BIODIV'2050 **OUTLOOK:**

CLUB B4B+

Measuring the contributions of business and finance towards the post-2020 global biodiversity framework

2019 technical update

N°15 - July 2020

MISSION ÉCONOMIE DE LA BIODIVERSITÉ

CDC BIODIVERSITÉ

Caisse des Dépôts GROUPE

TABLE OF CONTENT

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FOREWORD

The fight against nature loss should be a business priority: nature is essential to global economic prosperity and individual business success. We cannot have a sustainable future for people and economies if we do not address nature, climate and people in an integrated way.

Forward-thinking businesses understand that global economic prosperity relies on a healthy natural world. And that to resolve the climate crisis and reduce inequality, we must protect and restore nature. Many businesses understand the value of nature and are voluntarily shifting their practices towards sustainability and longer-term thinking. By doing so, they are contributing to mitigate the very real and significant risks that are posed to economies, communities and livelihoods.

However, in order to scale up and accelerate the action needed, regulatory and financial systems need to reward companies for their performance beyond financial returns – across environmental, social and governance issues.

In 2021, world leaders have a unique opportunity to forge international agreements to reverse nature loss as they did for climate change in 2015. We need businesses to call on governments to incorporate transformative and ambitious policies because safeguarding nature makes economic and financial sense. This will help create a level playing field and a stable operating environment for business. Only together will business, finance and governments be able to unlock new opportunities and drive the global systemic and transformative change for everyone and everything to live sustainably on a healthy planet.

The goals and targets set by at the Convention on Biological Diversity (CBD) Conference of the Parties (COP) in 2021 need to enable and encourage business and finance to assess their impact on nature and biodiversity. Corporate biodiversity impact measurement tools such as the Global Biodiversity Score (GBS) could play an important role in building such links. Business for Nature welcomes such developments because creating aggregated and standardized biodiversity data is a step to making sure nature is truly placed at the heart of our global economy.

Working with our partners – more than 50 leading business and conservation organisations Business for Nature engaged over 200 companies representing 15 sectors from around the world to articulate, strengthen and shape five high-level policy recommendations on nature which we announced in January at the World Economic Forum. Through our "Nature is everyone's business" Call to Action, more than 500 companies with combined revenue of around $4 trillion including Walmart, Citigroup, Microsoft, JD.com, Hitachi, Unilever, Axa, Mahindra Group and H&M urge governments to adopt policies now to reverse nature loss in this decade.

Davos was the first in a series of key events on nature and biodiversity this year and next. If we want to reverse the trend of nature loss by 2030 we need urgent action in 2020-2021. We need to use the political and business momentum on nature we have now to provide confidence to Heads of States and governments to adopt an ambitious new deal for nature and people at the CBD COP in Kunming in 2021.

This way, we can make sure the next decade is based on ten years of action that strengthens - rather than destroys - our relationship with nature.

EVA ZABEY
Business for Nature Executive Director

BUSINESS FOR NATURE
businessfornature.org

Business for Nature is a global coalition bringing together influential organizations and forward-thinking businesses. Together, they demonstrate business action and amplify a powerful business voice calling for governments to reverse nature loss.

A WORD FROM THE CHAIRMAN

The year 2020 should have been a super year of strong commitments in favour of biodiversity with the World Conservation Congress of the International Union for the Conservation of Nature scheduled for June in Marseille and the 15th Conference of the Parties COP15 of the Convention on Biological Diversity in November, during which the post-2020 global biodiversity framework was to be adopted. We had prepared ourselves. The Covid-19 pandemic has upset the agenda postponing to 2021 these two major international meetings, which will have to live up to expectations.

The crisis we are currently experiencing further highlights, if necessary, the urgency of combating the dynamics of biodiversity collapse by tackling its main drivers in order to move towards a more sustainable model of society.

To contribute to such a model, companies need targets, scenarios and tools. They also need credible partners to develop and implement their biodiversity strategy over time. We hope to be one of them by contributing to the development of the tools necessary for measuring biodiversity footprints and highlighting actions that can effectively reduce pressures on biodiversity.

On 12 May 2020, we presented to 350 participants the Global Biodiversity Score 1.0 (GBS 1.0) on which the CDC Biodiversité team has been working for almost 5 years. Built and tested with the support of more than thirty companies and financial institutions gathered within the Business for Positive Biodiversity Club (B4B+ Club) and thanks to collaborations with academics, NGOs and other initiatives measuring corporate biodiversity footprint, the GBS now makes it possible to assess the impacts of economic activities on biodiversity along their value chain, in a robust and aggregate way.

This step would not have been possible without the commitment of Groupe Caisse des Dépôts. I would also like to sincerely thank the companies, investors and partners who trust us, in particular Mirova, Solvay and Schneider Electric who have supported us for all these years.

Finally, I would like to acknowledge the pugnacity of the team which, within CDC Biodiversité and under the supervision of Antoine Cadi, our director of research and innovation, is working to prepare the GBS; thanks to Joshua Berger, Antoine Vallier, Rose Choukroun, Patricia Zhang and Sibylle Rouet Pollakis. I also thank Eva Zabey for accepting our invitation to sign the foreword of this publication.

I wish you a fruitful reading!

MARC ABADIE
CDC Biodiversité chairman

Context

1 Context

1.1 Brief history of the GBS

The links between business and biodiversity have been explored in a series of research projects over the past few years as part of *Mission Économie de la Biodiversité* (MEB), an initiative of *Caisse des Dépôts* spearheaded and run by CDC Biodiversité[1]. In 2015, extensive work was conducted to compare the drawbacks and limits of existing tools and try to guide companies in their choice of biodiversity measurement tool. It jumped out that there was a clear need for a tool focused on biodiversity itself rather than only on ecosystem services: a tool which uses an aggregated metric understandable by all and measures the biodiversity footprint of companies from various sectors at the scale of the entire value chain (from cradle to grave). In particular, Figure 1 highlights how the most advanced and regulated economic sectors in terms of impact mitigation are not the ones causing the largest impacts on biodiversity. Indeed, agriculture, forestry, consumer goods, manufacturing and energy cause the vast majority of impacts on biodiversity through their direct operations or their supply chains, but their obligations and current actions to mitigate their impacts on biodiversity are very limited.

As a result, the MEB launched the Global Biodiversity Score (GBS) project, which has been developed over the past five years in close collaboration with the members of the B4B+ Club (Business for Positive Biodiversity Club), a group of 25 companies and 10 financial institutions willing to quantitatively measure their impact on biodiversity. Each step of the GBS roadmap development was tested through about 10 case-studies with the members of the B4B+ Club, allowing the GBS developers to anticipate what was the available data, needs and realities for companies originating from different economic sectors. The first version of the GBS was released on 12 May 2020 and the first full-scale Biodiversity Footprint Assessment (BFA) will be delivered in the first semester of 2020.

(1) http://www.mission-economie-biodiversite.com/english

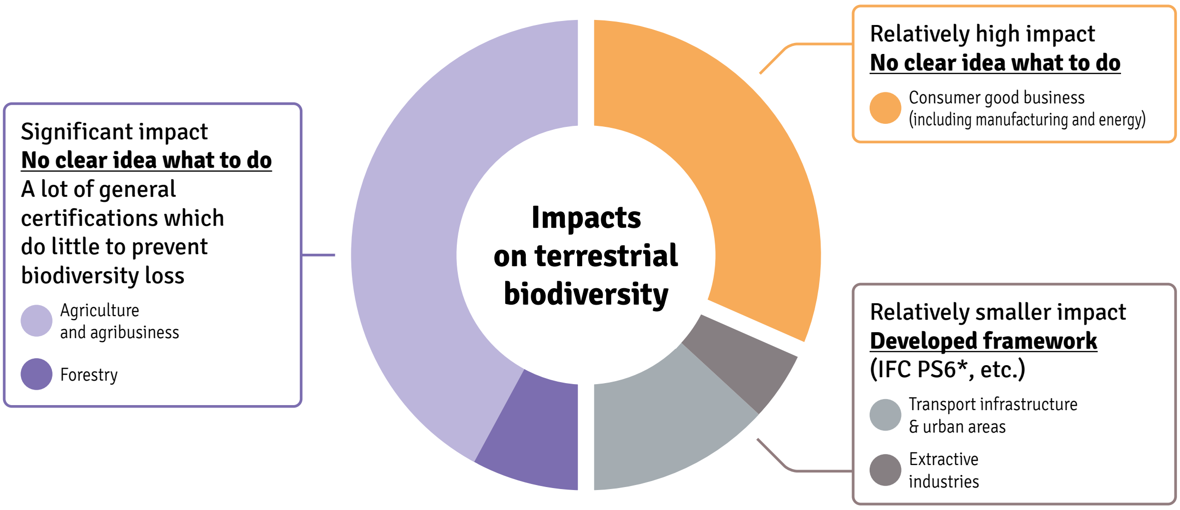


Figure 1: ***A significant share of impacting industries currently lack tools and frameworks to mainstream biodiversity. Inspired by work by The Biodiversity Consultancy. The proportions are indicative and based on the GBS and PBL publications*** *(Kok et al. 2014; 2018)*.

* International Finance Corporation Performance Standard 6

BOX 1 The GBS in short

This box aims to remind the GBS main features to readers already somehow familiar with it. For a more comprehensive introduction, readers are invited to refer to the 2017 and 2019 reports (CDC Biodiversité 2017; 2019b) and the FAQ section of this report.

Some definitions and clarifications

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[(2)]. Those differences are illustrated by Figure 2.

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**. Section 3.2 and our previous report (CDC Biodiversité 2019b) provide more details on this concept.

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, as detailed in section 3.1.

(2) The term “indicator” can also be used to describe specific data required by the GBS to conduct assessments. Such “input indicator” include for instance yearly corporate turnover by industry or region (EUR), area of natural forest converted into intensive agriculture every year (ha), etc.

Methodology

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 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 (section 3.4.2). 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)

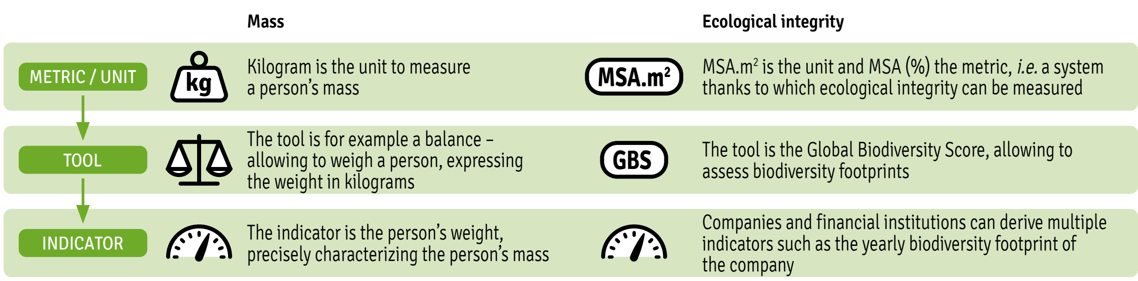


Figure 2: *Differences between metrics, units, tools and indicators*

1.2 An operational GBS

1.2.1 Our vision for the GBS Biodiversity Footprint Assessment ecosystem

Our vision for BFAs involves the same types of actors that are involved today in Carbon Footprint Assessments. That is:

- **Specialized external assessor consultants** who will conduct assessments for companies;
- **Data providers and rating agencies** providing biodiversity scoring for a wide range of companies and financial assets;
- **Companies** willing to assess their environmental footprint by themselves;
- **Investors** rating companies based on their biodiversity performance;
- **External auditors of non-financial information** whose role is to make sure that non-financial disclosures (including based on BFA results) are trustworthy.

Regarding this last category, companies may voluntarily seek auditors to provide quality checks on their BFA, and CDC Biodiversité thus plans to introduce a "*GBS verified*" service to provide such quality assurance with partner auditors. When disclosure of the most material corporate biodiversity impacts becomes mandatory, such quality checks will become part of the routine quality assurance conducted by non-financial auditors. The relationships between those actors, and CDC Biodiversité' role in the emerging GBS ecosystem are summarized in Figure 3 below.

Depending on whether they seek commercial use of the GBS (selling services using the tools), users will be required to purchase a license allowing commercial use or not.

CDC Biodiversité will host GBS trainings, tailored for each type of actors likely to use the tool. These trainings will ensure that rating agencies and GBS assessors know how to use the tool appropriately. Therefore, the trainees will have to pass a test at the end of their training and CDC Biodiversité will update a list of certified GBS assessors. More specifically, different training levels will start in 2020:

- Level 1 trainings, targeting anyone willing to understand how to draw a link between biodiversity erosion and economic activities using a GBS-based BFA. In particular, defining the perimeter of a BFA, getting a good command of the data collection process and interpreting GBS results will compose this training. It will last one day.
- Level 2 trainings, enabling participants to lead the comprehensive GBS-based BFA of any organization autonomously. It will include an in-depth walk-through of the GBS tool: input data, functioning of the GBS modules, biodiversity footprint computation, advanced results interpretation. It will last two days and require having completed the level 1 trainings.

The GBS has been developed in R programming language. A deep understanding of R is, however, not needed to assess biodiversity footprints which are conducted through a sim-

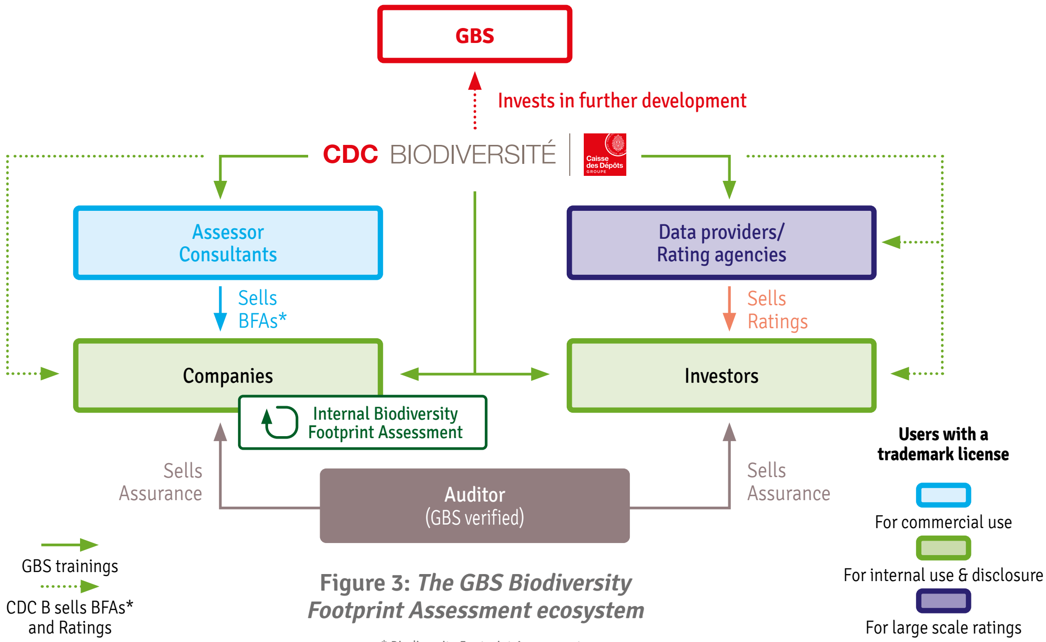


Figure 3: ***The GBS Biodiversity Footprint Assessment ecosystem***

* Biodiversity Footprint Assessment

plified user interface using RStudio software. All the GBS functions, impact factors and ready-to-use assessment files will be available through an R package.

1.2.2 Robustness and transparency: the GBS scientific review

A *OBJECTIVE*

Two of the core objectives of the GBS are to be scientifically consensual and transparent about its methodology and limitations. After five years of development, a formal review process has been launched and a review committee has been established. Two panels have been set up to conduct a "critical review" of the GBS. Their goals are complementary. **The expert panel verifies the consistency and quality of the tool (assumptions, data, uncertainty, etc.), suggests improvements and assists in the testing of the software component of the GBS.** The stakeholder panel assesses the consistency of the GBS tool with existing public policies related to corporate biodiversity and with existing tools.

B *MEMBERS OF THE REVIEW COMMITTEE*

The French Biodiversity Office (Office français de la biodiversité), a public institution, holds the secretariat of the review committee and is assisted by Solinnen, a consultancy, to ensure the independence of the review. The members of the review committee have been chosen to cover as many continents and areas of expertise related to the GBS as possible. 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.

C *REVIEW COMMITTEE PLANNING*

The review committee was kicked-off in November 2019 and has been reviewing documents produced by CDC Biodiversité since then. Following experts' and stakeholders' feedback, the GBS team has been updating the 11 review documents, covering all the concepts and methodological approaches used in the GBS (Figure 4). The output of the review will be the publication of the 11 updated documents and a report including the comments of the review experts as well as the point of view of each member of the stakeholders panel.

1.2.3 A tool rooted in business realities thanks to the B4B+ Club

The B4B+ Club gathers businesses and financial institutions seeking to move towards net gains for biodiversity through the measurement of their impacts, readjusting their strategy and the implementation of impact reduction actions. The GBS has been tested and fine-tuned with B4B+ Club members through around 10 case studies, completed or ongoing, and extensive exchanges and best practice sharing during the three annual Club meetings.

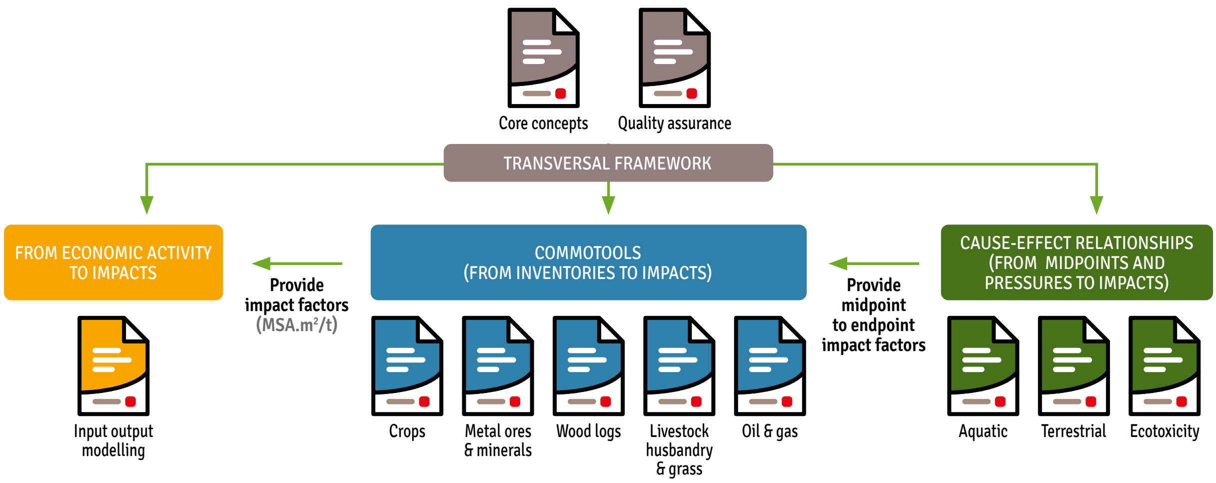


Figure 4: *Overview of the 11 GBS review documents and their relationships*

As of December 2019, the B4B+ Club included the following members:

VALUE CHAIN WORKSTREAM

3F Groupe ActionLogement
ACCOR HOTELS Feel Welcome
AIRFRANCE
Barilla The Italian Food Company. Since 1877.
cdc habitat
CIVB BORDEAUX
Compagnie des Alpes
EDF
egis
EIFFAGE
GRTgaz
HABITAT RÉUNION La force du logement social
ICADE
INGÉROP Inventons demain
KERING
L'ORÉAL
LVMH
Les Mousquetaires
MICHELIN
Life Is On Schneider Electric
storengy
suez
SOLVAY asking more from chemistry
TOTAL
VEOLIA

FINANCE WORKSTREAM

AFD Agence Française de Développement
BNP PARIBAS
bpifrance
CA Toute une banque pour vous
Caisse des Dépôts Groupe
CNP assurances
Generali Global Infrastructure
GROUPE BPCE Coopératifs, banquiers et assureurs autrement.
MEESCHAERT Asset Management
mirova Responsible Investing
SOCIETE GENERALE

PARTNERS

epe entreprises pour l'environnement
icare & consult
Noé
orée
B&L évolution
THE BIODIVERSITY CONSULTANCY

As noted in our previous reports (CDC Biodiversité 2017; 2019b), this feedback is very precious for the GBS and has helped ensure the tool is not an academic exercise but instead can adapt to the data actually available to businesses and meet their business applications (cf. section 2).

In 2019, members of the B4B+ Club have raised the following questions and comments:

- Pollutions such as ecotoxicity from pesticides should be easier to assess specifically in the GBS. This led to the development of an ecotoxicity module in the tool. It remains under development and a summary of its approach is provided in section 3.4.3. The capacity to assess a range of agricultural practices in detail is also a strong need which will be addressed in the second version of the tool (and which should also be expanded beyond agriculture too).
- A strong interest has been expressed to develop industry benchmarks detailing the main pressures by sector, the opportunities to reduce impacts and provide figures against which companies could compare themselves. CDC Biodiversité is currently developing such benchmarks which should be published by the end of 2020.

1.3 Post-2020 framework and the GBS

1.3.1 The CBD zero draft

2021[(3)] is a super year for biodiversity and new targets for the 2021-2030 period should be set at the CBD's Conference of the Parties (COP15) in early 2021.

At the time of writing **the post-2020 framework for biodiversity focuses on negotiating goals and targets concerning 1) the state of biodiversity; 2) drivers of biodiversity loss; and 3) tools & solutions to drive action** (CBD 2019). Indeed, if defining objectives for the state of biodiversity will be necessary for the 2020-2030 decade, it cannot be achieved without considering both direct and indirect root causes of its decline. Consequently, preserving biodiversity requires reducing drivers of biodiversity loss, enabling and incentivizing actors from both the private and public sector to implement actions favourable to biodiversity.

The zero draft of the CBD (CBD 2020) provides a first outline of which goals and targets could be adopted at COP15. Figure 5 provides an overview of the possible framework and highlights the goals and targets directly related to the GBS. Goal (a) deals with the area and integrity of ecosystems[(4)] which can be monitored with the MSA metric used in the GBS. **The goal to increase the area and integrity of freshwater, marine and terrestrial ecosystems could be interpreted as a gain of 20% MSA globally.** Targets (1) to (6)[(5)] focus on the five main drivers of biodiversity loss. The GBS assesses each driver of biodiversity loss separately, estimating its contribution to biodiversity loss (or gain). Target (14) mentions a specific target of reducing by 50% the negative impacts of economic sectors on biodiversity, including along their supply chains: this is exactly the type of target the GBS can contribute to track.

In that context, **the GBS comes as an empowering tool for the private sector to translate international targets on drivers of biodiversity loss at their level**. Figure 6 further illustrates how the GBS fits within that international framework. For instance, objectives such as *"Reduce by 2030 pollution from excess nutrients, biocides, plastic waste and other sources by at least [50%]"* (CBD 2020) could be translated at the company level by targets and actions on reducing pollutant emissions. The gains or losses of biodiversity associated to those responses can then individually be assessed by the GBS. Finally, the positive and negative impacts can be aggregated to calculate the total corporate footprint (broken down by Scopes, impacts on aquatic and terrestrial biodiversity and by pressure).

1.3.2 Metrics for the post-2020 framework

The CBD zero draft for the post-2020 framework lists a number of global indicators which could be tracked to monitor progress towards the achievement of its goals and targets. As noted above, the MSA metric can help track progress against objective (a) on ecosystem integrity. The Biodiversity Intactness Index (BII) metric (Newbold et al. 2016; Purvis et al. 2018) could also be used for this objective. Other complementary metrics and indicators are required to go beyond ecological integrity and track goals related to conservation status and population trends in particular (Mace et al. 2018). The Red List Index indicator (IUCN 2020) and the unit of risk of extinction track conservation status and species extinction. The Living Planet Index (Grooten and Almond 2018) tracks population trends. Both can monitor the achievement of objective (b). Adequate and comprehensive metrics are however lacking for objective (c) on genetic diversity.

1.3.3 Concrete example with the WWF targets for the post-2020 framework

The MSA metric can be used to assess global goals and provide a linkage between those goals and corporate actions. The metric can thus be very useful to stakeholders such as WWF International, who proposed targets and solutions for the post-2020 framework, listed in Table 1 (WWF 2020). The three WWF targets are possible **"apex**

(3) The super year was initially planned to be 2020 but the main biodiversity events have been delayed to 2021 due to the Covid-19 pandemic.

(4) And with the extents of biomes and ecosystem connectivity, which may be tracked with other metrics.

(5) Target (2) is more specifically focused on protected areas and is thus partly outside the focus of the GBS. Targets (3) and (5) deal with pressures which the GBS aims to cover in the future, but which are currently not included in assessments.

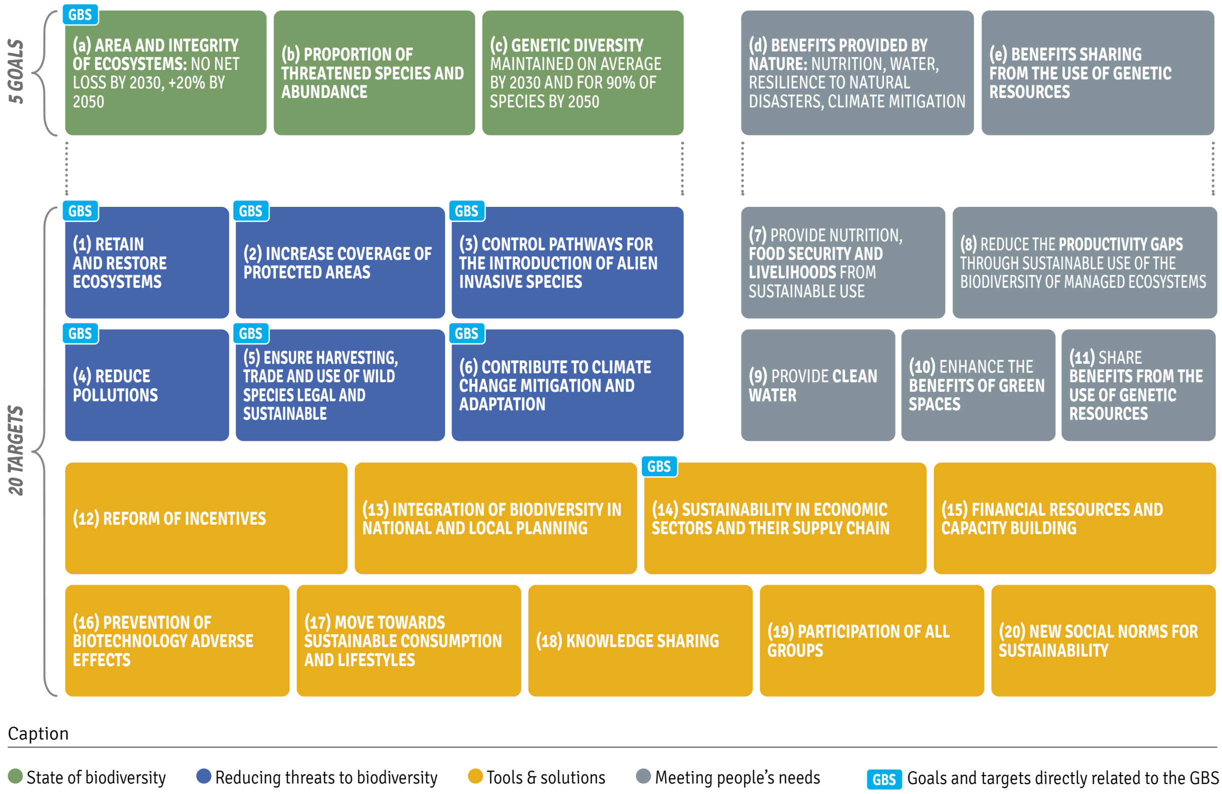


Figure 5: ***Summary of the goals and targets of the zero draft of the CBD and linkages with the GBS*** *(adapted from CBD, 2020)*

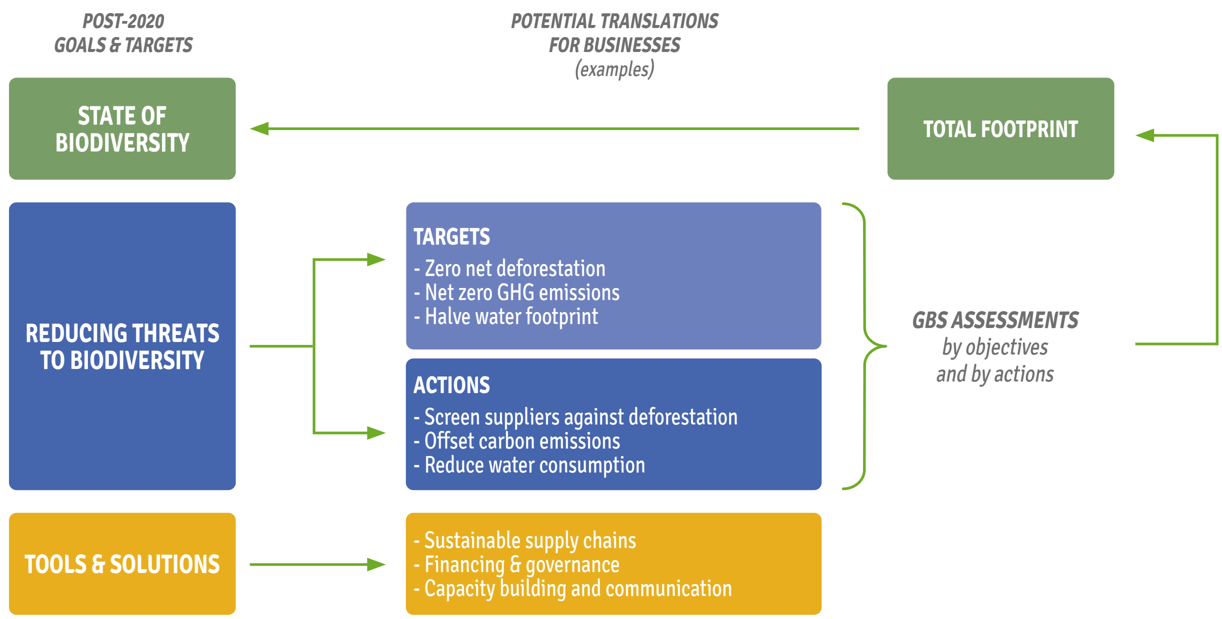


Figure 6: ***Post-2020 biodiversity framework and role of the GBS***

Table 1: Translation in terrestrial MSA of WWF targets for the post-2020 framework

WWF Target	WWF solutions	Global terrestrial MSA reduced losses compared to the trend scenario	
Zero loss of natural habitats	Protect 30%	2.1%*	
	Sustainably use 20%	4.4%**	
	Recognize rights to indigenous peoples' lands	*Not assessed*	
Zero human-induced extinction	Stop unsustainable wildlife exploitation and trade	*Not assessed*	
	Enable viable populations	*Not assessed*	
Halve footprint of production and consumption	Transition to sustainable practices: infrastructure, agriculture, fishing, extractives	Taken literally: 15.3%	Halving only the rate of increase: 4.8%***

* Netherlands Environmental Agency (PBL, 2010) calculates (Figure S.2 of its report) that if 20% of terrestrial areas were protected, that would translate into 10% of the baseline MSA losses avoided. Furthermore, it estimates that with 50% of protected areas, 40% of the baseline MSA losses would be avoided. Those gains are assessed against an initial situation of 14% protected area coverage, *i.e.* an increased coverage of protected areas of respectively 6% or 36%. The WWF target differs from the situation assessed by the PBL and aims for a protected area coverage of 30%, *i.e.* an increase of 30%-14% = 16%.
Assuming that the MSA gain is proportional to the increase of protected area coverage, between 16 x 10 / 6 = 27% and 16 x 40 / 36 = 18% of the baseline MSA losses could be avoided, equivalent to 1.7-2.5% MSA of the 9.5% MSA loss estimated in the trend scenario. Finally, the average between 1.7 and 2.5% MSA is equal to 2.1% MSA.

