km2 heat maps, of global threats and separately of single threats. Users will be able to overlay one or multiple polygons on top of these heat layers to calculate STAR values for their projects or commodity sources. This functionality will be available in IBAT in Q1 2021.
Limitations	• Interpretation of the results of polygon overlay onto STAR heat maps, in particular in planning responses to results, will require specialist support. This will be described in part in guidance notes, but in many cases, in order to deliver auditable changes in species extinction risk, will require management plans developed by technicians familiar with biodiversity risk management.
Opportunities for improvement	• Ultimately STAR will be available for users in such a way as to produce comprehensive taxonomic analyses, detailed threats analyses and specific management responses from protocols accessible at the point of access.
Investment	
Strengths	• The ex-ante estimate of STAR value for a site, such as that used in this demonstration case, takes at most a few days to produce and does not require technical input from the user. • Interpretation for management might take longer, as will measurement of baselines and target setting for management delivery
Limitations	• Delivery of STAR units towards targets are calculated from the reduction in pressures causing species to be at risk of extinction. This delivery requires auditable change in the pressure (e.g. deforestation, hunting). This may require significant work to elucidate the change in the pressure - for instance hunting pressure may be hard to monitor.
Opportunities for improvement	• As noted above, the process of measuring baselines and setting targets will become more efficient and less resource-intensive once guidance notes and analytical routines are further developed.

Overall assessment

STAR is based on real, field-relevant, scientifically tested global data on biodiversity assets, that is presented at a scale that reflects the scale over which biodiversity importance varies. In this case, it allowed the project developer to assess how they could plan their investment to deliver measurable conservation outcomes that can be compared to other interventions in other parts of the world. We were not able to access some of the data required to establish a baseline against which the impact of conservation actions could be measured owing to lack of access to critical information on some threatened species and some threats. Further fieldwork would be necessary to complete this step. However even using the estimated ex-ante evaluation will provide the project developer with concrete indications of relevant actions with significant impacts on globally-important biodiversity.

STAR does not cover all components of biodiversity- either all species or all scales (genetic to ecosystem). However these other components are not supported as yet by underlying geographical or thematic data layers that allow the impacts of management on biodiversity to be robustly estimated or measured. The version of STAR used here included assessments of birds, mammals and reptiles. The STAR method and formulation allow the inclusion of other taxa (some of which, for instance trees, freshwater fish and reptiles are close to being ready) in the short term.

Case study description and self-assessment carried out by

Frank Hawkins, IUCN

More information on the measurement approach can be found here:

https://www.iucn.org/regions/washington-dc-office/our-work/species-threat-abatement-and-recovery-star-metric

Case study 10: BISI Anglo American mine

Application of the Biodiversity Indicators for Site-based Impacts methodology to Anglo American's Kolomela open cast iron ore mine, South Africa

GENERAL INFORMATION

Biodiversity measurement tool	**Biodiversity Indicators for Site-based Impacts**
Company	**Anglo American**
Sector	Extractives (Mining)
Turnover	$29.9bn (2019)
Date/Period of measurement (year(s))	2019/20

Business application(s)

BA 1: Assessment of current biodiversity performance	Assessment of the efficacy of site-level biodiversity management actions in maintaining biodiversity at pre-project levels
BA 3: Tracking progress to targets	Tracking site progress towards Net Positive Impact commitments
BA 4: Comparing options	Comparing options for where targeted investment in improving management or data availability would be most beneficial.

BA 7: Screening and assessment of biodiversity risks and opportunities	Screening the potential risks to biodiversity present at a site by assessing biodiversity significance of the area.

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	Site-level managers can use the dashboards to identify the current state of biodiversity features, the pressures being placed upon them, and the current status of the company's response to mitigate those pressures. It also can be used to identify current data gaps.

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

This case study forms part of a wider piloting study to test the methodology, identify challenges with its practical implementation and explore its potential utility to wider application within Anglo American. The objective was to use the findings of the pilot case studies to refine the methodology.
The findings have been integrated into an updated Version 3.2 of the methodology (see link below).
The Kolomela mine is an open-cast iron ore mine consisting of multiple pits. It is a direct shipping iron ore project transporting bulk ore off-site for processing. The project had an existing Biodiversity Action Plan in place at the beginning of piloting, and this documentation was used to support the completion of Stage 2 (below). The BAP is part of the internal processes for Anglo operating in SA. The methodology has been piloted to examine how it can help support the company in understanding where it is on track.

Boundaries

The boundaries of this pilot assessment are restricted to the site and its surrounding area of influence. It considered both direct and indirect impacts (*1) relating to the company's mining activity at the site during the application.

When applied across a company's portfolio, the following considerations are used:

- Stage of operations: whether planned projects, and projects in closure and decommissioning stages are to be included
- Status of operations: whether inactive or on-hold projects are to be included
- Type of operations: whether certain activities are to be excluded and the rationale
- Responsibility: whether joint ventures and minority share projects are included

This pilot site would be categorised as:

- Stage of operations: Operational
- Status of operations: Active
- Type of operations: Extractive site
- Responsibility: Majority share

(*1) This term is being used to refer to impacts not caused by the operation of the site (e.g habitat loss through pit creation) but that would not occur without the proejct being in place (e.g. increased harvesting of bushmeat due to an influx of workers to the area). This is in line with the BBOP definition outlined here.

Location and scale

Kolomela open cast iron ore mine is located near Postmasburg, South Africa, approximately 320km northwest of Bloemfontein. The assessment incorporated the direct physical footprint of the site and its area of influence. The exact area of influence of the site was not quantified and a 50km buffer was applied as a precaution. Five towns/settlements with existing infrastructure are present within the 50km buffer so infrastructure further afield is not likely to be attributable to the mine. 50km likely represents an overestimate of the mines but is used as a precaution in the absence of a full assessment.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	• Habitat loss, fragmentation and degradation. • Species mortality due to landscape modifications (e.g. fences and transmission lines).		
Climate change	• Impacts of uncontrolled bushfires.		
Pollution	• Dust deposition.		
Direct exploitation	• Illegal harvesting of species by workers and associated sections of the community.		
Invasive species	• Invasive species impacts upon habitats.		
Other	• Indirect impacts on species due to increased mortality along roads.		

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Challenges		
Pressures		
Area of converted land for physical footprint. Qualitative assessment of other pressures into broad, clearly defined categories based on expert opinion.		
Challenges		
Pressures cannot be quantified for many of the threatened species present, some of the pressures are estimated while others are indicated as unknown.		
State		
Habitat extent and condition assessments conducted as part of the Biodiversity Action Plan for the site. Wildlife population monitoring has also been conducted.	In Stage 1 global datasets are used to assess the biodiversity significance of the site. These are: 1) World Database of Protected Areas 2) IUCN Red List of Threatened Species 3) Critical Habitat Screening Layer These indicate the significance of the site. They do not indicate company induced impact upon them as this is the focus of Stage 2.	
Challenges		
Accurate population data is not available for affected species, and the values for percentage remaining are therefore estimated using expert opinion (local expertise).		
Impacts		
Records of collisions with transmission lines, vehicles and mortality from electrified fences		
Challenges		

What was the role of qualitative information?

Qualitative assessments were used to assign categories (High, Medium, Low) within the site-level dashboard when quantitative data was unavailable. The three broad categories with clearly defined thresholds allows expert opinion to assign categories with relative accuracy and confidence. A data confidence assessment is also provided within the dashboard to highlight where results are less certain.

Qualitative data is also used to assess the Response of the company to the Pressures upon focal biodiversity features. Expert review of the site's Biodiversity Action Plan was used to assign scores for Planning and Implementation of Response as outlined in Tables 15 and 16 of the methodology document (see below).

Baseline/reference situation

The baseline was taken as a pre-project state for each of the biodiversity features. This information was obtained from site documentation, such as the Biodiversity Action Plan.

Required efforts for the measurement

In order to compile and assess the relevant data needed to produce the dashboards approximately 13 person days were required, split between Anglo American and their supporting partner. Required time will be heavily dependent on the availability of baseline information. Information on required efforts to compile the BAP (which includes a baseline inventory) is not available and would likely be highly variable across sites. The BISI methodology lists a number of documents from which the appropriate baseline information can be derived. It is a valid assumption to expect all sites to have already produced at least one of these documents through the regulatory process.

BISI application will be dependent on the company and will likely align with their current monitoring frequency. As this is a pilot, the decision on the frequency for this site has not yet been decided by the company.

Required skills to complete this exercise

Expert opinion was required in order to identify the focal biodiversity features and to qualitatively assess the State, Pressure and Response indicators.

Results and application

Figure 1 presents the Biodiversity Significance Screening Dashboard in Stage 1. Based on the applied screening criteria the site biodiversity significance is medium. Locally threatened species are not required to be included in Stage 1 as it is meant as a rapid assessment across a company's portfolio (which would be facilitated via IBAT). Inclusion of local assessments may skew results towards areas where more comprehensive local assessments have taken place which may mask the signficance of key sites across a company's global portfolio. That said if a company operates a small number of sites and/or operates primarily in a small number of comparable countries, local data could also be included.

	Global Screening Criteria		
	Protected Areas	Critical Habitat	Weighted IUCN Red List Threatened Species
Criteria	Overlap with Area of Influence (1 Protected Area)	No Overlap	Unweighted CR: 2 EN: 4 VU: 10 Unweighted Total: 16 **Weighted Total: 24**
Significance	Medium	Low	Medium
Site Biodiversity Significance			
Medium			

Figure 1:Stage 1 - Biodiversity Significance Screening Dashboard (CR: critically endangered; EN: endangered; VU: vulnerable)

Figure 2 presents the Site-level Dashboard in Stage 2. For the pre-project baseline, this refers to the State metric only. This metric measures the % change between a pre-project baseline and the time of assessment in terms of extent or quality of habitat or species population. Data confidence is defined as on page 33 of the methodology. Confidence level is higher for site-level data (score 3) than for regional or national data (based on expert opinion, so score 2).

PROJECT PHASE: OPERATIONAL			BASELINE: PRE-PROJECT			
	FOCAL BIODIVERSITY FEATURE	PROJECT-INDUCED PRESSURES	STATE	PRESSURE	RESPONSE	DATA CON-FIDENCE
1	**Biodiversity Management Units (BMUs) directly impacted by mining activities**	Habitat loss and degradation	Poor	High	Medium	Level 3
		Loss & trampling of sensitive species		Medium		
		Dust deposition		High		
		Non-compliance to plans		Low		
2	**BMUs outside the direct impact footprint**	Habitat loss and degradation	Good	Medium	Medium	Level 3
		Illegal harvesting		Low		
		Alien invasive plants		Medium		
		Uncontrolled bush fires		Low		
		Land mgmt & governance		Low		
3	**Large ground birds:** Ludwig's Bustard Secretarybird	Transmission line collisions	Moderate	Low	Medium	Level 3
		Habitat loss and degradation		Low		
		Illegal harvesting		Low		
4	**Wild cats:** Black-footed Cat Leopard	Habitat loss and degradation	Good	Low	Medium	Level 2
		Road kill		Unknown		
		Illegal harvesting		Unknown		
5	**Temminck's Pangolin**	Habitat loss and degradation	Moderate	Low	Medium	Level 2
		Electrocution along fences		Medium		
		Road kill		Low		
		Illegal harvesting		Low		
6	**Large Raptors:** Tawny Eagle Martial Eagle	Habitat loss and degradation	Moderate	Low	Medium	Level 3
7	**Vultures:** Cape Vulture White-backed Lappet-faced	Habitat loss and degradation	Moderate	Low	Medium	Level 3

Figure 2: Stage 2 - Site-level Dashboard

Interpretation of results and impact on decision-making

Stage 1

The site is assessed as having Medium biodiversity significance as a result of the presence of a protected area within the sites area of influence and the occurrence of several Threatened species. During Stage 1 a number of species were identified via global datasets that were known not to be present from on-site monitoring. These were subsequently excluded from the assessment based on validation with site managers. Site managers have been very helpful at this site and across the wider piloting in identifying when species provided by IBAT are not present at site (e.g. occur only in managed populations or have never been recorded despite targeted surveys) as well as with clarifying the boundaries of protected areas and site footprints etc. As a precautionary approach we emphasise data from Stage 1 being maintained unless site managers can provide credible evidence for its alteration in order to remove the incentive for site-managers to downplay risk.

The site was progressed to Stage 2 as the intent was to pilot both stages. When more widely applied to multiple sites across a company, a prioritization process would be required at this step in order to identify which sites will be progressed to Stage 2 first. This would be based on the biodiversity significance assessment and company capacity for implementing at multiple sites simultaneously.

Stage 2

Both habitats and species are considered to meet the criteria to be included as focal biodiversity features. Current documentation (BAP, 2013) describes habitats as Biodiversity Management Units (BMUs), and same terminology is adopted here. Habitats have been grouped into the BMUs within the mine footprint, and BMUs containing natural habitats outside of the mine footprint, but under the management control of Kolomela Iron Ore Mine. These have been split as the State and Pressures for these two groups differ greatly. Various species have been grouped for practical application of indicators, and include groups such as large raptors, vultures and wild cats.

State is variable across all features, with habitats in the direct impact area experiencing the largest declines compared to the pre-project baseline. Pressures are generally low to medium, with the exception of habitat loss and dust deposition in the direct impact area. Response is currently "Medium". Implementation is on schedule, but the plans need to be updated to reflect newly adopted Net Positive Impact commitments. NPI is a company-wide commitment. This would be reflected in the State metric being maintained in Green but for example the current "Good" rating could change to "Increased" or similar. This has not been included here as the NPI plan has not yet been developed. It may be that once the NPI plan has been developed by the company additional features could be added to the dashboard as a result.

The interpretation of the results therefore highlights the need to focus upon the site's Response to Pressures placed upon habitats within the directly impacted by mining activities, which have declined most severely. The assessment also highlights where data gaps may occur. In particular, Pressure data relating to wild cats has been difficult to obtain and consideration will be needed as to whether future data collection can take place, or a degree of caution should be applied to interpreting results for these species due to the uncertainty of data.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• Targeted stakeholders were internal company decision makers. Stage 1 was shown to be used to review and analyse where operations are in terms of their impact to areas of high biodiversity value, working with partners to gain access to global datasets of biodiversity helps to assess a site's potential impact on biodiversity. • The consistent approach using the same methodology, to make comparative assessments of the potential impact of an operation was also identified as important. • Stage 2 has been identified by site level managers to be a good way of indicating biodiversity value and determining the effectiveness of the management plans. • The case study covered the site and its area of influence, which were the key relevant parts of the organisation in this context. • Stage 2: If no BAP is available, BISI still provides very useful results. Box 2 of page 22 of the methodology provides a list of documentation that may contain information relevant to the application of BISI. It is expected that sites will have at least one of these documents already as a result of regulatory process. There is however room for BISI (as has happened in other pilots) to have the dashboard highlight where insufficient data is available to make an assessment (e.g. lack of monitoring to assess state).

	This no data outcome is equally valid in terms of directing how the company can improve management.
Limitations	• Current limitation is that the assessment is not aggregated in order to be of maximum use to corporate-level decision makers considering results from multiple sites. This work is currently under development.
Opportunities for improvement	• The case study (along with others) highlighted the need for clear guidance and criteria for selecting focal biodiversity features to ensure they capture all aspects of the company's impact at site. This has subsequently been added to the methodology.
Completeness	
Strengths	• Yes, the focal biodiversity feature selection process involves the identification of company-induced pressures and the aspects of biodiversity they may affect. The screening criteria to select features that are vulnerable to the effects of company-induced pressures, suitable as indicators (i.e. feasible to monitor and responsive to change) and significant (i.e. threatened or unique) ensures that all relevant taxa and habitats affected by company-induced Pressures are included.
Limitations	• Expert opinion is required to identify biodiversity features that meet these criteria. However, information key to this process can be located within existing site-level documentation or by engaging with consultants appointed for ongoing assessment and monitoring of biodiversity.
Opportunities for improvement	• None
Rigor	
Strengths	• Stage 1: Data is taken from robust global datasets. There is also a process in place to validate and adjust the results presented from global datasets where there is clear, demonstrable evidence from site-level data that these are inaccurate. In this case study a number of species were excluded from the biodiversity significance screening due to site-level data indicating their absence from the site. • Stage 2: Data is taken from primary sources including the Biodiversity Action Plan. The methodology for applying this data to the dashboard is robust with clearly defined threshold. Where primary data is not available, the Data Confidence assessment clearly highlights any potential for inaccuracy and in itself provides an indicator of data gaps which could be filled.
Limitations	• Quantitative data is not always readily available for all focal biodiversity features. In these cases, qualitative, expert opinion is used instead. While this is less robust, the broad categories through which State, Pressure and Response indicators are placed means that this is still likely to represent sufficient accuracy.
Opportunities for improvement	• None
Replicability	
Strengths	• The methodology document lays out a clear step by step process for implementing the approach and is publicly available. Within the detailed, confidential pilot report for the company, the process for selecting focal biodiversity features and assessing them in terms of State, Pressure and Response is clearly laid out. This should allow the replication of the approach in future to track changes over time. • The dashboards are supported by narrative text which aides the interpretation of results. Once focal biodiversity features are selected,

	future replication of the approach at site requires only the input of updated data so is easily replicable.
Limitations	• Due to the qualitative criteria for selection of focal biodiversity features, there may scope for variability in features deemed to meet these criteria. Guidance and case studies to support the methodology aim to alleviate this.
Opportunities for improvement	• Several case studies will soon be published which will assist users in understanding how to apply the methodology. This will ensure that companies are able to apply and interpret the approach correctly.
Aggregation	
Strengths	• The complete methodology (under development) will allow for aggregation from individual sites during Stage 3. A number of possible approaches are currently being developed. However, the focus of the pilot was on Stages 1 and 2 and therefore aggregation was not conducted in this case.
Limitations	• Lack of aggregation is currently a limitation to broader adoption within a company in order to provide useful information for corporate level decision makers.
Opportunities for improvement	• Stage 3 of the methodology will provide an approach for aggregation. It will be piloted in 2021.
Communication	
Strengths	• Both Stage 1 and 2 are presented in clear and easily interpretable dashboards which apply a traffic light system familiar to users. The dashboards are supported by an internal report which provides further detail regarding the assessments. The dashboards are presented externally as part of a public case study. The intention of this is to demonstrate the application of the methodology, not to externally disclose the biodiversity performance of the site.
Limitations	• Lack of aggregation is currently a limitation to wider internal communication within a company, as well as to external disclosure.
Opportunities for improvement	• The piloting of Stage 3 in 2021 will provide an opportunity to ensure that the clarity of the approach is maintained when aggregating to corporate level. This will address the challenges of clear corporate-level internal communication as well as external disclosure.
User friendliness	
Strengths	• Stage 1 is easily applied using readily available online platforms such as the Integrated Biodiversity Assessment Tool (IBAT) and UNEP-WCMC's Critical Habitat Screening Layer and can be conducted by any user. • Stage 2 dashboard relies on easily understood concepts such as percentages or direct monitoring rather than derived metrics which aides in its interpretation by a wide range of users. • Where possible alignment with existing site-level documentation (e.g. Biodiversity Action Plan) reduces the burden on users. • Additional resources are available to support implementation. A business case document is available to make the case for adopting biodiversity indicators, in order to facilitate buy-in at multiple levels within the company that are needed to effectively implement BISI. • An excel tool is also provided to generate the Stage 2 dashboard from input data, simplifying the process for users.

Limitations	• The methodology is detailed and requires an upfront investment of time in order to be able to successfully implement it. • In Stage 1 access to IBAT has an associated cost for commercial use. • The Critical Habitat Screening layer requires a basic level of GIS capacity to screen project sites. • For Stage 2, expert opinion is required to identify focal biodiversity features. Some users may therefore benefit from the engagement of consultants or partners in order to implement Stage 2.
Opportunities for improvement	• Potential to provide supporting materials, training and technical assistance for implementing companies is being explored in order to best support uptake of the methodology.
Investment	
Strengths	• The approach is publicly available and the intention is for companies to participate in or lead the implementation with support from external partners where appropriate. This case study was the first pilot of the methodology and so the time required (~13 days - see above) and the level of external assistance was greater than would be expected with increased familiarity.
Limitations	• The initial development of the dashboard (e.g. identifying focal biodiversity features and metrics) is time intensive (~11-12 days). However, once this initial investment has been made, updating the dashboard in order to track progress takes considerably less time and can be implemented by non-expert users.
Opportunities for improvement	• There is the opportunity now to work with companies to provide appropriate levels of technical support in order for them to transition towards implementing the methodology internally as well as expanding implementation to multiple sites within their portfolio.

Overall assessment

This initial pilot of the methodology was successful. The overall aim was to test the methodology, identify challenges with its practical implementation and explore its potential utility to wider application within Anglo American. The methodology was tested and challenges identified. The findings of this pilot (along with others) enabled us to update and improve the methodology.

The pilot screened the site for biodiversity significance, informing corporate-level assessment of potential biodiversity risk. It highlighted a number of focal biodiversity features, company-induced Pressures and data gaps in order to link biodiversity value with the effectiveness of management plans at the site level, assess current performance, in particular with regards to Net Positive Impact commitments, and provide users with the information needed to compare options for the targeting of additional resources to improve biodiversity performance.

Case study description and self-assessment carried out by

This case study description and self assessment was compiled by UNEP-WCMC from a number of documents generated during the piloting of the Biodiversity Indicators for Site-based Impacts at the Kolomela mine site. Overall coordination and guidance for all piloting projects was conducted by UNEP-WCMC, with piloting at the site conducted by Fauna & Flora International and Anglo American. The development and updating of the methodology based on findings from the piloting projects was carried out by UNEP-WCMC, Fauna & Flora International, Conservation International and The Biodiversity Consultancy.

More information on the measurement approach can be found here:

https://www.unep-wcmc.org/featured-projects/biodiversity-indicators-for-site-based-impacts

Case study 11: LafargeHolcim mine Spain

Biodiversity and Ecosystem Services valuation and accounting tool associated with quarry restoration works by LAFARGEHOLCIM

GENERAL INFORMATION

Biodiversity measurement tool	**It is a tailormade approach, based on combining BIRS (Biodiversity Indicator and Reporting System, developed by IUCN) and the LBI (Long-Term Biodiversity Index, developed jointly with WWF) with a monetisation of ecosystem services. It is being developed by LAFARGEHOLCIM ESPAÑA, with the technical and knowledge support of ECOACSA and the participation of University Castilla La Mancha and local NGOs**
Company	**LAFARGEHOLCIM ESPAÑA SAU (LHE)**
Sector	BUILDING MATERIALS
Turnover	278 million euros (2019)
Date/Period of measurement (year(s))	Annual period 2019

Business application(s)

BA 1: Assessment of current biodiversity performance	The tool allows to measure biodiversity value (both habitats/species and ecosystem services (ES)) in quarry restoration projects with focus on biodiversity conservation.
BA 4: Comparing options	Through this exercise, different scenarios can be compared, i.e. the current restoration method (natural succession), the ‘traditional’ restoration method (monocultures of pines) or even the option of returning to the previous land use, i.e. agriculture.
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Monetized outcomes of environmental performance are part of the annual Integrated Profit & Loss reporting of Lafarge Holcim at corporate level. After a long ecological restoration based on natural succession, in 2019, LafargeHolcim assessed the value of the ecosystem services (ES) created.

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	At this moment, the valuation tool only has been implemented in one quarry. But it is being tested in two other quite different quarries. So, we think the valuation approach followed in this case study allows its application in any type of ecosystem where specific restoration actions take place. It can be specifically interesting for quarry rehabilitation projects.

DESCRIPTION OF THE CASE

See LafargeHolcim summary description of methodology here

Context

Until a few years ago, Lafarge Holcim (LH) used to restore quarries only after a lot of time without mining activity. The revegetation – mainly monoculture of pine trees – was executed and completed in little time (less than 2 years). However, in these cases, LH frequently detected new habitats that were occupied by interesting species and gradually initiatives were taken to support them. Now, LH applies a new concept of quarry restoration with the main objective of restoring the quarry into an important biodiversity site and thus, providing an added value in conservation that positively affects its environment and society. The approach aims at optimizing the net positive contribution to biodiversity through a process based on not only optimizing habitats and species populations but also ecosystem services. On request of LH Spain, Ecoacsa has developed a methodology for the study and valuation of ecosystem services for the restoration and rehabilitation of quarries, which has been developed and tested by applying it to the Yepes – Ciruelos case study. This project responds to LH's interest in valuing the ecosystem services generated in the restoration of its quarries, in order to achieve the goal of a positive net impact on natural capital. With the tool, it is possible to assess the existing ecosystem services in a phase prior to exploitation, during exploitation and after restoration, helping to make the best decisions in the rehabilitation processes to increase biodiversity. The objective of the approach is to attach a social dimension to the ecological restoration process, for which it develops a series of actions:

- Identification and quantification of ecosystem services, including their most prominent beneficiaries, provided by the restoration process of the quarry after its mining.
- Capturing and calculating the economic value of the ecosystem services provided.
- Valuing the social, economic and environmental benefits of the rehabilitation process from the ecosystem services approach, introducing – to the extent possible – this approach in decision-making on future restoration projects.
- Understanding, communicating and conveying the ecological, economic and social importance of the ecological restoration of quarries in the landscape context.

So far, LH has rehabilitated about 250 hectares beyond legal requirements, while the rest of mined area (about 300 ha) has to fulfill an "as usual rehabilitation model" with monocultures or simple actions of revegetation.

The rehabilitation model implemented includes an agreement with University of Castilla La Mancha to guide rehabilitation works with the aim of enhancing biodiversity. Now, the quarry has become an experimental ground for ecological restoration. As part of rehabilitation works in Yepes_Ciruelos quarry, LH decided to invest in a better knowledge of biodiversity and in promoting it through experimental actions (ex. introduction of red list species; enhance biodiversity index; promote natural succession ...), improving habitat for pollinators, creating habitats for cliff nesting bird species, creating small wetland habitats, promoting biodiversity awareness and conservation education... LH is fully aware that they need a science-based tool to be able to objectively assess and value net positive outcomes obtained through restoration actions that go beyond legal requirements and in the longer term to aggregate site level results in order to demonstrate corporate net positive impact.

Boundaries

Extent and condition of biodiversity is measured in the operational and rehabilitated part of the quarry. Ecosystem services are also measured for these same parts of the quarry (providing flows of ecosystem services) but the surrounding area which is affected by these ES flows is taken into account for the valuation approach (presence of beneficiaries). The area of the quarry with limestone reserves which is not yet operational (now with agricultural use) is not included in the measurement.

Location and scale

The quarry is located in the municipality of Yepes and Ciruelos (Toledo, Castilla-La Mancha, Spain). The total surface of the property (including area not yet in operation, i.e. orange area in Figure 1) is 939 hectares. The quarry is located at 700 m of altitude, on the geological formation known as the Mesa de Ocaña. Limestone predominates in this area and, to a lesser extent, gypsum. The surroundings of the quarry are mainly agricultural lands, where cereal, olives and vineyards are grown in a semi-arid bioclimate. The predominant natural vegetation is formed by holm oaks and kermes oak, and their different successional stages.

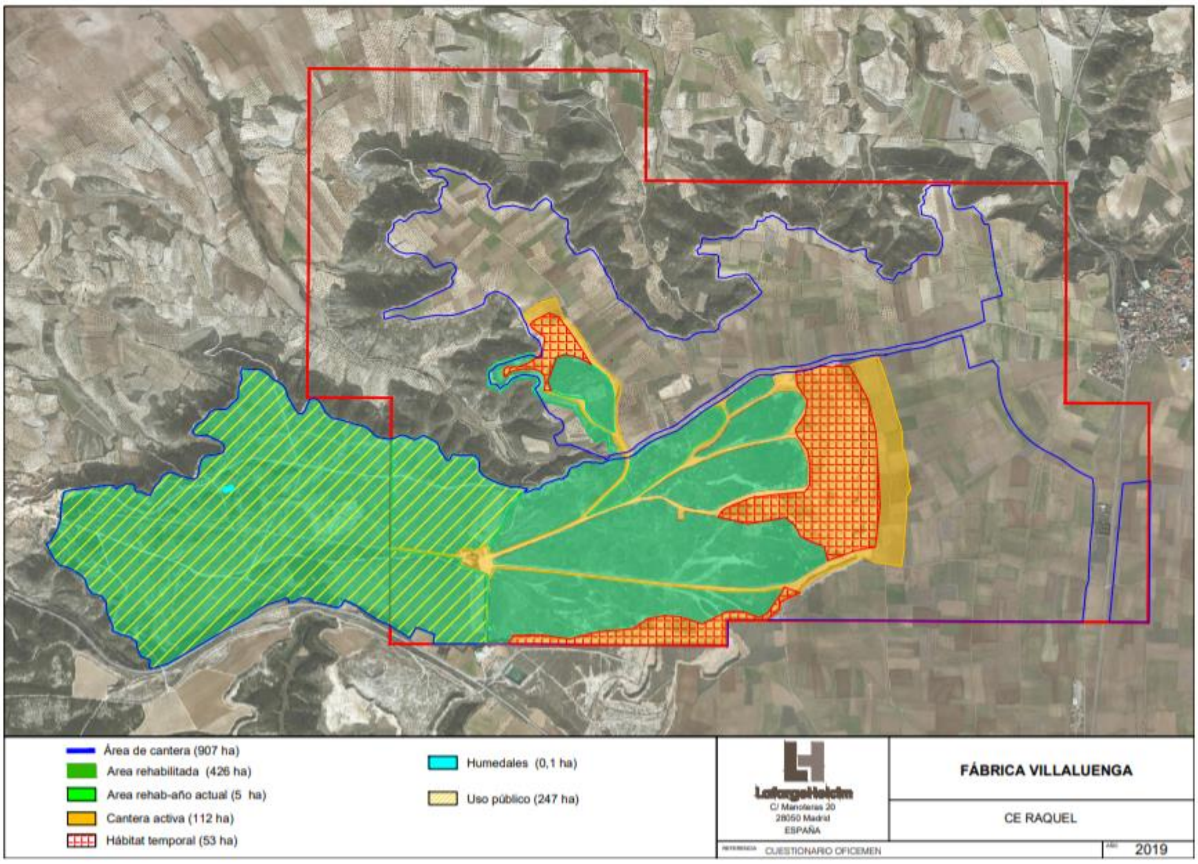


Figure 1: Yepes Ciruelos quarry with indication of active part of the quarry (yellow part), rehabilitated part (green) and total surface (blue line marks boundaries of total quarry, northern and eastern parts still in use as agricultural land)

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Before mining activity: highly human-altered environment because intensive agriculture land use. After Mining: natural vegetation succession; public use	None	None
Climate change	None	None	None
Pollution	None	None	None
Direct exploitation	None	None	None
Invasive species	None	None	None
Other	None	None	None

Collected data on economic activities, pressures, state and impacts.

Primary data	Secondary data	Modelled data
Economic data		
Rehabilitation costs // Public use facilities cost // University and NGOs agreement cost (experimental species introduction; educational sessions..) // Economic data from National Statistical Offices and market values.	Theoretical production costs of seeds // Costs for pest control	None
Challenges		
Picking up historical information around social uses and recreational activities // Information on environmental educational programs participation // Harmonized economic data on cultural values and restoration activities for monetary assessments	Few references, no endemic species market	None
Pressures		
Habitat classification based on BIRS and LBI categories. Tier 1 Habitat classification based on LULC (Corine Land use Land Cover) Tier 2 Habitat classifications based on LH information from restoration or quarries activities. Tier 3	Market species extractions CO2 absorption by forestry habitats Natural seed bank provisioning data	None
Challenges		
Develop a robust methodology to assess pest and disease control and seed dispersal ecosystem services. For these ecosystem services, science is still in development, so difficult to incorporate this into an ecosystem services assessment for initial users.	None	None
State		
Field inventories by university experts Field surveys by quarry operator with external expert	(BIRS)	
Challenges		
The need to contract external experts // Information on species density or abundancy		
Impacts		
Field inventories for measuring habitats and species	Calculation of changes in ecosystem services year after year	
Challenges		
	Data to underpin monetization are often proxies	

What was the role of qualitative information?

During a first ES assessment carried out in Yepes quarry in 2016, outcomes showed many ES value generated by restoration actions were related to provisioning services which contributed to improve local economy (such as grazing, agriculture or harvest of wild raw materials). LH Spain wanted a different approach for its restoration works to foster the generation of value based on biodiversity conservation and with the aim of achieving Net Positive Impact objectives. Therefore, provisioning services are excluded from the total monetized value.

Baseline/reference situation

The methodology was designed taking in consideration a restored quarry as baseline scenario (Scenario I). Other scenarios in this exercise are 'return to the original land use which is agriculture (Scenario II) and a more traditional rehabilitation approach fir quarries, i.e. plantation of monoculture of pine forest (Scenario III).

However, as the primary information for the assessment is based on Land Use Land Cover (LULC), future users can define additional land use scenarios according with LULC categories, each of them generating specific ecosystem services and related monetary value flows. Qualitative data should be redefined in each scenario according to proxies about the structure and composition of species to adjust ecosystem services assessment outputs.

Required efforts for the measurement

Important efforts required. Bibliographic and local expert consultation and long-term studies (University) and mapping.

Required skills to complete this exercise

Required expertise on habitat categorization and data recompilation and qualitative assessments based on BIRS and other indicators. Economic valuation of nature capital, ecosystem services mapping and on assessing local biodiversity not available in the company.

Results and application

Figure 2 gives an idea about the mapping of habitat categories, according to BIRS and refined with LBI data. Figure 3 provides a map showcasing the cumulative number of different ecosystem services provided by different spots in the quarry. The eastern part of the quarry is the part with long natural succession. It provides a higher variety of ecosystem services compared to the western side that is still in use as agricultural land. Figure 4 presents the same distribution of ecosystem services, now in terms of aggregated monetary value (excluding provisioning services!). Finally, Figure 5 presents the differences in monetary value of ecosystem services categories between scenario I and scenario III.