** Kok et al. (2018) assesses the reduced losses associated to a number of policies (Figure 6 of their report). We considered the following actions matched the WWF target of "Sustainably use 20%": Reduce nitrogen emissions, Increase livestock productivity and Increase crop productivity. For these, we took the values of reduced losses from the "Global Technology" scenario of Kok et al. (2018). In addition, the actions Dietary changes and Reduce waste and losses also match the WWF target and the values from the "Consumption Change" scenario were used. All combined, these reduced losses amount to approximately 4.4%. The WWF considers sustainable use applies to 20% of the total terrestrial area, *i.e.* 26 million km^2. The area considered by Kok et al. (2018) in 2010 includes 14.3 million km^2 of Agricultural land (cropland and cultivated pastures), 7.1 million km^2 of Area of forest managed for wood production and 1.0 million km^2 of Area of planted forests for wood production, *i.e.* 22.4 million km^2. As a first approximation, and given that this area exploited for agriculture and wood production is expanding, we consider that the area considered by Kok et al. (2018) matches the 20% of WWF.

*** Halving the ecological footprint basically means halving all land occupation, emissions, water consumption, commodity consumption, etc. That would translate into halving the **static biodiversity footprint**, excluding climate (since it would not remove GHG from the atmosphere) and – very optimistically - assuming a prompt recovery of ecosystems. This static footprint was assessed at 32% MSA in 2010 and 41.5% in 2050 (Kok et al. 2018), meaning a value of 34.2% in 2018, assuming a linear rate of change. Excluding climate change leads to an impact of about 30% MSA. Halving it yields a 15.3% reduced impact.
If we interpret "halving the footprint" as dividing by two the rate of loss, that means halving the **dynamic biodiversity footprint**: which is 9.5% MSA loss by 2050 under the trend scenario (Kok et al. 2018), *i.e.* 4.75% MSA reduced impact (rounded at 4.8%).

goals" for biodiversity, which could be defined as the uppermost objectives, counterparts to both the 1.5-2°C increase climate limit and its associated carbon budget for climate.

Matching these apex goals and solutions with the PBL scenarios pathways (Kok et al. 2018) allows to estimate the terrestrial MSA gains or reduced losses(6) corresponding to the achievement of the WWF recommendations. Table 1 provides the results. What is called "reduced losses" is the reduced degradations compared to the "trend scenario", a scenario in which no significant policy changes occur around the world and drivers of biodiversity loss keep intensifying at the same rate. In the trend scenario, **global MSA is expected to go down by 9.5% between 2010 and 2050** (Kok et al. 2018), which is equivalent to an area about the size of China switching from an undisturbed pristine state to a parking lot with no life left (0% MSA).

The gains associated to protecting 30% of the terrestrial area with protected areas may seem lower than expected even though non-negligible. It is because the new protected areas would be "less pristine" than the areas currently under protection, and thus generate less "reduced losses" expressed in MSA. Indeed, existing remote locations are already mostly protected; expanding protected areas thus means establishing them close to human activities in areas therefore subjected to pressures such as nitrogen deposition, fragmentation and encroachment (Netherlands Environmental Agency (PBL) 2010). Those additional protected areas are however likely to expand over areas with unique and endangered species, which means their expansion should translate into larger gains for the Red List Index indicator, which measures risks of extinction.

The goal "zero human-induced extinction" is harder to translate directly into MSA but could be translated in gains in the Red List Index. **WWF targets for the post-2020 framework illustrate the complementarity between metrics focusing on the different aspects of biodiversity.**

Taken literally, and as the WWF understands it, the "Halve footprint of production and consumption" target means **dividing by two the static impacts**, *i.e.* halving the accumulated negative impacts in human history. Achieving a 50% reduction of the static impacts may for instance be achieved by dividing by two the areas occupied by cities, farmland and logging operations, halving water consumption, getting half the CO_2 already in the atmosphere out of it, etc. It would also require time as ecosystems would need time to recover from human degradations. The WWF target could also be understood as **halving the dynamic impacts** *i.e.* the incremental impacts year on year, which could be achieved by dividing by two the biodiversity loss caused by land use change, increases in water consumption in water-stressed areas, or the emissions of greenhouse gas (GHG). The difference between the two interpretations is significant and the two cases are illustrated by Figure 7. The figure details the expected MSA losses by pressure between 2010 and 2050(7), and the estimated total gains

(6) Freshwater biodiversity is not included in this analysis.

(7) Land use, Encroachment, Fragmentation and Infrastructure figures are summed up and displayed as "Spatial pressures".

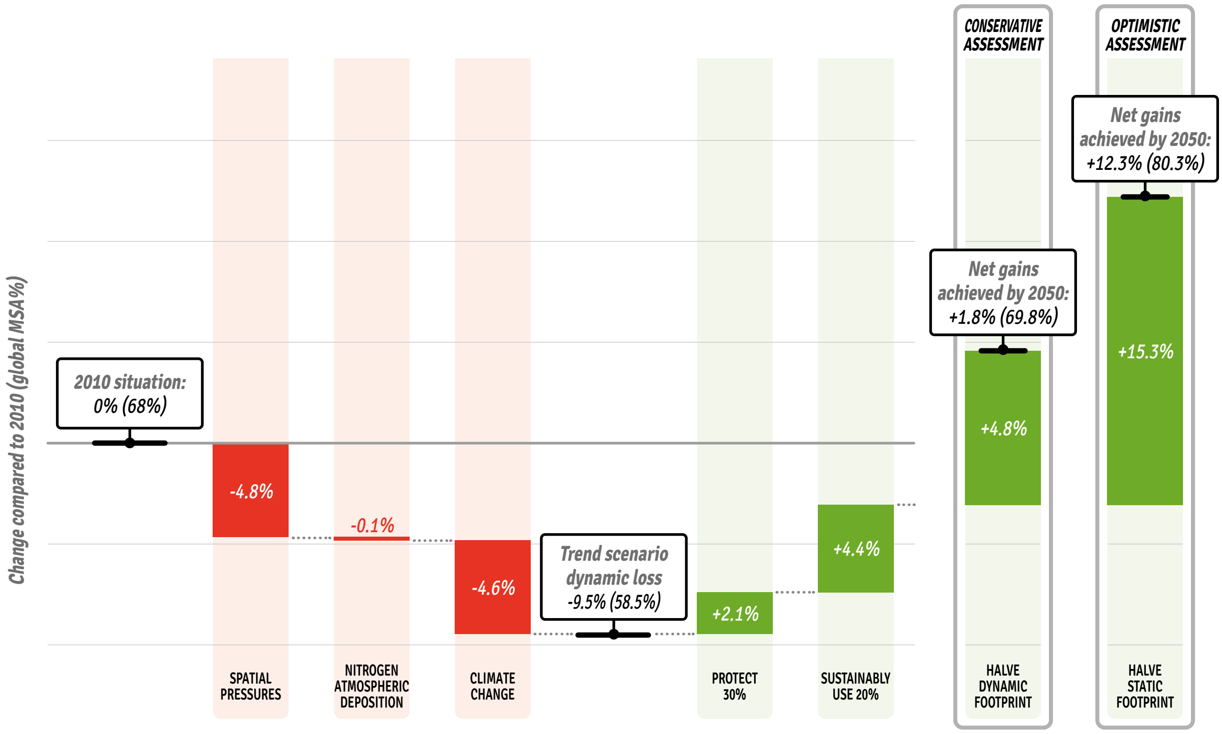


Figure 7: *WWF apex goals barely achieve a halt of terrestrial biodiversity loss by 2050 under a conservative assessment and bend the curve of terrestrial biodiversity loss by 2050 under an optimistic assessment*

or reduced losses if the WWF objectives are achieved. **Biodiversity loss would be halted and only slightly reversed if only the dynamic footprint is halved. If "halve the footprint" means dividing by two the static footprint, the world would bend the biodiversity-loss curve and regain 12.3% MSA**.

Figure 7 should be read from left to right as the losses (in red) and reduced losses and gains (in green) cumulated between 2010 and 2050. In 2010, the global remaining biodiversity was 68% MSA (Kok et al. 2018). The cumulated losses in the trends scenario amount to 9.5% MSA between 2010 and 2050 and only 58.5% MSA biodiversity would remain globally (Kok et al. 2018). When summed up with those losses, the reduced losses and gains described in Table 1 lead to a cumulated net impact of +1.8% MSA and a global remaining biodiversity of 69.8% MSA.

1.3.4 Towards science-based targets for biodiversity

Science-based targets (SBTs) have recently played a key role for states and companies to establish climate change mitigation as a governance priority. The efforts required to keep climate change within 1.5°C to 2°C have been translated into greenhouse gas emission budgets and regions, countries, industries or companies have been allocated a fair share.

Similarly, SBTs are being established for biodiversity[8]. The planetary boundary for biodiversity loss is estimated to amount to 72% MSA (Lucas and Wilting 2018) and has been exceeded more dramatically than the climate boundary: in 2018 only 65.8% MSA was remaining and about 0.27% MSA were being lost each year. This boundary can inform the budgets of efforts necessary to safeguard biodiversity.

Researchers have already started pondering how to allocate efforts among geographies. Figure 8 illustrates what different equity principles would mean in terms of biodiversity budget in 2010. These equity principles include among others an allocation based on the share in global population (immediate equal per capita allocation), on the gross domestic product (GDP) per capita (ability to pay), or on the economic efficiency of generating the gains (efficiency).

(8) The Science Based Target Network, a large group of diverse organisations, is developing SBTs for biodiversity, but also for land, water and ocean: http://sciencebasedtargetsnetwork.org/earth-systems/biodiversity.html.

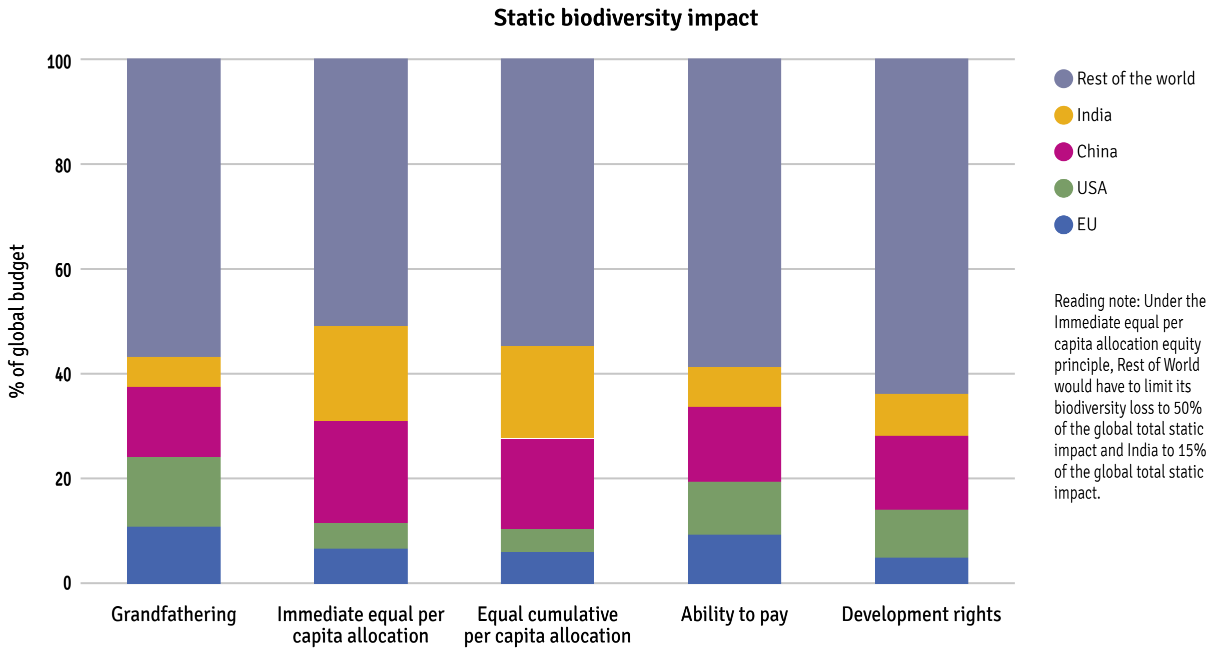


Figure 8: ***Allocation of the 2010 static impacts* by region of the world depending on the equity principle*** *(Lucas and Wilting 2018)*

* Lucas and Wilting (2018) actually reports on "biodiversity loss".
Its definition is however the same as "static impact", defined in section 3.1.

1.3.5 Action agenda: towards COP15

A *POSSIBLE COMMITMENTS FROM THE FINANCE INDUSTRY*

The finance sector has a key role to play in enabling the transformational change called for by the CBD's post-2020 framework for biodiversity. Several of the Zero draft's targets on tools and solutions related to implementation and mainstreaming can be directly influenced by financial institutions. This includes objectives (12) on reforming incentives, (14) on reforming economic sectors towards sustainability, (15) on providing financial resources to implement the framework and (17) on moving towards sustainable consumption and lifestyles. The finance industry can indeed go beyond simple conservation and ecological restoration funding, it can play an active role in transforming the structure of the economy through its investment and financing choices.

Financial institutions are increasingly understanding the systemic risks caused by the global biodiversity crisis. Slightly ahead of a likely mandatory reporting (see **Box 4**) and in line with the European Union Green Taxonomy, several leading banks and asset managers are committing themselves to measure the impacts of their investments and financing in order to progressively take measures to align with the CBD framework. The commitments taken by a group of European financial institutions could be formulated around those lines:

1. **Collaborate and share knowledge**

"We will collaborate and share knowledge on biodiversity-related metrics, targets and assessment methodologies to finance positive impact."

2. **Engage with companies**

"We will incorporate criteria for biodiversity in our ESG policy, while engaging with companies to reduce negative and increase positive impacts on biodiversity"

3. **Assess impacts**

"We will assess positive and negative impacts on biodiversity and identify the drivers of loss across the value chain within our portfolio, investments and finance activities."

4. **Set impact targets**

"We will set and disclose impact targets based on the best available science (aligned with the CBD, and then with science-based targets when available) to increase positive while reducing the negative impacts on biodiversity."

5. **Report publicly**

"We will report annually and be transparent about our positive and negative impacts on biodiversity."

The GBS can support the implantation of the third commitment, and thus also the fourth and fifth. In particular, CDC Biodiversité is teaming up with several non-financial rating agencies and data providers to conduct large scale assessments of thousands of corporates. These assessments will provide asset managers and owners with an analysis of the impacts of their listed equity or fixed income portfolios. AXA IM, BNP Paribas AM, Mirova and Sycomore AM have launched a call for expression of interest[9] and investor statement[10] in early 2020 which should accelerate the deployment of such data on biodiversity impacts for large universes of companies. CDC Biodiversité will produce several sectoral analyses using the GBS, to provide industry benchmarks and guidelines in terms of biodiversity footprint to support investors' assessments of the performance of companies against their industry.

(9) https://www.mirova.com/sites/default/files/2020-01/CEI%20-%20Biodiversity%20CP%20EN_FINAL.pdf

(10) https://www.mirova.com/sites/default/files/2020-05/Press%20release_european%20investors%20rally%20around%20biodiversity_final.pdf

B **STEPS AND OPPORTUNITIES TOWARDS COP15**

BOX 2

Invited expert – Aleksandar Rankovic on the CBD process and post-2020 framework

COP15 will be an important milestone in the history of international biodiversity governance. In the last two decades, the international community has twice set ambitious 10-year biodiversity targets (2010 targets set in 2002, 2020 targets set in 2010) with limited success on halting biodiversity loss. At CBD COP14, at the end of 2018, an international process began to develop a "post-2020 global biodiversity framework", which will serve as the international policy reference for the coming decade, and even until 2050. These discussions are far from being limited to the post-2020 goals and targets. There are four interconnected streams of topics being discussed: 1) the post-2020 objectives and targets, for 2030 and 2050, 2) the mechanisms and conditions to support implementation, 3) transparency and responsibility mechanisms, 4) cross-cutting and cross-sectoral issues such as interactions with socio-economic sectors, the empowerment of "indigenous peoples and local communities" and young people. The "zero draft" of the post-2020 framework, released on 13 January 2020, and its discussion during a negotiation session held at the FAO headquarters in Rome (24-29 February 2020), confirmed these orientations. This should enable, in the coming decade(s), that more attention will be paid to implementation at the national level, and there will be a stronger international follow-up of the decisions taken at COP15.

A number of Parties to the CBD, both in developed and developing countries, are calling for the five drivers of biodiversity loss listed by the IPBES[1] to be reflected in the COP15 decisions, as is being reflected in the current "zero draft". Nevertheless, implementation will not be easy, given the strength of the drivers of biodiversity loss: addressing them is very often linked to sectoral reforms that can have a strong impact on countries' development trajectories and on issues such as international trade. Even if ambitious decisions are taken at COP15, much work will be necessary at the national and international levels to support their implementation. A critical aspect will be to develop stronger cooperation with productive sectors, both at the level of institutions and of economic actors. At the institutional level, stronger cooperation between biodiversity-related conventions and other conventions and institutions dealing with sectoral issues (*e.g.*, the "chemical cluster of conventions" to work on pollutions, or the FAO on agriculture, forestry and fisheries) could help set up processes that would favor more institutional cooperation at the national and regional levels. The economic actors should also be involved in such discussions, and the Action Agenda for Nature and People, launched at COP14 but still underused, could serve as an embryo to develop a more powerful platform to build multi-stakeholder coalitions around certain sectors (such as the finance industry coalition illustrated in the next section).

ALEKSANDAR RANKOVIC
Senior Research Fellow & Lead on Post-2020
International Biodiversity Governance, Iddri

1.4 Reflections towards building biodiversity abatement & restoration curves

Another decisive aspect in the preservation of biodiversity will be the financial cost of the different measures that must be undertaken. Figure 9 is a first attempt to establish an "abatement & restoration curve" for biodiversity: it plots the MSA cumulative global gains compared to the trend scenario of 9.5% MSA loss by 2050 (vertical axis) against the expected cost of various measures (horizontal axis). This abatement & restoration curve is exploratory. The study of the economic costs (and benefits) of biodiversity preservation is a crucial decision-making information for policymakers and requires more work from the research community.

To obtain these rough estimates, the CBD's estimations of the costs of achieving the Aichi targets (CBD 2012) are matched to forecasts of gains associated to different global scenarios (Kok et al. 2018)(11). A number of climate change mitigation actions are also considered (McKinsey 2009)(12) since mitigating climate change can lead to reduced biodiversity losses compared to the trend scenario. Figures on the gains and costs of ecological restoration are an educated guess based on GBS case studies and CDC Biodiversité's experience regarding ecological restoration(13). Carbon footprint offsetting measures do not appear on Figure 9 due to a lack of data but can also represent a way to reduce climate change impacts on biodiversity, especially when those offsets are conducted through agro-forestry or mangrove restoration projects which have significant biodiversity co-benefits. The costs of such offsets with co-benefits could be relatively low (0-2€/MSA.m²). It is important to highlight again that the goal of Figure 9 is to be thought-provoking but not to reflect precisely the actual costs or gains generated by the actions considered (as accurate and comprehensive figures are currently lacking).

Significant MSA gains can be achieved with costs below 5 €/MSA.m²

Significant MSA gains can be achieved with **costs below 5 €/MSA.m²**, but they require significant efforts and planification from a number of industries. These actions put together would be **close to achieving a global no-net loss objective of biodiversity by 2050** – as the trend scenario estimates that we will be losing 9.5% MSA by then.

Furthermore, if we are to **achieve a global net positive biodiversity gain by 2050, major investments will be necessary to restore areas such as abandoned agricultural lands, former extraction sites, brownfields, etc. or even purchase and restore some areas currently active**. The high costs of these restoration measures show how crucial respecting the mitigation hierarchy (and thus avoiding impacts!) will be to achieve the 2050 targets for biodiversity.

(11) The annual expenditures are multiplied by 30 and summed up with the costs of investment. The following matching is applied between Aichi targets and actions in the PBL's scenario:
- Target 4 - Sustainable consumption and production: Reduce Waste and Losses; Dietary changes;
- Target 5 - Reducing Habitats Loss (forests and wetlands): Prevent forest conversion;
- Target 7 - Sustainable Agriculture, Aquaculture and Forestry: Reduced impact logging; Reduce pollution by nitrogen; Increase agro-biodiversity; Increase livestock and crop productivity;

For Target 11 – Protected areas (terrestrial and marine), the MSA gain calculated in section 1.3.3 is directly used. The costs reported by the CBD for both terrestrial and marine protected areas are used but MSA gains are assessed only for terrestrial biodiversity: the cost is over-estimated and should be seen only as a first estimate to be refined. The cost is further multiplied by (30%-12.85%)/(17%-12.85%) = 4.1 as the CBD cost estimate was based on an increase of terrestrial protected areas from 12.85% to 17% of the Earth (Ervin and Gidda 2012).

(12) GHG emission abatement measures are also included, but only take into account the climate change pressure on biodiversity – and not the potential co-benefits or losses, *e.g.* in terms of land use change. The annual gains are assumed to start in 2020 and to be maintained over 30 years and the emissions saved per year are thus multiplied by 30. This is likely to overestimate the gains compared to other measures such as ecological restoration. These measures are:
- Energy efficiency, mainly in transports and building sectors
- Power demand reduction
- Maximum low-carbon energy sources development in an optimistic scenario (nuclear, wind and solar).

GBS climate change impact factors (MSA.m²/kg CO2-eq) are applied to the avoided emissions to assess biodiversity gains. Costs come from the carbon abatement curve (McKinsey 2009).

(13) Lacking data on the extent of possible restorations, assumptions were made on the extent of land which could be restored. For easily accessible lands where restorations do not require land purchase, it was assumed a little less than 10% of the terrestrial biodiversity lost by 2050 could be restored (about 41.5% MSA), *i.e.* about 4% MSA. Restorations involving cheap land purchase were assumed to yield the restoration of an additional 30% of the terrestrial biodiversity lost by 2050, *i.e.* about 12% MSA. The remaining 60% of the 2050 static terrestrial biodiversity impact was assumed to be difficult if not impossible to restore.

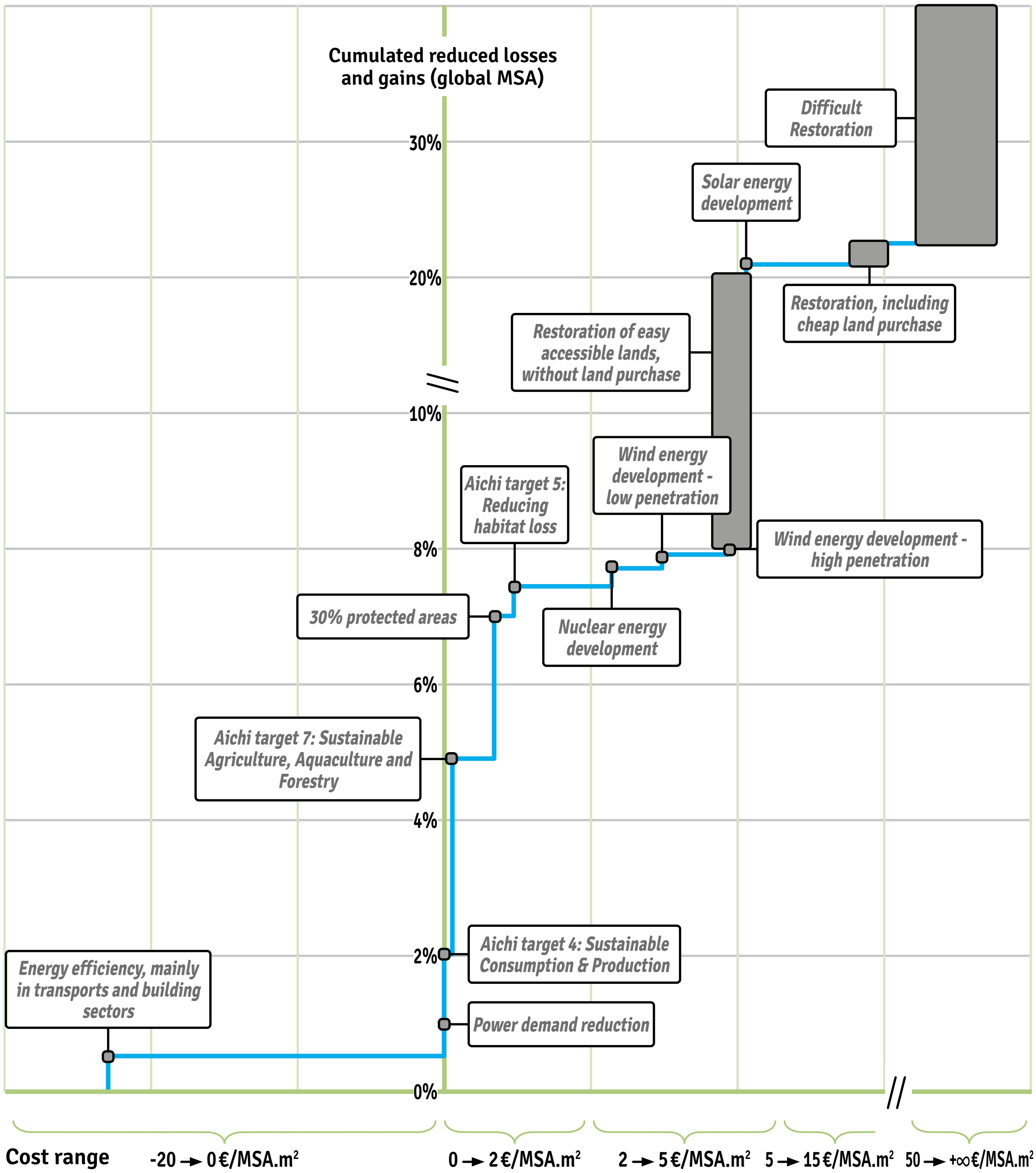


Figure 9: *Exploratory biodiversity abatement & restoration curve: cumulated MSA gains by 2050 compared to the trend scenario by cost-effectiveness.*

Figure 9 should be read as follows: the reduced losses associated to *Energy efficiency, mainly in transports and building sectors* represent about 0.5% MSA (associated to reduced climate change impact) for a negative cost (cost range of -20 €/MSA.m² to 0 €/MSA.m²). The second cheapest action is *Power Demand Reduction* which has a cost close to 0 €/MSA.m² and adds a reduced loss of about 0.22% MSA. Figure 9 thus shows cumulated gains of 0.5+0.22 = 0.72%. The same logic applies to the following actions, represented as points on the figure. For actions such as *Restoration of easy accessible lands, without land purchase*, the uncertainties around costs and gains are higher and instead of a point with a precise cost and gain, the range of possible values is displayed by a filled rectangle.

Role of the Global Biodiversity Score in the biodiversity impact measurement landscape

2 Role of the Global Biodiversity Score in the biodiversity impact measurement landscape

A number of platforms and networks more or less directly related to corporate biodiversity impact measurement exist. They fulfil different roles, as illustrated by Figure 10:

- Build the **business case** for measuring corporate impacts (and dependencies) on biodiversity;

- **Share best practices** on corporate impact measurement: most measurement tools have their own piloting network of businesses, such as the B4B+ Club for the GBS;

- **Road-test** the corporate impact measurement approaches;

- Evaluate existing tools through **criteria about the "best" assessments** of biodiversity impacts. Tools coming from the life-cycle assessment frameworksuch as ReCiPe benefit from the work of Life Cycle Assessment (LCA) expert groups such as ScoreLCA[14] or the International Reference Life Cycle Data System (ILCD)[15] defining which pressures should be taken into account and how. But for non-LCA tools, no such platform currently exists. In particular, Aligning Biodiversity Measures for Business (ABMB, described in Box 3) does not play that role;

- **Converge** on a limited number of **common input data and calculation processes**, especially for tools which are similar;

- **Describe** what tools are currently capable of;

- Provide a **common language**;

- Provide **recommendations to policy makers** on biodiversity measurements.

(14) https://www.scorelca.org/en/index.php

(15) https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/international-reference-life-cycle-data-system-ilcd-handbook-general-guide-life-cycle

	BUSINESS CASE	BEST PRACTICE SHARING	ROAD-TESTING	TOOL DESCRIPTION	TOOL ASSESSMENT	RECOMMENDATIONS TO POLICY MAKERS	COMMON LANGUAGE	DATA & CALCULATION CONVERGENCE
ABMB				✔		✔	✔	✔
Business @ Biodiversity		✔		✔				
BDP							✔	✔
Business for Nature	✔	✔				✔		
Club B4B+		✔	✔					
CSR Europe		✔						
ipbes						✔		
Natural Capital Coalition		✔					✔	
Natural Capital Finance Alliance		✔	✔					
Natural Capital Impact Group		✔	✔					
proteus		✔	✔					
Tools' affiliated companies		✔	✔					
LCA expert groups					✔			

Figure 10: ***Role of the international platforms and networks involved in corporate biodiversity impact measurement*** *(non-exhaustive)*

2.1 The Aligning Biodiversity Measures for Business collaboration

BOX 3

Invited expert – Katie Leach on the Aligning Biodiversity Measures for Business collaboration

As the Convention on Biological Diversity's Post-2020 Global Biodiversity Framework is developed, understanding and tracking private sector actions and performance in managing impacts and dependence on biodiversity will be of fundamental importance to halting the loss of biodiversity. Robust and broadly agreed biodiversity metrics and indicators for business are in high demand. Currently the measurement of business performance on biodiversity issues is hampered due to a lack of broadly agreed measurement approaches and because existing reporting standards focus on measures of process implementation rather than performance on the ground.

A wide range of biodiversity measurement approaches have developed in recent years. However, these are developing in parallel with little opportunity for alignment between the different approaches. Furthermore, these developments are taking place in parallel with broader policy discussions on Science-Based Targets for biodiversity and targets for the Post-2020 Global Biodiversity Framework.

The Aligning Biodiversity Measures for Business initiative led by UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) aims to address these issues by convening 20 institutions across relevant business, policy and biodiversity conservation groups with expertise in emerging biodiversity measurement approaches for business. Through a series of workshops, sub-group meetings and discussion papers, the initiative is working to form a common view among key stakeholders on the measurement, monitoring and disclosure of corporate impact and dependence on biodiversity and then communicate this into key business reporting and disclosure mechanisms and global policy discussions and frameworks. Four sub-groups – working groups aimed at driving the work forward and creating common thinking between the different measurement approaches – were developed on the following topics:

1. **Business applications and targets**. Sub-group 1 agreed a typology of business applications and targets, as well as a decision tree, to help businesses select a relevant biodiversity measurement approach.
2. **Boundaries and baselines.** Sub-group 2 worked to develop alignment among approaches on how biodiversity impact from business can be measured, focusing on creating alignment in the boundaries of assessments and baselines/reference points.
3. **Data and metrics.** Sub-group 3 is developing alignment on and clearer links between the datasets used in measuring biodiversity impact from business across the different measurement approaches.
4. **Mainstreaming.** Sub-group 4 explored how the measurement approaches can better link with disclosure initiatives, such as the Global Reporting Initiative and policy discussions on the Post-2020 Global Biodiversity Framework.

Each sub-group is working to identify and explore methodological challenges between approaches and identify common ground in which alignment can be reached. Developers and users of biodiversity measurement approaches and their stakeholders were brought together in two workshops and a series of webinars to explore the topics above. The key outputs to date are:

- Discussion paper on **identifying common ground** between corporate biodiversity measurement approaches.
- Discussion paper on corporate biodiversity measurement approaches within the current and future **global policy context**.
- Report in collaboration with the European Business and Biodiversity platform with an **assessment of biodiversity measurement approaches** for businesses and financial institutions, and summarising outcomes of discussions on common ground.
- A draft summary **information document** for submission to the Convention on Biological Diversity parties highlighting process results.

Work will continue into 2020 with engagement of the initiative into the Post-2020 Global Biodiversity Framework, further identification and agreement on common ground between measurement approaches on data, and outreach and communication of progress to businesses and standard setters.

KATIE LEACH,
Senior Programme Officer, UNEP-WCMC

2.2 Towards a biodiversity accounting framework : the Biological Diversity Protocol

The Biological Diversity Protocol (BD Protocol) is an output of the Biodiversity Disclosure Project[16], managed by the National Biodiversity and Business Network (NBBN) of South Africa[17] and hosted by the Endangered Wildlife Trust (EWT), a South African environmental non-governmental organisation. It aims to provide a unified accounting framework for corporate impacts on biodiversity and to help business compile a biodiversity impact inventory. The BD Protocol could thus become a reference framework equivalent to the Greenhouse Gas (GHG) Protocol[18] for biodiversity. Most of the corporate biodiversity impact assessment tools identified by ABMB could use the BD Protocol to report and disclose impacts: **the Protocol is not a tool itself but a set of rules and recommendations on how impacts should be reported.**

The first concept document for the BD Protocol was circulated in late 2018 and a first comprehensive draft was produced in March 2019. EWT then launched a consultation process, including an online one hosted by the Natural Capital Coalition[19] to which CDC Biodiversité contributed significantly. Following this consultation, an updated version of the BD Protocol will be published in 2020.

The emergence of the BD Protocol is a sign of the maturing of biodiversity impact assessment community and is very positive. It could support the reporting of corporate biodiversity footprint by businesses and financial institutions under the future mandatory disclosure in France and in the EU (called for by the French National Biodiversity Plan, described in Box 4).

As an illustration of how assessments using the GBS could fit within the BD Protocol (v1.1), it is applied to data regarding the Cossure ecological restoration project (in southern France). The BD Protocol prescribes that the inventory accounts and records biodiversity impacts as changes in **habitats** and **taxa**. The GBS and the MSA metric are used as a habitat rating method, thus focusing only on the habitat part. The case of Cossure was chosen because data are publicly available (Mulongoy and Fry 2016) and another habitat rating approach has already been applied to it (Houdet et al. forthcoming), which makes it easier to identify the similarities (and divergences) of the GBS with other approaches.

Three main "journal entries" have to be distinguished when accounting for the impacts of the project[20]. **Journal entry 1** accounts for the "reference state" and is somehow theoretical. **Journal entry 2** registers the purchase of 357 ha of orchards[21]. To simplify, in this example, only the land use pressure is considered (though other pressures such as fragmentation, encroachment, climate change, etc. actually apply). The orchards is considered to fall within the Intensive cropland land use (10% MSA). **Journal entry 3** registers the situation after the ecological restoration, which consisted in transforming the orchards into grassland fallow ("Coussous" habitat) favourable to targeted bird species, and involved exotic tree species and infrastructure removal. After restoration, the following habitats could be found:

- 270 ha of "regular" grasslands considered as Pasture - man-made (30% MSA);
- 87 ha where additional measures were tested to further accelerate the return of the Coussous steppe with the seeding of various species (60 ha), the addition of mycorrhizae and vegetative parts to seed mixes (3.0 ha), and the spreading of hay obtained from other nearby Coussous habitats (24 ha). The habitats where these measures were conducted is considered as Pasture - moderately to intensively used (60% MSA).

Table 2 and Table 3 provide a glimpse of two out of four of the tables produced when applying the BD Protocol. For example, in Table 2, for journal entry 3, the periodic gain is 270 x 30% = 81 MSA.ha for the regular grasslands. Readers can refer to Houdet et al. (forthcoming) for guidance on how to interpret the tables.

The **net *Periodic gains and losses*** from one journal entry to the next in the Statement of Biodiversity Performance **are equivalent to the notion of *dynamic* impact**. The ***Accumulated negative impacts*** in the ***Statement of Biodiversity Position*** **is equivalent to the notion of *static* impact**. A detailed case study involving the application of the Protocol to the GBS is planned in 2020.

(16) http://www.bdprotocol.org

(17) https://www.ewt.org.za/what-we-do/what-we-do-people/national-biodiversity-and-business-network/

(18) https://ghgprotocol.org/

(19) https://collaborase.com/bdprotocol

(20) To simplify reading, only the journal entries related to Y and Z accounts were numbered here. In theory, journal entries in A, B and C accounts should also be numbered.

(21) The surface area of this project is relatively small, and its assessment is outside the usual perimeter of GBS assessments, which focus on whole corporates or financial institutions. The project is used only for illustrative purpose and, as noted above, was chosen because data related to it are publicly available and the BD Protocol has already been applied to it.

Table 2: Statement of Biodiversity Performance for the Cossure project

Journal entries	Periodic gains (Y)		Hectares equivalents (MSA.ha)
1	Accounting for reference state of ecosystem assets on purchase, which underpins their subsequent condition scoring	Coussous MSA 100%	357.0
2	On purchase of ecosystem assets, recording condition-adjusted losses associated to existing ecosystem asset condition scores	Orchards MSA 10%	35.7
3	After restoration measures, recording condition-adjusted gains associated to new ecosystem asset condition scores	Regular grasslands MSA 30%	81.0
3		Improved grasslands MSA 60%	52.2
Sub-total periodic gains (Y)			**525.9**
Journal entries	**Periodic losses (Z)**		**Hectares equivalents (MSA.ha)**
2	On purchase of ecosystem assets, recording condition-adjusted losses associated to existing ecosystem asset condition scores	Coussous 100%	357.0
3	Recording ecosystem assets according to changes in their condition scores	Orchards MSA 10%	35.7
Sub-total periodic losses (Z)			**392.7**
Net ecosystem impacts (X = Y - Z)			**133.2**

Table 3: Statement of Biodiversity Position for the Cossure project

Assets (A)		
Ecosystem accounts	Hectares (ha)	Percentage (%)
Regular grasslands MSA 30%	270	76%
Improved grasslands MSA 60%	87	24%
Total	**357**	100%

Accumulated negative impacts (C)		
Ecosystem accounts	Hectares equivalents (MSA.ha)	Percentage (%)
Regular grasslands MSA 30%	189	53%
Improved grasslands MSA 60%	34.8	10%
Accumulated positive impacts (B)		
Ecosystem accounts	Hectares equivalents (MSA.ha)	Percentage (%)
Regular grasslands MSA 30%	81	23%
Improved grasslands MSA 60%	52.2	15%
Total	**357**	100%

2.3 Update of the mapping of biodiversity footprint assessment tools

Since our previous technical update, some tools have merged, new tools have been designed and some have become less active. **Figure 11 provides an updated version of our previous mappings** (CDC Biodiversité, ASN Bank, and ACTIAM 2018; CDC Biodiversité 2019b). It does not seek to assess the initiatives listed against any criteria. Instead, it seeks to provide a non-exhaustive overview of existing biodiversity impacts measurement tools and illustrate that most of them fulfil different needs, thus being complementary to each other. Figure 11 focuses on the core (or primary) business applications and perimeters of each tool. However, most of the tools are not limited to their core applications.

Figure 11 distinguishes three broad categories of **business applications (BA)**, built on previous works (Addison, Carbone, and McCormick 2018; CDC Biodiversité 2019b). The associated business applications of the joint European Union Business & Biodiversity (EU B@B) platform and ABMB report (Lammerant 2019) are listed in italics:

➨ **A - Assessment / rating by and for third parties with external data**:

- *BA 5: Assessment / rating of biodiversity performance by third parties, using external data*;
- Assessment of corporate biodiversity performance by third parties (*e.g.* rating agencies) for their own use and based on external (and often public) data. Typically, the assessment conducted by financial institutions (FIs) of the footprints of businesses they fund falls within this business application (FIs act as third parties here);

➨ **B - Biodiversity accounting for external audited disclosure**:

- *BA 8: Biodiversity accounting for internal reporting and/ or external disclosure*;
- Accounting and reporting by companies of information on their corporate biodiversity performance based on internal data, to demonstrate effective impact management . The data used and impacts reported follow accounting principles such as the ones listed by the BD Protocol (EWT - NBBN 2019) and can thus be audited by third parties. This business application can fulfil the needs of regulatory external reporting of corporate biodiversity footprint;

➨ **C - Biodiversity management & performance**:

- *BA 1: Assessment of current biodiversity performance, BA 2: Assessment of future biodiversity performance, BA 3: Tracking progress to targets, BA 4: Comparing options, BA 6: Certification by third parties, BA 7: Screening and assessment of biodiversity risks and opportunities;*
- Monitoring and evaluation by companies of the effectiveness of their own management interventions such as actions taken to mitigate impacts. This feeds into companies' internal decision-making on topics such as the concrete actions which could be implemented to move towards biodiversity net gains (for instance should one supplier be encouraged to switch to more biodiversity-friendly practices, or should agricultural practice X or agricultural practice Y be implemented on farmlands operated by the company).

Internal communication is not listed as a separate business application because it is not a differentiating factor between tools: all can be used to support internal communication.

In addition to business applications, Figure 11 lists five broad perimeters, covering different application areas and answering different questions (CDC Biodiversité, ASN Bank, and ACTIAM 2018; CDC Biodiversité 2019b):

1. **Public policy**
   - How can quantified targets for countries/sectors be set and monitored to reduce biodiversity loss; *e.g.* by the CBD, national governments and other actors?
   - How can trends in biodiversity decline be expressed and how can the contribution of each industry be assessed at a national level?
   - What does the biodiversity footprint per capita look like?
   - What percentage of the total biodiversity impact of a country is 'imported' through dependencies on foreign resources?
2. **Corporate / portfolio of companies**
   - What is the biodiversity footprint of a financial institution or company and what is the footprint it induces across its value chain?
   - What is the footprint of different asset classes and investments?
   - How do the investments in companies compare to each other regarding their biodiversity impact?
3. **Supply options**
   - How do different suppliers and supply chain options compare with regards to their impact on biodiversity?[22]
4. **Product or service**
   - What design and composition of products or services guarantees the lowest biodiversity footprint? How do different commodities compare with regards to their impact on biodiversity?
5. **Project or site**
   - How can operational impacts on biodiversity be minimised at the site or project level and how can positive impacts be measured and compared?
   - How can the impacts of onsite direct operations be summed to come up with aggregated figures at the corporate level?

(22) Assessing the impact of the commodities produced by one specific raw material producer without comparing different sourcing options falls under Product or service use.

Figure 12 provides a new angle to this mapping and shows where the tools stand in the driver, pressure, state, impact and response (DPSIR) framework. Drivers are not represented as the tools directly focus on pressures on biodiversity. Some indicators of pressures, biodiversity state or response are also indicated to highlight the differences between indicators and measurement tools (the list of indicators is far from exhaustive and is meant only as an illustration).

The perimeter of the mapping was determined following the same rule as the assessment conducted by the EU Business and Biodiversity Platform in 2018: "*biodiversity accounting approaches for businesses and financial institutions (FIs) which rely on quantitative indicators that provide information on the significance of impacts on biodiversity, and which are not case-specific*" *(Lammerant, Müller, and Kisielewicz 2018).*

The selection of international initiatives mapped is briefly described below:

- **GLOBIO-IMAGE** (PBL): GLOBIO is a model developed by the PBL, UNEP GRID-Arendal and UNEP-WCMC. It includes two components: cause-effect relationships linking pressures to impacts on biodiversity and an integration with IMAGE, a suite of models developed by the PBL which provides a dynamic integrated assessment framework to analyse global change. The second component can lead global or national public biodiversity policy analyses based on the evaluation of the impacts of environmental drivers on past, present and future biodiversity[23].
- **LPI** (WWF): the Living Planet Index measures the global state of biodiversity based on changes in the populations of 16 700 populations covering over 4 000 vertebrate species throughout the planet[24].
- **EP&L** (Kering)[25]: Kering assesses its land use (among other indicators) impact through its Environmental Profit & Loss methodology.
- **BFFI** (ASN Bank)[26]: PRé and CREM assess the biodiversity footprint of the assets of ASN Bank through the Biodiversity Footprint for Financial Institutions, combining data from EXIOBASE, other input-output databases and direct data, the ReCiPe methodology and a qualitative analysis.
- **GBS** (CDC B): CDC Biodiversité assesses the biodiversity footprint of economic and financial activities with the Global Biodiversity Score using GLOBIO cause-effect relationships.
- **CBF** (Iceberg)[27]: the Corporate Biodiversity Footprint developed by Iceberg Data Lab provides data to investors on the biodiversity impacts of a large number of corporates depending on their activities (throughout the value chain) and the location of their facilities.
- **STAR** (IUCN) [28]: the IUCN is developing the Species Threat Abatement Reduction tool to assess the gains of investing in biodiversity conservation to reduce species extinction risk.
- **LIFE Key** (LIFE Institute) [29]: For over eight years, the Lasting Initiative for Earth (LIFE) Institute has been developing and applying a Biodiversity Impact Index in South America to assess businesses' biodiversity performance and their eligibility to the LIFE certification.
- **BIM** (CISL)[30]: Cambridge Institute for Sustainable Leadership is developing the Biodiversity Impact Metric to compare the impacts of different commodities and supply chains.
- **PBF** (I Care + Sayari)[31]: I Care and Sayari combine biodiversity studies and companies' data to assess the impact of products and services through their Product Biodiversity Footprint.
- **BF** (Plansup): Plansup uses the Biodiversity Footprint Calculator to assess the impact of a range of businesses, *e.g.* to compare biodiversity improvement options[32].
- **BISI** (WCMC)[33]: UNEP-WCMC, Conservation International and Fauna & Flora International have developed an aggregated approach for assessing corporate biodiversity performance resulting in biodiversity indicators for site-based impacts. With support from IPIECA and the Proteus Partnership and pilots with 7 energy and mining companies, it is focused on tracking state-pressure-response indicators at the site level, with the possibility to aggregate results at the corporate level.
- **BPT** (Solagro)[34]: Solagro has developed the Biodiversity Performance Tool (BPT) under the European LIFE Food & Biodiversity project. It qualitatively assesses farm-level biodiversity and recommends actions to include in biodiversity management plans.
- **ABD Index** (Bioversity-CIAT)[35]: the Alliance of Bioversity-CIAT is developing the Agrobiodiversity Index to assess risks in the food and agriculture industries related to low agrobiodiversity.
- **B-INTACT** (FAO)[36]: the Food and Agriculture Organisation has developed the Biodiversity Integrated Assessment and Computation Tool, a biodiversity module for the Ex-Ante Carbon-balance Tool to assess the impacts of development projects in the Agriculture, Forestry and Other Land Use sectors.
- **LCA methods**: several LCA endpoint methods allow to assess impacts on biodiversity, including ReCiPe[37], LC Impact[38], Impact World+[39]. These methods can be used through tools such as Simapro or OpenLCA.

A handful of key reports provide more in-depth comparisons of biodiversity footprint methodologies (Lammerant 2019; Core initiative on Biodiversity One Planet Program on Sustainable Food Systems 2018; ABMB 2019b; 2019a) [40].

(23) https://www.globio.info/

(24) https://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_2018/

(25) https://www.kering.com/en/sustainability/environmental-profit-loss

(26) https://www.asnbank.nl/web/file?uuid=14df8298-6eed-454b-b37f-b7741538e492&owner=6916ad14-918d-4ea8-80ac-f71f0ff1928e&contentid=2453

(27) http://www.icebergdatalab.com Demo available on demand.

(28) https://www.iucn.org/regions/washington-dc-office/our-work/biodiversity-return-investment-metric

(29) http://institutolife.org/o-que-fazemos/desenvolvimento-de-metodologias/documentos-que-dao-suporte-tecnico-a-metodologia/?lang=en

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

(31) http://www.productbiodiversityfootprint.com/

(32) http://www.plansup.nl/models/biodiversity-footprint-model/

(33) https://www.unep-wcmc.org/featured-projects/biodiversity-indicators-for-site-based-impacts This tool is the result of the merger of the "Mining footprint" and "Extractive" tools listed in our previous mapping.

(34) https://www.business-biodiversity.eu/en/biodiversity-performance-tool

(35) https://www.bioversityinternational.org/abd-index/

(36) http://www.fao.org/tc/exact/b-intact/en

(37) Huijbregts et al. (2016)

(38) https://lc-impact.eu

(39) http://www.impactworldplus.org/en

(40) The two ABMB position papers are going to be updated in 2020 after the publication of this report.

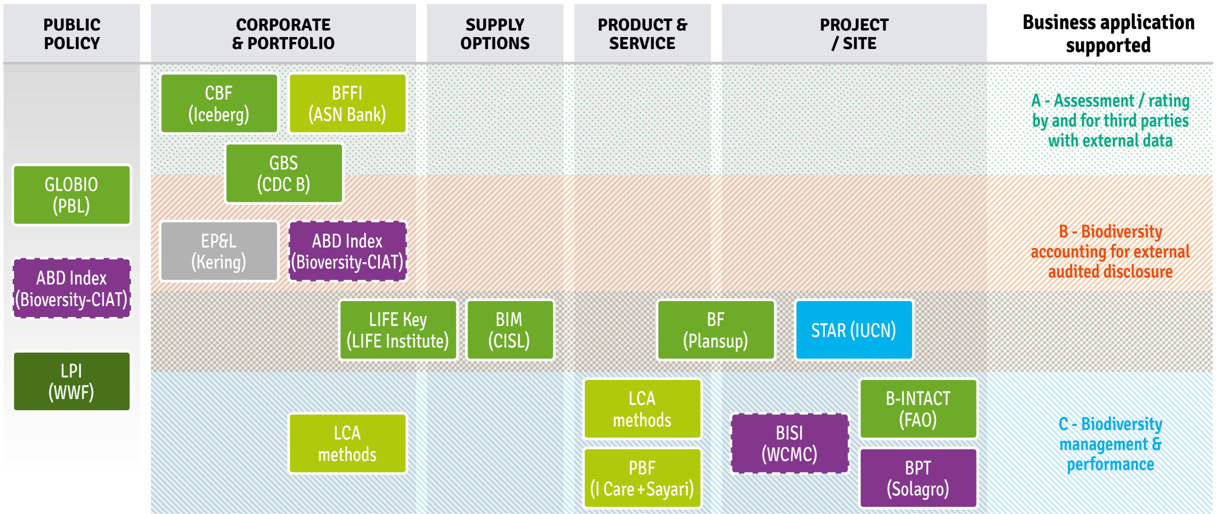


Figure 11: *Mapping of the core business applications and perimeters of biodiversity impact assessment initiatives*

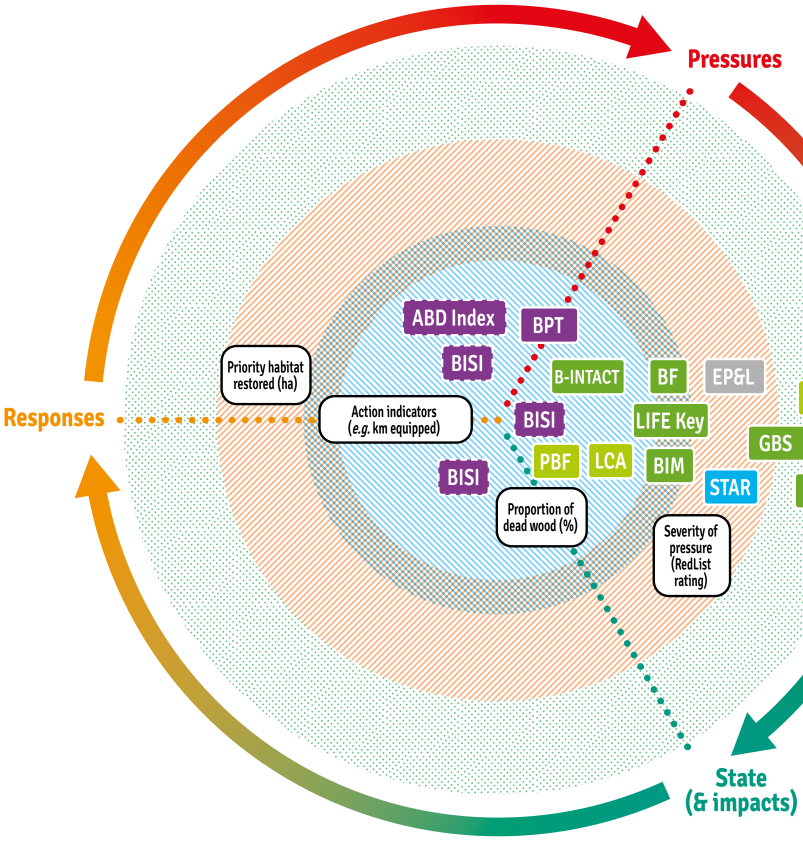
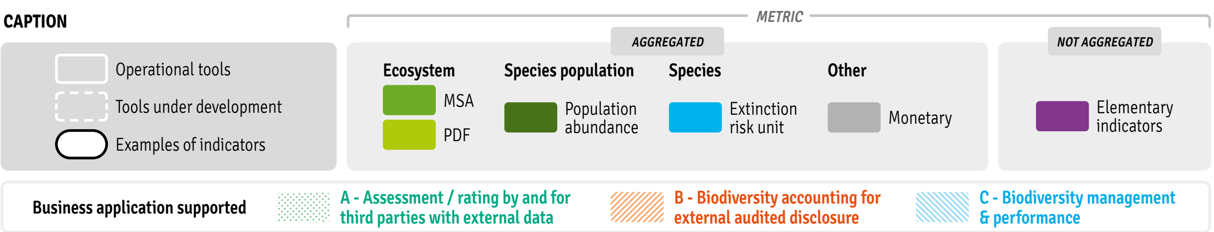


Figure 12: *Mapping of the core business applications and location in the pressure, state, impact, response framework of biodiversity impact assessment initiatives*



2.4 Core business applications covered by the GBS

As noted, assessments can be used for a number of business applications. The following paragraphs provide examples of the use of the GBS for key business applications, using the same names as in Lammerant (2019).