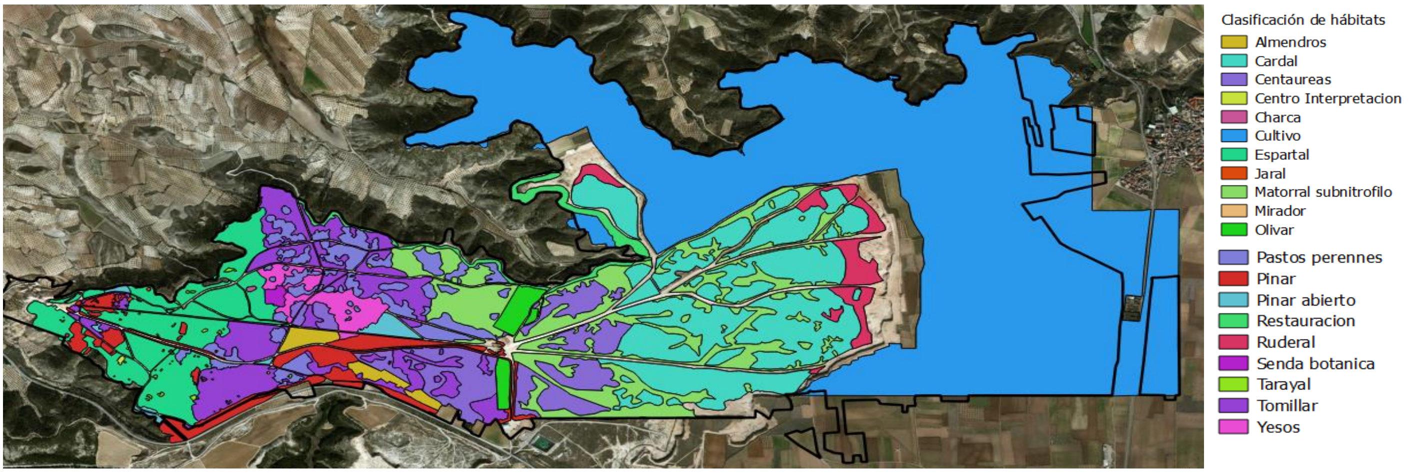


Figure 2: Overview of detailed habitat inventory, based on the LBI and BIRS approach

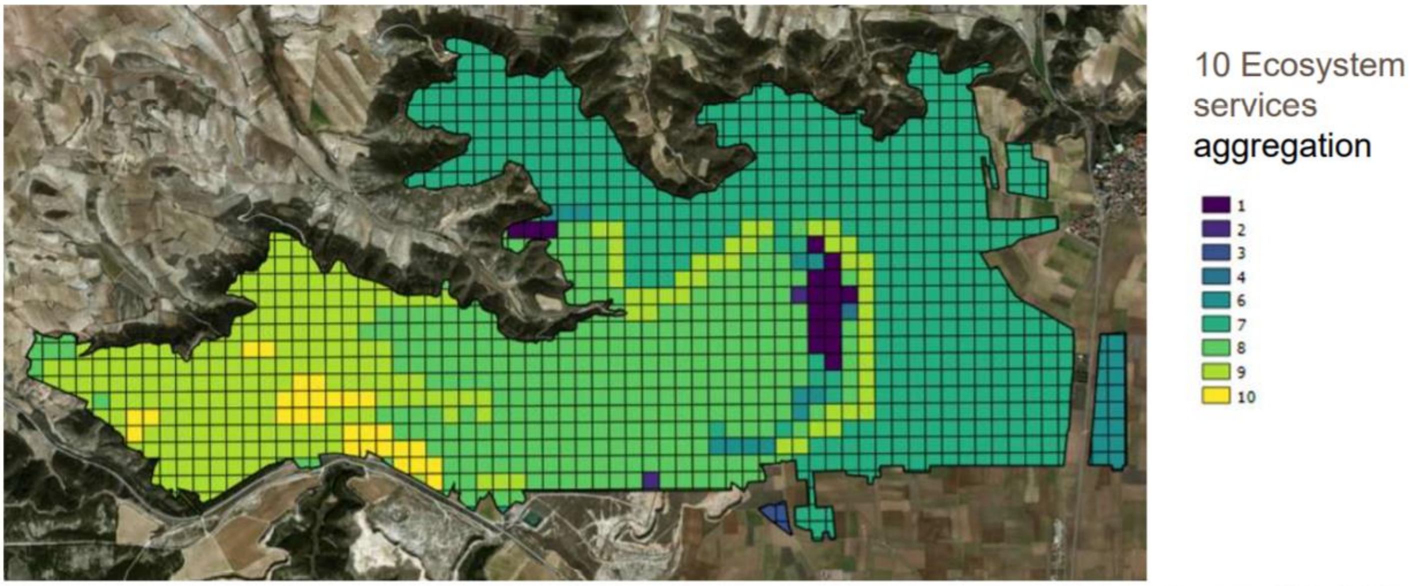


Figure 3: Cumulative number of different ecosystem services provided by different spots in the quarry

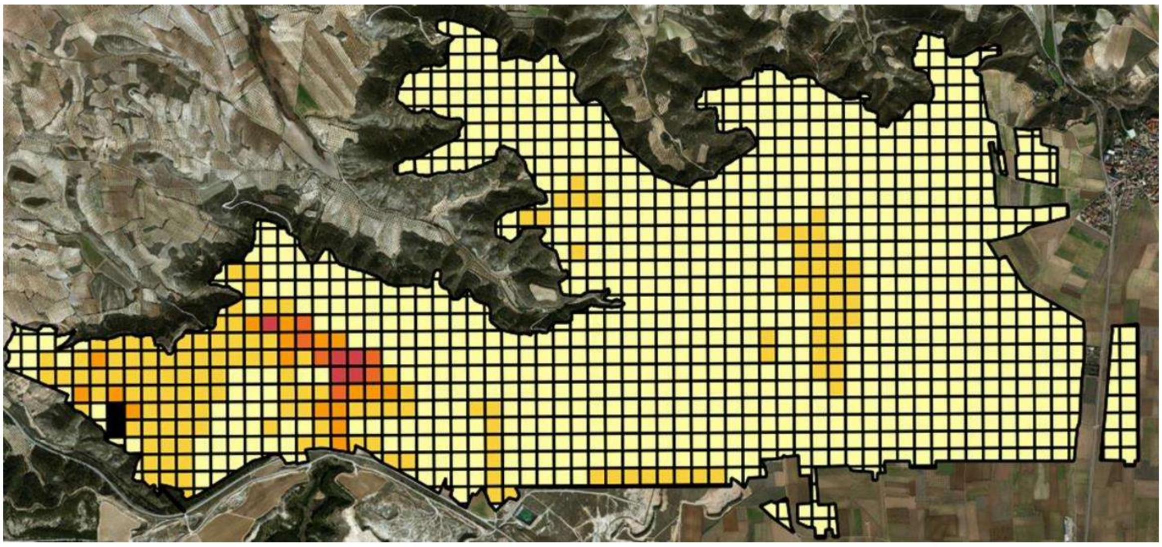


Figure 4: Aggregated monetary value of all ecosystem services identified in the restoration.

	Seed bank	CO2 absortion	Pest and diseases control	Active and Passive use	Seed dispersal	Education and Science	Legacy	Maintaining biodiversity and species extraction	Organic materia and Edafogenesis	Polinators	Fire Protection
Scenario I	↑	↑		=		↑	↑	↑	↑	↑	=
Scenario II	↓	↓		↓		↓	↓	↓	↓	↓	↓
Scenario III	↓	↑		↑		↓	↓	↓	↓	↓	↑

Scenario I: Estimation of current restoration evolution.
Scenario II: ES assessment from scenario I in an agriculture landscape under traditional exploitation management.
Scenario III: ES assessment from scenario I in a traditional restoration with perennial forest trees.

Due to the loss of habitat variety, the qualitative and quantitive value of ecosystem services modifies their values. Each restoration scenario defines different landscapes having a direct and indirect impact on species richness, social uses, and ecosystem regulation. Therefore, monospecific landscapes could reduce the quality and quantity flow of some ES due to the low variety of natural assets that can affect nature demands from society (Kay et al 2019). However, it can increase the provision of specific ES and regulation ecosystem flows. These issues have a direct impact on the economic value of natural capital, especially on those ecosystem services focussed on biodiversity values.

	Seed bank	CO2 absortion	Pest and diseases control	Active and Passive use	Seed dispersal	Education and Science	Legacy	Maintaining biodiversity and species extraction	Organic materia and Edafogenesis	Polinators	Fire Protection
Scenario I	938.254,55 €	375.605,89 €	0	327.654,04 €	0	934.129,33 €	84.141,01 €	2.831.422,30 €	7.573.987,94 €	2.638,28 €	4.915.445,94 €
Scenario III	45.437,28 €	2.510.771,86 €	0	1.330.491,24 €	0	867.819,34 €	0	169.176,43 €	1.314.128,40 €	0	7.864.713,50 €

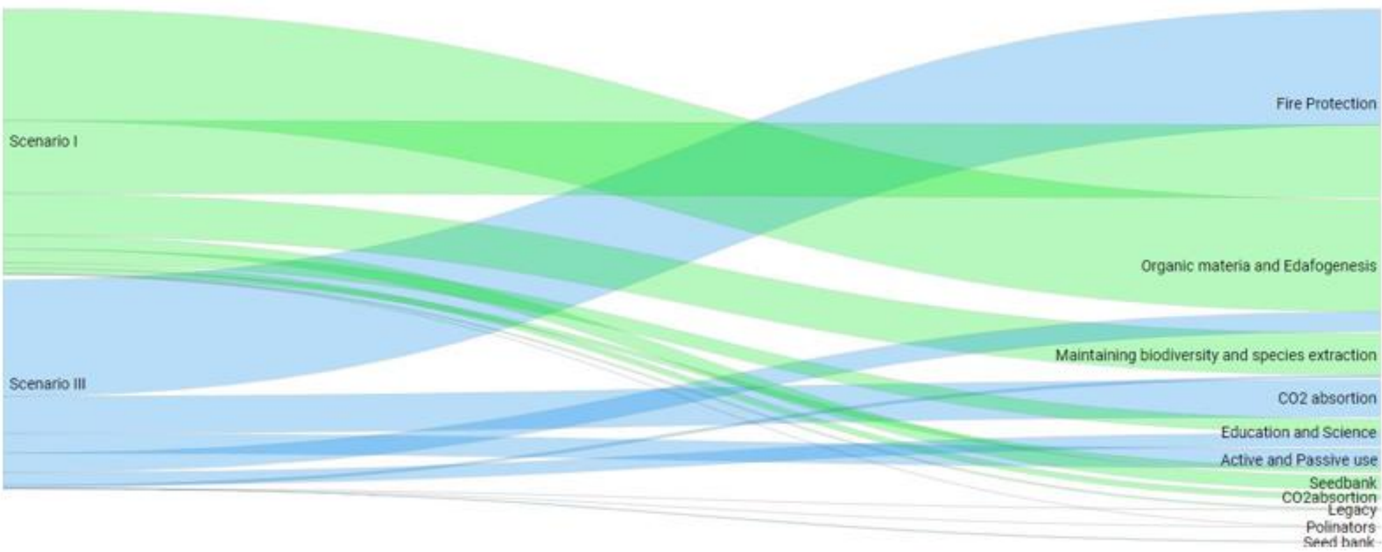


Figure 5: Scenario modeling based on different restoration structures and compositions.

Interpretation of results and impact on decision-making

From Figures 3 and 4 it's clear that older restored territorial units (left site maps) provide more ecosystem services value due to the ecosystem maturity incrementing the potential benefits flows rather than those areas restored in recent years (center of the map). This is largely due to the fact that these areas centralize all the educational activities, social uses and legacy values, which on its turn is only due to the high quality of restored nature on these sites.

Cultural interactions with nature are very important in the valuation of ecosystem services in the quarry. Therefore, the biodiversity value for society can be underestimated if restoration actions are implemented without collaboration of local stakeholders or when no access to local people is provided. It is a practical case that shows that ecosystem restoration in mining is possible and that high societal values can be obtained if local stakeholders are involved.

This LH Spain commitment is part of its strategy incorporating biodiversity as an asset to their environmental accounting within a natural capital policy. This collective work was essential to identify how restoration focused on conservation and biodiversity criteria encourages the presence and resilience of rare species or species of conservation interest, as well as generates value through cultural and regulating ecosystem services, due to the improvement of habitat conditions and the restoration of ecological and biological functions in the ecosystems.

The lessons learned through this project have served to make public authorities aware that other restoration models with a greater cost-benefit balance for private companies and for biodiversity are possible (compared to traditional monoculture).

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Assessment of specific criteria

Relevance	
Strengths	• LafargeHolcim was awarded the European Business Award for the Environment (EBAE Spanish level) for the collaborative model of quarry restoration that improves biodiversity and natural capital. • The approach has proved to be very relevant in the context of LafargeHolcim's I P&L approach at corporate level which is fed by monetary values covering also natural and social capital. Therefore, LH is interested in having monetary values for biodiversity performance. In the long run, the company aims to have these values for all their sites.
Limitations	• At this moment, these site level monetary values are only available for a very limited number of sites
Opportunities for improvement	• If the approach will be rolled out over all sites of LH, monetary values at site level can be aggregated to one figure at corporate level. The extensive application of this rehabilitation model in quarries could be a significant lever to improve biodiversity.
Completeness	
Strengths	• Biodiversity is covered both in terms of habitats and species as in terms of ecosystem services, which makes this a strong approach.
Limitations	• The approach is limited to one key pressure, which is land use. Land use change is the most relevant pressure in this specific case of an open cast quarry.
Opportunities for improvement	• Expanding the approach to other pressures e.g. GHG emissions is not the intention.

Rigor	
Strengths	• The approach combines different tools which have proved to be scientifically robust (e.g. BIRS, LBI). Moreover, academia are engaged for field surveys and for elaborating and implementing biodiversity enhancement measures. Valuation of ecosystem services is now being checked on compliance with SEEA EEA, the UN developed System for Environmental Economic Accounting – Experimental Ecosystem Accounting, although this system has been developed for country level assessments.
Limitations	• Valuation of ecosystem services has its intrinsic limitations (i.e. limitations in methodologies)
Opportunities for improvement	• Degree of certainty of outcomes will be included in future update of the approach
Replicability	
Strengths	• BIRS and LBI are both tools which are publicly available and with clearly described methodologies. So, application of these tools can be easily replicated to other sites. Valuation techniques of ecosystem services are widespread, but sometimes require decisions on assumptions. Ecoacsa has clearly described these assumptions for this case.
Limitations	• Ecosystem services valuation coefficients are often context specific. Application of this approach on other sites will require defining new context specific valuation factors.
Opportunities for improvement	•
Aggregation	
Strengths	• Monetary values of ecosystem services are aggregated into one site level figure. Aggregation of biodiversity value (LBI) and ecosystem services value is not possible but they can be displayed together in one dashboard.
Limitations	• No road-testing for demonstrating aggregation to corporate level yet
Opportunities for improvement	• Road-testing aggregation to corporate level
Communication	
Strengths	• Monetary values provide easy to understand arguments for communication in order to capture the importance of ecosystem services.
Limitations	• Many of these monetary values are virtual as the market for ecosystem services is not there yet. Virtual values are more difficult to communicate. Moreover, monetisation of nature has its limits (although LH already removed provisioning services from the calculation)
Opportunities for improvement	
User friendliness	
Strengths	
Limitations	• Although the development of a user-friendly tool was the initial idea, we are still far from this. Applying different steps of the approach requires the involvement of specialists. Mainly in the first habitat and species mapping phase, in the ecosystem service identification and selection process and providing data for monetary valuation.
Opportunities for improvement	• incorporate the methodology into a software and normalize the input data of some qualitative and economic aspects
Investment	
Strengths	
Limitations	• Application of the whole approach is time intensive and requires budget for involving external specialists.
Opportunities for improvement	

Overall assessment

The tool provided the final outputs that were intended to be expected. Nonetheless, further efforts should be implemented in order to:

- Make it easier to apply by non experts
- Make data easy to access.
- Implement a new scenario-based tool to predict future ecosystem services provided by alternative restoration measurements.

Case study description and self-assessment carried out by

Main author: Jesus Carrasco (Ecoacsa)
Collaborators: David Álvarez (Ecoacsa); Jorge Miguel Isabel Rufo (Castilla La mancha University); Santiago Sardinero (Castilla La mancha University); Jesus Gallardo (Plegadis Group)
Contractor: Pilar Gegundez (LafargeHolcim)

Case study 12: GBS Schneider Electric company

Schneider Electric's Biodiversity Footprint Assessment with the Global Biodiversity Score

GENERAL INFORMATION

Biodiversity measurement tool	**Global Biodiversity Score (GBS)**
Company	**Schneider Electric**
Sector	Manufacture of electrical equipment
Turnover	27,2 billion EUR
Date/Period of measurement ((year(s))	01/01/19 to 31/12/19

Business application(s)

BA 1: Assessment of current biodiversity performance	
BA 3: Tracking progress to targets	Schneider Electric is starting to think about a Science-Based Target (SBT) and will take its final decision on the ambition of this target in the coming months. The assessment was used to evaluate the alignment with this target. The unit MSA.km² (see summary description of tool) is indeed a metric relative to ecosystem integrity, which is being considered within the

	Science-Based Target Network (SBTN). The GBS can be used to Measure, Set & Disclose (step 3 of the SBTN Interim Guidance): measure impacts and express them in MSA.km², set a target of impact reduction in MSA.km² or in % of the footprint in a specific year (e.g. –30% compared to 2019 by 2030). It can also be used to disclose impacts regularly. On top of that, preliminary assessment of the planetary boundary for terrestrial biodiversity have been conducted and expressed in MSA (Lucas & Wilting 2018): even though these works require significant additional research, they provide the foundations to set scientifically meaningful targets.
BA 7: Screening and assessment of biodiversity risks and opportunities	Screening of the ecological integrity risks, i.e. the risks of impacting ecosystem integrity (as measured by the MSA.km² unit). In turn, risks of impacts on biodiversity translate into business risks (e.g. reputational, regulatory, financial) or possibly legal.
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Biodiversity accounting for external audited disclosure, by external auditors of non-financial information whose role is to make sure that non-financial disclosures are trustworthy.

Organisational Focus Area (site, product, supply chain, …)

OFA 5: Corporate level	Covering whole value chain from cradle to grave

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

As a global specialist in energy management and automation in more than 100 countries, Schneider Electric offers integrated energy solutions across multiple market segments. Sustainability is at the heart of its strategy, and it has recently started its biodiversity journey. For Schneider Electric, this evaluation was therefore an opportunity to quantify biodiversity risks and opportunities for reducing theses risks all along its value chain, with a global and scientific approach.

Boundaries

The perimeter of the assessment is the whole value chain (from cradle to grave). However, downstream impacts are limited to those caused by climate change, due to data and methodological limitations. As in carbon accounting, impacts of direct operations are included in Scope 1. Impacts of energy purchases are included in Scope 2. Impacts of other purchases are included in upstream Scope 3, while impacts of product life and end of life are included in downstream Scope 3.

To account for impacts lasting beyond the period assessed, impacts are split into dynamic – periodic gains/losses occurring within the period assessed – and static – persistent impacts or stock of accumulated losses.

Three overarching types of biodiversity are usually distinguished: terrestrial, aquatic (lakes, rivers, wetlands) and marine (oceans and seas). Marine biodiversity is not covered by the GBS (due to lack of scientific data) and is therefore not included in this assessment. Marine biodiversity is not considered to be a material impact of the direct operations of the electrical machinery industry (for instance ENCORE does not list any impacts on marine biodiversity for this industry). But impacts related to sea transport in its supply chain may be material.

Location and scale

The assessment is not made at the site level but at the company level, over the whole value chain. There is therefore no specific location or map. For Scope 1 alone, it corresponds to an area of over 100ha.