BA 1: Assessment of current biodiversity performance; BA 2: Assessment of future biodiversity performance; BA 4: Comparing options

For **businesses**, the GBS can be used to assess current biodiversity gains and losses and identify the main pressures impacting biodiversity. Once the value chain boundary (upstream, direct operations, downstream), location and most material pressures (land use change, hydrological disturbance, etc.) are identified, businesses can propose actions to reduce their negative impacts or increase their positive impacts and evaluate the expected results.

BA 3: Tracking progress to targets

For **businesses** and **FIs**, the GBS can be used to set and track progress against "Specific corporate-level biodiversity commitments or engagements", "Aichi targets and post 2020 biodiversity targets" and "No net loss/net gain" (three of the targets listed in Lammerant, 2019). It can be used to define and measure key performance indicators (KPIs) such as the "total Scope 1 impacts on biodiversity (MSA.m^2)" and "total Scope 2 and Scope 3 upstream impacts on biodiversity (MSA.m^2)". It can then set targets such as reducing those two KPIs by 30% by 2030 compared to 2019. As seen above, the post-2020 framework will include targets which can be translated into MSA.m^2 and initiatives such as the SBTN will allow to set science-based corporate targets. The GBS will be able to track progress against such targets and inform on the contribution of individual businesses to the achievement of post-2020 biodiversity targets.

CDC Biodiversité does not encourage aggregating gains and losses of biodiversity, but rather recommend to report them separately. If a company wants to assess its net contribution to biodiversity though, it is also possible by summing positive and negative impacts at the appropriate geographical level and for the appropriate Scopes. The mitigation hierarchy should be applied to ensure that losses are avoided as much as possible, the remaining impacts are minimised and that once these two steps of avoidance and minimisation have been implemented, if any residual impacts remain, restoration and offset measures should be implemented. The GBS can assess the losses and gains. Figure 13 illustrates how this could translate for a portfolio. The questions of the appropriate geographical level and Scopes have not yet been properly discussed by any platform and remain open.

BA 5: Assessment / rating of biodiversity performance by third parties, using external data; BA 4: Comparing options

For **FIs**, the GBS can provide unsolicited assessments of the companies financed, using public data or ratings provided by specialist providers. It can be used to define criteria to inform investment decisions. For instance, the intensity of impact per thousand euros of turnover can be calculated for industries or for individual businesses and the intensities can be compared between industries or businesses, or against benchmarks. Such criteria can then be used to screen industries or companies for **inclusion or exclusion** from investment and **environment social governance (ESG) integration**. For instance, Figure 14 shows the impact intensity in MSA.m^2 per thousand euros of turnover for five fictitious companies extracted from the GBS example portfolio, further described in the GBS review documents (CDC Biodiversité 2020e). The *Food 1* and *Food 2* companies both belong to the food industry: *Food 2* has a higher impact intensity of 13 MSA.m^2/k€ across its direct operations and supply chain and an asset manager seeking to minimise impacts and targeting an intensity of less than 10 MSA.m^2/k€ at the portfolio level may thus use the information to invest in *Food 1* in priority. Assessments using the GBS can also be used to assess the achievement of the positive environmental returns expected from **impact investing**.

GBS assessments can further inform FIs' **votes** at Annual or Extraordinary General Meetings of companies, to push proposals aiming at aligning companies with global biodiversity goals. It can also feed into their **engagement policy**, *i.e.* active ownership stimulating responsible business conduct by entering into a dialogue with the company on violations made.

BA 7: Screening and assessment of biodiversity risks and opportunities

Biodiversity is climbing up the political agenda and citizens are aware of the damage caused to nature and are increasingly holding businesses accountable for their impacts. In the future, mandatory biodiversity footprint reporting will be mainstreamed into national regulations (Box 4). Starting to use tools like the GBS now helps companies limit associated **regulatory risks**.

Companies causing significant negative impacts on biodiversity are further associated with **legal risks** of future litigations (mirroring climate-related litigations currently being pursued globally) associated to their degradation of biodiversity upon which others rely (through the ecosystem services it provides) and to their contribution to biodiversity losses preventing global targets from being achieved. For the same reasons, those companies also face **reputational** and possibly **market risks**. The fossil fuel divestment movement related to the climate issue might be replicated for biodiversity, leading to the **financial risk** of higher financing costs for companies unable to demonstrate good biodiversity performance.

The GBS can help businesses anticipate and work to reduce their biodiversity footprint to limit those risks.

BA 8: Biodiversity accounting for internal reporting and/or external disclosure

Disclosure of impacts on biodiversity should become mandatory in the next few years in France and the EU (Box 4). Tools like the GBS can provide businesses with solutions to measure, audit and disclose their impacts in a robust and consistent way.

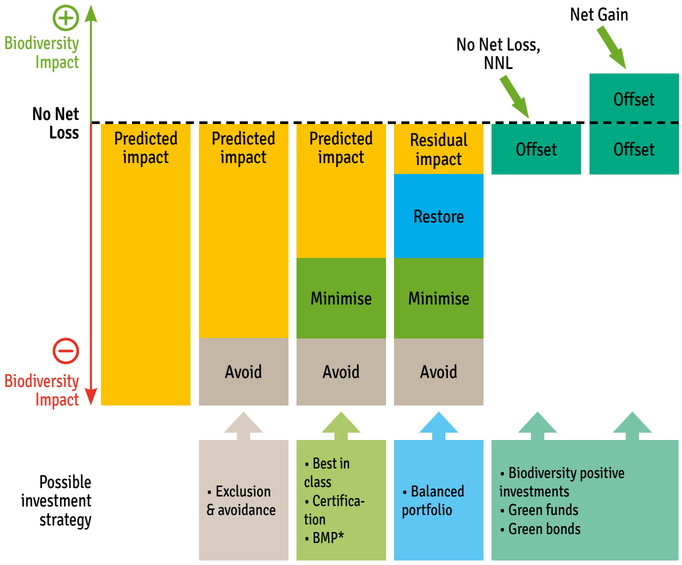


Figure 13: ***Going for net gains at the portfolio level: how various approaches to investment can contribute*** *(adapted from Forest Trends 2018)*

* Best management practice

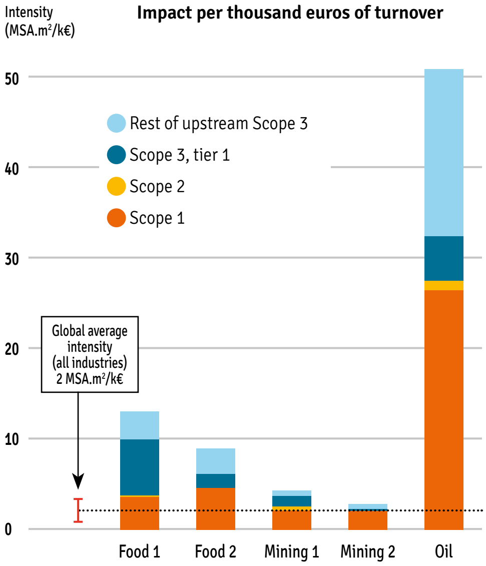


Figure 14: ***Example of uses of the GBS for ESG integration and "best in class" investment***

BOX 4 Reporting of corporate biodiversity footprint should become mandatory for large companies

A lot of progress towards the generalization of the evaluation of corporate biodiversity footprint has been made in France and at the EU level recently. The French government launched its 2018-2024 Biodiversity Plan on 4 July 2018(41). Among its 90 actions, action 30 is especially relevant for BFA:

"*From 2018, we will launch works to encourage companies to qualify their biodiversity footprint. In this context, we will support works aimed at defining an indicator of impact on biodiversity comparable to the tonne of CO_2 for climate impact. When this biodiversity footprint is qualified, we will generalize its use and we will support the compulsory reporting of this indicator at the European level as part of the corporate social responsibility (CSR) review planned for 2020. The French CSR Platform will be mobilised in 2018 to make proposals in this perspective.*"(42)

As planned by the French government, the CSR Platform has been tasked in June 2019 to produce an overview of existing corporate BFA tools and current corporate reporting practices(43). It is supported by the French Foundation for Research on Biodiversity (FRB) which organised a scientific assessment of seven key BFA tools, including the GBS (FRB in press). In March 2020, the Platform published ten recommendations to the government(44). They include encouraging companies to analyse "the impact of their activities on the main drivers of biodiversity loss" and "better integrate biodiversity into extra-financial reporting". At the European level, the European Union (EU) Biodiversity Strategy(45) aims at "measuring the environmental footprint of products and organisations on the environment" and in particular the essential features of biodiversity. Clear biodiversity criteria will also be listed in the EU green taxonomy for finance and the non-financial reporting directive will be reviewed to more explicitely include biodiversity impacts. The strong political support for biodiversity footprint reporting in France and the alignment with the agenda of the European Union means that reporting of the impacts of companies on the drivers of biodiversity loss should become mandatory for large companies in France and the EU in the coming years (*e.g.* above EUR 100 million of turnover). The GBS is one of the tools which will facilitate such reporting.

(41) Available in French: https://www.ecologique-solidaire.gouv.fr/sites/default/files/2018.07.04_PlanBiodiversite.pdf This 2018-2024 Plan proposes 90 actions defining the priorities and vision of the government for biodiversity. The translation of action 30 in English is available in our previous technical update (CDC Biodiversité 2019b).

(42) This translation from French has been conducted by CDC Biodiversité and is not official.

(43) French version of the request to the CSR Platform: https://www.strategie.gouv.fr/actualites/biodiversite-nouvelle-saisine-de-plateforme-rse

(44) https://www.strategie.gouv.fr/english-articles/corporate-biodiversity-footprint

(45) https://ec.europa.eu/info/sites/info/files/communication-annex-eu-biodiversity-strategy-2030_en.pdf

Update on methodological developments

3 Update on methodological developments

3.1 Accounting for impacts over time

Some impacts are long-lasting and continue to harm biodiversity years after their source disappeared. These include the impact of GHG emissions on climate change or chemical pollution which remains harmful in soil, air or water over several years. Some measurement tools currently do not specifically account for such long lasting impacts, but those that do use two approaches (Lammerant 2019; ABMB 2019b). The approach favoured by LCA-based tools is to integrate impacts over time. The current approach used in the GBS is to break them down into **'dynamic footprint' and 'static footprint'.**

***'Dynamic footprint'* is the footprint caused by changes, consumptions or restorations during the period assessed. *'Static footprint'* or *'ecological opportunity cost'*[46] includes all the *'persistent'* or *'long-lasting'* effects which remain over time.** Static footprints can result from the spatial pressures (land use, fragmentation, encroachment) linked to existing facilities and also the persistent (and constant) effect of past emissions still impacting biodiversity today, for instance greenhouse gas emissions emitted years ago but still keeping the atmosphere warm. They also include the persistent effects of past pollutions, for instance in freshwaters. Static footprints should be accounted for separately and, unlike dynamic footprints, should not be summed up over time to avoid double-counting. Static impacts are stocks of (past) accumulated losses and fall into the "statement of position" in the Biological Diversity Protocol (EWT - NBBN 2019), while dynamic impacts are flows of impacts (during the period assessed) or "periodic gains/losses" fall into the "statement of performance" in the Protocol.

The dynamic/static approach and the time-integrated approach both have advantages and drawbacks and they answer different questions. They can thus be seen as complementary, as illustrated by Table 4.

(46) In microeconomic theory, the opportunity cost is the 'cost' incurred by not enjoying the benefit that would have been if an alternative scenario had occurred. It is not necessarily a monetary or financial cost. Here we use the term 'ecological opportunity cost' to address the biodiversity lost due to the existence of an economic activity, compared to a scenario where the activity would not exist.

Table 4: Comparison of dynamic/static vs time integration in the context of biodiversity footprint

Item	Dynamic/static	Time integration
Questions answered	What is the current state of remaining biodiversity and how much damage is being caused during the period assessed?	What impacts on the state of biodiversity will the pressures applied during the assessment period cause over their "lifetime"?
Capacity to link to trajectories of biodiversity state	Yes: the dynamic impacts for instance equates the changes in the "Bending the curve" or the +20% ecosystem integrity in the CBD zero draft (CBD 2020).	No: except if those trajectories are also time-integrated (*e.g.* "the biodiversity loss should be reduced by 30%.Earth.yr by 2030").
Capacity to set no biodiversity loss targets (including no net loss)	Yes: no net loss means the sum of variations of dynamic impacts equal zero.	Yes but only targets aiming at 0 loss. Targets aiming at +20% gains or "only -10% loss" cannot be set, *cf.* Capacity to link to trajectories.
Incentive for companies to limit today pressures with persistent impacts	Strictly applied, the dynamic/static framework alone does not provide strong incentives because the impacts in 10 years' time of pollutants emitted today will in theory be accounted for in the company books only in 10 years. In practice, this issue has not yet been met for the pressures assessed with the GBS*. Furthermore, the incentive can be corrected through the introduction of the concept of "Future impacts" (see below). Such a multi-year accounting system is complex to implement and currently not implemented in the GBS.	Yes: time integration by definition accounts for future impacts caused by today's pressures.
Capacity of non-expert stakeholders to understand the results	Relatively easier.	Difficult as time integration and ".yr" units are complex to grasp.

*For climate change in particular, the impacts are likely to occur relatively quickly following GHG emissions and, in the GBS, they are accounted for as dynamic impacts on the year they are emitted (instead of being accounted for as *future* impacts). Companies thus have an incentive to reduce their GHG emissions, even if those emissions may fully impact biodiversity only a few years after being released in the atmosphere.

This comparison led to the choice of the dynamic/static accounting framework: it answers the need to understand the current position of a company in terms of remaining biodiversity, it is compatible with international targets (as they are currently formulated), and based on the feedback of companies who road-tested the GBS, it is easier to understand.

Conceptually, the dynamic/static accounting framework requires an accounting of impacts over multiple-time periods. In the GBS, we usually use the year as the accounting period (though impacts can be assessed over periods longer than one year). Pressures originating in year 0 and causing long-lasting impacts varying over several years should in theory be accounted for by dynamic impacts matching those gains or losses year after year. As noted in Table 4, it is necessary to introduce an additional concept to avoid incentivising companies to discount impacts which will occur in the future. **Future impacts** are impacts which have not yet occurred – and thus have not yet been accounted as dynamic or static impacts – but will occur in the future[47]. Figure 15 illustrates how such a framework would work in practice.

As explained in detail in the GBS Core concepts review document (CDC Biodiversité 2020a), this comprehensive accounting framework is currently only partially implemented in the GBS due to several obstacles. In practice, the pressures evaluated so far have not required the use of the future impact concept. For climate change for instance, the impacts on biodiversity occur over a handful of years (Joos et al. 2013; Arets, Verwer, and Alkemade 2014) and the future impact has been approximated as being negligible while the dynamic impact was considered to raise directly to its highest level in year 1, becoming a static impact in year 2 (CDC Biodiversité 2019b; 2020a).

The question of the best accounting framework for long-lasting impacts is complex and many biodiversity impact measurement tools have not yet considered it in detail (Lammerant 2019). CDC Biodiversité is open to discussions on the advantages and drawbacks of all approaches, including time integration, and will continue to work with other tool developers and accounting frameworks such as the BD Protocol to properly account for those impacts.

(47) The concepts match the concepts of accumulated negative impacts (static impacts), (net) periodic gains and losses (dynamic impacts) and future impacts (future impacts) from the BD Protocol (EWT - NBBN 2019).

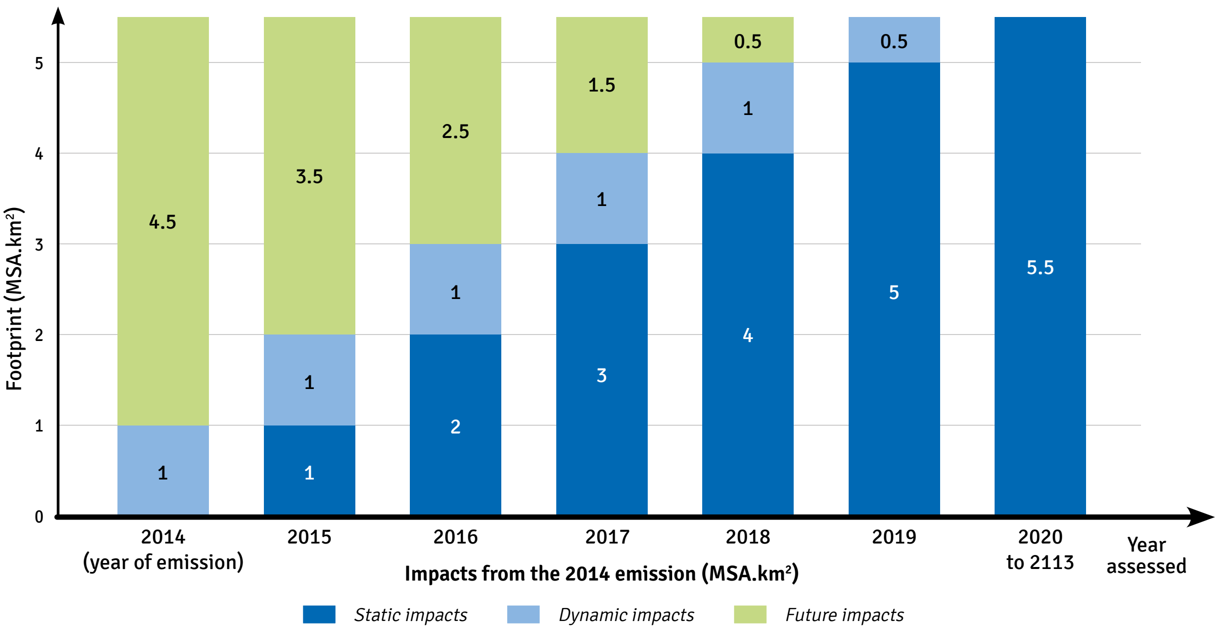


Figure 15: *Example of long-lasting impacts caused by an emission in 2014.*

3.2 Compatibility of the Scope accounting framework with existing protocols

Impacts assessed with the GBS are broken down by value chain boundary. Figure 16 illustrates how the boundaries distinguished by the GBS (CDC Biodiversité, ASN Bank, and ACTIAM 2018; CDC Biodiversité 2019b) match those of the Natural Capital Protocol (NCP), and thus of the BD Protocol, which uses the same boundaries. The impacts of each boundary are defined as:

- **Scope 1**[48]: impacts generated on the area controlled by the entity and other impacts directly caused by the entity during the period assessed. Those impacts occur "gate to gate", within the direct operations (NCP) or controlled operations (BD Protocol);
- **Scope 2**: impacts resulting from non-fuel energy (electricity, steam, heat and cold) generation, including impacts resulting from land use changes, fragmentation, etc. They belong to the "cradle to gate" impacts and the "upstream" boundary (in the NCP and BD Protocol);
- **Scope 3**: impacts which are consequences of the activities of the company but occur from sources not owned or controlled by the company. They are further split into:
  - **Tier 1 of upstream Scope 3**: impacts caused by the first tier of suppliers of the company, *i.e.* its direct suppliers. They also belong to "cradle to gate" impacts and the "upstream" boundary;
  - **Upstream Scope 3 excluding tier 1**: impacts caused by the suppliers of the direct suppliers, *i.e.* in tier 2 and beyond. They also belong to "cradle to gate" impacts and the "upstream" boundary;
  - **Downstream Scope 3**: impacts caused downstream of the company's activities, *i.e.* during the use or end of life of its products and services. They belong to the "gate to grave" impacts and the "downstream" boundary (in the NCP and BD Protocol).

(48) "Scope" is capitalised to clearly distinguish the concept of value chain boundary from the broader meaning of "scope" as perimeter (*e.g.* "scope of the assessment").

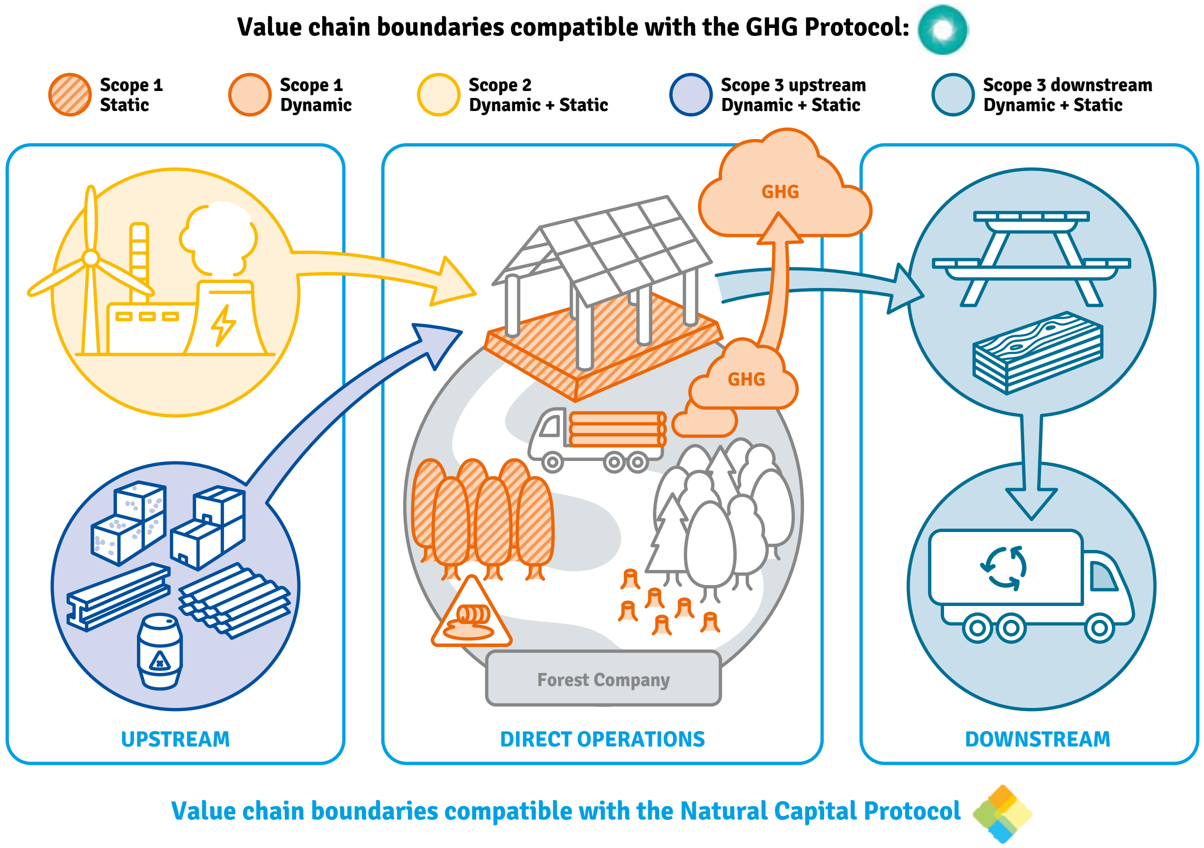


Figure 16: *Correspondence between the Natural Capital Protocol and the Scope framework used in the Global Biodiversity Score*

3.3 Overview of data inputs

The GBS follows a hybrid approach to assess the footprint of economic activities as described in the 2018 Technical update (CDC Biodiversité 2019b). As explained in Box 1, there are four main entry points, which can also be calculation stages, in the GBS. The first stage is (i) financial data (economic quantification of human activities) which can be used to estimate (ii) raw material consumption, emissions and water use (inventories). In turn, it allows to assess (iii) pressures on biodiversity. Through pressure-impact relationships, (iv) impacts on biodiversity state can be assessed. The GBS uses the best data available at each calculation step, in what can be called a stepwise approach. In the absence of data, a financial default approach evaluates companies based on turnover figures and regional industry averages. Fed with more specific data, the assessment is refined to take into account company-specific pressures, etc. Figure 17 lists the different types of data inputs which can be used in the GBS.

Data inputs may originate from user collected data or externally collected data, *i.e.*, as defined by the ABMB collaboration, direct measurement conducted on-site by the company and data from national or global databases respectively (Lammerant 2019). For instance the quantity of copper extracted by a mining company and used by an electric manufacturing company to produce circuit board might be known by the manufacturer, but it will more likely be modelled through a life cycle assessment and the tonnage will come from a Life Cycle Inventory (LCI). LCI data generally covers the entire life cycle of the item assessed, which means it may be difficult to disentangle impacts caused by material extraction, processing, manufacturing, transport, etc.

Table 5 details the data inputs which can be used at each calculation step. The closer to the state of biodiversity the data input is (*i.e.* the more it is on the right of Figure 17), the more refined the assessment will be. Conversely, assessments conducted only with financial data are called "default financial assessments" and cannot distinguish two companies with the same breakdown of geographical and industry turnover (CDC Biodiversité 2019b). The GBS data collection guidelines (CDC Biodiversité 2019a) provide guidance on the most appropriate data to collect for each category (from economic quantification to pressures). When using refined data to replace less refined one, it is important to ensure the value chain boundaries are identical. For example, and using the numbering from Table 5, impacts assessed based on the "financial default" (*i.e.* (1.i) Scope 1 economic quantification of economic activity) cover Scope 1 and upstream. Similarly, LCI data usually cover Scope 1 and upstream (though they may also cover downstream). Impacts calculated with LCI data can thus replace financial default impacts. But impacts assessed only with a GBS commodity tool (2.A), or CommoTool, cover only the extraction step, and cannot replace entirely impacts obtained based on LCI data.

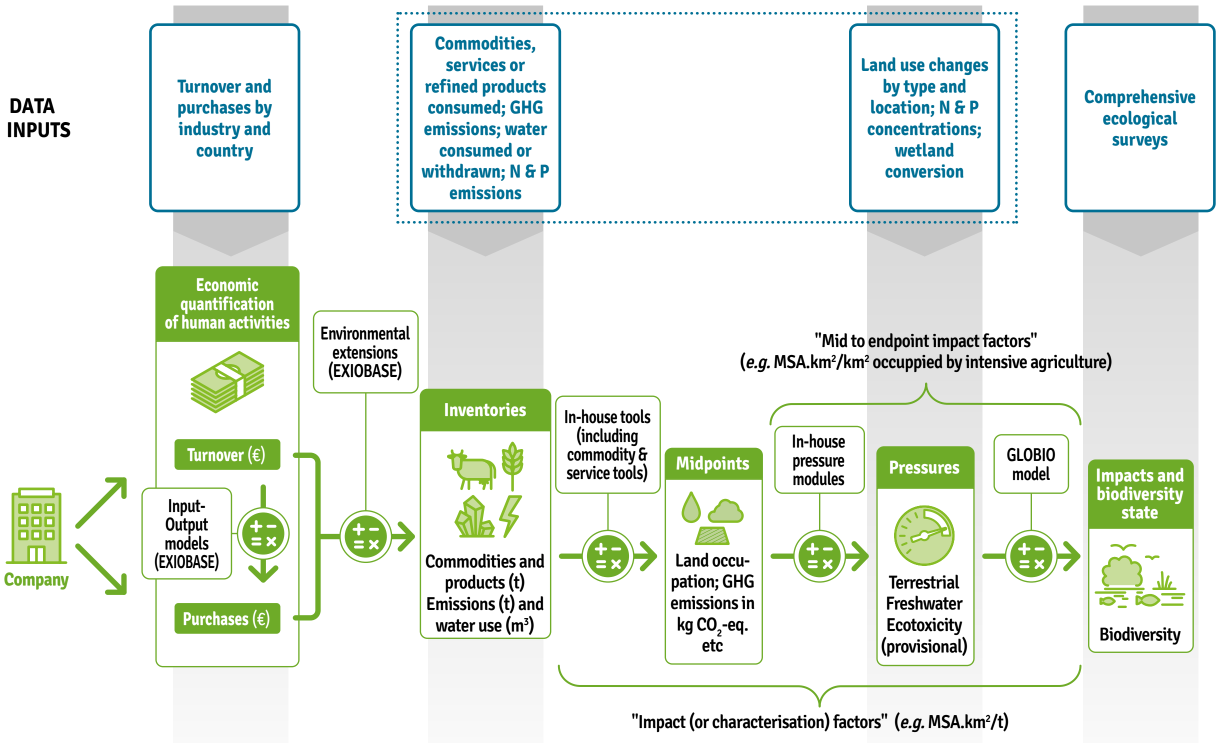


Figure 17: ***Possible data inputs and connections with the GBS modules***

Table 5: Details of the data businesses can provide to conduct assessments with the GBS and consequences of these choices

	(1) Economic quantification of human activity		**(2) Inventories**	**(3) Pressures**	**(4) Biodiversity state**
	(1.i) Scope 1	**(1.ii) Scope 2 and tier 1 of Scope 3**			
Data inputs	Turnover (€) by EXIOBASE industry and region	Purchases (€) by EXIOBASE industry and region	(2.A) Commodities (t), services or refined products extracted (Scope 1) or consumed (Scope 3 upstream) (2.B) GHG emissions by Scope and gas (kg) (2.C) Water withdrawal and consumption by Scope (m^3) (2.D) Nitrogen and phosphorous emissions by Scope (kg N-eq. or P-eq.)	(3.A) Land use change and occupation (m^2) by GLOBIO land use category (3.B) Wetland conversion (m^2)	Yearly population count of all (or at least indicator species) the species of birds, reptiles, amphibians, terrestrial invertebrates and vascular plants; assessment of the undisturbed population counts for the same species
Steps of the value chain covered by the impact factor	Scope 1 and upstream	Upstream	(2.A) Raw material extraction* (2.B), (2.C) and (2.D): same as the level covered by the data	Same as the level covered by the data	Same as the level covered by the data
Modules of the GBS involved	Environmentally extended Input-output modelling involving EXIOBASE		(2.A) CommoTools for commodities (2.B), (2.C) and (2.D) Inventory evaluators	(3.A) Terrestrial and aquatic pressure evaluators (3.B) Aquatic pressure evaluators	
Intermediate output of the modules	For each industry and region: (1.i.1) Purchases by industry and region, fed into (1.ii) (1.i.1) Inventories, fed into (2)	(1.ii.1) Inventories, fed into (2)	Midpoints: (2.1) Land occupation (2.2) GHG emissions in kg CO_2-eq. (2.3) Water consumed or withdrawn (2.4) N emissions (2.5) P emissions	(3.1) Land use impacts (3.2) Land use in catchment impacts (3.3) Wetland conversion impacts	(4.1) Overall biodiversity impacts
Refinement variable (and associated intermediate output)	(1.i.1) Custom purchases	-	(2.1) Custom yield (for crops, wood logs, grass) (2.1), (2.2) and (2.3) Custom ore** grade*** (for metal ores)	Not applicable	Not applicable
Source for the default value in the absence of refinement variable (and associated intermediate output)	(1.i.1) EXIOBASE average industry purchases	-	(2.1) FAO yields (2.1), (2.2) and (2.3) GBS-compiled ore grades	Not applicable	Not applicable

* For metal ores, the beginning of the processing step is also included, which can lead to some minor double counting, as explained in section 1.16.1. The term "extraction" is used but it also includes crop and wood log production.

** Ore is a natural rock or sediment containing desirable minerals, typically metals, that can be extracted from it.

*** Grade is the relative quantity or the mass percentage of desirable mineral or metal content in an ore.

3.4 From pressures to impacts

3.4.1 Update on terrestrial pressures

The way midpoint to endpoint impact factors are built for terrestrial pressures in the GBS has been described in the GBS first report (CDC Biodiversité 2017), and an update for climate change and land use was provided in the 2018 technical update (CDC Biodiversité 2019b). This section provides a brief summary of the changes which have been brought to the methodology since those reports. More details are available in the review document associated to terrestrial pressures (CDC Biodiversité 2020i).

The main updates relate to the Atmospheric nitrogen deposition pressure. Only a global midpoint to endpoint impact factor is now calculated, by dividing the pressure's global impacts from GLOBIO-IMAGE scenario by global N-compounds' emissions from EDGAR (Janssens-Maenhout et al. 2019). The global N-compounds' emissions are assessed in kg N-equivalent through the use of molar masses, with for instance 1 kg of NH_3 worth 0.823 kg N-equivalent. N_2O is considered to have no eutrophication potential and is thus excluded from the total N-compounds' emissions considered.

Biodiversity in freshwater ecosystems is undergoing a rapid and global decline

3.4.2 Freshwater pressures

A *CONTEXT*

Biodiversity in freshwater ecosystems is undergoing a rapid and global decline: the world average aquatic mean species abundance has decreased to 76.1% in 2000 and is predicted to drop to 74.5% by 2050 (Janse et al. 2015). Other key figures on freshwater ecosystems and the description of pressures covered by the GLOBIO Aquatic cause-effect relationships were detailed in the previous GBS technical update (CDC Biodiversité 2019b). This section thus focuses on explaining how these freshwater pressures are integrated into the GBS. As a reminder, GLOBIO Aquatic covers the following IPBES main drivers of biodiversity loss:

- Land / sea use change[49]: Land use in catchment of rivers (LUR) and wetlands (LUW), Wetland conversion (WC);
- Direct exploitation: Hydrological disturbance (HD_{water}), since the impacts of over-withdrawal of water beyond the capacity of natural ecosystems is taken into account. The pressures associated to unsustainable freshwater fishing are not yet covered;
- Pollution: Nutrient emissions or Freshwater eutrophication (FE). Pollution related to pesticides and ecotoxicity is covered in section 3.4.3. Other pollution sources such as plastic pollution are not covered yet;
- Climate change: Hydrological disturbance (HD_{CC}), as it also includes the impact of climate change on rivers and floodplain wetlands and swamps.

The following IPBES driver is not yet covered: Invasive alien species.

B *METHODOLOGY SUMMARY*

Figure 18 provides an overview of the input data and describes the main characteristics of the impact factors obtained. More details are available in the review document associated to freshwater pressures (CDC Biodiversité 2020d).

Key assumptions:

- Land uses of all the cells belonging to the basin are considered equally, independently from the relative position of the cell (upstream or downstream) in the hydraulic network;

(49) Sea use change is not assessed in this module.

- A very rough attribution of the contribution of climate change, water use and occurrence of infrastructure to the amended annual proportional flow deviation (AAPFD) is conducted at the basin level and is used to build impact factors per unit of water withdrawal or consumption and per unit of GHG emissions;
- The impact on hydrological disturbance caused by climate change associated to GHG emissions is assumed to be a share of the total loss estimated for hydrological disturbance in 2050 in the GLOBIO-IMAGE scenario. This share is its contribution to the expected 2.5°C global mean temperature increase (by 2050);
- In a simplifying assumption, the monthly water withdrawal rates (which may differ each month) are supposed to be proportional to yearly water withdrawals due to a lack of access to data on withdrawal rates;
- Within each geographical unit, all agricultural lands are assumed to participate equally to wetland conversion;
- Only P compounds are assumed to be responsible for lakes eutrophication and each kg emitted in a given EXIOBASE region is assumed to equally contribute to P concentrations and thus eutrophication[50].

(50) Based on feedback received during the review of the GBS, in addition to emissions to air expressed in P-eq. (based on molar mass), 10% of emissions to soild expressed in P-eq. are also considered to contribute to freshwater eutrophication.

Limitations and perspectives:

- Some assumptions had to be made to build midpoint to endpoint impact factors because of a lack of access to the IMAGE component which models atmospheric nitrogen depositions and to the PCR-GLOBWB and LPJmL-hydrology models regarding the amended annual proportional flow deviation. In the future, access to these models could help refine impact factors;
- The linkage between GLOBIO and AQUEDUCT basins is satisfactory in most cases but edge cases exist for very narrow or very large watersheds. These cases will be further investigated in future versions. The GBS thus uses impact factors at the country level and not at the basin level (which are calculation intermediaries);
- In default assessments, only agricultural areas, mines and oil & gas extraction sites are held responsible for wetland conversions. When companies provide data on actual wetland conversion, it can be used to refine evaluations;
- The land use occupations and changes currently involved in GBS midpoint to endpoint impact factors calculations rely on data from the GLOBIO-IMAGE scenario. Using actual land use data (*e.g.* from satellite images) would be more accurate, but such data currently lack information on land use intensity and thus cannot be used. This limitation is especially valid for wetlands.

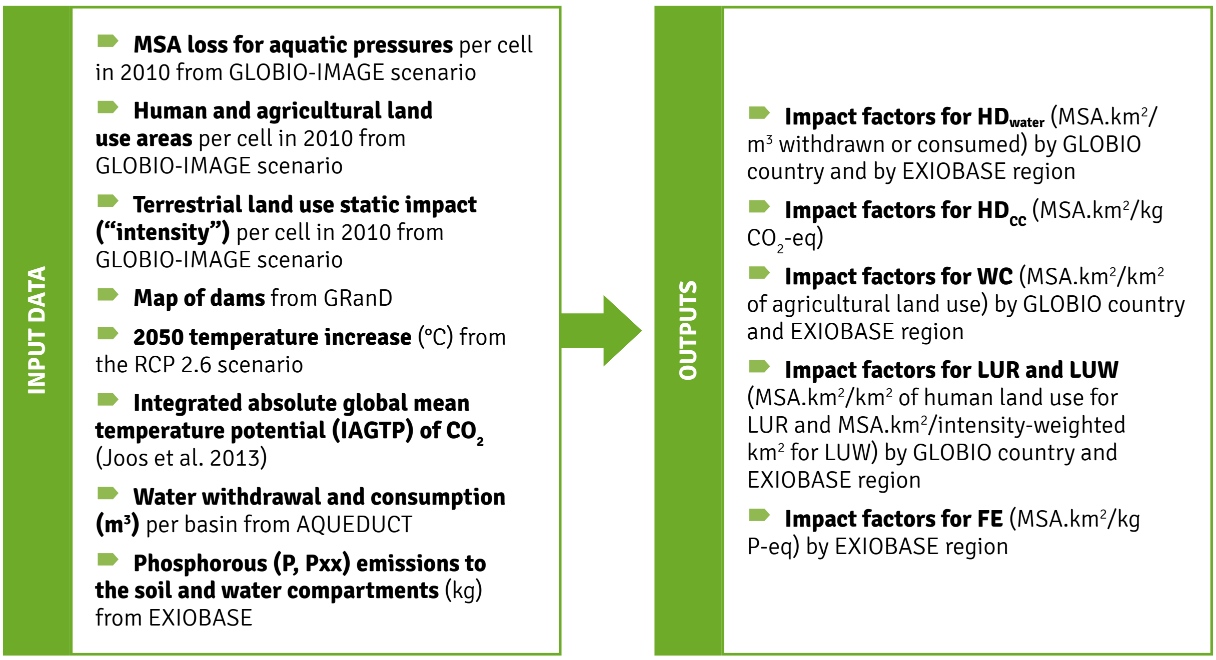


Figure 18: ***Overview of input data and impact factors related to freshwater pressures***

3.4.3 Ecotoxicity

A *CONTEXT*

Pollution is among the five main direct drivers of change in nature in the IPBES latest report (Díaz et al. 2019). Currently, various components of pollution are partly accounted for in the GBS, namely noise, light, and pollution related to substance emissions (Table 6). As such, default and refined assessments conducted with the GBS partly include the biodiversity impact of pollution.

Ecotoxicity is one category of pollution impacts. For several reasons, **important ecotoxicity impacts are likely not accounted for** in the GLOBIO-IMAGE scenario and thus in the GBS. One reason is that the GLOBIO-IMAGE scenario data does not include particularly pollutant sites and activities like mines or isolated industrial sites. Another reason is that ecotoxicity is not accounted for directly but by considering land uses as proxies for emissions (pressures Land use and Land use in catchment in Table 6).

As explained above, ecotoxicity impacts are intertwined with the impacts of other drivers in GLOBIO cause effect relationships. For instance, the difference in the MSA of extensive and intensive croplands embeds the use of pesticides (but also varying agricultural practices such as the intensity of fertiliser use). In fact, contrary to what exists in Life Cycle impact assessment methods such as ReCiPe (Huijbregts et al. 2017), **GLOBIO cause-effect relationships do not include a direct relationship linking quantities of chemicals to biodiversity impacts in MSA**[51].

Considering that assessing properly the impacts of ecotoxicity is key in the current political context and that data exists to do so, a methodology allowing the direct assessment of ecotoxicity was developed in the GBS tool. This assessment of the biodiversity impacts of chemical substances can be fed by a large and increasing body of science mainly stemming from chemical products regulation, the LCA-world and environmental modelling dealing with the environmental impacts of ecotoxicity.

(51) The only existing direct pressure-impact relationships are those related to the pressure N – concerning nitrogen deposition in excess of the ecosystem critical load – and to the pressure FE – concerning nitrogen and phosphorous concentration in water. They do not belong to ecotoxicity though.

B *METHODOLOGY SUMMARY*

The general idea of the methodology is to **derive PDF.m².yr-MSA.m² relationships based on pressures for which impact factors in both metrics are available**. Two pressures qualify for this purpose: land use and climate change. Figure 19 provides an overview of the input data and describes the main characteristics of the impact factors related to ecotoxicity obtained. More details can be found in the review document dedicated to ecotoxicity (CDC Biodiversité 2020c).

Key assumptions and limitations

As clearly stated in the review report, the methodology is preliminary and calls for further work. Notably, the PDF.m².yr-MSA.m² conversion factor computation has no scientific basis and the attribution of ecotoxicity impacts to avoid double-counting with impacts accounted for through other GLOBIO pressures (Table 6) is preliminary. Discussions involving MSA and PDF experts are needed to tackle methodological issues which largely outbound the GBS framework. Indeed, such discussions will serve the community of biodiversity footprint tool developers as a whole, as well as other parties interested in biodiversity assessment.

3.5 From inventories to pressures and impacts

The GBS' commodity tools (CommoTools) link tonnages of raw materials to impacts on biodiversity, using the midpoint to endpoint impact factors developed in its "pressure to impact" modules. CommoTools focus on the production in the most raw "out-of-the-field" form, excluding transformation processes as much as possible. The CommoTools currently assess only a limited number of techniques of production for each commodity and very specific practices (such as no-till agriculture, etc.) cannot be distinguished yet. Future versions of the GBS will increase the coverage of production techniques. Table 7 lists the pressures covered by the CommoTools.

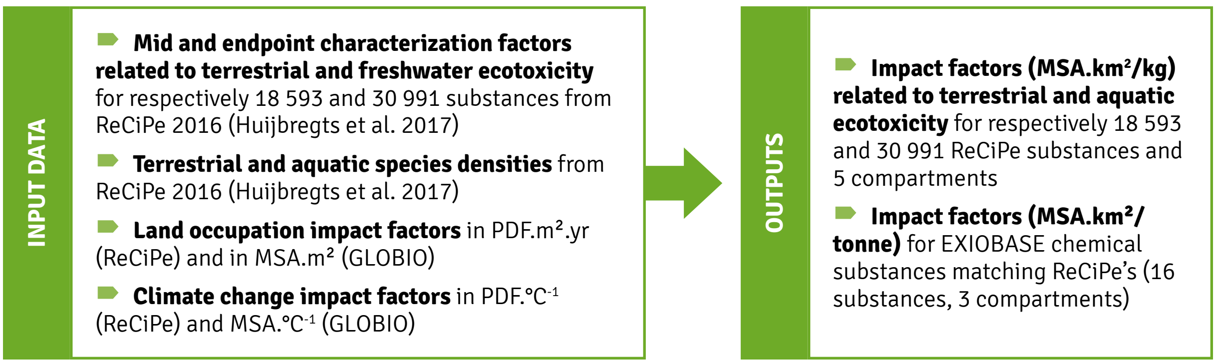


Figure 19: *Overview of input data and impact factors related to ecotoxicity*

GLOBIO cause effect relationships		Type of pollution accounted for	LCA pressure correspondence
TYPE OF BIODIVERSITY	*PRESSURE*		
Terrestrial	*Land use*	On-site pollution, especially in agricultural and urban areas	Terrestrial ecotoxicity, on-site only
	Encroachment	Off-site pollution due to noise and light	Not accounted for in LCA
	Atmospheric nitrogen deposition	Off-site pollution due to nitrogen deposition	Terrestrial acidification, partial
Aquatic	*Land use in catchment*	Leaching of substances in freshwater	Freshwater ecotoxicity
	Freshwater eutrophication	Eutrophication due to phosphorous and nitrates	Freshwater eutrophication, lakes only

Table 6: Pollution in GLOBIO cause-effect relationships

GBS		STATUS IN THE COMMOTOOLS					
			Mining				
TYPE OF BIODIVERSITY	*PRESSURE*	Crops	Mining and mineral processing	Metallurgical processing	Livestock husbandry	Grass	Wood logs
Terrestrial biodiversity	*Land use*	✔	✔	○	✔	✔	✔
	Encroachment	✔	✔	○	✔	✔	✕ (Not applicable)
	Fragmentation	✔	✔	○	✔	✔	✕ (Not applicable)
	Nitrogen deposition	✔	○ (negligible)	○ (negligible)	✔	✕ (100% attributed to livestock)	○ (negligible)
	Climate change	✔	✔	✔	✔	✕ (100% attributed to livestock)	✔
Aquatic biodiversity	*Land use in catch-ment of rivers*	✔	✔	○	✔	✔	✕ (Not applicable)
	Land use in catch-ment wetlands	✔	✔	○	✔	✔	✔
	Hydrological distur-bance due to climate change	✔	✔	✔	✔	✕ (100% attributed to livestock)	✔
	Hydrological distur-bance due to water consumption	✔	✔	○	✔	✕ (considered as negligeable)	○
	Wetland conversion	✔	✔	○	○	✔	○
	Freshwater eutrophication	✔	○ (negligible)	○ (negligible)	○	✕ for organic fertilizers (100% currently attri-buted to livestock) Not assessed for inorganic fertilizers	○ (negligible)

✔ Included ○ Not yet assessed ✕ Not included / Not applicable

Table 7: Summary of the pressures considered in the GBS CommoTools

3.5.1 Mining

A *CONTEXT*

The mining sector plays a key and growing role in our economies as it provides materials essential to almost all industries and day-to-day lives. But mining operations generate significant impacts on biodiversity. The impacts are direct through land occupation at the mine site level. They are also indirect through pollutants, associated infrastructures (roads, power lines, train tracks, etc.), GHG emissions, water consumption, water management infrastructures, noise, etc. These impacts occur at the different stages of the lifecycle of a mining project, including exploration, construction, operation, closure, post closure and legacy. On top of these "business as usual" impacts, accidents may occur, causing significant impacts on the environment. Over the last 10 years, tailings[52] dam failures occurred in average 3.3 times per year (Wise Uranium 2020), with an upward trend. Considering a total number of dams of around 3500 (Davies 2002), this figure suggest a dam failures occurrence rate of 0.1% per year. Therefore, achieving a sustainable economy compatible with the preservation of a high level of biodiversity across the globe requires mining operations impacts to be assessed and mainstreamed at all levels of the economy: extractions industry but also manufacturers, retailers and investors.

B *PERIMETER OF THE MINING COMMOTOOL*

The Scope 1 boundaries of the mining CommoTool are impacts occurring at the mine site level. Therefore, both the impacts of mining and mineral processing are assessed (Figure 20 and Figure 21). Impacts due to metallurgical processing are not covered except for climate change. Indeed, it is assumed that this process does not occur at the mine site level. Climate change impacts are included because GHG emissions are estimated using Product Environmental Footprint (PEF) processes, which embed both on-site and off-site processes.

In the GBS 1.0, several significant impacts related to mining are currently not covered:

- **Pre-operation phase**: impacts related to the exploration phase to assess the feasibility of a mine site are not included. These include impacts of various nature on the concession owned by the company: land occupation at the future mining site, pollution, noise, infrastructure, etc.
- **During the operation phase**: pollutants such as emissions from mineral and metallurgical processes (including heap leaching), generation of acid mine drainage (AMD) as well as deportment of dusts and particulates, are not included. Infrastructure outside of the mine site, such as roads, pipelines or power lines reaching the mine site, are not accounted for (on-site infrastructures are taken into account).
- **Post-operation phase**: all positive (mine site rehabilitation) or negative (lasting chemical pollution) impacts occurring after mine closure are not included.

The pressures covered are listed in Table 7. More details are provided in the review document dedicated to the wood logs CommoTool (CDC Biodiversité 2020g).

C *METHODOLOGY SUMMARY*

Figure 22 provides an overview of the input data and key assumptions involved in the mining CommoTool and describes the main characteristics of the impact factors obtained.

The key assumptions of the CommoTool are:

- The land occupied by the mine site is a function of its total annual extracted volume (Kobayashi, Watando, and Kakimoto 2014). The land occupied is not the surface area of the mining concession but the area where the extraction actually occurs;
- The annual land conversion needed to extract the mined commodity is split into (i) land converted to expand the excavation area (pit) and (ii) land converted for other processes (mineral processing) and supporting infrastructures. (i) is linked to the total volume which needs to be extracted (including gangue) and therefore depends on the ore grade. The size of the pit expansion is assumed to follow simple geometric rules. (ii) is proportional to (i): the surface area of supporting areas is calculated by using a multiplier of the additional surface needed for mining;
- Based on unpublished assumptions from the PBL, terrestrial and aquatic MSA of mines are equal to 0%;
- For encroachment, we consider mine sites as a "human" land use and therefore a 85% MSA multiplier is applied to a 10 km buffer zone around them.

The main limits and perspectives regarding this module include:

- Mine site data from USGS is old (ranging from 2005 to 2007) and uncomplete, especially for the United States where mine capacities are not reported;
- Ore grades are global averages. Regional or mine site specific figures would be preferred if available;
- Only three mining techniques are modeled: open-pit, strip and underground mining. More techniques exist and future versions of the GBS will seek to integrate them to more accurately assess their impacts;
- The data used to assess water use (Lovelace 2009) is too focused on the United States. Other sources from other regions of the world should be considered in future versions to reflect the variety of techniques and biophysical environment around the world.

(52) **Tailings** are the materials left over after the process of separating the valuable fraction from the uneconomic fraction (gangue) of an ore.

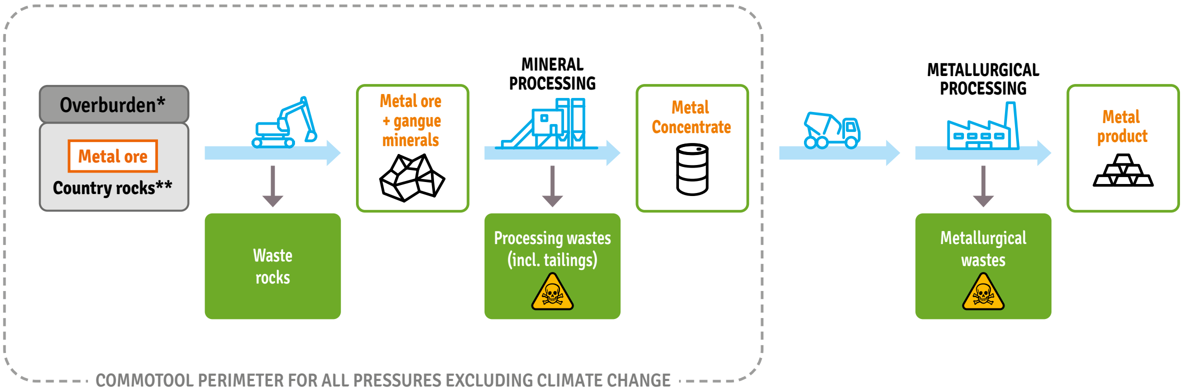


Figure 20: *Overview of input data and impact factors related to ecotoxicity*

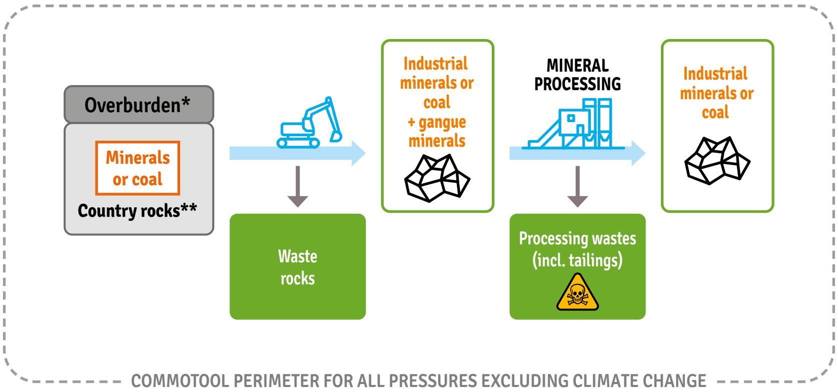


Figure 21: *Perimeter of the CommoTool for minerals and coal*

***Overburden** is the waste rock or other material that overlies an ore or mineral body and is displaced during mining without being processed.
****Country rocks** are rocks surrounding the rock that is bearing the metal ore.

INPUT DATA

- **Commodity mined, location and annual capacity of global mines** from USGS (United-States Geological Survey)
- **Global ore grades** from British Geological Survey (BGS) and Geoscience Australia
- **Water use intensities** from USGS (Lovelace 2009)
- **GHG emissions** from PEF
- **Terrestrial spatial MSA mid to endpoint impact factors** from GBS terrestrial pressures module
- **Aquatic spatial MSA mid to endpoint impact factors** from GBS aquatic pressures module
- **Wetland coverage ratio** from GLOBIO - IMAGE scenario
- **Remaining MSA%** per cell from GLOBIO-IMAGE scenario

OUTPUTS

- **Impact factors (MSA.km²/t)** for 18 pure commodities and 24 mining products, for 201 GLOBIO countries and 49 EXIOBASE regions broken down by dynamic & static impacts and for LU, CC, LUW and HD_{CC}

Figure 22: *Overview of input and output data of the mining CommoTool*

3.5.2 Crops

A *CONTEXT*

Agriculture is a major user of natural resources today: over one third of the terrestrial land surface is used for crop production or animal husbandry, and three quarters of the available freshwater resources are devoted to crop or livestock production (Díaz et al. 2019). Crop production is continuously increasing, its value has tripled since 1970 to reach USD 2.6 trillion in 2016 according to the IPBES, and will continue to rise with the growing world population and food demand. This will emphasize agriculture expansion, which is the most widespread form of land use change – the main direct pressure on biodiversity pointed out by the IPBES – and accentuate as well the other direct pressures on biodiversity, namely direct exploitation (here biomass extraction), climate change, pollution and invasive alien species.

The PBL estimates that crop production is responsible for the loss of 10.3% MSA globally in 2010, representing about one third of the total biodiversity loss, and this loss is predicted to increase to 12.5% MSA in 2050 (Kok et al. 2018).

B *PERIMETER OF THE CROPS COMMOTOOL*

The crops CommoTool provides **biodiversity impact factors related to crop production** per GLOBIO country and EXIOBASE region, and crop commodity. It has been the first GBS in-house tool developed to assess biodiversity footprints of commodities (CDC Biodiversité 2017). It focuses on primary crops, produced for direct human consumption, and fodder crops, destined to animal feeding. Transformed feed and processed food are not included in the CommoTool.

The boundaries of the Scope 1 of the CommoTool are those of the cultivation of crops. Scope 2 (energy purchases of crop cultivation), Scope 3 upstream (non-energy purchases of crop cultivation, such as fertilizers) and Scope 3 downstream (crop processing and consumption) are not covered by the crops CommoTool.

The pressures covered are listed in Table 7. More details are provided in the review document dedicated to the crop CommoTool (CDC Biodiversité 2020b).

C *METHODOLOGY SUMMARY*

Figure 23 provides an overview of the input data and describes the main characteristics of the impact factors obtained.

The methodology followed for primary crops was detailed in previous GBS reports, and in particular the one published in 2017 (CDC Biodiversité 2017; 2019b). The key new assumptions of the **crops CommoTool** are:

- For **fodder crops**, when yield data is lacking, yields from similar primary crops were considered as proxies instead;
- An economic allocation is used, which means all the impacts are attributed to the **part of the harvested crops intended for human consumption** and zero impact is attributed to **crop residues**;
- **Agricultural GHG emission data of FAOSTAT** have been allocated between crops, livestock husbandry and grass (two CommoTools described in section 3.5.3). The impacts of manure applied to soils are attributed to crops for example.

The main limits and perspectives regarding this module include:

- Another allocation method could be considered for crop residues;
- A methodology to deal with multi-cropping (multiple harvests every year) needs to be developed;
- Agrobiodiversity (diversity of cultivated and bred species) and soil biodiversity are not considered in the GBS.