Types of pressures[1]

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land Use, Fragmentation, Encroachment	Wetland conversion	
Climate change	Climate Change	Hydrological disturbance due to Climate Change	
Pollution	Atmospheric nitrogen deposition, Ecotoxicity (assessed but not displayed in results).	Freshwater euthrophication, land use in catchment of rivers and wetlands, Ecotoxicity (assessed but not displayed in results)	
Direct exploitation		Hydrological disturbance due to water use	
Invasive species			
Other			

Collected data on economic activities, pressures, state and impacts[2]

Primary data	Secondary data	Modelled data
Economic data		
Turnover breakdown by industry and country (EUR); Breakdown of direct purchase by procurement category (EUR)	Purchases Tier 2 and more modelled with Global dataset from EXIOBASE Input-Output model (*1)	
Challenges		
Pressures[3]		
Land occupation (Scope 1), volumes of water consumed or withdrawn by site or by country (Scope 1) and GHG emissions (Scope 1,2,3).	Tonnage of metal ores, crude oil and woodlogs purchased; Electricity bought by country and technology, fossil fuel bought for heating.	
Challenges		
For Scope 1 land-use impacts, the evolution of the land occupation from 2018 to 2019 was unknown, only the 2019 land occupation was known. Despite a trend of declining land occupation for Schneider Electric, a conservative assumption (overestimating the impact) of no land use change was considered.	Despite the best efforts, it was impossible to know all quantities of raw material with complete accuracy – especially for fabricated products. It was especially difficult to estimate the recycled content of products. It was not possible to identify where raw material originated from and, as a result, global impact factors had to be used, instead of more precise country impact factors.	

[1] More information on the different pressures in the technical update report (CDC Biodiversité, 2020d)

[2] More information on the use of data and the methodology in the technical update report (CDC Biodiversité, 2020d) and the following critical review documents: Input output modelling (CDC Biodiversité, 2020b), terrestrial pressures (CDC Biodiversité, 2020c), freshwater pressures (CDC Biodiversité, 2020a)

[3] When pressure data is available, it is used to replace the assessment made from economic data. For some pressures (e.g. encroachment) we therefore keep the results from the evaluation made from economic data. See technical report (CDC Biodiversité, 2020d)

Primary data	Secondary data	Modelled data
State		
Challenges		
Impacts		
Challenges		

(*1) EXIOBASE is applied for all tier 2 and higher, i.e. all the purchases of the suppliers, and their purchases, and so on. All countries. EXIOBASE has data until 2011 but GBS application in 2019 assumes a similar structure of the economy as in 2011, cf.GBS technical report.

What was the role of qualitative information?

Studying the impact of recycling, but also the impact of a FSC certification allowed us to have a better vision in order to consider which targets should be set (the target setting process is still ongoing in December 2020). The share of recycled content and share of FSC certified for wood and metals, allowed us to have a better idea of the real impact, since the potential impact had been calculated considering 0% recycled content or FSC certified content. We were therefore able to estimate which targets would be realistic. Since in reality the impact of Schneider Electric is already lower than the calculated one, we estimated how much the impact could be reduced by increasing the share of recycled content and certified content.

Baseline/reference situation

The reference state against which 100% Mean Species Abundance (MSA) is defined, is the undisturbed state (by definition of the MSA metric). This is a totally different concept from the baseline situation. At this stage, since it is the first evaluation of Schneider Electric's activities, there is no baseline. For next assessments, the baseline will be 2019's results.

Required efforts for the measurement

The assessment required about 40-80 mandays from the consultants (CDC Biodiversité and PRé) and about as much from Schneider Electric. Data collection took a significant share of the time, as did the interpretation of results and the exploration of options to reduce impacts. The appropriation of a few new concepts (dynamic, static, aquatic, terrestrial, etc.) by the Schneider Electric teams took time. Furthermore, the fact that the entire value chain is covered implies a large number of figures (4 figures, dynamic aquatic, dynamic terrestrial, static aquatic, and static terrestrial, for Scope 1, Scope 2, Tier 1 of Scope 3, Rest of Upstream Scope 3 , etc.) so it takes time to come up with clear ideas about business performance and reduction options.

Required skills to complete this exercise

A specialised consultant and employees from Schneider Electric have followed a two days training about the GBS.

Results and application

All detailed results can be found in the White Paper on this case study[4] . The figures below only provide some of the relevant outcomes.

Figure 1 presents Schneider Electric's **terrestrial dynamic footprint**. The share of the impact due to climate change is important in the dynamic footprint because the company has a low use of biomass and therefore the impact related to other pressures is limited. There is no land use conversion in Scope 1, therefore the dynamic impact related to Land Use pressure is null in Scope 1. In the static impacts, the shares of impacts due to land use as well as other pressures are more

[4] https://download.schneider-electric.com/files?p_File_Name=Schneider+Electric+Biodiversity+White+Paper+-+September+2020.pdf&p_Doc_Ref=WPBiodiversity&p_enDocType=White+Paper

important. The avoided impacts related to the use of recycled material have not been quantified (qualitative analysis) and are therefore not shown in this graph.

Figure 2 (terrestrial dynamic) and **Figure 3 (aquatic static)** provide orders of magnitude of the **impact intensities** (impact per unit of turnover in MSAm2/kEUR) **through a "green light" system**. They display the impact intensities of an "average company" globally (Global average) and of the Manufacture of electrical machinery and apparatus n.e.c. (not elsewhere classified) industry (Industry average), to which Schneider Electric belongs. The current knowledge on aquatic static impacts (Figure 3) is more limited, and figures are more uncertain.
The figures aim to give some context to understand the performance of the industry and of Schneider Electric, and to provide some background figures on what can be considered high, or low impact intensities. This is a representation we will be using very often so it will become familiar to people. The green area on the figures is the one towards which the company should tend. 'Positive impacts on biodiversity' include avoided impacts but could also include actual gains. The amber area represents an average performance (which is not satisfactory and still causes biodiversity loss). The red area is associated with high impact intensities, which correspond to companies causing significant harm to ecosystem integrity. The boundaries of the greenlight system are set as follow: the red threshold (20 MSAm2/kEUR for terrestrial dynamic impacts, 300 MSAm2/kEUR for aquatic static impacts) is an empirical limit observed by CDC Biodiversité between sectors with very high impacts (extraction, agriculture with deforestation, etc.) and sectors with lower impacts. But of course, different sectors have different impact intensities and some sectors still have to reduce their impacts, even if their aquatic static impact intensity is below 300 MSA.m2/k€.

In **Figure 2 (terrestrial dynamic intensity)**, for Scope 1, Schneider Electric's impact intensity per unit of turnover is 0.03 MSA.m2/kEUR, against a 2011 global sectoral benchmark of 0.06 MSA.m2/kEUR. This sectoral (Manufacturing of electrical machinery and apparatus) benchmark is itself very low compared to the global benchmark of 2 MSA.m2/kEUR, which is driven mainly by raw material extraction and production industries, such as agriculture, logging or extractive industries. However, the upstream impacts are more significant and amount to 0.04 MSA.m2/kEUR for Scope 2, and 1.7 MSA.m2/kEUR for upstream Scope 3. The impact intensity of a hypothetical "vertically integrated" Schneider Electric (summing across Scopes 1, 2 and 3 upstream) amounts to 1.7 MSA.m2/kEUR. This compares to a benchmark for a vertically integrated manufacturer of electrical equipment of 4.9 MSA.m2/kEUR.

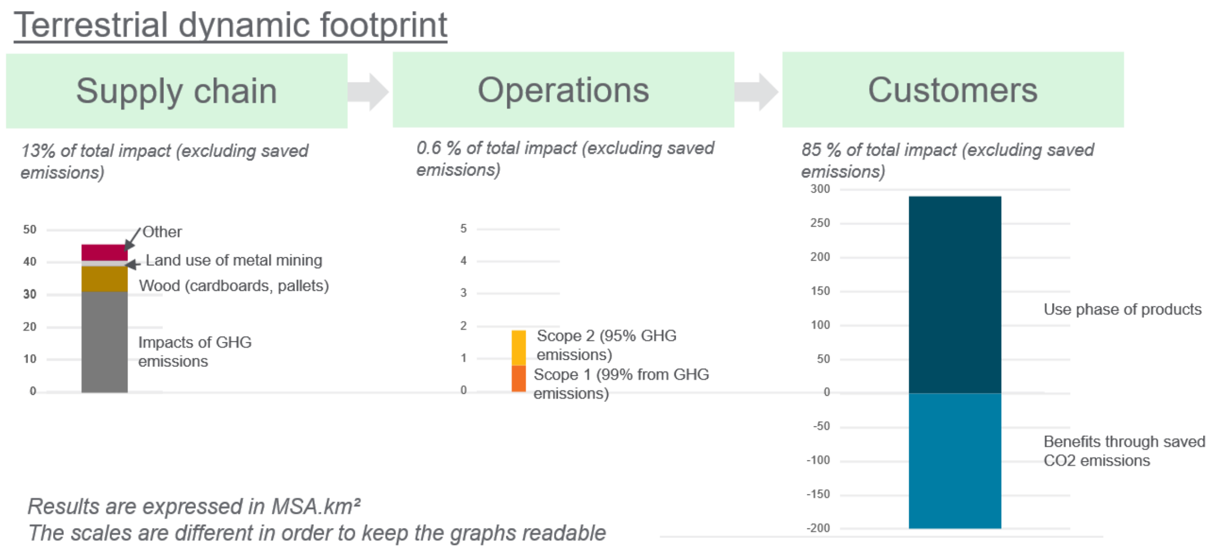


Figure 1 SE_terrestrial_dynamic_footprint

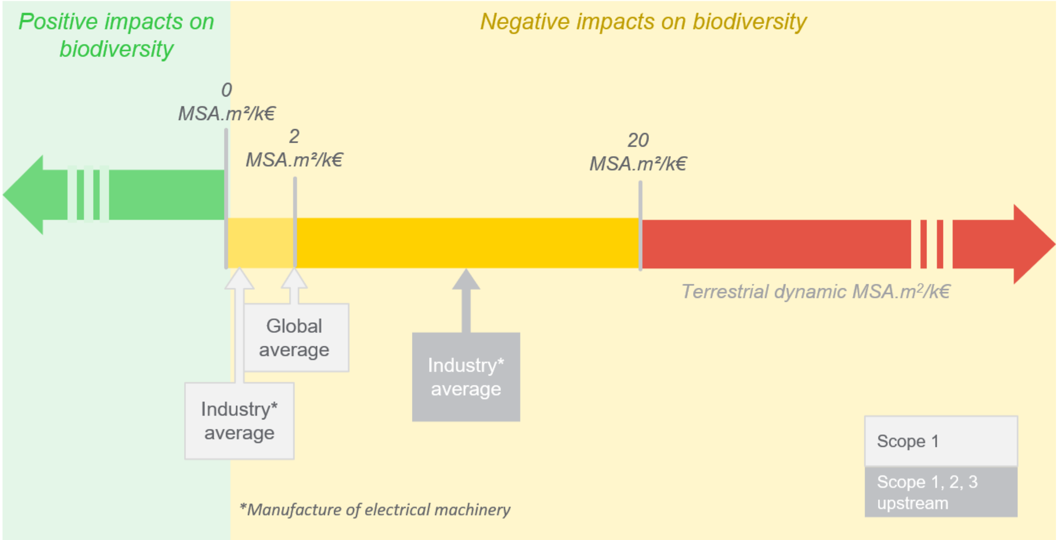


Figure 2 SE_terrestrial_dynamic_greenlight

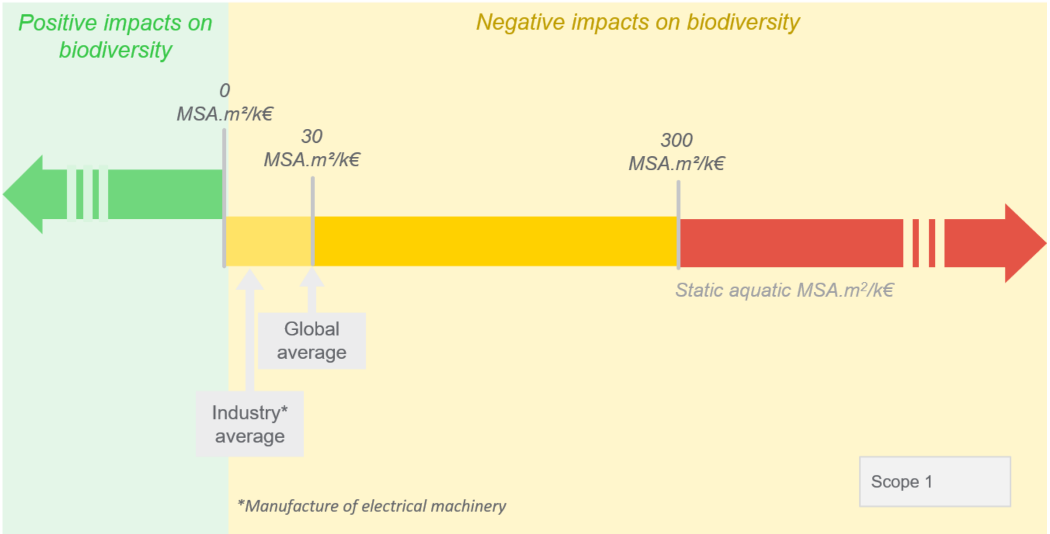


Figure 3 SE_aquatic_static_greenlight

Interpretation of results and impact on decision-making

The results (in the White Paper) show that the most significant part of impacts occurs within downstream Scope 3, which, for Schneider Electric, is due to the CO2 emissions during the use phase of its products. Looking at the craddle to gate footprint, 98% of impacts are caused by the supply chain which is consistent with the industrial role of a manufacturer such as Schneider Electric, ultimately reliant on the extraction of raw materials. For Schneider Electric, climate change is a key driver of biodiversity (dynamic) loss. Within non-climate upstream Scope 3 impacts, wood logs represent about 56% of terrestrial dynamic impacts. For Schneider Electric, wood logs are mainly embedded within cardboard and pallets, with 96% coming from recycled or certified sources. In the assessment however, an average, non-certified, wood was considered and the impacts are likely to be over-estimated as certification can in some cases lead to lower impacts. In any case, further engagement with suppliers will be necessary to obtain assurances of low impacts on biodiversity, as current certifications appear too flexible to ensure systematic reduction in biodiversity impacts. Lastly, Mining of metals represents 17% of non-climate terrestrial dynamic impacts (and 43% of non-climate terrestrial static impacts). At Schneider Electric, the metal with the highest impact on biodiversity (both in extraction and transformation phase) is copper and specific actions with suppliers all along the supply chain are needed to reduce those impacts. (Schneider Electric & CDC Biodiversité, 2020)

Those outcomes from the GBS allowed Schneider Electric to take some decisions and set some goals: besides working on local biodiversity on sites, they aim at avoiding and reducing impacts in their supply chain. Profound transformations are needed, in the way they design their products to allow for more recycled materials. The main areas of action will be, as shown by the results of the assessment, GHG emissions, wood, and mining (both through increased recycling and better mining practices and certifications). Although there are many challenges ahead and high uncertainties, they wish to influence beyond their operational scope, where most of the cradle-to-gate impacts occur.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The need of Schneider Electric was to conduct the first stage of a biodiversity footprint assessment for external audited disclosure, to understand its current impact at the corporate level and explore possible targets. This business application is the core use of the GBS. The methodology allows to use the best available data. When available, impacts calculated from pressure data (e.g. land use) or from inventory data (e.g. GHG emissions) will indeed replace impacts calculated from economic data. It therefore takes into account the business context.
Limitations	• For this sector, a substantial part of the impact lies in Scope 3 upstream. Better data on pressures caused by suppliers all along the supply chain are needed to properly assess their impacts.
Opportunities for improvement	• The most material impacts of Schneider Electric have been identified. It allows us to know which data to collect for next assessment in order to better assess Schneider Electric's impacts.
Completeness	
Strengths	• The GBS currently covers direct operations and upstream impacts (cradle to gate) on terrestrial and aquatic (freshwater) biodiversity.
Limitations	• The Mean Species Abundance (MSA) metric does not cover the risk of extinction of species, nor the degradation of the diversity of genes. The GBS also does not cover marine biodiversity, or some pollution types such as plastic waste. Regarding marine biodiversity, the electronic equipment & instruments sector has no impact on marine biodiversity in ENCORE (https://encore.naturalcapital.finance/en/explore) but it is likely that low to moderate materiality impacts exist in its value chain (especially maritime transport).
Opportunities for improvement	• As metrics and approaches to cover impacts on species extinction and genes mature, Schneider Electric will seek to integrate that data into its biodiversity strategy. Locally, sites can use IBAT tool to gain knowledge on protected areas and species close by. Furthermore, as the GBS evolves, future evaluations will be more complete.

Rigor	
Strengths	• The robustness and transparency of the tool are reinforced by an external GBS critical review committee. Two panels were set up to conduct "critical review" of the GBS in 2020 (the review was completed in early 2020). Their goals were complementary. The expert panel verified the consistency and quality of the tool (assumptions, data, uncertainty, etc.), suggested improvements and assisted in the testing of the software component of the GBS. The stakeholder panel assessed the consistency of the GBS tool with existing public policies related to corporate biodiversity and with existing tools. The experts panel includes half a dozen international scientific experts among which are members of the World Conservation Monitoring Centre (UNEP-WCMC), the French Geological Survey (BRGM), the Food and agricultural Organisation (FAO), the French National Institute of Agricultural Research (INRA), and Senckenberg Biodiversity and Climate Research Centre in Germany. The stakeholders panel is constituted of entities from NGOs, platforms and institutions playing a key role in the post-2020 biodiversity framework and international corporate biodiversity discussions. They include the Directorate-General Environment of the European Commission, EY, the WWF, the Foreign Economic Cooperation Office (FECO) of the Chinese Ministry of Ecology and Environment, the International Union for Conservation of Nature (IUCN), the CBD, the Natural Capital Coalition, the International Finance Corporation (IFC) and Finance for Tomorrow. • The quality of impact factors associated to data inputs is explicitly flagged in input files through a data quality tier system. • Furthermore, companies may seek auditors to provide quality checks on their 'biodiversity footprint assessment', and CDC Biodiversité thus plans to introduce a "GBS verified" service in 2021 or later to provide such quality assurance with partner auditors.
Limitations	• Uncertainties in the assessment of impacts are higher for freshwater (or aquatic) biodiversity than for terrestrial biodiversity and the freshwater impact assessment should thus be considered more as a compass, pointing at the direction to follow to reduce impacts.
Opportunities for improvement	• This first end to end evaluation allowed CDC Biodiversité to see where improvement in the tool should be made and for Schneider Electric, where more precise data should be gathered. For example, the user friendliness of the input files has been improved since the evaluation, but also the graphical outputs such as the greenlight system is a need that has been identified during the evaluation with Schneider Electric.
Replicability	
Strengths	• The GBS and its underlying assumptions are transparent (publication of 11 technical reports explaining how impact factors are built, each report having been externally reviewed) and the impact factor used for each data input has been transparently displayed to Scheider Electric. A technical note for the assessment has also been drafted.
Limitations	• Even if the impact factors (MSA.m2/t) are clearly visible to users in the tool, tracing calculations is not yet available without expert use of the GBS (involving code knowledge). Tracing of calculations (like seeing equations in Excel) will be available to non-expert in the future.
Opportunities for improvement	• The assessment has been an opportunity to highlight the need to display the impact factors used to calculate impacts: an Excel file has been produced and future developments will mean this information is routinely displayed for all assessments.

Aggregation	
Strengths	• Data are available at different geographical or organisational level. After processing by the GBS, impacts expressed in MSA.km² are obtained at the same level. They are then aggregated at the corporate level. Aggregation is at the core of the GBS.
Limitations	
Opportunities for improvement	
Communication	
Strengths	• The MSA measures biodiversity intactness relative to its abundance in undisturbed ecosystems. A 100% ratio indicates an intact ecosystem while damages caused by an increase of pressures brings the MSA progressively to 0% when all originally occurring species are extinct in the ecosystem. The gradual deterioration from a pristine ecosystem to a completely artificialized space is • easily understandable for non experts.
Limitations	• MSA.km² is not yet widespread
Opportunities for improvement	• MSA.km² can help track progress with the “ecosystem integrity” target of the current CBD Zero draft. The dynamic impacts for instance equates the changes in the “Bending the curve” or the no net loss, +5% or +20% ecosystem integrity in the CBD Zero Draft.
User friendliness	
Strengths	• The GBS works with data currently available for companies (but with accuracy in line with the quality of the data inputs) and the outputs met the needs of Schneider Electric. Furthermore, a dozen of consultancies are already trained to use the tool and able to help companies. There is also a clear framework and support ecosystem with CDC Biodiversité.
Limitations	• 3 days of training are needed for evaluators, 1 day for users. R and RStudio are needed to be able to calculate with the GBS (for the evaluator not for the user), but no R knowledge is needed. Application of the GBS usually requires support by consultant. The user interface is currently relatively simple.
Opportunities for improvement	• The user interface can be refined.
Investment	
Strengths	• It is very compatible and in synergy with the carbon balance, water balance, etc. approaches. already engaged by companies. The data required is mostly already available in existing • reporting and environmental declarations.
Limitations	• The assessment required about 40-80 mandays from the consultants (CDC Biodiversité and PRé) and about as much from Schneider Electric.
Opportunities for improvement	

Overall assessment

This case study constitutes the core business application of the GBS.

Overall, the GBS has achieved what it promised to do: quantify the global and end-to-end biodiversity footprint of a large corporation. By providing relevant metrics, the GBS has proven its ability to provide a guide for companies to define meaningful biodiversity strategies.

Case study description and self-assessment carried out by

Sibylle Rouet Pollakis (CDC Biodiversité)

More information on the measurement approach can be found here:

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

Case study 13: GBS BIA application with C4F

Carbon4 Finance biodiversity footprint database using the Global Biodiversity Score

GENERAL INFORMATION

Name of biodiversity measurement tool	**Biodiversity Impact Analytics (BIA) database (application of the Global Biodiversity Score)**
Name of company	**Carbon4 Finance**
Sector	All sectors
Turnover	Not applicable
Date/Period of measurement (year(s))	BIA database released in year n is based on company data for year n-1

Business application(s)

BA1: Assessment of current biodiversity performance	
BA 3: Tracking progress to targets	BIA can be used to track progress relatively to international targets (bending the curve, no net loss...). The MSA.km2 is indeed a metric relative to ecosystem integrity, which is being considered within the Science-Based Target Network (SBTN). The GBS can be used to Measure, set & disclose (step 3 of the SBTN Interim Guidance): measure impacts and express them in MSA.km2, set a target of impact reduction in MSA.km2 or in % of the footprint in a specific year (e.g. –30% compared to 2019 by 2030). It can also be used to disclose impacts regularly. On top of that, preliminary assessment of the planetary boundary for terrestrial biodiversity have been conducted and expressed in MSA (Lucas & Wilting 2018): even though these works require significant additional research, they provide the foundations to set scientifically meaningful targets.
BA 4: Comparing options	BIA analysis is available at portfolio level to compare the portfolio's impact with its benchmark and at company level to compare the company's impact with its sectoral peers.
BA 5: Assessment / rating of biodiversity performance by third parties, using external data	Core application
BA 7: Screening and assessment of biodiversity risks and opportunities	Screening of the ecological integrity risks at a portfolio level, i.e. the risks of impacting ecosystem integrity (as measured by the MSA.km² unit). In turn, risks of impacts on biodiversity translate into business risks (e.g. reputational, regulatory, financial) or possibly legal.
BA 8: Biodiversity accounting for internal reporting and/or external disclosure	Users can track and report biodiversity impact of their investments for listed assets (equities, corporate bond and sovereign bonds).

Organisational Focus Area (site, product, supply chain, …)

OFA 5: Corporate level	
OFA 6: Sector level	Portfolio level

DESCRIPTION OF THE CASE

See summary description of Global Biodiversity Score here

Context and specifics of Biodiversity Impact Analytics (BIA)

Launched in 2016 and based in Paris, Carbon4 Finance offers a complete set of climate data solutions covering both physical risk (CRIS Methodology: Climate Risk Impact Screening) and transition risk (CIA Methodology: Carbon Impact Analytics). These proprietary methodologies allow financial organisations to measure the carbon footprint of their portfolio, assess the alignment with a 2°C-compatible scenario and measure the level of risks that arise from events related to climate change. Carbon4 Finance applies a rigorous "bottom-up" research-based approach, which means that each asset is analysed individually and in a discriminating manner.

For climate data, they cover main equities and fixed income market indices (MSCI World, S&P 500, STOXX 600, BB EURO aggregate IG Index). Together with CDC Biodiversité, Carbon4 Finance leverages on their climate expertise and data to build a dataset of biodiversity footprints for investors using the Global Biodiversity Score (GBS).

More precisely Carbon4 Finance provides company specific data of two types: turnover amount and split by economic sector (based on the CRIS existing database) and countries and GHG emissions (all scopes, based on the CIA existing database). This data is then plugged in the GBS model. In this case, for all pressures except climate change, pressure amounts are estimated based on a combination of EEMRIO model (Exioabse) and CDC Biodiversité's commodity impact factors. Pressure amounts are then translated into potential impacts using GLOBIO pressure-impact relationship.

So, BIA is a database built from a combination of company data provided by Carbon4Finance and GBS methodology provided by CDC Biodiversité.

Boundaries

The perimeter of the biodiversity footprints is the whole value chain (from cradle to grave). However, downstream impacts are limited to those caused by climate change (when material), due to data and methodological limitations. As in carbon accounting, impacts of direct operations are included in Scope 1. Impacts of energy purchases are included in Scope 2. Impacts of other purchases are included in upstream Scope 3, while impacts of product life and end of life are included in downstream Scope 3.

To account for impacts lasting beyond the period assessed, impacts are split into dynamic – periodic gains/losses occurring within the period assessed – and static – persistent impacts or stock of accumulated losses.

Three overarching types of biodiversity are usually distinguished: terrestrial, aquatic (lakes, rivers, wetlands) and marine (oceans and seas). Marine biodiversity is not covered by the GBS (due to lack of scientific data) and is therefore not included in the dataset. This limitation will be highlighted for sectors where marine biodiversity impact is significant such as fishery or seafood related businesses.

Location and scale

The assessment is not made at the site level but at the company level, over the whole value chain. Impacts are broken down at the country level.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land Use, Fragmentation, Encroachment	Wetland conversion	
Climate change	Climate Change	Hydrological disturbance due to Climate Change	
Pollution	Atmospheric nitrogen deposition, Ecotoxicity (assessed but not displayed in results).	Freshwater eutrophication, Land use in catchment of rivers and wetlands, Ecotoxicity (assessed but not displayed in results)	
Direct exploitation		Hydrological disturbance due to water use	
Invasive species			
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
For each company assessed: turnover breakdown by industry and country (EUR) from Carbon4 Finance (CRIS database)		
Challenges		
Pressures		
For each company assessed: GHG emissions (Scope 1,2,3) from Carbone4 Finance (CIA database)		
Challenges		
State		
Challenges		
Impacts		
Challenges		

What was the role of qualitative information?

No qualitative information is used to complement the quantitative data used to assess the biodiversity footprint at this stage.

Baseline/reference situation

The reference state against which 100% MSA is defined, is the undisturbed state (by definition of the MSA metric). This is a totally different concept from the baseline situation. At this stage, since it is the first dataset release, there is no historical reference. For next releases, the baseline will be 2019's dataset.

Required efforts for the measurement

The development of the dataset requires time and resources from Carbon4 Finance and CDC Biodiversité. However, the use of the dataset is effortless for end users in a sense that biodiversity footprint is directly accessible without any extra data needed other than company identification number (such as ISIN Code, LEI or Ticker).

The web interface will allow users to explore results at company and portfolio levels. Even though accessing biodiversity footprint figures is straightforward, fully understanding results, underlying concepts and assumptions requires some time and possibly training. An annual fee will be required to access the database.

Required skills to complete this exercise

We recommend dataset users to study GBS methodology fundamentals in order to better understand the biodiversity footprints figures. Numerous options are available: CDC Biodiversité's publicly available reports and videos, commercial webinars or trainings.

Results and application

Figure 1 is a visual of the user interface which will be available for BIA users on C4F web platform. Users can set up a portfolio composed of various listed equities, then results can be explored at the portfolio or the company level. An example of the exploration interface is given with McDonalds (Figure 1). Underlying raw data can be downloaded in an Excel form.

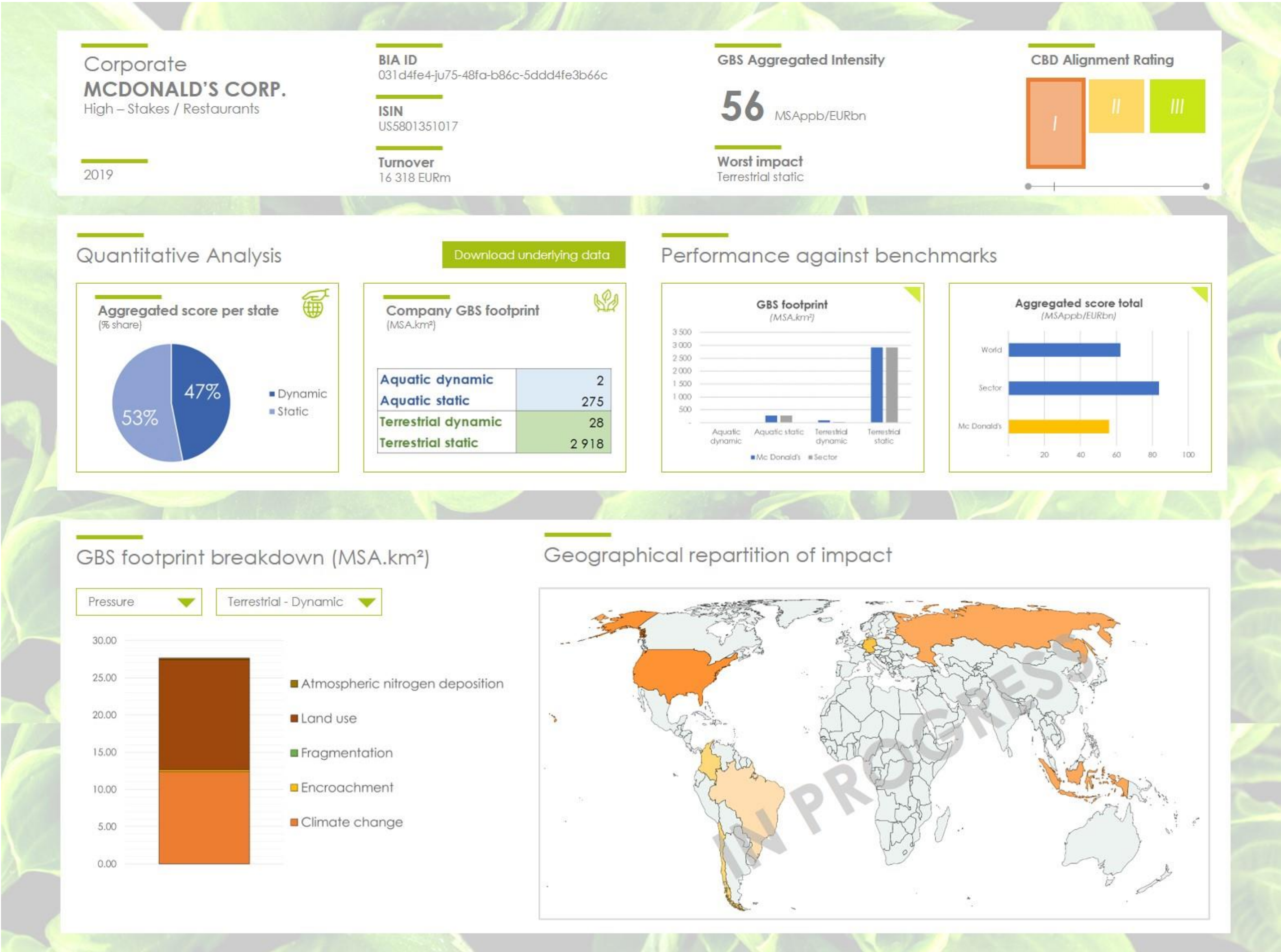


Figure 1 Example of exploration interface

Figure 1: Example of exploration interface

GBS Aggregated intensity: Results are expressed using MSA parts per billion (MSAppb) in order to combine terrestrial and aquatic impacts. The graphs showing the aggregated score for dynamic and static seem not to be in line with the absolute figures in the second image (GBS footprint) as these show a much lower percentage of dynamic impact than the pie chart on the left suggests. However, this is due to the fact that for combining a dynamic and static impact, a 50 years recovery time is assumed for static impacts which is reflected in the formula for GBS aggregated intensity below:

$$\begin{aligned}&\boldsymbol{GBS\ aggregated\ intensity}\\&\quad = \frac{\mathbf{1}}{\boldsymbol{Enteprise\ value}}\\&\quad\times\left(\frac{\mathbf{1}}{\boldsymbol{Terrestrial\ global\ surface}}\left[\boldsymbol{Dynamic}_{\boldsymbol{MSA.km^2}}^{\boldsymbol{terrestrial}}+\frac{\mathbf{1}}{\mathbf{50}}\boldsymbol{Static}_{\boldsymbol{MSA.km^2}}^{\boldsymbol{terrestrial}}\right]\right.\\&\quad\left.+\frac{\mathbf{1}}{\boldsymbol{Aquatic\ (freshwater)\ global\ surface}}\left[\boldsymbol{Dynamic}_{\boldsymbol{MSA.km^2}}^{\boldsymbol{aquatic}}+\frac{\mathbf{1}}{\mathbf{50}}\boldsymbol{Static}_{\boldsymbol{MSA.km^2}}^{\boldsymbol{aquatic}}\right]\right)\end{aligned}$$

CBD Alignment rating: this visual is not stabilized yet as CBD target has still to be defined. In this version we suggest a red-light type visual where green is “compatible with the target”, yellow “close to the target” and red “incompatible with the target”

Interpretation of results and impact on decision-making

As BIA is still under development, we cannot yet give a feedback on how it is used. BIA, in its first version, is relevant to identify biodiversity risks at a portfolio level. It is an interesting first step in mainstreaming biodiversity for investors in a quantified way:

- they can understand the concepts and key drivers by applying a footprint methodology on their portfolio,
- they can prioritize their analysis effort and engagement process starting with companies where potential impacts are the highest relatively to their portfolio exposure,
- they can also understand the limitations in terms of granularity and hopefully call (and invest) for a more sophisticated database feed by more granular data in order to extend the potential applications.

BIA database and interface are still under development and several improvements could be included in the final version. The interface will allow users to explore the results either at the portfolio and at the company level. An example of this exploration tool is given for McDonalds. Main functionalities, for both companies and portfolios, are:

- global aggregated score in MSAppb*/b€ combining the 4 combination of terrestrial/aquatic and dynamic/static,
- a rating relative to the alignment to international target (to be defined),
- a breakdown of the score between static and dynamic impacts,
- a breakdown of absolute impacts in MSA.km² for the 4 combination of terrestrial/aquatic and dynamic/static,
- performance relatively to sectoral and global benchmarks,
- absolute impacts breakdown per scopes or pressures,
- Country location of impacts (estimated),
- link to download associated raw data.