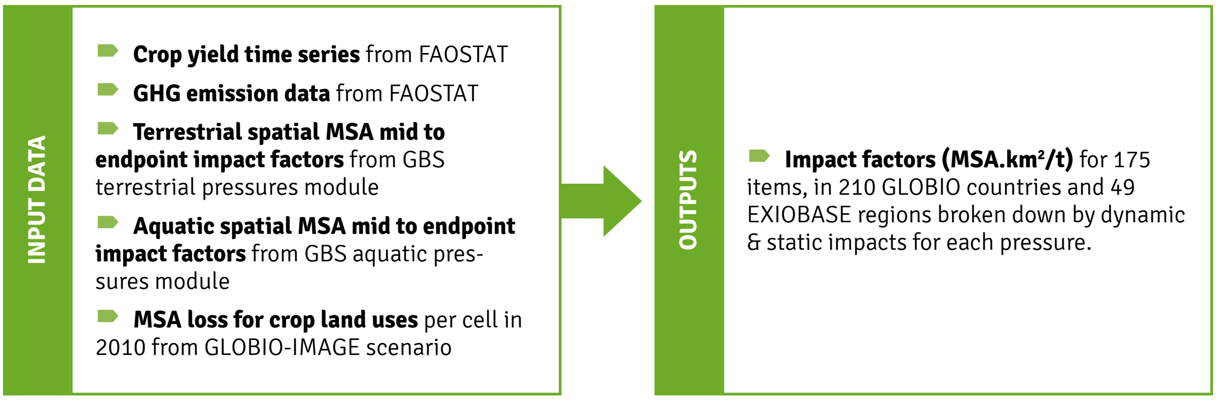


Figure 23: *Overview of input and output data of the crops CommoTool*

3.5.3 Livestock husbandry and Grass

A *CONTEXT*

Livestock designates terrestrial and domesticated animals raised in an agricultural setting to produce labour and co-products such as meat, eggs, milk, wool. These livestock co-products play a major role in human nutrition today, and their production are **continuously growing worldwide:** meat production has reached at least 300 million tonnes in total in 2013 and has tripled since 1960. According to FAO projections, meat demand will increase by over 200% by 2050 in a business as usual scenario (FAO 2018). This will **accentuate the five main pressures on biodiversity identified by the IPBES** (Díaz et al. 2019). Livestock production uses one third of world crop production for feed purposes (Balvanera et al. 2019). Depending on estimations, the amount of ice-free land mobilised by livestock production varies from 22% (Mottet et al. 2017) to 30% (Ramankutty et al. 2008; Monfreda, Ramankutty, and Foley 2008). The sector is also responsible for about 15% of global anthropogenic greenhouse gas emissions (FAO 2019; Gerber and FAO 2013). Yet, livestock husbandry can also positively contribute to nature and ecosystems, notably through grazing, if it is well managed (without overgrazing nor under-grazing): it helps keeping open landscapes and can create favourable conditions to form habitat structures preferred by some species.

The PBL estimates that pastures were responsible for the loss of 6.1% MSA globally in 2010 (Kok et al. 2018).

B *PERIMETER OF THE LIVESTOCK HUSBANDRY AND GRASS COMMOTOOLS*

The impacts of the livestock sector are assessed in the GBS through two distinct CommoTools: the livestock husbandry CommoTool and the grass CommoTool.

The **livestock husbandry CommoTool** provides **biodiversity impact factors related to animal production**. The boundary of the Scope 1 direct operations is the husbandry part of the farm, and includes animal direct water consumption, buildings for livestock husbandry, animal enteric fermentation and manure treatment (excluding application on crops).

The **grass CommoTool** provides biodiversity impact factors related to grazed biomass on pasture. The Scope 1 boundaries include the pasture exploitation and grazing only.

The impacts of fodder crops used as feed are taken into account in the crops CommoTool (c.f. section 3.5.2 and the dedicated review document (CDC Biodiversité 2020b)). The GBS does not include specific impact factors for processed feed for now and they thus need to be broken down into their constituent parts for their impacts to be assessed.

The pressures covered by the livestock husbandry and grass CommoTools are listed in Table 7. More details are provided in the review document dedicated to these CommoTools (CDC Biodiversité 2020f).

C *METHODOLOGY SUMMARY*

Livestock husbandry CommoTool

Figure 24 provides an overview of the input data and key assumptions involved in the livestock husbandry CommoTool and describes the main characteristics of the impact factors obtained.

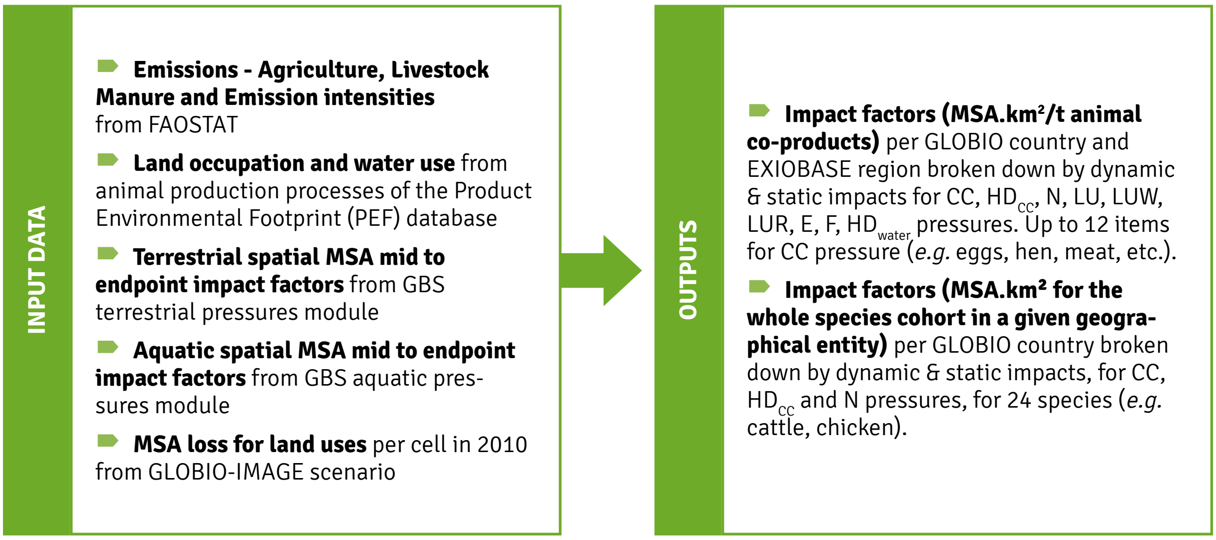


Figure 24: *Overview of input and output data of the livestock husbandry CommoTool*

The key assumptions of the **livestock husbandry CommoTool** are:

- The GHG emission data considered in the livestock husbandry CommoTool impact factors are **enteric fermentation, manure management** (application on crops excluded) and **manure left on pasture** as reported in the "Emissions - Agriculture" domain of FAOSTAT;
- The atmospheric nitrogen deposition pressure (N) impact factors are based on **manure left on pasture that volatilises** and **losses from manure treated** as reported in the "Livestock Manure" domain of FAOSTAT;
- Land occupation reported in PEF as "construction site", "industrial area" and "urban, discontinuously built" are considered to represent livestock buildings. Water uses reported in PEF as sourced from "freshwater", "ground water", "lake water", "river water" and "water –" are considered as water withdrawal. The data is considered to fall **within the Scope 1 of livestock production**, however it may partly overlap upstream and downstream processes;
- It is assumed that the **reported time-integrated area in LCI data of PEF is equal to the used area during 1 year to produce the given mass of the co-product** (*i.e.* the area is used continuously for the co-product for the whole year);
- **Areas occupied by livestock buildings are considered to host limited biodiversity (MSA = 5%);**
- Allocation of impacts between the co-products (*e.g.* meat, milk) are based on FAOSTAT methodology to compute GHG "Emission intensities" per co-product[53].

(53) http://fenixservices.fao.org/faostat/static/documents/EI/EI_e_2019_final.pdf

The main limits and perspectives regarding this module include:

- The allocation method between animal co-products (*e.g.* meat, milk) could be refined through further research;
- Agrobiodiversity (in particular the diversity of bred species) and soil biodiversity are not considered in the GBS.

Grass CommoTool

Figure 25 provides an overview of the input data and key assumptions involved in the **grass CommoTool** and describes the main characteristics of the impact factors obtained.

The key assumptions of the **grass CommoTool** are:

- Pastures for livestock production are all considered to host biodiversity equivalent to the GLOBIO land use **"Pasture – moderately to intensively used" (MSA = 60%)** and each hectare of pasture is considered equally responsible for the average national land use change related to pastures. Besides, due to the limitations of available data, a single global average yield is used for all pastures. The only differentiating factor between countries is thus their national land use trends;
- Green water, *i.e.* "water evaporated through crop growth that originates from soil moisture (from rainfall)" (SABMiller 2009), is considered for now to have no impact on biodiversity. Blue water, *i.e.* "the water evaporated through crop growth that originates from surface or groundwater" (*e.g.* from irrigation) is considered negligible. HD_{water} is considered to be null for now;
- Impacts of **manure left on pasture** are attributed to livestock husbandry for now.

One of the main limits and perspectives regarding this module is the need for further research to be conducted to identify regional pastures yields to differentiate impacts by geography.

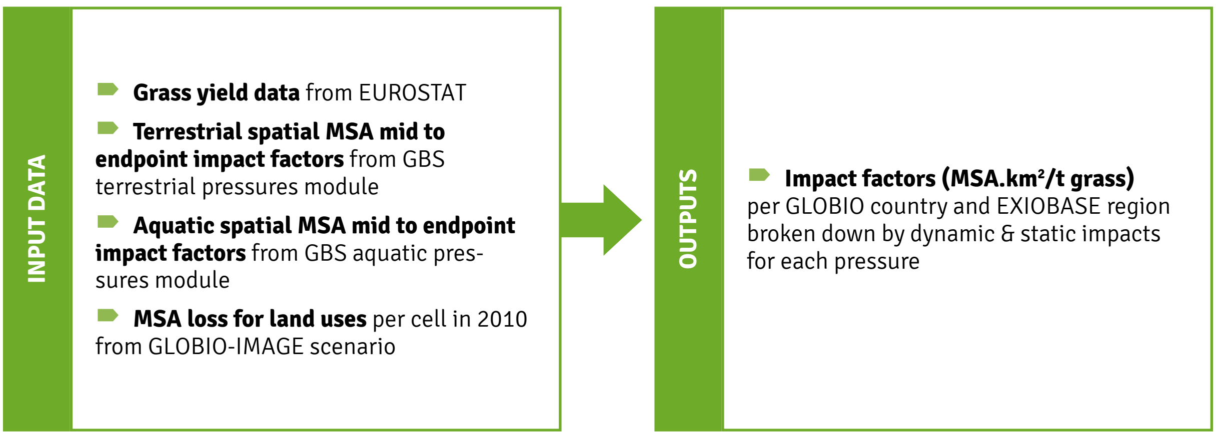


Figure 25: *Overview of input and output data of the grass CommoTool*

3.5.4 Wood logs

A CONTEXT

Forests play a key role in the overall Earth system and provide ecosystem services indispensable to human populations. They are home to some of the richest biodiversity on the planet. Sadly, as demand for commodities grows, forest degradation and deforestation from industrial-scale agriculture, illegal harvesting of timber and mining increases. Forest loss is further exacerbated by urbanization, diseases and fires. The FAO Forest Resource Assessment estimates that more than 5 million ha of forest have been lost between 1995 and 2015 (FAO 2015) and up to 170 million ha of forests could be destroyed by 2030 according to the WWF (WWF 2015).

The PBL estimates that wood production is responsible for the loss of 2.2% MSA globally in 2010 (7% of the total biodiversity loss), an impact predicted to reach 3.4% MSA in 2050 (Kok et al. 2018).

B PERIMETER OF THE WOOD LOGS COMMOTOOL

The wood logs CommoTool provides **biodiversity impact factors related to the logging of hardwood and softwood** per GLOBIO country and per EXIOBASE region. Transformed wood products such as pulp wood, wood chips and fibreboard are not included in the CommoTool. Figure 26 provides a simplified view of the wood industry and the wood logs CommoTool perimeter.

The CommoTool assesses only Scope 1 impacts, defined as those caused by the direct exploitation of forests for logging. Scope 2 (energy purchases of the logging exploitations), Scope 3 upstream (non-energy purchases of logging exploitations, notably impact due to forestry, *e.g.* production of saplings) and Scope 3 downstream (wood transformation, manufacturing, distribution and recycling) are not covered by the CommoTool.

The pressures covered are listed in Table 7. More details are provided in the review document dedicated to the wood logs CommoTool (CDC Biodiversité 2019a).

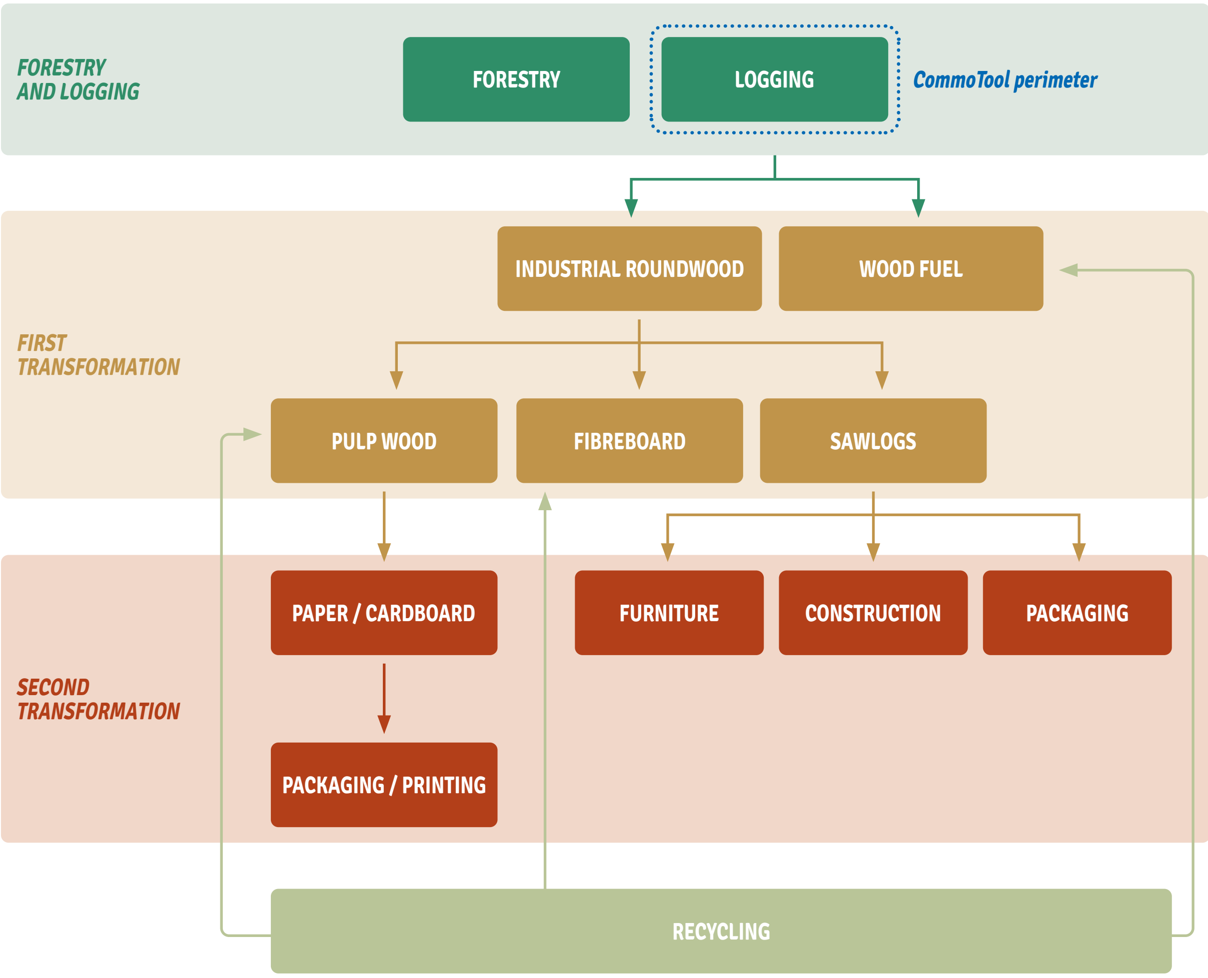


Figure 26: *Simplified view of the wood industry and wood logs CommoTool perimeter*

C *METHODOLOGY SUMMARY*

Figure 27 provides an overview of the input data and key assumptions involved in the wood logs CommoTool and describes the main characteristics of the impact factors obtained. More details can be found in the review document dedicated to the wood logs CommoTool (CDC Biodiversité 2020j).

The key assumptions of the CommoTool are:

- Only areas documented as "forests" in the PEF process data are considered. A correspondence is made with GLOBIO forest land uses and the weighted average of the corresponding national average MSA for forest land uses from GLOBIO-IMAGE scenario is used to compute the MSA value related to PEF forest areas;
- The impact for LU and LUW is linearly dependent on the surface used;
- Trees are permanent plants, so that there are no multiple planting/cutting during the year and the area occupied is equal to the time-integrated area;
- Biogenic carbon emissions related to land use changes are ignored;
- Positive impacts related to carbon storage are ignored.

The main limits and perspectives regarding this module include:

- The yields are computed based on limited data (PEF wood production processes), inducing **limited differentiation among wood types and locations**. In the future, more refined yields could be computed based on national wood production and forest area data from the FAO;
- **The items considered do not distinguish tree species beyond hardwood and softwood and there is no distinction between management practices**. The hardwood and softwood items correspond to the PEF "non-sustainable" wood production processes;
- Default dynamic impacts are computed based on GLOBIO-IMAGE scenario outputs (company specific data can always be used instead when they are available). Getting access to real land use changes, for instance thanks to satellite images, would improve the biodiversity impact factor;
- **Setting carbon storage impacts to zero, though conservative, fits a desire to ensure consistency with the crops CommoTool and to avoid numerous arbitrary assumptions** regarding tree species, age at falling and ultimate use of the wood. In refined assessments though, this assumption does not hold in the cases of climate dedicated reforestation programmes like REDD+ and carbon offset programmes.

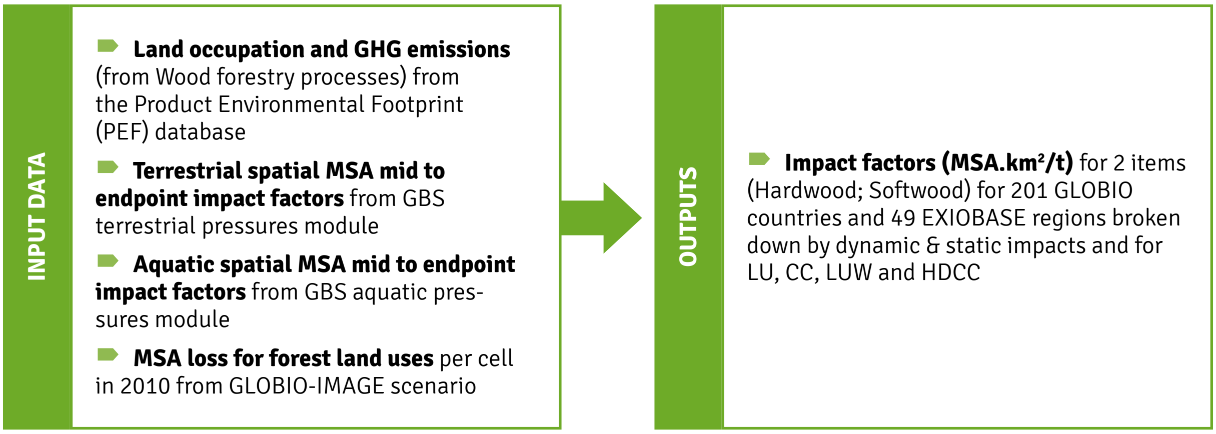


Figure 27: *Overview of input and output data of the Wood logs CommoTool*

Case studies

4 Case studies

Case study Summary sheet

Context

CASE STUDY

Footprint use category: Project or site
Assessment time: 2014-2018

Business application: Biodiversity management & performance

Perimeter		LUEFN Pressures	CC Pressure	Aquatic Pressures	Direct measurement of biodiversity state
Scope 1		☐	☐	☐	✓
Scope 2		☐	☐	☐	☐
Scope 3	Tier 1	☐	☐	☐	☐
	Rest of value chain	☐	☐	☐	☐
	Downstream	☐	☐	☐	☐

COMPANY'S IDENTITY

AFD
AGENCE FRANÇAISE DE DÉVELOPPEMENT

Industry
Financial institution

Turnover over 2011-2017
EUR 32.75 billion

Why?

EXPLORE THE EVALUATION OF THE BIODIVERSITY FOOTPRINT OF AFD-FUNDED PROJECTS

When?

EX POST ASSESSMENT OF PERFORMANCE OF THE ENTIRE PROJECT (2014-2018)

How often?

ONCE, AT THE END OF THE PROJECT

What?

SCOPE 1 IMPACTS OF THE ECOLOGICAL RESTORATION PROJECT DEDICATED TO THE 6500 HA WOLONG LAKE BASED ON DIRECT MEASUREMENT OF BIODIVERSITY STATE

For who?

INTERNAL USE FOR *EX POST* PERFORMANCE ASSESSMENT AND POTENTIAL USE IN *EX ANTE* EVALUATIONS

How detailed?

RESULTS ARE REPORTED FOR THE PROJECT AS A WHOLE

DATA COLLECTED

Item	Details	Source
Bird counts	Weekly or bi-monthly bird counts from ecological surveys between 2015 and 2018 for 11 bird species screened as good "indicator species".	AFD & project technical assistance
Estimation of the abundance in an undisturbed ecosystem	Assessment by the ornithologist of the abundance the 11 species would reach under undisturbed conditions	Ornithologist from the project technical assistance

Footprint analysis

RESULTS

Total **Dynamic** footprint
-4.5
MSA.km²

Total **Static** footprint
64.0
MSA.km²

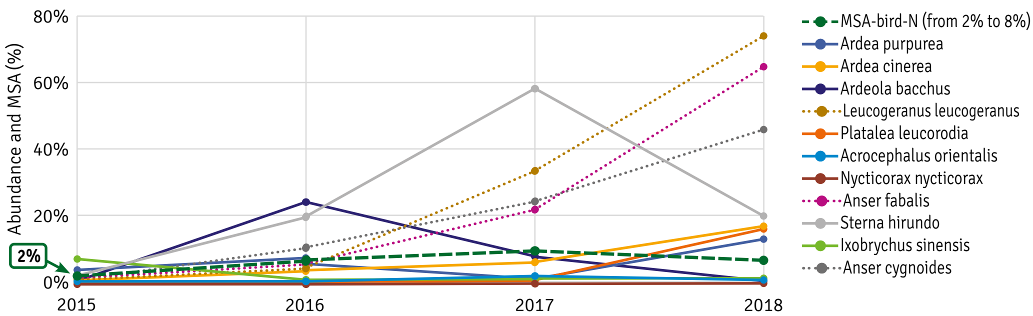


Figure 28: Evolution of the relative abundance of the indicator bird species (solid lines) used to calculate MSA-bird-N, a partial MSA based on the bird taxa (dashed line)

(source: GBS calculations, May 2020)

KEY MESSAGES

➔ The GBS can take direct measurements of biodiversity state as input to assess biodiversity footprints.

➔ The use of the GBS provides an order of magnitude for *ex ante* screening of projects based on the "cost of restoration" or "return on investment"

➔ A relatively conservative *ex post* assessment of the project demonstrates significant biodiversity gains of 4.5 MSA.km², equivalent to 640 football pitches or to the yearly Scope 1 impact of 1 million tons of wheat produced in France

IMPROVEMENTS

➔ The study highlights the need to collect comprehensive surveys of mammals, reptiles, amphibians, invertebrates and vascular plants, not just birds, but also of pressure data on land use, climate change, etc.

➔ With more time and budget, the following elements could be improved: other ornithologists could be involved in the choice of indicator species and the estimation of undisturbed abundances and the coverage of habitats by the indicator species could be more comprehensive. Some technical challenges require more thoughts: how to deal with species with global population below the carrying capacity of the assessed ecosystems? And what should be considered as the undisturbed state in practice?

4.1 French Development Agency

4.1.1 Context and objectives

The Wolong lake, situated in the Kangping district, Liaoning province, China, is an important stopover site for migratory birds on the Asia-Australia route, namely the flyway from the Arctic Circle through Southeast Asia to Australia and New Zealand. It is located at a chokepoint between the desert in the west and small mountains in the east, meaning most migratory birds have to fly over the lake during their migration (Figure 29). Past management of the lake had led to an increase of water levels, destroying habitats favourable to birds and causing a very significant drop of bird populations. In 2013, the AFD (French Development Agency) agreed to fund the Wolong Lake Ecological Restoration Project aiming to contribute to the sustainable development of the area and restore biodiversity habitats. The project led to the building of a dyke to allow a differentiated management of water level, splitting the lake into a water reservoir in its northern part and a wetland in its southern part.

The case study seeks to explore the evaluation of the biodiversity footprint of AFD-funded projects through the Wolong lake example. The objective is to refine the current internal indicators used by the AFD (Rio markers, biodiversity elements in Project Performance Management Systems or PPMS, etc.).

The perimeter of the case study is that of the AFD-financed project, *i.e.* the 2014-2018 period and the 6500 ha of the Wolong lake and its immediate surrounding. Only the Scope 1, *i.e.* the "direct operations" of the project is assessed (from the AFD perspective, it is the impact of a loan, and thus belongs to Scope 3 downstream).

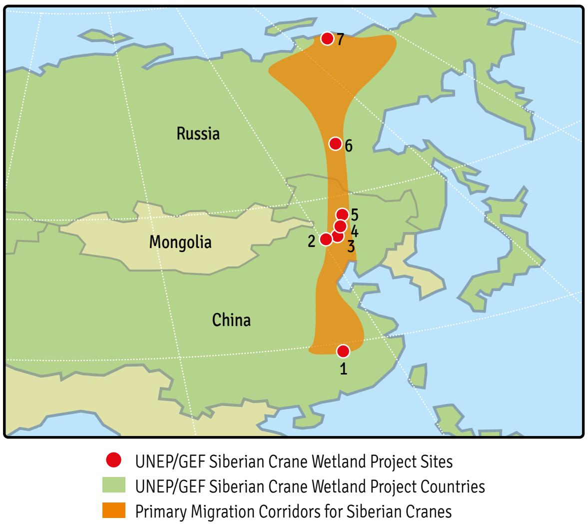


Figure 29: ***The Wolong lake is located near site 3 (Xianghai) on the map****

**https://www.cms.int/siberian-crane/sites/default/files/uploads/SiberianCrane/SCWP_final_low_spreads-reduced.pdf*

4.1.2 Methodology

A refined *ex post*[54] assessment based on direct biodiversity state measures is conducted.

This is the first GBS case study involving (partial) MSA assessment based on direct measurements of the state of biodiversity. Usually, data from ecological surveys are too incomplete or inaccurate to be used directly to assess MSA values. The Wolong project included an ecological monitoring component which provided a wealth of data on birds. This allowed to assess bird abundances with enough confidence to pilot a protocol for the assessment of MSA based on biodiversity state data and apply it with the case of Wolong birds.

MSA is defined theoretically as:

$$MSA = \frac{1}{N_{reference\ species}} \sum_{i=1}^{N_{reference\ species}} \text{Min}\left(\frac{A_{observed}(i)}{A_{intact}(i)}, 100\%\right),$$

Where

MSA = mean abundance of original species (those found in undisturbed ecosystems, thus excluding invasive species),

$N_{reference\ species}$ = total number of species in an undisturbed ecosystem,

$A_{observed}(i)$ = abundance of species *i* in the observed ecosystem,

$A_{intact}(i)$ = abundance of species *i* in an undisturbed ecosystem,

In order to assess the MSA of an ecosystem, three steps should therefore be followed:

- Determine the originally occurring species (and the invasive species which should be excluded from counts)
- Assess $A_{intact}(i)$ for each species
- Count populations to determine $A_{observed}(i)$

In practice, assessing the population of each original species would be near impossible and extremely costly. Two simplifications are thus considered: 1) only birds are included in the calculations for this case study (mammals, reptiles, amphibians, terrestrial invertebrates and vascular plants are usually considered to assess the MSA), 2) only some indicator species are monitored and are considered to represent the whole taxa.

(54) *Ex post* impact assessment of a project occurs after the project implementation, in opposition to *ex ante* impact assessment, which is a preliminary study of the future project impacts.

All three steps have to be conducted by biodiversity specialists. For the case study, a bird specialist familiar with the project was interviewed. If a full-scale assessment (and not an exploratory case study) was conducted, involving more biodiversity experts would have been necessary to prevent any bias.

The **first step** and the choice of indicator species rely on the guidelines provided by reports issued by RIVM, a Dutch public environment agency (Ten Brink et al. 2000). In particular, the reports define 12 criteria to choose indicator species.