This information will help users to understand biodiversity impacts of their investments, where they come from (sector, company, pressure, scope, location), how they perform relatively to benchmarks and if they are aligned with international targets, in order to report their biodiversity impact or to integrate it into their investment decision process.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The large coverage of the dataset allows investors to get a full picture of their portfolios' footprint, allowing them to identify risks and track performance
Limitations	• The footprints are computed based on sectoral financial data and carbon data. Therefore, company footprints are at this stage estimates and not fit for one-on-one comparisons, especially within the same sector.
Opportunities for improvement	• Dataset will be improved in the future leveraging on Carbon4 Finance expertise on bottom-up approach (collecting company-specific data at the site or company level). More and more physical data on pressures and raw materials will be collected and integrated in the footprint results, making them more precise and more granular.
Completeness	
Strengths	• BIA currently covers cradle to grave impacts for climate change pressure, it only covers direct operations and upstream impacts (cradle to gate) on terrestrial and aquatic (freshwater) biodiversity for all other pressures.
Limitations	• The MSA does not cover the risk of extinction of species, nor the degradation of the diversity of genes. The GBS also does not cover marine biodiversity, or some pollution types such as plastic waste
Opportunities for improvement	• As metrics and approaches to cover impacts on species extinction and genes mature, BIA dataset could integrate that data. Also, a line by line qualitative analysis will be provided to identify high risks for those topics. Furthermore, as the GBS evolves, future evaluations will be more complete and might involve spatial data.
Rigor	
Strengths	• The robustness and transparency of the tool are reinforced by a GBS independent critical review committee. Two panels were set up to conduct “critical review” of the GBS in 2020 (the review was completed in early 2020). Their goals were complementary. The expert panel verified the consistency and quality of the tool (assumptions, data, uncertainty, etc.), suggested improvements and assisted in the testing of the software component of the GBS. The stakeholder panel assessed the consistency of the GBS tool with existing public policies related to corporate biodiversity and with existing tools. The experts panel includes half a dozen international scientific experts.
Limitations	• Uncertainties in the assessment of impacts are higher for freshwater (or aquatic) biodiversity than for terrestrial biodiversity and the freshwater impact assessment should thus be considered more as a compass, pointing at the direction to follow to reduce impacts.
Opportunities for improvement	

Replicability	
Strengths	• Users have access to global level as well as intermediary levels to facilitate interpretation. For each company impacts can be broken down by region, pressure, scope or raw material.
Limitations	• BIA does not display GBS impact factors used to calculate impacts.
Opportunities for improvement	• GBS impact factors for financial data (at the sector and region level) will be available soon as CDC Biodiversité is working on sectoral benchmarks guides including them
Aggregation	
Strengths	• Data are available at the company level and can be aggregated at the portfolio level. Even aquatic and terrestrial data are aggregated using MSAppb, see complementary information
Limitations	•
Opportunities for improvement	• In the future, with the integration of bottom-up collected data, it will be possible to compare the biodiversity impact of one company amongst its sectoral peers (namely qualitative information like the strategy and governance of the company regarding biodiversity impact).
Communication	
Strengths	• The MSA measures biodiversity intactness relative to its abundance in undisturbed ecosystems. A 100% ratio indicates an intact ecosystem while damages caused by an increase of pressures bring the MSA progressively to 0% when all originally occurring species are extinct in the ecosystem. The gradual deterioration from a pristine ecosystem to a completely artificialized space is easily understandable for non experts.
Limitations	• MSA.km2 is not yet widespread
Opportunities for improvement	• GBS allows to address targets expressed in CBD Zero draft. The dynamic impacts for instance equate the changes in the “Bending the curve” or the +20% ecosystem integrity in the CBD Zero Draft
User friendliness	
Strengths	• C4F will integrate BIA dataset to all its analysing tools so that end users will benefit from the same experience as for climate data. On CDC Biodiversité's side, there is a clear framework and support system. Training are available for a fee to better understand GBS methodology concepts, strengths and limitations.
Limitations	• Methodology can be seen as complex even though trainings are available. An annual fee is required to access the database.
Opportunities for improvement	• The user interface can be refined to integrate biodiversity specificities relatively to climate change.
Investment	
Strengths	• Dataset is ready to use, no additional data collection effort is required.
Limitations	• Time might be needed to get familiar with GBS methodology and correctly interpret the results. An annual fee is required to access the database.
Opportunities for improvement	

Overall assessment
This dataset is a first version of the large scale application of the GBS for investors. A testing phase is planned before the official launch in Q2 2021.

Overall, BIA has achieved what it promised to do: quantify the global and end-to-end biodiversity footprint with a global coverage. By providing relevant quantitative footprint estimations, BIA dataset will greatly improve the biodiversity mainstreaming for finance where aggregated quantitative data need had been clearly identified.

Case study description and self-assessment carried out by
Marie-Anne Vincent (Carbon4 Finance)
Antoine Vallier (CDC Biodiversité)

More information on the measurement approach can be found here:
C4F CIA: http://www.carbone4.com/wp-content/uploads/2019/09/CarbonImpactAnalytics_November18.pdf
C4F CRIS:
http://crisforfinance.com/en/cris-finance-climate-risk-impact-screening/

CDC B/GBS 2019 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2020/09/N15-TRAVAUX-DU-CLUB-B4B-GBS-UK-MD-WEB.pdf
CDC B/GBS 2018 technical update: http://www.mission-economie-biodiversite.com/wp-content/uploads/2019/05/N14-TRAVAUX-DU-CLUB-B4B-GBS-UK-WEB.pdf
CDC B/GBS GBS technical update 2017: http://www.mission-economie-biodiversite.com/downloads/biodiv2050-outlook-no-11/

Case study 14: BNGC Alvance Aluminium Site

Application of Biodiversity Net Gain Calculator (BNGC) on the site of Alvance Aluminium in Duffel (Belgium)

GENERAL INFORMATION

Biodiversity measurement tool	**Biodiversity Net Gain Calculator (BNGC), commercial tool developed by Arcadis Belgium**
Company	**Alvance Aluminium Duffel**
Sector	Manufacturing
Turnover	ca. 542 million euros (2019)
Date/Period of measurement (year(s))	2018 and 2020

Business application(s)

BA 1: Assessment of current biodiversity performance	Site visit by ecology expert who gives biodiversity value scores to each predefined spatial unit (built areas have score ‘0’ while unbuilt areas have score between ‘0’ and ‘1’)
BA 2: Assessment of future biodiversity performance	Adaptation of biodiversity value scores, based on potential biodiversity value that can be achieved by implementing specific measures (either by reducing pressures such as e.g. pesticide ban, or by applying habitat and species restoration actions e.g. adapted mowing regime for grasslands)
BA 3: Tracking progress to targets	BNGC supports the implementation of a ‘zero net loss’ approach at site level and is applied for annual tracking progress to target; habitat destruction due to building of new constructions on the site might trigger the need to increase the value of remaining habitat patches at the site or even to invest in off-site biodiversity offsets in order to maintain ‘zero net loss’

BA 4: Comparing options	Comparing options for site level investments or maintenance activities (impact on biodiversity value either by reducing/increasing extent or condition of habitats)
BA 7: Screening and assessment of biodiversity risks and opportunities	BNGC allows for rapid screening of biodiversity risks at site level (e.g. presence of invasive alien species) and opportunities for increasing biodiversity value

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Site level	

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

In 2018 Alvance Aluminium decided to become compliant with the ASI Performance Standard V2 (2017)[1] for its site in Duffel. The purpose of this sectorial standard is to make sustainability more transparent and measurable for the entire aluminum supply chain from mining to end-product. ASI requires sites to develop "*a Biodiversity Action Plan which shall be consultative and designed in accordance with the Biodiversity Mitigation Hierarchy*". Alvance Aluminium Duffel has added an explicit No Net Loss target to this action plan. Sites also "*shall proactively prevent accidental or deliberate introduction of Invasive Alien Species (IAS) that could have significant adverse impacts on biodiversity*". The Biodiversity Net Gain Calculator (BNGC) appeared to be an excellent tool to qualify and quantify the biodiversity values at the production site, to monitor changes in biodiversity value over time, to make brief proposals for changes to improve the total biodiversity value and finally to provide guidance on how much biodiversity compensation is needed in case of new industrial developments at the site. In addition, one of Alvance's objectives in compliance with the ASI Standard v.2 was to manage and reduce IAS.

Boundaries

In the case of Alvance Aluminium Duffel the boundaries for the BNGC were limited to the production site (land use). The BNGC allows for expanding the boundaries in order to include selected biodiversity offset locations, but for this site that didn't appear to be necessary so far. Currently planned expansions of built assets in forest habitat at the site can be compensated by a more biodiversity friendly management of other green areas at the site.

Location and scale

Alvance Aluminium Duffel is located in the municipality of Duffel (close to Antwerp) in Belgium. The surface of the site is 50 ha.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land use change due to the operations of the company		
Climate change			
Pollution			

[1] ASI Standards - Aluminium Stewardship Initiative (aluminium-stewardship.org)

Pressures	Terrestrial	Freshwater	Marine
Direct exploitation			
Invasive species	Presence and spreading of invasive terrestrial species		
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Challenges		
Pressures		
Data on land use and land use change, obtained/confirmed through site visit by ecologist	Satellite data in combination with infrared data to estimate the amount of surface hardening. In this particular case, information on pressures was also available in an earlier EIA (environmental impact assessment report) covering a part of the production site.	
Challenges		
	In the absence of a recent EIA, getting a rapid understanding and insight in pressures is more challenging.	
State		
Field visit by experienced ecologist to assess current biodiversity value, including presence of threatened species (see summary description of methodology)	Online cartographic data on vegetation, protected nature, etc.	
Challenges		
Access to company site often requires compliance with strict safety measures and requires thorough preparation. Species information needs to be collected during the 'growing' season (April – September).	Some taxa have poor spatial information	
Impacts		
Challenges		

What was the role of qualitative information?

A qualitative interpretation is less useful in this case where mainly primary data have been collected.

Baseline/reference situation

The baseline was established in 2018 with a first application of the BNGC tool. In 2020, the assessment was repeated to track changes and whether biodiversity no net loss remained valid.

Required efforts for the measurement

Field visit + assessment in BNGC: 8 mandays. Annual or bi-annual update: 5 days.
Required efforts for BNGC assessment depend on geographical location, biodiversity context and size of the site.

Required skills to complete this exercise

Field survey needs to be conducted by experienced ecologist with sound knowledge of local biodiversity. The outcomes are tailor-made for the company and delivered to the company in an easy-to-understand format. A limited training is recommended for company staff to work with the tool.

Results and application

Figure 1 provides a client friendly overview of the applications the BNCG can be used for.

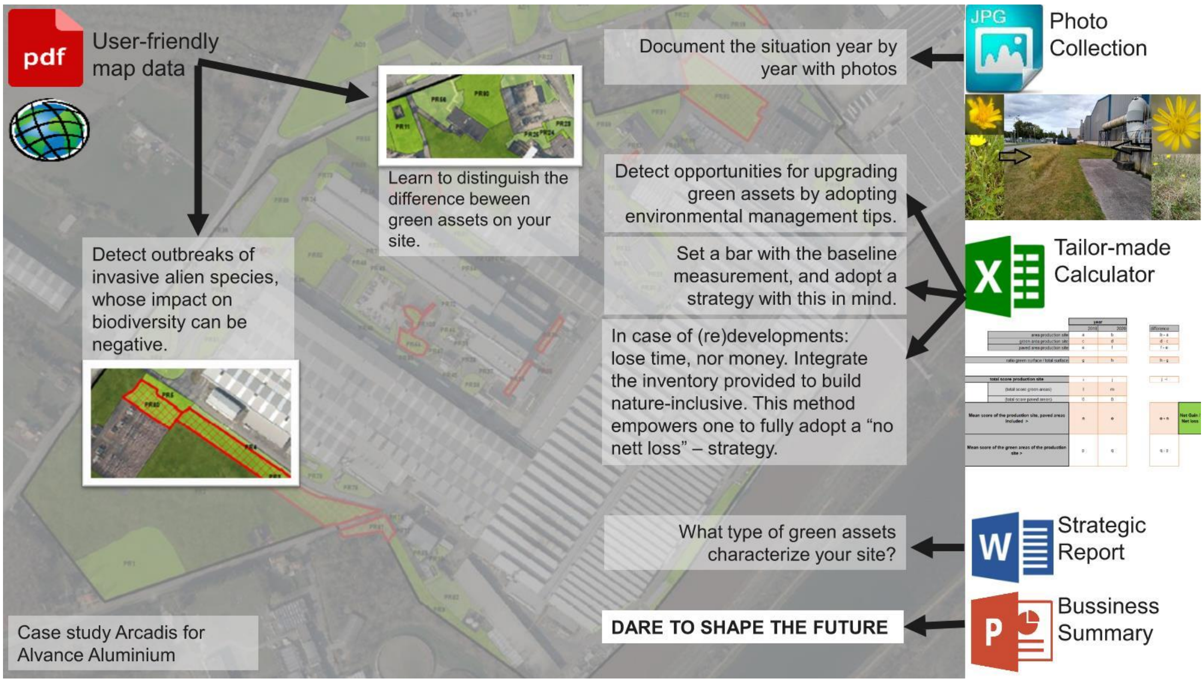


Figure 1: Overview of key elements of the Biodiversity Net Gain Calculator

Figure 2 presents the biodiversity value maps for the Alvance Duffel site in 2018 and 2020 as well as a difference map. The difference map highlights the zones that have undergone a change in score. This could be a deterioration or an upgrade. For the example given, there were only improved situations thanks to the adoption of a more biodiversity-friendly greenery management. The decision for assigning a new score to a polygon is based on and documented by the textual description and the photo library in the previous version of the site inventory.
Furthermore, local extinctions and new colonies of invasive alien species in polygons can be shown in the difference map (in this case, one new colonization of a small patch was found).

Figure 3 demonstrates a 'net gain' result in 2020 compared to 2018, which in this case purely reflects the upgraded management of the green polygons that were already present (between 2018 and 2020 no change in the surface of built areas was observed.

Figure 2: Biodiversity value maps for Alvance Duffel site in 2018 and 2020, and difference map.

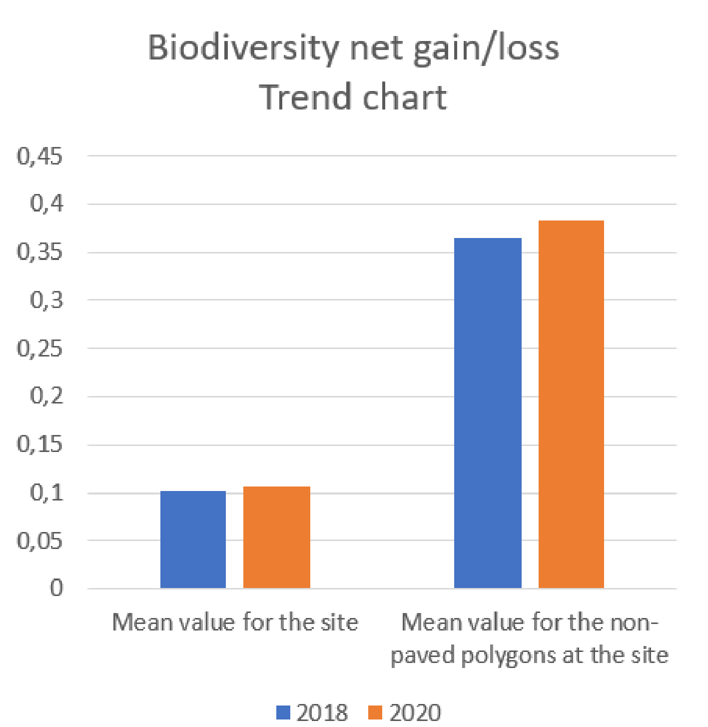


Figure 3: Comparison between site level biodiversity value in 2018 and 2020

Interpretation of results and impact on decision-making

The maps are very easy to understand, not only for the client but also for its contractors such as the garden contractor: they immediately get a good insight in the locations of areas with a higher biodiversity value. Due to the color differences and size of the different plots, the client could easily decide on priorities for improving biodiversity value. Furthermore, infections with invasive alien species are indicated on the maps as well. By starting to compare maps across years biodiversity changes over time become visible.

Results have been used for demonstrating compliance with the ASI Performance Standard V2. Furthermore, they have allowed the company to take decisions on garden maintenance, on actions to enhance biodiversity and on preferred locations for industrial expansion. Examples of actions to enhance biodiversity values are a shift to more extensive management of the current green zones and actions for managing the infections with invasive alien species. At this moment, an industrial expansion is planned for the site to which end the BGNC information is being used.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The BNGC has proved to be well suited for the purposes of Alvance. It allows to demonstrate compliance to the ASI Performance Standard V2 for site level processing activities in the aluminum sector by applying the biodiversity mitigation hierarchy and by tackling the issue of invasive alien species. The BNGC also supports Alvance in the implementation of its No Net Loss commitment at site level. If Alvance would need to invest in offsets in order to preserve NNL, the BNGC can be applied to calculate the (potential) biodiversity value in offset sites too. • The scoring approach is flexible as it always takes into account the local ecoregional context. Therefore, scores for Alvance reflect well the actual biodiversity value of the site.
Limitations	• The BNGC is only suitable for implementing a site level NNL approach if land use is considered as the only driver for biodiversity loss. If other drivers for biodiversity loss would need to be included in the NNL approach, the BNGC needs to be combined with other approaches providing a compatible metric (MSA is quite compatible).
Opportunities for improvement	• Exploring possibilities to combine the BNGC with complementary biodiversity measurement approaches.
Completeness	
Strengths	• The approach provides a sufficient level of completeness for the purposes of this case.
Limitations	• The approach only focuses on land use and invasive alien species (IAS). Although all biodiversity taxa with relevance for the site are covered, field surveys will not result in a 100% coverage of all present species. • Other pressures on biodiversity are not covered. Ecosystem services are not covered.
Opportunities for improvement	• As the BNGC is specifically developed to address land use and IAS, there are no reasons to expand the focus.

Rigor	
Strengths	• The appraisal of biodiversity condition and significance needs to be conducted by experienced ecologists with solid knowledge of the local ecological context. This is a prerequisite for providing a sufficient level of scientific rigor. The approach is a pragmatic application of habitat equivalence analysis (HEA)2. HEA provides a credible, widely-accepted and in the scientific literature validated approach for determining the amount of compensatory mitigation needed to achieve NNL. • The approach provides a high level of accuracy and granularity.
Limitations	• Field surveys have their limitations, in particular if only one field visit takes place (different plants often grow or flourish in different periods of the year).
Opportunities for improvement	• Higher frequency of field visits but this might become too expensive for the company
Replicability	
Strengths	• The assessment is easy to replicate. For the site in question, a methodology for the scoring system is described in the report (pdf) that accompanies the documentation. This enables to conduct a repeatable survey over the course of several years. The accompanying report provides insight into species and vegetation types and describes the plots where a decline or an increase of biodiversity value is noted. All scoring by the ecologist is underpinned by a complete photo-report that is available upon request. • Replicability over different sites is also easy, based on the summary description of the methodology.
Limitations	• Expert judgement, even if underpinned with a clear methodological framework (see summary description), always includes a risk of obtaining different scores for certain plots if assessment is done by different experts. However, this only applies to minor changes in biodiversity. Substantial changes in biodiversity, e.g. due to implementation of restoration actions, will be scored equally by different experts and capturing these changes over time is the real purpose of the instrument.
Opportunities for improvement	• The accuracy of the assessment could benefit from having different ecologists involved for one site e.g. another ecologist is taking over from time to time; this might also improve scientific rigor
Aggregation	
Strengths	• The BNGC allows to assess NNL compliance at site level and as such allows for aggregation of these site level outcomes to corporate level (e.g. 4 on 5 sites are compliant with NNL, one is not compliant). However, this was not relevant for this particular case.
Limitations	• As the scoring approach is tailormade for each site and dependent on local context, scores cannot be aggregated over sites. This might cause issues when comparing with potential offset areas too, as similar scores in these offset areas will represent higher biodiversity values.
Opportunities for improvement	• Conversion factors might be required when applying the BNGC for calculating the required offsets

Communication	
Strengths	• The results can easily be communicated and interpreted by non-specialists, since the approach has been developed with the specific objective to be understandable and applicable by non-specialists (in the company). The metric is simple as it reflects 'biodiversity value' and ranges between 0 and 1. Color codification in the maps is also straightforward.
Limitations	
Opportunities for improvement	
User friendliness	
Strengths	• The results are easy to understand by the company and allow for taking decisions on land use at the site. The BNGC provides a pragmatic excel-tool which is easy to understand and apply by the company. • To ensure a fast and accurate inventory during the field visit, the android-available tool "ArcGIS Collector" (ESRI) is used as a platform. This tool also enables to edit polygons in the field, as well as providing photos of each polygon.
Limitations	• The inventory needs to be conducted by an experienced ecologist, so by a third party. • The field visit should be performed during the right time of the year to accurately assess the biodiversity values. • The 'app' functionality for now is not as such that it can be shared for being used by the client.
Opportunities for improvement	• Training could be provided to interested employees of the client company on how to conduct periodic monitoring and apply the calculator on condition that they have the required background in terms of ecological expertise.
• Investment	
Strengths	• Limited investment in relation to wide range of benefits (mapping of current site level biodiversity value, calculator for managing No Net Loss ambition, listing of concrete actions on how to improve biodiversity value)
Limitations	• Data collection and interpretation by experienced ecologist is necessary.
Opportunities for improvement	

Overall assessment

Using the Biodiversity Net Gain Calculator offers the following benefits at a relatively low cost:

- Quick insight in current biodiversity value at site level with high level of detail and accuracy;
- Having an instrument for assessing, monitoring and managing Biodiversity No Net Loss or Net Gain targets;
- Allows for deriving KPIs at management level and for reporting purposes (i.e. natural capital accounting)
- Provides insight in opportunities for improving biodiversity value and allows for comparing different options in terms of land use.

Case study description and self-assessment carried out by

Kim Driesen, Hans Van Gossum and Pieterjan Dhont - Arcadis Belgium
Approved by Wim Van Loock, Alvance Aluminium Duffel BV

More information on the measurement approach can be found in the summary description

Case study 15: BIM Asda Retail company

Assessing Asda's instant coffee supply chains using the Biodiversity Impact Metric

GENERAL INFORMATION

Biodiversity measurement tool	**Biodiversity Impact Metric**
Company	**Asda**
Sector	Retail
Turnover	Approximately £22 billion
Date/Period of measurement (year(s))	2020

Business application(s)

BA 1: Assessment of current biodiversity performance	An investigation of the biodiversity performance in their existing instant coffee sourcing (although BIM is more a risk screening approach, it can track changes in scores – land use intensity score – and therefore can also measure performance)
BA 4: Comparing options	The approach allows to compare estimated biodiversity risks in different sourcing regions
BA 7: Screening and assessment of biodiversity risks and opportunities	The approach examines the biodiversity risk in Asda's supply chain and can be used to identify opportunities to reduce this risk.

Organisational Focus Area (site, product, supply chain, …)

OFA 4: Supply chain level	The study examines instant coffee supply chains originating in Brazil, India & Viet Nam
OFA 5: Corporate level	The study looks across all of Asda's own-brand instant coffee sourcing

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

Asda is a core member of the Cambridge Institute for Sustainability Leadership's Natural Capital Impact Group and was involved in the development of the Biodiversity Impact Metric. This study applies the metric to Asda's instant coffee sourcing in order to provide an overview of the biodiversity risk in their supply chains. The purpose is to provide context to their risk allowing prioritisation of efforts to improve the impact of their sourcing in future.

Boundaries

This study focuses on Asda's coffee supply chain, specifically the production stage of coffee beans. From Asda's perspective this is upstream and within their scope 3 impacts.

Location and scale

This focuses on sourcing within Brazil, India and Viet Nam. Within these countries, sourcing was pinpointed to sub-national administrative regions. This was combined with information on biodiversity importance summarised at the level of eco- regions.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Land use conversion and land management (intensification and extensification)		
Climate change			
Pollution			
Direct exploitation			
Invasive species			
Other			

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
Company information on quantity of coffee beans purchased in tonnes.		
Challenges		
Pressures		
Company information on land use type and production practices	FAO data on yields.	
Challenges		
Detailed information on production practices was limited so ‘intense’ production was assumed. Detailed information on land use type not available but coffee production compatible with the ‘Plantation Forestry’ category.	FAO holds yield estimates that are averaged at the country level. This introduces uncertainty depending on how different these are from actual yields.	

Primary data	Secondary data	Modelled data
State		
Company information on location of coffee production.	Range rarity values for country-ecoregion components calculated using IUCN Red List range maps.	State of biodiversity based on modified GLOBIO MSA values.
Challenges		
		MSA values cover a limited number of land use types and intensities. The Biodiversity Impact Metric therefore uses interpolated values when there is no direct MSA value for a land use type/intensity combination.
Impacts		
Challenges		

What was the role of qualitative information?

Baseline/reference situation

We calculate both global average and country average per ton impact scores for coffee production in order to provide a reference for Asda's results.

Required efforts for the measurement

Data collection by suppliers took approximately one week, but this was undertaken as part of an existing Asda initiative. Approximately 1 day was required to clean the data and undertake the analysis.

Required skills to complete this exercise

Some analytical skills were required to undertake the analysis and produce graphs and maps. CISL provided this service.

Results and application

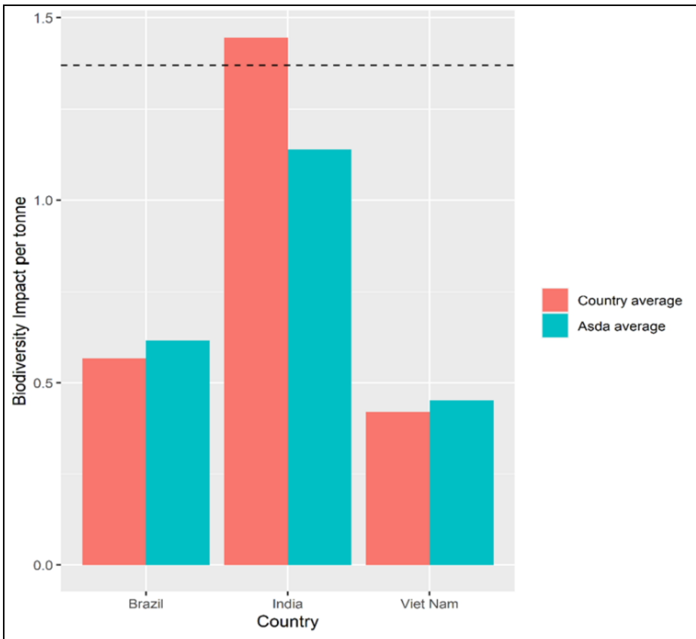


Figure 1: Plot showing the average biodiversity impact per ton of coffee produced for Asda's sourcing compared to the average impact of coffee production in that country assuming intense production practices. The global average biodiversity impact for coffee production is also shown with the dotted line. The Biodiversity Impact is measured in "weighted hectares" – which reflect the total land footprint of the sourcing, weighted by biodiversity impact.

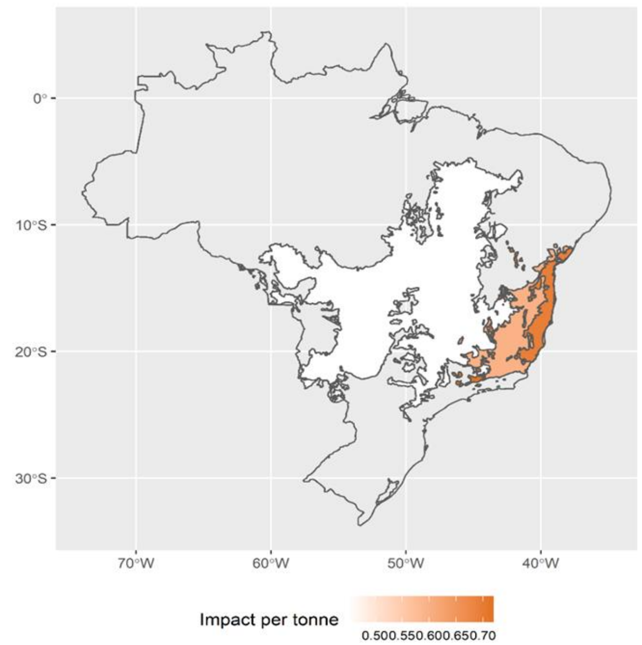


Figure 2: Plot showing the average biodiversity impact per ton of coffee produced for Asda's sourcing in different regions of Brazil. As no information is available to differentiate land use or intensity between regions, the results reflect the different values of biodiversity importance in different regions

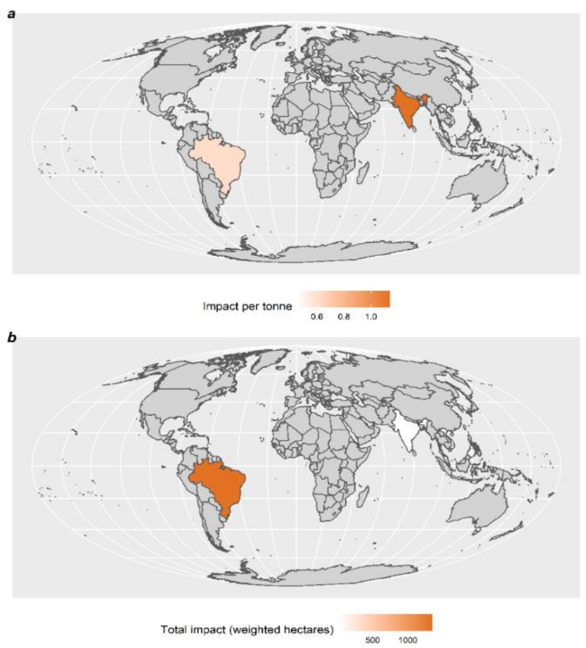


Figure 3: Plots showing a) the average biodiversity impact per ton of coffee produced for Asda's sourcing in different countries, compared to b) their total impact summed across all tonnes sourced within a country. This illustrates how a company's exposure depends not just on the per tonne impacts, but the total quantity they are purchasing from different areas.

Interpretation of results and impact on decision-making

The results have provided Asda with an initial overview of the biodiversity risks that lie within their instant coffee supply chain. This brings important additional context to their existing work assessing the sustainability of their coffee sourcing. The results highlight that, in general, Asda is not exposed to a significantly greater than average risk as a result of its coffee sourcing. However, there is variation in the potential risk both between and within countries.

The project provides a number of opportunities to take further action, but the immediate next steps are to examine the reasons for specific results, for example:

1. Why is risk higher in some countries and regions? For example, what aspect of the metric is driving particular results: yields, production practices or biodiversity importance of growing regions?
2. Where do the results need to be sense checked with better information on the supply? For example, if the results are due to FAO yield estimates can we use actual yield estimates to get a more accurate picture?

3. Where would more granular biodiversity information help support action? For example, where would knowing the landscape that the producers are located in, their proximity to protected areas and species at risk, help inform an action plan?
4. How can this additional insight be used to drive improvements in the supply chain? For example, where can training be targeted to increase yields or improve biodiversity outcomes at the farm-level?

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• The information was useful to the company's work on sustainable sourcing. The metric is able to provide information covering the geographic scope of the company's coffee supply chains.
Limitations	• The results from the metric are not yet granular enough to inform changes to sourcing practices.
Opportunities for improvement	• With additional context the metric can help prioritise where additional data collection efforts would help inform decision making.
Completeness	
Strengths	• The approach a key pressure (land use) for agricultural commodities. Land use intensity is a proxy for other pressures such as water use and water pollution (e.g. N and P due to fertilizers) • It currently examines impacts on mammals, amphibians and birds.
Limitations	• The approach does not cover GHG emissions and does cover water use and water pollution in a very indirect and inaccurate way. Fragmentation is not covered neither. • The range rarity metric does not currently include other taxonomic groups.
Opportunities for improvement	• As other taxonomic groups are fully mapped, they can be added to the range rarity layer. This would provide a more accurate reflection of species that may be present in an area.
Rigor	
Strengths	• The approach draws on primary data where available, but uses credible alternative data sources and assumptions where it is not.
Limitations	• The accuracy of the metric is limited by the granularity of the information that Asda is able to gather on its supply chain. The modelled data used is also limited in its accuracy and ability to reflect local conditions and circumstances. For example, MSA values are based on global averages, thus, the method is still quite crude and does not respond to local circumstances. The 'Quantity impacted' component informed by the GLOBIO model is limited in its ability to distinguish the impact of a number of different management practices).
Opportunities for improvement	• As supply chain traceability improves, the precision of the metric will improve also.
Replicability	
Strengths	• The Biodiversity Impact Metric is a simple and straightforward approach. A full methodology is available and with the necessary data can be easily replicated.
Limitations	• A certain level of expert judgement may be required to correctly assess land use type and intensity.
Opportunities for improvement	

Aggregation	
Strengths	• The BIM is aggregable. It can for example, we summed across all suppliers of a different commodity, it can be aggregated at the product level and it can also be aggregated across all commodities/products to produce a 'company score'. These scores can be used to compare product formulations and track company performance through time. In this instance, we produced results at regional, country and company level.
Limitations	• Results should not be compared directly between different commodities and/or companies that have different portfolios of commodities or products. As the three components of the equation are weighted equally, land area and therefore yields often make the largest difference to the overall score. Therefore, comparing commodities that have very different yields is not a fair comparison. For example, a company that only sources high-yielding crop would have a better company score that a company that only sources low-yielding crops.
Opportunities for improvement	
Communication	
Strengths	• The results are relatively straightforward to interpret, essentially reflecting a company's land footprint weighted by biodiversity impact.
Limitations	• However, while the hectares component of the output unit is intuitive is not – the biodiversity impact component is not, for example it does not represent a particular number of species impacted per hectare.
Opportunities for improvement	
User friendliness	
Strengths	• The Biodiversity Impact Metric is a simple equation, but some specialist analytical skills are likely required to access all the necessary data sets and undertake the calculations.
Limitations	• The approach does require access to data – the range rarity layer - for which a license is required for commercial use from the IBAT platform.
Opportunities for improvement	
Investment	
Strengths	• The Biodiversity Impact Metric requires only a minimal amount of company data and can be calculated relatively efficiently.
Limitations	
Opportunities for improvement	

Overall assessment

The Biodiversity Impact Metric is a practical risk-screening tool for supply chain businesses that source agricultural commodities. It is an accessible starting point for businesses that are just starting to explore their impacts on biodiversity and/or that lack complete data on their value chains. The Biodiversity Impact Metric uses a robust approach to address knowledge gaps with credible alternative data sources and assumptions.

Asda has applied the metric to examine risk in their instant coffee sourcing. The Biodiversity Impact Metric showed that in general Asda’s exposure was close to or lower than the average country score. Nonetheless, operating in some countries and regions was associated with slightly elevated risk. By highlighting these potential risks, Asda can prioritise where they would benefit from better visibility of their supply chain and begin to think through potential actions to improve outcomes for biodiversity.

Case study description and self-assessment carried out by

Dr Cath Tayleur

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

Case study 16: ReCiPe Hand drying systems

Life Cycle Assessment comparing different hand drying systems for the Dutch Government, using ReCiPe.

GENERAL INFORMATION

Biodiversity measurement tool	**Life Cycle Assessment using ReCiPe**
Company	**Dutch Ministry of Internal Affairs**
Sector	Government
Turnover	
Date/Period of measurement (year(s))	2019

Business application(s)

BA 4: Comparing options	Comparison of the environmental impact of three hand drying systems as part of a public procurement process. A specific additional analysis on the biodiversity impact has subsequently been carried out for the purposes of this case study.

Organisational Focus Area (site, product, supply chain, …)

OFA 1: Product level	Three hand drying products are included

DESCRIPTION OF THE CASE

See summary description of methodology here

Context

The Dutch government has goals for a sustainable and circular economy and procures around € 73 billion worth of work, services and supplies every year. Taking sustainability into account in public procurement can therefore have a huge impact. An example was the recent tender from the purchasing authority from the Dutch Ministry of Internal Affairs on sourcing hand drying solutions for all its locations. The organization commissioned a study to understand which type of hand drying systems has the lowest environmental impact.

The following types of hand drying systems were compared: paper towels, electric dryers and textile rolls.

Boundaries

The following boundaries are applied to each of the hand drying systems:

- For paper towels: the entire life cycle, from forestry until assumed disposal scenario.
- For electric dryers: the entire life cycle, including the production of the machine and, the electricity generation for the use phase and the assumed disposal scenario.
- For textile rolls: the entire life cycle, from cotton (or other type of textile) growing until the assumed disposal scenario and around 100 times laundering.

Direct and indirect impacts are included. Direct impacts are impacts from using the product, indirect impact are impacts related to the supply chain and waste management. The results are expressed at midpoint level (per impact category). Furthermore, the impact in three areas of protection (or endpoints) is provided: human health, ecosystems and resource availability. The damage to human health is expressed in DALY (Disability Adjusted Life Years). The damage to ecosystems is expressed in species.yr. This unit represents the species loss over time, and it is used to model the biodiversity impact.

Location and scale

The geographical scope is the Netherlands, but the supply chain and the environmental impacts are global.