In the **second step**, the assessment of $A_{intact}(i)$ can also be called the "assessment of the 100% abundance" for each species. The Important Bird Areas (IBA) framework of BirdLife provides guidelines on how to assess the "optimum [population size] for the site": it can be calculated as the *estimated extent of potential habitat* multiplied by the *population density in undisturbed conditions* (BirdLife International 2006). The estimated extent of potential habitat has to be assessed by biodiversity specialists based on the characteristics of the area evaluated. Ideally, population density in undisturbed conditions could be found in global databases gathering such information to facilitate assessments. However, such databases do not exist yet and assessments need to rely on published literature and expert knowledge.

The **third step** is more straightforward: all individuals of the indicator species chosen must be counted over a relevant period. Double counting must be avoided.

11 bird species were shortlisted by the expert to conduct the assessment. After a further screening during step 1, the 3 migratory species were excluded from the assessment as the variation of their populations may be due to factors uncorrelated with the site (*e.g.* pressures in their wintering or breeding sites). To derive MSA.km² from % MSA, % MSA values are multiplied by the corresponding surface.

4.1.3 Results and discussion

Figure 29 shows the evolution of the relative abundance of the 8 bird species between 2015[55] and 2018. The dashed line illustrates the evolution of the calculated MSA: MSA-bird-N which is based on nesting species.

Despite year on year variations for some species, the overall trend is clear: MSA-bird-N is multiplied by 4 between 2015 and 2018.

The increase from 2% MSA to 8% MSA translates into a gain of 4.5 MSA.km², an area comparable to an average "arrondissement" of Paris (Table 8). The static footprint is 92% MSA or 64 MSA.km² and can be seen as the potential gains of biodiversity which could be tapped if the restoration was expanded to the rest of the lake.

This first case study is an exploration of assessments based on direct measurements of biodiversity state (ecological survey) data. It highlights a number of limitations, providing guidance for potential future field-based assessments:

- Comprehensive assessments would require surveys which also include mammals, reptiles, amphibians, invertebrates and vascular plants;
- Multiplying assessments conducted by ornithologists on the list of species considered, their extent of suitable habitat and their undisturbed density should reduce the possible assessor bias;
- Gains of biodiversity take time and there is a time lag between ecological restoration projects and the recovery of species populations. Measuring the progress over a long time period is thus necessary to monitor gains;
- The coverage of species from all types of habitats need to be adequate to limit possible bias due to some species' specificities (in this case, more than one mudflat species should have been monitored);
- Technical difficulty to deal with species for which the global population is a limiting factor (a situation often faced by critically endangered species such as Siberian cranes): should their undisturbed population be capped by the current global population or should it be assessed as an hypothetical population (higher than the current global population)?
- Technical questions regarding the definition of the 100% undisturbed state: what should be considered as the reference in practice?

Most of these limitations could be alleviated if more time and budget was available to conduct the biodiversity footprint assessment.

4.1.4 Lessons learnt

The case study demonstrates that the GBS can take direct measurements of biodiversity state as input to assess biodiversity footprints.

It provides guidance on data requirements and order of magnitude for *ex ante* screening of projects (*i.e.* the AFD was able to calculate a "cost of restoration" or "return on investment" for the project, including from *ex ante* assessments of the project).

The *ex post* assessment of the project demonstrates that significant biodiversity gains are achieved. A relatively conservative evaluation shows a gain of **4.5 MSA.km²**, equivalent to 640 football pitches or to the yearly Scope 1 impact of 1 million tons of wheat produced in France.

(55) The project situation did not evolve much between 2014 and 2015 and the 2015 bird data is thus considered representative of the beginning of the project.

		2015 (baseline)	2018
Mean abundance of nesting birds	*% MSA*	2%	8%
	MSA.km²	1.0	5.5
Static footprint (100% - MSA-bird-N)	*% MSA*	98%	92%
	MSA.km²	64.0	59.5

Table 8: ***Evolution of the abundance of the 8 nesting bird species in Wolong lake area between 2015 and 2018 and associated static impact***


Oriental storks and restored habitats of Wolong Lake © X. Rufray/Biotope

Case study Summary sheet

Context

CASE STUDY

Footprint use category: Project / Site
Assessment time: Construction: 2014 - 2016, Offset: 2017 - 2059
Business application: Biodiversity management & performance

Perimeter

		LU Pressure	CC Pressure	Aquatic and other Pressures
Scope 1		✓ (Evaluated company)	✓ (Evaluated company)	☐
Scope 2		☐	☐	☐
Scope 3	Tier 1	☐	✓ (Evaluated company)	☐
	Rest of value chain	✓ (Evaluated company)	✓ (Evaluated company)	☐
	Downstream	✓ (Asset owner)	✓ (Asset owner)	☐

✓ Asset owner ✓ Evaluated company

COMPANY'S IDENTITY

GRTgaz

Industry
Energy

Sub-industry
Gas distribution

2017 turnover
EUR 1.9 billion

Why?

ASSESS BIODIVERSITY FOOTPRINT OF INFRASTRUCTURE PROJECTS WITH A METHODOLOGY THAT COULD BE SHARED IN THE SECTOR, AND REPRODUCED FOR FINANCIAL INSTITUTIONS FOR THEIR ESG ANALYSES

What?

BIODIVERSITY FOOTPRINT OF THE CONSTRUCTION OF THE PIPELINE (DIRECT OPERATION AND UPSTRAM IMPACTS), AND OF THE BIODIVERSITY OFFSET MEASURES

When?

2 DIFFERENT TIME PERIODS: 2014 - 2016 FOR THE IMPACTS WHICH ALREADY OCCURED DURING THE PIPELINE CONSTRUCTION, AND 2017 - 2059 FOR A PREDICTION OF EXPECTED GAINS GENERATED BY THE OFFSET MEASURES. PIPELINE OPERATION, MAINTENANCE AND END-OF-LIFE ARE EXCLUDED FROM THE ANALYSIS

For who?

INTERNAL USE, STRATEGY, PROJECTS' ESG ANALYSIS FOR BOTH THE COMPANY AND INVESTORS

How often?

ONE OFF WITH AN *EX POST* EVALUATION OF THE CONSTRUCTION PERIOD, AND AN *EX ANTE* EVALUATION OF THE OFFSET PROJECT

How detailed?

EXTRACTION OF GIS DATA ON LAND USES AT THE PROJECT LEVEL (PIPELINE EASEMENT BAND AREA) AND FOR EACH OFFSET SITE

DATA COLLECTED

Item	Description	Source
Land use changes	Land use transformation (ha) due to the construction	GRTgaz
GHG emissions	GHG emissions linked to the construction, detailed per Scope	EIA study of the project
Pipeline materials	Material composition of the pipelines (in terms of weights)	EIA study of the project
Biodiversity offset land use changes	Land use transformation (ha) due to the biodiversity offset programme	CDC Biodiversité
Ownership breakdown	Share of GRTgaz detained by each shareholder and debt owner	CDC DIDL

Footprint analysis

RESULTS

Scope 1 **Static** footprint **5 MSA.km²**

Total **Dynamic** footprint Construction **2.18 MSA.km²**

Expected offset gain
0 to - 0.35 MSA.km²
(<0 : gain, >0: loss)

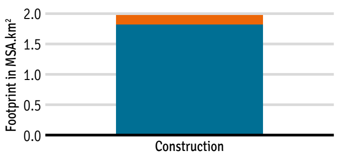


Figure 30: Dynamic biodiversity footprint of the Arc de Dierrey project per scope related to climate change

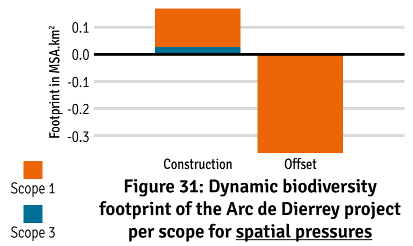


Figure 31: Dynamic biodiversity footprint of the Arc de Dierrey project per scope for spatial pressures

(source: GBS calculations, April 2019)

KEY MESSAGES

Disclaimer: The GBS is not fully designed for project scale assessments, the results of this case study are provided as indicative impacts

➔ During the construction, the most significant dynamic footprint is caused by the climate change pressure generated by the manufacturing of the pipelines

➔ The total land use change Scope 1 impact is mainly related to forest clearance on the easement strip

➔ Static impacts should be seen as a reservoir of biodiversity that can be regained, even though the whole static impact is not attributable to GRTgaz (agricultural crops)

➔ This case study showcases the application of the GBS to assess and forecast positive impacts of biodiversity offset measures in terms of functional biodiversity, besides the expected gains of those measures for species populations and their habitat.

IMPROVEMENTS

➔ Developments on other pressures refined assessment are needed to have a better coverage of the overall biodiversity impacts

➔ The project value chain is not fully taken into account, especially for some pipelines construction material (concrete, polyethylene)

➔ The trend of biodiversity gains over time should be refined in the future

4.2 GRTgaz

4.2.1 Context and objectives

The Caisse des Depôts et Consignations (CDC), a French public financial institution, has been exploring the best options to integrate biodiversity into ESG criteria for the assessment of projects for years and expressed interest in piloting the GBS to explore how it could meet this need. Discussions with its Investments and local development management direction (CDC DIDL), which supports the development of territories and invests in infrastructure projects, led to the identification of GRTgaz as a potential partner to lead an exploratory case study. GRTgaz is a French company specialized in the construction, operation and maintenance of natural gas pipeline networks. A public consortium including the CDC is among the shareholders of GRTgaz. Assessing a GRTgaz project would thus amount to evaluating a project indirectly financed by CDC. Discussions with GRTgaz led to the choice of the **Arc de Dierrey** project to explore a **"Project/site" and "Biodiversity management & performance"** application of the GBS. This is not (and will not become) a typical use of the GBS, so the results of this case study should not be considered as formal results of the tool, but rather as exploratory data to illustrate how the tool deal with site level data before aggregating them.

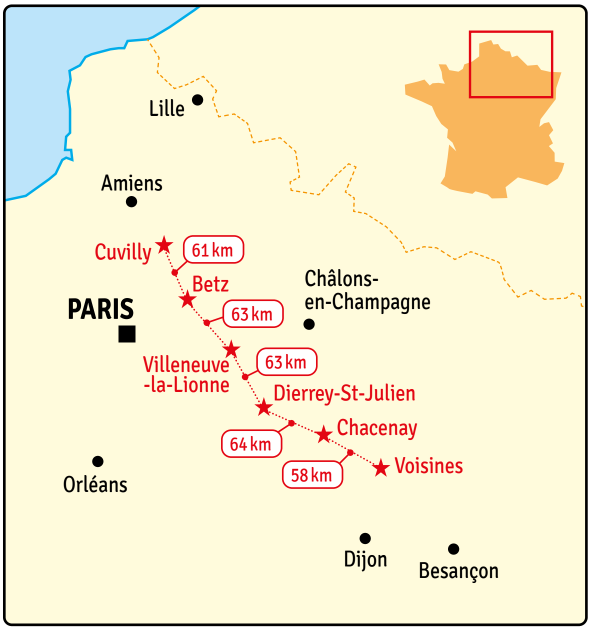


Figure 32: ***"Arc de Dierrey" pipeline layout*** *(source : GRTgaz*)*
**http://www.grtgaz.com/fr/medias/communiques-de-presse/gazoduc-arc-de-dierrey.html*

The Arc de Dierrey project consists in the construction of a **natural gas pipeline** of about 310 km that would complete the French natural gas network and enable the distribution of natural gas imported in the liquified natural gas (LNG) terminal in Dunkerque to Eastern and Southern France (Figure 32)(56). The project budget is about EUR 623 million and the construction lasted from 2014 to 2016. After the pipe-laying, the impacted pastures and crops are rehabilitated, but impacted forestry areas cannot always be restored as an easement strip over the pipeline is set up for technical and regulatory reasons. No tree nor construction can be installed over the easement strip, which is for the most part 20 m wide. The mitigation hierarchy was followed in the design of the project: impacts on biodiversity were first avoided, then remaining impacts were reduced, and finally biodiversity offset measures were identified to compensate the residual impacts.

This case study aims to determine the **biodiversity footprint due to the construction of this pipeline between 2014 and 2016, and to assess the likely effects of the biodiversity offset measures after 2017**. It excludes the operation, maintenance and end-of-life phases of the pipeline life cycle. **Direct operation impacts** (Scope 1 from the perspective of GRTgaz) are taken in account, and **upstream impacts** (Scope 3 for GRTgaz) like those generated by the production of the pipeline materials are assessed. For CDC DIDL, as a financer of the project, all the assessed impacts fall within its downstream Scope 3. Only the terrestrial land use change and climate change pressures are assessed in this case study.

(56) http://www.grtgaz.com/fileadmin/grands_projets/arc_dierrey/documents/fr/presentation-projet-arc-de-dierrey-sept2014.pdf

4.2.2 Methodology

GRTgaz provided data on **aggregated surfaces per land use type of areas impacted** by the pipeline construction. The data was limited to land occupation and did not include information about land conversion (*i.e.* what was the previous land use). The environmental impact assessment (EIA) study was used to gather data on **greenhouse gas emissions** in all Scopes during the construction phase. The EIA also provided data on the **materials composing the pipelines**.

To "dimension", or assess, the impacts, the **pressure-impact relationships** of GLOBIO were used on data about **land use change and climate change**, in a typical pressure-based refined assessment. The precise methodologies are explained in the latest technical developments of the GBS of our last publication (CDC Biodiversité 2019b). The Scope 3 impacts associated to the extraction of iron upstream of the production of the steel used in the pipeline was estimated with the **mining CommoTool**. On top of this, **data on the areas and types of offset measures** were provided by the technical assistance to GRTgaz (entrusted to the operational team of CDC Biodiversité). The offset measures were further translated into land use changes (*e.g.* from "Pasture – man-made" to "Forest – reduced impact logging).

Following this dimensioning, the impacts can be attributed among capital owners - the methodology applied to listed equity and corporate date in our last report (CDC Biodiversité 2019b) was applied to GRTgaz by using the equity share of its owners. Data was thus collected to conduct this attribution. The **breakdown of the ownership of GRTgaz by shareholders** and the **debt structure** was provided by CDC DIDL. Balance sheets of the different companies were retrieved from public financial reports and prospectus for admission to trading.

4.2.3 Results and discussion

A IMPACTS DIMENSIONING

Figure 30 and 31 displays the **summary graphs of the dynamic biodiversity footprints assessed during the construction phase and the offset phase**, split between the climate change pressure and other terrestrial pressures and by Scopes. The breakdown of biodiversity footprints per Scope and pressure and the associated impacts intensities – impacts divided by the project budget – are displayed on Table 9. For the construction phase, the most significant dynamic footprint is caused by the climate change pressure generated by **the manufacturing of the pipelines**, representing a **loss of 1.8 MSA.km²** (260 soccer fields). The remaining footprint linked to spatial pressures has a relatively low impact intensity (maximum 0.53 MSA.m²/kEUR) compared to the world average biodiversity impact intensity of 2 MSA.m²/kEUR. The **total land use change Scope 1 impact is a loss of 0.14 MSA.km²**, mainly related to the forest clearance on the easement strip. The cleared forest cannot be replaced on the easement strip as trees higher than 2.7m are not allowed there.

Conversely, the **biodiversity offset measures implemented between 2017 and 2059** are expected to yield **dynamic gains of up to 0.35 MSA.km²** if the measures are successfully carried out over the period.

Static impacts are assessed for the **Scope 1 land use change impact** and are mainly caused by the land use **"Intensive agriculture"**. They amount to an **impact of 5 MSA.km² (714 soccer fields)**. In this case study, the area under the easement strip was considered to belong to GRTgaz' Scope 1 and the Intensive agriculture land uses thus fall into its Scope 1. However, these land uses predate the Arc de Dierrey project and GRTgaz did not generate the associated static impacts in the first place. The static impact can be seen as a **potential reservoir of biodiversity that can be regained** if renaturation actions were implemented.

Scopes and pressures	Dynamic	
	MSA.km² losses	Intensities MSA.m²/kEUR
SCOPE 1 – SUB-TOTAL	**0 to 0.34**	**0 to 0.53**
Land use – easement strip	0.14	0.23
Land use - biodiversity offset measures	-0.35 to 0 (gain)	-0.58 to 0
Climate change	0.2	0.3
SCOPE 3 UPSTREAM (PARTIAL) – SUB-TOTAL	**1.84**	**2.96**
Climate change for the pipelines manufacturing and transportation	1.8	2.9
Iron extraction (world average mix)	0.04	0.06
SCOPE 1 + 3 UPSTREAM	1.8 to 2.2	2.9 to 3.5
vs World biodiversity impact intensity (Scope 1)		2

Table 9: *Summary of the dynamic biodiversity impacts of the project*

Easement strip of the gas pipeline © ARTELIA, 2019

B IMPACTS ATTRIBUTION

The "Arc-de-Dierrey" project is part of GRTgaz' investment programme between 2011 and 2020 and is thus 100% financed by GRTgaz. Attribution factors are computed to determine the biodiversity footprint of the project which could be attributed to CDC, as a capital owner (equity and debt) of GRTgaz. Figure 33 presents the structure of ownership and debts of GRTgaz:

CDC finances GRTgaz through three channels, all going through SIG, a holding company which owns 24.91% of GRTgaz' equity. CDC owns 46% of the EUR 586 million debt of SIG[57]. Two of its entities also own indirect equity stake in GRTgaz. CDC General section (GS) and CDC Savings fund (SF) are shareholders in HIG, which itself owns SIG. An attribution factor (AF) can be calculated and is equal to the ratio between the financed value (financed equity or debt) and the enterprise value (total equity and debt). In this example, the biodiversity footprint attributed to CDC for the Arc-de-Dierrey project is expressed as follows (Table 10):

$$Footprint_{CDC} = Footprint_{GRT} \times (AF_{CDC} + AF_{GS} + AF_{SF})$$

The total Scope 1 and Scope 3 dynamic impact of the "Arc de Dierrey" project attributed to CDC is thus about **0.1 MSA.km²** which is equivalent to a dozen soccer fields, and the static Scope 1 impact of the "Arc de Dierrey" project attributed to CDC is about **0.2 MSA.km².**

C LIMITS AND IMPROVEMENTS

The materiality of several pressures was considered to be limited compared to the efforts required to assess them in terms of data and calculations. These pressures are human encroachment, habitat fragmentation, atmospheric nitrogen deposition and aquatic pressures. As the GBS is still under development and some Commodity and Services Tools are not yet completed, some impact factors are lacking. The project's value chain is thus not fully taken into account, especially regarding the concrete and polyethylene used in the construction of the pipeline.

In this case study, we also assumed that some biodiversity gains happen in a short time scale to simplify the computations. However, reforestation may actually require several decades to be completed so biodiversity gains may be delayed.

Overall, the GBS is not designed and fit for project scale assessments: the use of its pressure-impact relationships causes its results to adequately reflect the average impact of a large entity but not the individual impacts of small projects or sites. Here we can roughly estimate that the project area is about 600 ha maximum (300 km x 20m easement strip max, in some departments the easement strip is only 10m or 15m wide). As a rule of thumb, we consider that the GBS should be used only for areas above a threshold of 100-1000 ha (*cf.* 4.2). The results of this case study are thus provided as indicative impacts but might not be usable for external disclosure and reporting.

4.2.4 Lessons learnt

For the GBS team, this case study led to improvements in the data collection process and to the development of specific calculations for "refined assessments" of the land use pressure. We also started to work on better describing GLOBIO land use categories in order to match them to land use categories identified by companies. This case study is also an example of the application of the GBS to assess and forecast positive impacts of biodiversity offset measures in terms of ecological integrity, besides the expected gains of those measures for species populations and their habitat.

For GRTgaz, the pilot highlighted the materiality of impacts occurring upstream in the value chain, *i.e.* those related to the manufacture of the pipes. In order to reduce the impacts of the pipeline construction on biodiversity, mitigating the upstream climate change impacts (Scope 3 for GRTgaz) could be an important lever, and could be achieved through carbon offset programmes. Such programmes could also provide co-benefits for other pressures such as land use change. The quality of the biodiversity offset programme and its outcomes can also be a key point in reducing the biodiversity impacts of the pipeline construction. This analysis strengthens the interest to consider the Scope 3 in EIA in accordance with regulation, as in practice the current EIA framework mainly focuses on Scope 1 direct operation impacts while Scope 3 impacts could potentially be more important than Scope 1 impacts. However, properly avoiding and reducing Scope 1 impacts remain critical, in particular for impacts on endangered or protected species or their habitats. And residual impacts should continue to be offset, in accordance with the mitigation hierarchy. The GBS thus comes as a complement to the existing framework, to cover upstream and downstream impacts and capture the Scope 1 impacts on species abundance.

CDC DIDL got a better understanding of the GBS approach with this case study. Other infrastructure projects should be tested out (railways, highways) to verify if the GBS methodology can be reproduced to assess other infrastructures projects.

(57) Here to simplify, the bond of EUR 586 million indicated on Figure 33 is considered to represent the total debt of SIG although there could be a slight difference with the figures in the balance sheets of SIG.

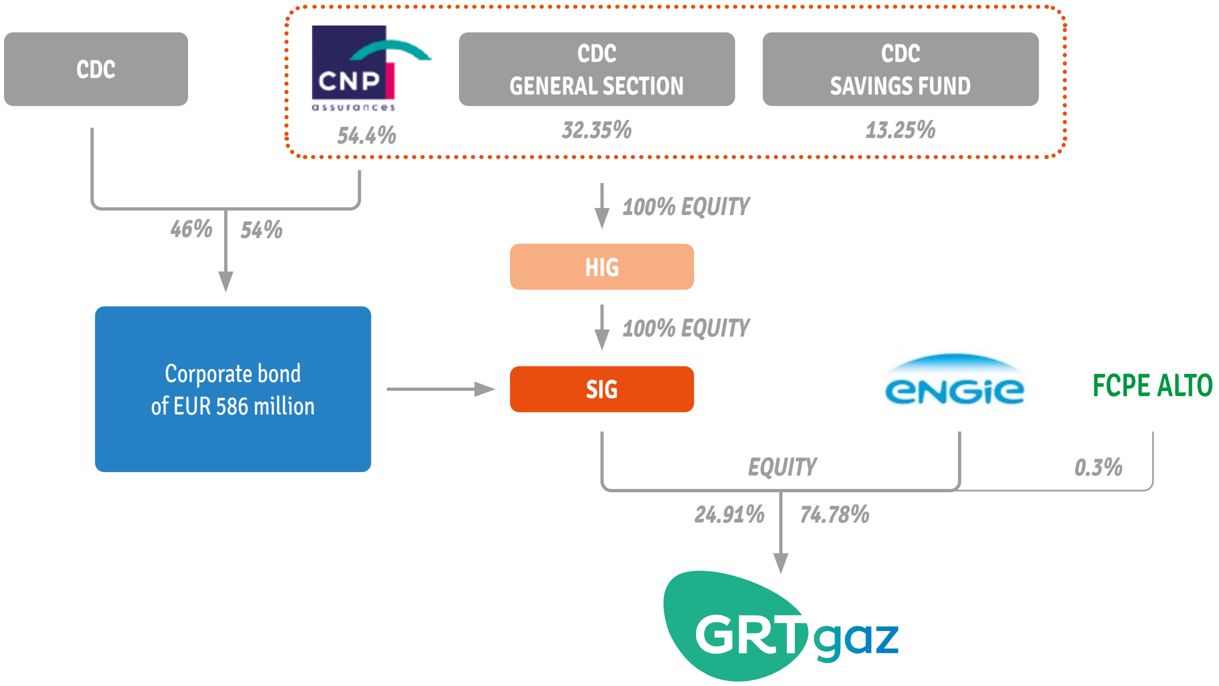


Figure 33: *Structure of ownership and debts of GRTgaz in July 2018* (source: CDC)

FINANCING SOURCE	Attribution factor (AF) of GRTgaz' footprint to the financing source*
CDC	$\frac{3\,848\,000\,000 \times 24.91\,\%}{10\,643\,000\,000} \times \frac{586\,000\,000 \times 46\,\%}{1\,216\,620\,000} = $ **2 %**
CDC General section	$\frac{3\,848\,000\,000 \times 24.91\,\%}{10\,643\,000\,000} \times \frac{704\,135\,000 \times 100\,\%}{1\,216\,620\,000} \times \frac{658\,588\,388 \times 32.35\,\%}{658\,606\,917} = $ **1.7 %**
CDC Savings fund	$\frac{3\,848\,000\,000 \times 24.91\,\%}{10\,643\,000\,000} \times \frac{704\,135\,000 \times 100\,\%}{1\,216\,620\,000} \times \frac{658\,588\,388 \times 13.25\,\%}{658\,606\,917} = $ **0.7 %**
Attribution factor of GRTgaz' footprint to CDC group	2% + 1.7% + 0.7% = 4.4%

* Data sources for attribution factors computation:
Total equity of GRTgaz (EUR 3 848 million) and enterprise value of GRTgaz (EUR 10 643 million): http://www.grtgaz.com//fileadmin/plaquettes/fr/2018/RADD2017.pdf ;
Total debt of SIG (EUR 586 million): from CDC (c.f. Figure 33) ;
Total market capitalization of SIG (EUR 704 135 000) and enterprise value of SIG (EUR 1 216 620 000): http://societe-infrastructures-gazieres.com/Rapport_du_Commissaire_aux_comptes_sur_les_comptes_consolides_au_31_d%C3%A9cembre_2016_incluant_les_comptes_consolides_de_l_exercice_clos_le_31_decembre_2016.pdf ;
Total market capitalization of HIG (EUR 658 588 388) and enterprise value of HIG (EUR 658 606 917): https://www.verif.com/bilans-gratuits/HOLDING-D-INFRASTRUCTURES-GAZIERES-532779105/

Table 10: *Attribution factors of GRTgaz' biodiversity footprint*

Case study Summary sheet

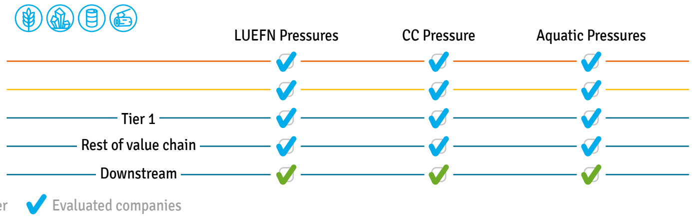
Context

CASE STUDY

Footprint use category: Corporate and portfolio
Assessment time: 2017

Business application: Assessment/rating by and for third parties with external data

Perimeter



COMPANY'S IDENTITY

mirova
Responsible Investing

Industry
Financial institution
(asset manager)

Assets under management in 2019
EUR 12.5 billion

Why?

EXPLORE THE EVALUATION OF THE BIODIVERSITY FOOTPRINT OF COMPANIES MIROVA IS INVESTED IN BY LOOKING AT THE FOOTPRINT OF ONE SUCH COMPANY: BONDUELLE

When?

ASSESSMENT BASED ON 2017 REPORTED DATA

How often?

ONCE FOR THIS CASE STUDY, AIMING FOR ANNUAL UPDATES

What?

SCOPE 1, 2 AND 3 (UPSTREAM) IMPACTS OF BONDUELLE BASED FIRST ON PUBLICLY REPORTED DATA AND THEN ON REFINED DATA PROVIDED BY THE COMPANY

For who?

FOR MIROVA'S ANALYSTS AND ASSET MANAGERS, TO GUIDE THEIR INVESTMENT DECISIONS

How detailed?

RESULTS ARE REPORTED AT THE COMPANY LEVEL BUT CAN BE SPLIT BY SCOPES, PRESSURES, IMPACT TYPE FOR A BETTER UNDERSTANDING BY ANALYSTS AND ASSET MANAGERS.