Types of pressures

Pressures	Terrestrial	Freshwater	Marine
Land use change	Included in ReCiPe2016		
Climate change	Included in ReCiPe2016	Included in ReCiPe2016	Included in ReCiPe2016
Pollution	Included in ReCiPe2016: - Acidification - Ecotoxicity - Ozone formation - Ionizing radiation	Included in ReCiPe2016: - Eutrophication - Ecotoxicity	Included in ReCiPe2016: Ecotoxicity
Direct exploitation	Excluded	Excluded	Excluded
Invasive species	Excluded	Excluded	Excluded
Other	Water consumption	Water consumption	

	An additional circularity assessment was made using the Material Circularity Indicator from the Ellen MacArthur Foundation[1] (*1)		

(*1) It is a different method, not a part of ReCiPe. Although it does not mention anything about biodiversity, increased circularity reduces consumption of raw materials and from this perspective has a positive impact on biodiversity too. This hasn't been further explored in this case study.

Collected data on economic activities, pressures, state and impacts

Primary data	Secondary data	Modelled data
Economic data		
NA	NA	NA
Challenges		
NA	NA	NA
Pressures		
Primary data on hand drying systems was collected from literature	Ecoinvent was used for the secondary data	NA
Challenges		
No specific product was chosen, so representative products were selected and publicly available data was used.	Although ecoinvent is the world's most widely used, complete, and transparent LCA database, some datasets are not up-to-date.	
State		
NA	NA	NA
Challenges		
		Not all drivers of environmental impact and biodiversity loss are included
Impacts		
NA	NA	Pressure response modelling from ReCiPe2016 was used for the environmental impact
Challenges		

What was the role of qualitative information?

Baseline/reference situation

In this comparative analysis the biodiversity impact of all three products were assessed in terms of the potentially disappeared fraction of species (PDF) which uses the concept of potential natural vegetation (PNV). This concept describes the expected state of mature vegetation that would develop if all human activities were to be stopped at once.

[1] https://www.ellenmacarthurfoundation.org/resources/apply/material-circularity-indicator

Required efforts for the measurement

Approximately 20 - 40 days. The lower range represents a screening LCA used for internal communication. The high range is required for an ISO 14040 compliant LCA study which can be used for external communication. An ISO compliant LCA also requires external review.

1. Goal and Scope definition (1-2 days)
2. Data collection and modelling (10 - 20 days)
3. Impact assessment (4 - 8 days)
4. Interpretation (5 - 10 days)

Required skills to complete this exercise

The study was done by a junior LCA analyst under the supervision of a senior LCA consultant. The study was externally reviewed by a senior LCA consultant

Results and application

The results include:

- the overall environmental impact (single score results in Pt. using normalisation and weighting) on human health, ecosystems and resource depletion per life cycle stage (Figure 1)
- the impact on ecosystems per driver and life cycle stage (Figure 2)
- single score results for a number of sensitivity analyses (Figure 3).

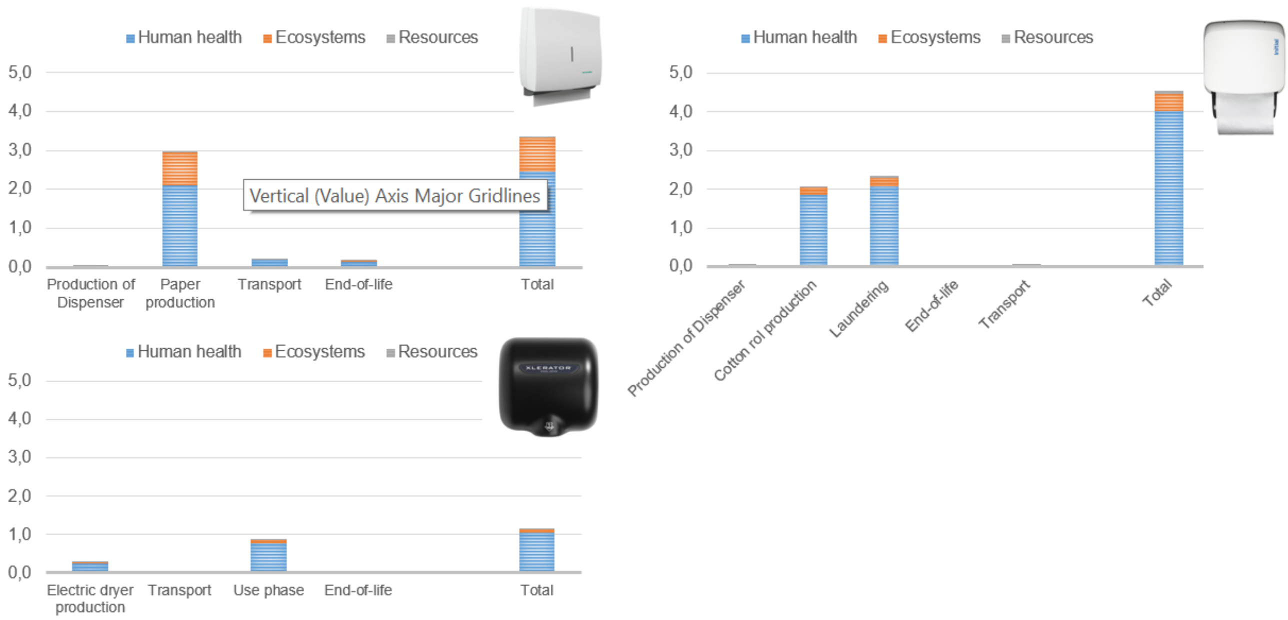


Figure 1: Endpoint results

Figure 1 shows the single score results per endpoint. The impact on human health is shown in blue, biodiversity impact is in red, and the impact on resource availability in grey. On the right side of each chart you can see the total environmental impact of 10 000 hand dryings using a paper towel, a cotton roll or an electric hand drying system. The bars on the left side of each chart show the impact per life cycle stage. For the paper towel, the majority of the impact is caused by the production of the towels. Production of the dispenser is negligible, and the impact from transport and end-of-life is very low. For the cotton roll, most environmental impact is caused by laundering, followed by the production of the cotton. Production of the dispenser, the impact from transport and end-of-life is negligible. For the electric dryer, the impact in the use phase (electricity use) is most important. The impact from the production of the dryer is low and the impact from transport and end-of-life is negligible.

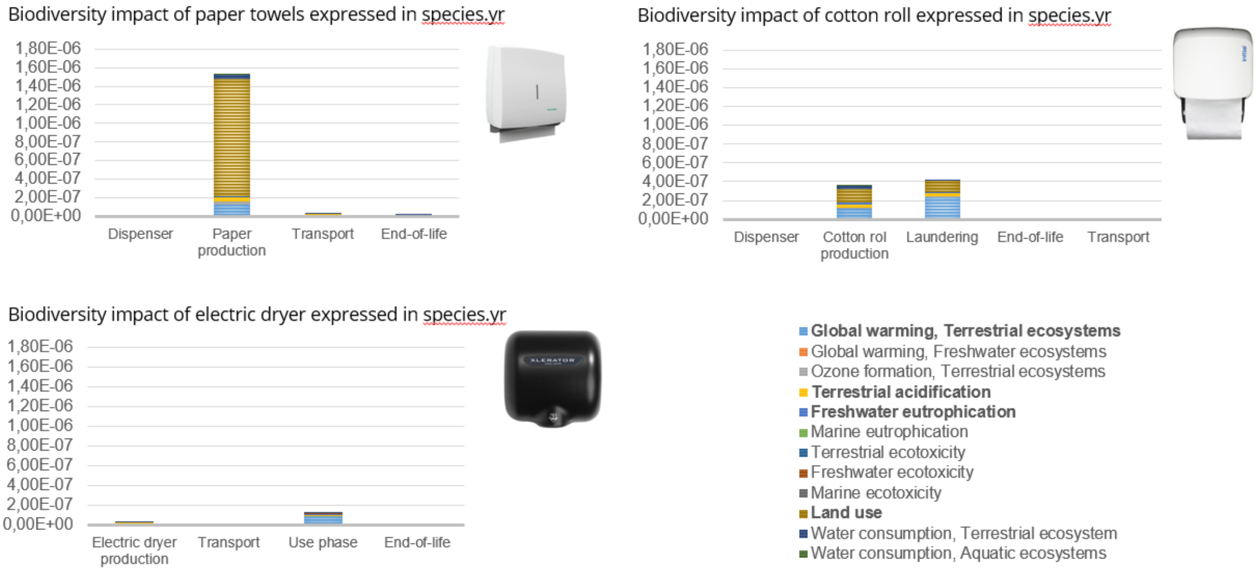


Figure 2: Biodiversity impact

Figure 2 shows the impact on biodiversity per life cycle stage. The impact is also split by driver of biodiversity loss. In these charts we can see that for the paper towel, the impact from paper production is most important. The main driver of biodiversity loss in that part of the life cycle is land use change and to a lesser extent climate change, acidification and eutrophication. For the cotton roll, both laundering, and production of cotton are important. Both land use and climate change are the main drivers and to a lesser extent acidification and eutrophication. For the electric dryer most impact is caused in the use phase (electricity use). Climate change is the main driver of biodiversity loss.

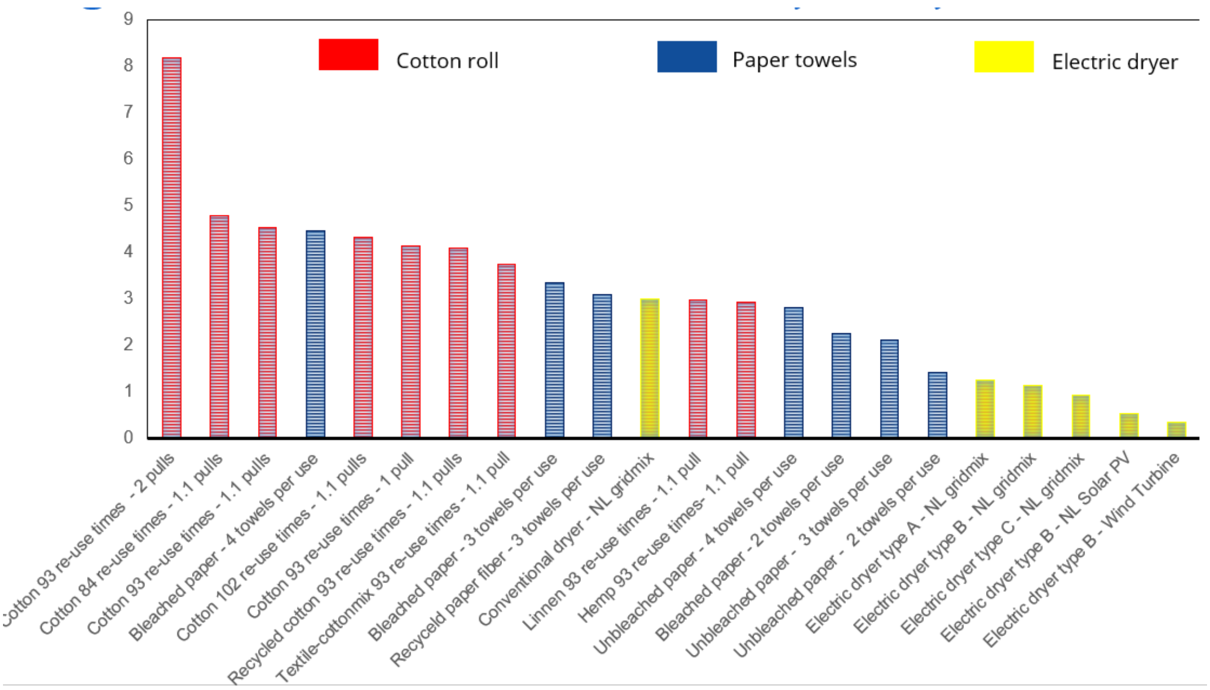


Figure 3: Single score results – sensitivity analysis

Figure 3 shows the results of the baseline scenarios. In these scenario's we assumed that the paper towel were made from primary fibers, the towels were bleached, and 3 towels are used per hand drying. For the cotton roll, we assumed that on average people use 1.1 pull per hand drying and the roll is washed and reused 93 times. For the electric dryer, a certain type of dryer is used, and the impact from electricity is modelled using the average grid mix in The Netherlands. Figure 3 shows the change in single score results once these assumptions are altered. The impact of the cotton roll increases when the number of pull increase or when the number of reuses decreases. Other materials for the roll such a linen or hemp can decrease the environmental impact. The impact from using paper towels is lower when unbleached towels are used. Using less towels per hand drying also reduces the environmental impact. For the electric dryer, using renewable energy can reduce the total environmental impact.

Interpretation of results and impact on decision-making

The interpretation shows that in general, electric hand drying systems have a lower environmental impact compared to the textile roll and paper towels. In general, the textile roll has the highest environmental impact. The user behavior is very important as the impact depends strongly on the amount of textile or paper used.

Based on these results the purchasing authority could include environmental information in the decision making on which products to include in the tender document.

STRENGTHS AND LIMITATIONS OF THE APPLIED MEASUREMENT APPROACH IN THIS SPECIFIC CASE

Self-assessment

Relevance	
Strengths	• This case study demonstrates very well how measuring biodiversity impacts with an LCA-based approach such as ReCiPe can provide very useful information in the framework of public procurement.
Limitations	• This study was used for the procurement, but it was not used by the companies producing the sanitary supplies.
Opportunities for improvement	
Completeness	
Strengths	• The purchasing authority was mostly interested in environmental impact and circularity. In this analysis biodiversity was one of three endpoint impact categories next to impact on human health and resource scarcity. • The ReCiPe impact assessment model typically looks at impact on lower level organisms. And although not all species are impacted in the same way, they serve as a good proxy for the health of ecosystems. The unit of ReCiPe is the potentially disappeared fraction of species. For each impact category the relation between the pressure and the species richness is determined. As an example, for land use the midpoint characterization factors (CFs) were derived using the species richness data for several taxonomic groups: plants, vertebrates (mammals and birds) and invertebrates (mainly arthropods) (De Baan et al. 2013, Elshout et al. 2014). These taxonomic groups react differently to land use, given that they generally have varying requirements for food, shelter and breeding or nesting (Elshout et al. 2014). Due to the variety of taxonomic groups included, the CFs are a proxy for the impact of land use on total species richness.

Limitations	• ReCiPe currently does not cover the impact on invasive species and overexploitation (forthcoming work from Helias et al. will include overexploitation of fish stocks) but the consequence of not having included these pressures is very limited for this particular case study.
Opportunities for improvement	
Rigor	
Strengths	• The Life Cycle Assessment methodology can systematically assess the impact of a product across the entire value chain. The use of impact assessment methods covers a range of environmental issues which prevents burden shifting. ReCiPe and ecoinvent are widely used and internationally recognized as robust and scientifically sound. Uncertainty analysis and sensitivity analysis complement the baseline results and improves the reliability of the results • In this case the modelling choices, allocation procedures, background data and impact assessment methods are consistent over the three product groups (which is sometimes an issue when applying LCA: depending on the goal and scope, the quality of LCA's can differ; different modelling choices, allocation procedures, background data and impact assessment methods can lead to different results).
Limitations	
Opportunities for improvement	• International initiatives such as the Product Environmental Footprint can lead to LCA studies which are more reproducible, comparable and verifiable, compared to the current range of approaches.
Replicability	
Strengths	• All documentation of ReCiPe and ecoinvent is available on their websites. In the report, all individual datasets are included in an annex. All modeling choices are documented clearly
Limitations	• In order to reproduce the results, one would need an ecoinvent licence and access to LCA software.
Opportunities for improvement	
Aggregation	
Strengths	• As ReCiPe translates all ecosystem related impacts into PDF, the final score can be expressed in one single metric.
Limitations	
Opportunities for improvement	
Communication	
Strengths	• The issuer of the study had no previous LCA experience, but the results were clear and understandable
Limitations	• For external communication, LCA studies need to be performed in accordance with the ISO 14040 standard. This is a time consuming and costly activity which includes third party reviewing. • The metric "species.yr" or the derived "PDF.m2.yr", is difficult to understand. This is due to the complexity of the unit. It is a multiplication of a factor (PDF range from 0-1), an area (in m^2) and a time element (year). There are also other units such as MSA.m2.yr. The scientific community is still looking for consensus on which unit to use.

Opportunities for improvement	• Once a consensus can be reached, on which unit to use, we can also communicate more easily once people get familiar with the unit. I think few people can properly explain what radiative forcing, global warming potential (GWP) and CO_2-equivalents mean. Since this unit is generally accepted by the IPCC (Intergovernmental Panel on Climate Change) everybody is working with it. Other units such a global temperature potential (GTP) also exist, but they are less mainstream, so people are not confused by their existence.
User friendliness	
Strengths	• This type of LCA studies require an in-house sustainability specialist with LCA experience or an experienced LCA consultant. Furthermore, LCA software and access to databases is needed
Limitations	• It takes time to invest in in house knowledge on LCA
Opportunities for improvement	• Companies without access to LCA software, data or sustainability specialists can opt for a screening LCA which is less costly and time consuming. The results of a screening LCA can only be used for internal communication and decision making, because the sensitivity analysis is less extensive, the uncertainty analysis is often excluded and there is no external review required. • For companies without LCA knowledge, trainings are available, so it is possible to acquire the skills needed to perform LCA studies.
Investment	
Strengths	• A screening LCA can be done when limited time or funding is available (15 days).
Limitations	• The results of a screening LCA are less robust, often limited sensitivity analyses are performed, data quality is only assessed in a qualitative way, and uncertainty analysis is often excluded
Opportunities for improvement	• A company can start with a screening LCA upgrade the screening LCA to an ISO-compliant LCA at a later stage.

Overall assessment

The LCA study allowed the purchasing authority to take environmental and biodiversity information into account in the procurement of sanitary supplies. The study includes the impact on 18 impact categories. Since reporting on 18 impact categories is hard to interpret, the endpoint modelling offers the impact on 3 endpoint indicators, human health, ecosystem quality and resource availability.

Case study description and self-assessment carried out by

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More information on the measurement approach can be found here:

LCA in general: https://www.lifecycleinitiative.org/starting-life-cycle-thinking/what-is-life-cycle-thinking/
ecoinvent: https://www.ecoinvent.org/
ReCiPe: https://www.rivm.nl/en/life-cycle-assessment-lca/recipe

COLOPHON

ASSESSMENT OF BIODIVERSITY MEASUREMENT APPROACHES FOR BUSINESSES AND FINANCIAL INSTITUTIONS

UPDATE REPORT 3

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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.