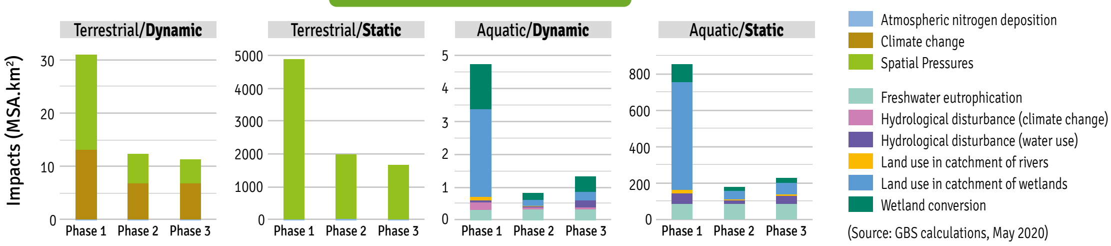
DATA COLLECTED

Item	Details	Source	Phase
Turnover (EUR million)	Global turnover and regional split for 2017	CSR Report	1
Cultivated area (km²)	Total cultivated area for Scope 1 and Scope 3 in 2017	CSR Report	2
Supply scheme	Vegetable supply scheme specifying sourcing type and location	CSR Report	2
Water consumption (m³)	Global water consumption (and not withdrawal) volume for Scope 1	CSR Report	2
Proxies	Proxies for spatialization of land occupation and water consumption	Mirova	2
GHG emissions (t CO_2-eq)	Estimations by Scope and by greenhouse gas	Carbone 4	2 and 3
Cultivated area (km²)	Spatialized cultivated area for Scope 1 and Scope 3 in 2017	Bonduelle	3
Water consumption (m³)	Spatialized water consumption (and not withdrawal) volumes for Scope 1	Bonduelle	3

Footprint analysis

RESULTS

Figure 34: Impacts of Bonduelle by type of pressure



(Source: GBS calculations, May 2020)

KEY MESSAGES

➔ The workload required to conduct an assessment for one corporate is important. Extending it to a large perimeter of companies would be therefore an ambitious project if conducted manually by asset manager analysts. This calls for specialised data providers to produce such analyses.

➔ By reporting quantified data on pressures on biodiversity, companies improves significantly biodiversity footprints accuracy.

➔ The traceability of raw materials along the value chain is key to better assess biodiversity impacts when data on pressures is not retrievable.

IMPROVEMENTS

➔ In future versions of the tool, CDC Biodiversité also aims at better integrating specific agricultural practices, labels and certifications as it could also allow companies to improve their footprint.

➔ CDC Biodiversité will also build sectoral benchmarks to help investors compare corporate biodiversity performance.

4.3 Mirova

4.3.1 Context and objectives

Mirova is an asset manager specialized in sustainable investment and socially responsible investing. It seeks to provide its client with innovative investment solutions contributing to the transformation of the economy towards a sustainable model. In addition to its asset management practices, Mirova sees impact measurement as a key tool to pilot and demonstrate the environmental footprint of its investment choices. For Mirova, this case study is an opportunity to explore how corporate biodiversity footprint could be used by their Sustainable Responsible Investing (SRI) analysts and integrated into Mirova's investment decisions and portfolio-level impact monitoring.

This case study is an opportunity for CDC Biodiversité to better understand the practical constraints of the application of the GBS for asset managers, especially regarding data accessibility. Both CDC Biodiversité and Mirova are interested to understand the feasibility of such assessments for large universes of companies.

Several businesses operating in various industries were analyzed. We present hereafter the results obtained for the French food processor Bonduelle, world leader in ready-to-use vegetables. The overall footprint of Bonduelle over its Scopes 1, 2 and 3 upstream for the year 2017 was computed.

4.3.2 Methodology

Three phases can be distinguished regarding data collection. In **phase 1**, the GBS's (financial) default approach is used based on Bonduelle's financial activity data (turnover over the period) and the Input-Output module of the GBS (based on EXIOBASE). In **phase 2**, a refined assessment is implemented using figures provided by the analysts of Mirova specialized in the food sector. Those figures replace the default values for Scope 1 and 3 for the following inputs: land use (harvested areas), water consumption in the production processes and GHG emissions. For land use and water consumption they are based on Bonduelle's public data (from the company's CSR report[58]) and Mirova's in-house assumptions. For GHG emissions, Mirova uses data from Carbone 4 (detailed per GHG type and Scope). Phase 2 illustrates the type of assessments SRI analysts could conduct based on publicly reported data. Finally, in **phase 3**, dialogue was directly initiated with Bonduelle and data was partially adjusted for Scope 1.

For all three phases the static and dynamic biodiversity impacts due to **terrestrial pressures** (climate change, land use, encroachment, fragmentation and nitrogen deposition) and **aquatic pressures** (hydrological disturbance, land use in catchment of rivers and wetlands, wetland conversion and freshwater eutrophication) are considered, using the best available data.

4.3.3 Input data

A *PHASE 1: DEFAULT ASSESSMENT BASED ON MIROVA'S ACTIVITY SPLIT ESTIMATE*

The activity data provided by Mirova specify that Bonduelle's turnover in 2017 was EUR 2.78 billion, split between North America (47%), Europe (45%), Eurasia (6%) and Other countries (2%). The best match for Bonduelle's sector in EXIOBASE industry nomenclature is "Processing of food products, nec" ("nec" means "not elsewhere classified").

B *PHASE 2: REFINED ASSESSMENT BASED ON MIROVA'S INVENTORY AND PRESSURES ESTIMATE*

Land use: Bonduelle's CSR report shows high level of transparency compared to other companies from the same sector. The company reports its total cultivated area for Scope 1 and Scope 3, which is not common practice. The cultivated area reported is not broken down by geographic region which is a major obstacle for the calculation of an accurate biodiversity footprint. Therefore, Mirova's analysts used the turnover regional split and vegetable supply scheme reported by Bonduelle to estimate a spatial allocation of the cultivated area (Table 11). For land use type, cultivated area was considered to be irrigated (5% MSA remaining).

(58) https://www.bonduelle.com/fileadmin/user_upload/SITE_CORPO/FINANCE/Document_de_reference/document_reference_bonduelle_2017-2018.pdf

Water: Bonduelle reports a global water consumption (and not withdrawal[59]) volume for Scope 1 without spatialisation. Scope 3 water consumption is estimated by assuming that the water consumption intensity is the same for the vegetables purchased by Bonduelle compared to the vegetables the company produces itself. Scope 1 and Scope 3 water consumptions are broken down by country using the same data and principles as for land use (Table 12).

GHG emissions: estimations by Scope and by greenhouse gas provided by Carbone 4 are used. Calculations are performed using a global warming potential associated to a time horizon of 100 years.

C *PHASE 3 REFINED ASSESSMENT ADJUSTED WITH DATA NOT PUBLICLY DISCLOSED BUT PROVIDED DIRECTLY BY BONDUELLE*

Mirova's analyst communicated to Bonduelle their first estimate for spatialised land use and water consumption. On that basis, Bonduelle corrected Mirova's spatial allocation for land use and its global figure for Scope 3 water consumption. Then Mirova and Bonduelle agreed to use the updated (compared to phase 2) land use spatial allocation to distribute water consumption to countries in proportion of their respective cultivated area. The data obtained during phase 3 is confidential and thus not reported here.

(59) Water withdrawal is defined as "[water pumped out] of e.g. a groundwater body or diverted from a river", while water consumption is the water withdrawal minus the water which flows back to ecosystems (CDC Biodiversité 2019a).

Country	Scope 1 (km²)	Scope 3 (km²)	TOTAL (km²)
France	45	309	354
Germany	0	221	221
Spain	11	206	217
Italy	0	162	162
Portugal	0	133	133
Canada	11	133	144
Poland	0	74	74
Brazil	0	59	59
Hungary	0	29	29
United States	0	29	29
Russian Federation	22	15	37
TOTAL	*90*	*1 370*	*1 459*

Table 11: *Bonduelle's cultivated area breakdown per country and Scope estimated by Mirova*

4.3.4 Results and discussion

The total dynamic footprint of Bonduelle in 2017 assessed during phase 1 with the (financial) default assessment amounts to around 23 MSA.km² while the total static footprint reaches 5 000 MSA.km². Such a large static footprint is characteristic of agri-businesses as food production requires significant surfaces of croplands. Bonduelle is mostly a food processor so its impacts related to spatial pressures mainly occur within its Scope 3 (its suppliers).

The analysis of Bonduelle's public data on harvested areas and water consumption during phase 2 allowed to refine the assessment of land use impacts (Scope 1 and 3, static and dynamic) and hydrological disturbance impacts related to water consumption for the industrial processes. Refined impacts are smaller for terrestrial biodiversity but higher for aquatic biodiversity. It reveals that in that case, the financial default approach over-estimates the cultivated area and under-estimates water consumption.

Country	Scope 1 (10³ m³)	Scope 3 (10³ m³)	TOTAL
France	5 414	32 483	37 897
Germany	0	23 202	23 202
Spain	1 353	21 656	23 009
Italy	0	17 015	17 015
Portugal	0	13 921	13 921
Canada	1 353	13 921	15 275
Poland	0	7 734	7 734
Brazil	0	6 187	6 187
Hungary	0	3 094	3 094
United States	0	3 094	3 094
Russian Federation	2 707	1 547	4 254
TOTAL	*10 828*	*143 855*	*154 683*

Table 12: *Bonduelle's water consumption breakdown per country and Scope estimated by Mirova*

Terrestrial	Dynamic	11 MSA.km²
	Static	1 673 MSA.km²
Aquatic	Dynamic	1.3 MSA.km²
	Static	226 MSA.km²

Table 13: *2017 biodiversity impacts of Bonduelle calculated with phase 3 data*

4.3.5 Lessons learnt

While a previous case study with BNP Paribas Asset Management already showcased the application of the GBS financial default assessment on a portfolio (CDC Biodiversité 2019), this case study with Mirova goes further, as it is the first case study with an asset manager involving a refined assessment (using inventory and pressure data). It explores how asset managers can apply the GBS refined approach to publicly disclosed corporate data, and how it can better track the performance of companies within a given industry and inform investment decisions than GBS financial default assessments. It reveals to Mirova the workload required to conduct such an assessment, corporate by corporate, and highlights the gaps in data availability to scale up the approach and assess hundreds or thousands of businesses[60].

The assessment of Bonduelle demonstrates that, by reporting quantified data on pressures on biodiversity, companies improve significantly biodiversity footprints accuracy. As the critical data varies according to the industry in which companies operate, an efficient way for Mirova to better inform its investment decisions in line with ambitious biodiversity objectives would be to establish a list of such key data per industry. Carbon disclosure is already mainstreamed and still improving, which is very useful for biodiversity footprint assessments as climate change is one of the main drivers of biodiversity loss. Disclosure could be complemented by data relative to land occupation and land use change (critical for raw material intensive industries; land use data should include the land occupation of infrastructures), water consumption and withdrawal, pollution (critical for chemical, textile, paper and other industries). The Aligning Biodiversity Measures for Business collaboration provided a list of data common to multiple biodiversity footprint assessment tools which can inform data collection choices (*cf.* section 2.1)[61]. Some of these data are disclosed today by companies, either voluntarily or due to regulation. Making them fit for biodiversity assessment, essentially by ensuring their spatialisation, is a promising first step towards generalised refined biodiversity assessments. Also, and for all industries, the traceability of raw materials along the value chain is key to better assess biodiversity impacts when data on pressures is not retrievable.

In future versions of the tool, CDC Biodiversité also aims at better integrating specific agricultural practices, labels and certifications as it could also allow companies to improve their footprint.

(60) Mirova, AXA IM, BNPP AM and Sycomore AM joined forces in February 2020 to catalyze such a scaling up of the availability of data for biodiversity footprint assessments and called for expression of interest to develop a biodiversity data provider, see https://www.mirova.com/sites/default/files/2020-01/CEI%20-%20Biodiversity%20CP%20EN_FINAL.pdf

(61) Lammerant (2019)

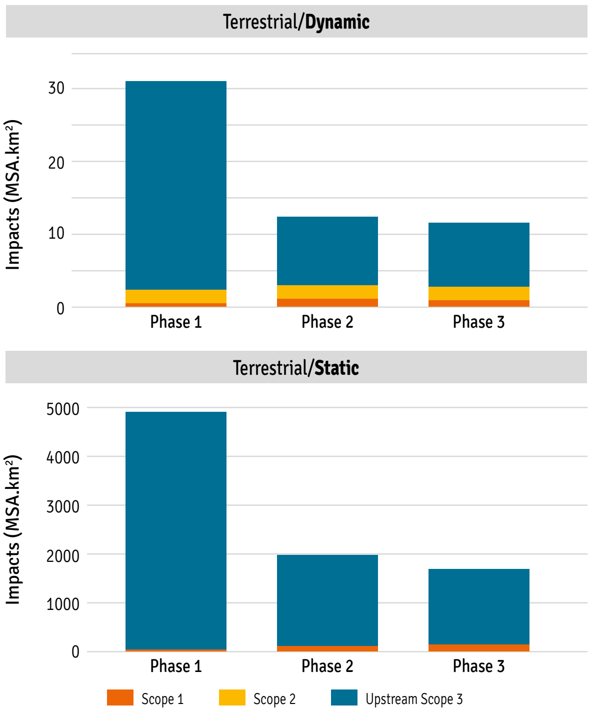


Figure 35: 2017 terrestrial biodiversity impacts of Bonduelle per Scope, phase 1 versus phase 3

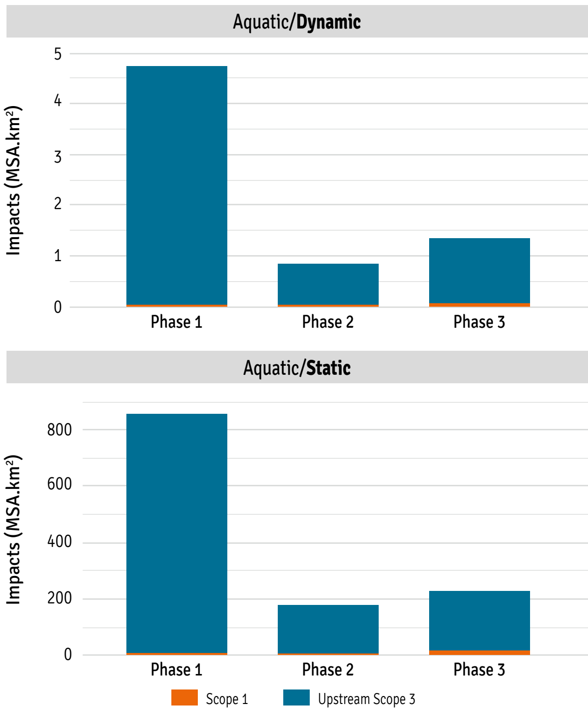


Figure 36: 2017 aquatic biodiversity impacts of Bonduelle per Scope, phase 1 versus phase 3

Case study Summary sheet

Context

CASE STUDY

Footprint use category: Corporate and portfolio
Assessment time: 2011-2017

Business application: Biodiversity management & performance

Perimeter

	LUEFN Pressures	CC Pressure	Aquatic Pressures
Scope 1	✓	✓	
Scope 2	✓	✓	
Scope 3 – Tier 1	✓	✓	
Scope 3 – Rest of value chain	✓	✓	
Scope 3 – Downstream			

✓ Evaluated companies

COMPANY'S IDENTITY

VEOLIA
Eau d'Ile-de-France
Délégataire du SEDIF

Industry
Collection, purification and distribution of water

Turnover over 2011-2017
EUR 2.4 billion

Why?

ASSESS THE BIODIVERSITY IMPACT OF THE WHOLE ACTIVITY (SCOPES 1, 2, 3 UPSTREAM) OVER THE PERIOD 2011-2017

When?

THE DEFAULT FOOTPRINT IS COMPUTED BASED ON VEOLIA EAU D'ILE DE FRANCE'S TURNOVER OVER THE 2011-2017 PERIOD

How often?

ONE-OFF FOR THE PILOT BUT COULD BE LED EVERY ONE TO FOUR YEARS TO FEED NON-FINANCIAL REPORTING

What?

TOTAL DEFAULT IMPACT OF THE ACTIVITY OVER THE PERIOD. THE IMPACT OF VEOLIA EAU D 'ILE DE FRANCE'S SITES AND CARBON OFFSET PROJECTS ARE ASSESSED THROUGH A REFINED ASSESSMENT

For who?

INTERNAL USE MONITORING OF ENVIRONMENTAL STRATEGIES

How detailed?

CORPORATE LEVEL, TAKING INTO ACCOUNT SPECIFIC DATA ON VEOLIA EAU D'ILE DE FRANCE'S SITES AND THE CARBON OFFSET PROJECTS FINANCED

DATA COLLECTED

Item	Details	Source
Tunover	Total turnover over the period 2011-2017 per region and industry	Veolia Eau d'Ile de France
GHG emissions	Total Scope 1 emissions over the period 2011-2018 Carbon offset per year and per project over the period 2011-2018	Veolia Eau d'Ile de France
Land-use	Surface areas per land-use type on Veolia Eau d'Ile de France's sites in 2011 and 2017 Location and surface areas per land-use type on carbon offsetting projects in 2011 and 2017, details on the content of each project	Veolia Eau d'Ile de France Up2green

Footprint analysis

RESULTS

Results of the refined assessment over the period 2011-2017

Total **Dynamic** footprint
-3.07 MSA.km²

Total **Static** footprint
34 MSA.km²

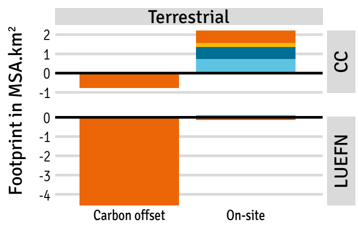


Figure 37: VEDIF's **dynamic** biodiversity footprint over the period 2011-2017, refined approach

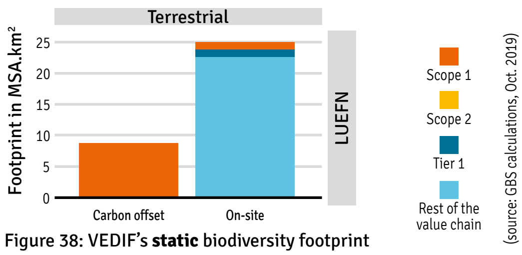


Figure 38: VEDIF's **static** biodiversity footprint over the period 2011-2017, refined approach

KEY MESSAGES

➔ The case study showcases the "corporate footprint" use of the GBS, which is the main one. It enabled the assessment of the footprint of Veolia Eau d'Ile de France's whole activity

➔ Across its Scope 1, 2 and 3 upstream, the refined total dynamic footprint of Veolia Eau d'Ile de France amounts to -3.07 MSA.km² (biodiversity gain), for an intensity of -1.3 MSA.m²/kEUR over the perimeter of pressures and raw materials assessed. Veolia Eau d'Ile de France's impacts could be a loss of biodiversity when all pressures and raw materials are taken into account

➔ The land use Scope 1 dynamic impact is a gain of approximately -4.6 MSA.km² thanks to carbon offsetting projects and -0.06 MSA.km² thanks to the implementation of late-mowing on Veolia Eau d'Ile de France's sites

➔ The climate change dynamic impact is approximately 0.8 MSA.km² for its Scope 1 and 1.4 MSA.km² for its Scope 2 and 3 upstream. The Scope 1 impact is compensated by carbon offsetting, so *in fine* the Scope 1 net dynamic CC impact is 0 MSA.km²

➔ Offsetting Scope 3 GHG emissions would allow Veolia Eau d'Ile de France to further reduce its footprint

IMPROVEMENTS

➔ Considering Veolia Eau d'Ile de France's activity, the greatest improvement would be to assess the impacts on aquatic biodiversity. This could be done through the integration of aquatic pressures and the consideration of the depollution activity

➔ Integrating the impacts of other raw materials than primary crops and water consumption in the default assessment would improve the coverage of the study

4.4 Veolia Eau d'Ile-de-France

4.4.1 Context and objectives

Veolia Eau d'Ile-de-France is in charge of water collection, purification and distribution for 150 municipal areas and 4.6 million inhabitants in the Île-de-France region in France. Sustainable development issues are a pillar of Veolia Eau d'Ile-de-France's strategy and the company has been seeking to manage its environmental footprint since the beginning of its public service delegation contract, in 2011. This case study assesses the overall footprint of Veolia Eau d'Ile-de-France over its Scopes 1, 2 and 3 upstream over the 2011-2017 seven-year period. The GBS default approach is used based on Veolia Eau d'Ile-de-France's activity data (turnover over the assessment period). For two actions, a refined assessment is conducted: 1) Veolia Eau d'Ile-de-France's participation to 12 reforestation programmes conducted by the French NGO Up2green in Latin America and Sub-Saharan Africa in order to achieve its carbon neutrality objective and 2) the differentiated management of green areas over Veolia Eau d'Ile-de-France's sites. The reforestation projects aimed to go beyond simple tree plantations and to achieve biodiversity co-benefits.

4.4.2 Methodology

The default assessment is conducted through the Input-Output module of the GBS based on Veolia Eau d'Ile-de-France's activity data. Veolia Eau d'Ile-de-France operates only in France in the industry "Collection, purification and distribution of water" and its total turnover over the period 2011-2017 is EUR 2.4 billion. The static and dynamic biodiversity impacts due to terrestrial pressures (climate change, land use, encroachment, fragmentation and nitrogen deposition) are assessed for the 3 Scopes based on industry averages provided in the environmental extensions of EXIOBASE.

In the refined assessment, Scope 1 default data related to land use are replaced by real surface areas per land-use type in 2011 and 2017 on Veolia Eau d'Ile-de-France's sites (approximately 130 ha), which includes the implementation of late mowing over green spaces. Data on the carbon offsetting projects (approximately 1 500 ha and 4 million trees planted), which consist in reforestation projects, for instance converting degraded plantations into agroforestry, are also taken into account. Scope 1 default GHG data are also replaced by Veolia Eau d'Ile-de-France's real emissions. The refined assessment thus incorporates a refined value of the Scope 1 dynamic and static footprints, along with the default Scopes 2 and 3 impacts.

4.4.3 Results and discussion

The total dynamic footprint of Veolia Eau d'Ile-de-France's activity over the period 2011-2017 is -3.1 MSA.km², *i.e.* biodiversity gains. The gains are achieved within Veolia Eau d'Ile-de-France's Scope 1 thanks to actions related to land use and climate change (-4.7 MSA.km²) while losses due to climate change in the supply chain amount to 1.4 MSA.km². The static Scope 1 footprint is 10 MSA.km², 90% of which are due to carbon offset programmes. The rest of the static impacts (24 MSA.km²) are computed by default and occur in the upstream value chain due to some limited purchases of crop products.

Scope 1 GHG emissions amount to 180 000 t CO_2-eq over the period 2011-2017. Since these emissions are fully compensated by the offsetting projects financed by Veolia Eau d'Ile-de-France and led by Up2green, the Scope 1 climate change net impact is considered null.

Detailed data allowed to quantify the associated benefits for the land use pressure related to late-mowing and the reforestation projects. The data collected included 1) the surface areas of Veolia Eau d'Ile-de-France's sites for each land use type and 2) the content and location of carbon offsetting projects. As expected, the land use dynamic impact is a gain of 4.7 MSA.km², highlighting the positive land use changes induced.

Combined with the null climate change net impact, this leads to a Scope 1 **dynamic** loss of -4.7 MSA.km² (negative losses, *i.e.* biodiversity gains). The supply chain impacts assessed are mainly due to climate change and amount to 1.6 MSA.km². Figure 37 displays the breakdown of Veolia Eau d'Ile-de-France's dynamic footprint per Scope[62].

The additional site and offset data also allow the computation of the refined **static** Scope 1 impact of Veolia Eau d'Ile-de-France. The impact is mainly due to the offsetting projects – which expands over 1 500 ha versus only 130 ha for Veolia Eau d'Ile-de-France's sites – and amounts to 0.9 MSA.km² on Veolia Eau d'Ile-de-France's sites and 9.2 MSA.km² on carbon offsetting projects. When the static impact from the supply chain is added, Veolia Eau d'Ile-de-France's overall static impact over the period is 34 MSA.km² as shown by Figure 38. The static impact may seem high, especially compared to the dynamic impact, yet it can be seen as an area over which opportunities to reduce the footprint exist, *e.g.* through restoration.

(62) As suggested by the US Environmental Protection Agency (2018) impacts related to carbon offsets are considered to belong to the same Scope as that of the impacts they mitigate (here Scope 1). It was decided to report carbon offset impacts separately rather than representing the net impact, *i.e.* to represent both the on-site negative Scope 1 GHG emissions impacts and Scope 1 carbon offset positive impacts.

4.4.4 Lessons learnt

The case study with Veolia Eau d'Ile-de-France was the first corporate assessment (whole activity) run with the GBS, thus showcasing the main use of the tool.

The biodiversity gains related to carbon offset projects and green space management show that positive impacts can be reached through dedicated actions. The results are however highly dependent on the land use categories chosen. A more conservative assessment was run, leading to dynamic biodiversity gains of 3.17 MSA.km² (compared to 4.61 MSA.km² with the current hypotheses). Furthermore, these gains are achieved through one-off actions such as switching from conventional management of green spaces to late-mowing: once late-mowing is in place, it will not be possible to reproduce the associated 0.06 MSA.km² gain in the future. Also, Veolia Eau d'Ile-de-France's footprint is incomplete since the perimeter of the case study excluded several impact sources (non-agricultural commodities, pollution) and impacts on aquatic biodiversity. Still, the study shows that positive impact trajectories could be reached and measured if ambitious strategies are set and dedicated actions implemented.

Thanks to the quality of the data provided by Veolia Eau d'Ile-de-France, this case study was among the firsts to enable the implementation of a refined assessment and the first one enabling the comparison of the default and refined assessments. As such, it provided the opportunity to develop and test the data collection files and computation procedures related to refined climate change and land use assessments. As expected, refined company data are very valuable to properly measure the company's footprint. In the case of Veolia Eau d'Ile-de-France, refining the analysis indeed caused the dynamic footprint to drop below 0, thus expressing biodiversity gains that could not be accounted for in the default assessment. On the contrary, the static impact increased by 40%. Though this result is very specific to this case study due both to Veolia Eau d'Ile-de-France's important investment in reforestation projects and to the perimeter studied, it confirms the need to make sure that the tool is flexible enough to incorporate the best available data and handle various data qualities simultaneously.

FAQ

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5 FAQ

The following five frequently asked questions complement the FAQ published in the 2018 technical update (CDC Biodiversité 2019b).

5.1 Why do global trends expressed in MSA or with the LPI report slightly different biodiversity decline rates?

In a sense, the *Mean Species Abundance* is close to the *Living Planet Index* (LPI): if the first measures the *ecological integrity* and the latter the *population trends*, they both track the size of remaining populations. However, the GLOBIO-IMAGE scenario reports a global remaining MSA of 68% or a loss of 32% in 2010 and will lose another 9.5% by 2050 (Kok et al. 2018), while the LPI already reported a 60% decline of biodiversity compared to 1970 (Grooten and Almond 2018). Five intrinsic differences could explain the gap between the two values:

- **Cause 1**: LPI assesses only vertebrates, which tend to disappear earlier when habitats shrink, while GLOBIO assesses plants and invertebrates too.
- **Cause 2**: the way GLOBIO-IMAGE scenario outputs are actually calculated involve the use of pressure-impact relationships applied to global pressure data whereas the LPI is calculated based on measures of populations.
- **Cause 3**: GLOBIO does not take into account all existing drivers of biodiversity loss (*cf.* Box 1), while the LPI inherently takes into account all the drivers because it is based directly on population monitoring. However some threats may be over- or under-represented as for some populations, biases may exist towards threatened species, well-studies species, populations from wealthy countries or from protected areas (McRae, Deinet, and Freeman 2017).
- **Cause 4**: different mathematical formula are used to calculate the two metrics – the LPI uses a geometric average whereas MSA uses an arithmetic average (Santini et al. 2017; Buckland et al. 2011).
- **Cause 5**: the LPI-D is weighted by species-richness (McRae, Deinet, and Freeman 2017) while MSA gives the same weight to all species (the LPI-U, displayed on Figure 39 is not weighted, isolating the effect of Cause 5). Since trends of biodiversity decline tend to be worse in the tropics and for species groups heavily weighted in the LPI, such as amphibians and fish, this can lead to larger decline in the LPI.

Figure 39 shows the difference between MSA, LPI-U (unweighted) and LPI-D (weighted with the taxa weight from the terrestrial system, Indo-Pacific realm from McRae, Deinet, and Freeman (2017)). It is based on the data listed in Table 15. The figure illustrates Cause 4 (difference between LPI-U and MSA; which may have a larger or smaller effect depending on the shape of the data) and Cause 5 (difference between LPI-U and LPI-D): based on the same data on populations, the three metrics can yield different results. At a global level, it is likely that Cause 5 is a key explanatory factor of the difference between LPI and GLOBIO-IMAGE scenario trends (explaining about a third or more of the difference).

TAXON	*SPECIES POPULATION*	1970	1980	1990	2000
Mammals	*Panda*	100	95	90	85
	Fox	100	95	90	85
Reptiles and amphibians	*Frog*	5000	3000	2000	1000
Birds	*Siberian crane*	1000	900	800	750

Table 15: *Example dataset of fictitious population evolutions for four species*

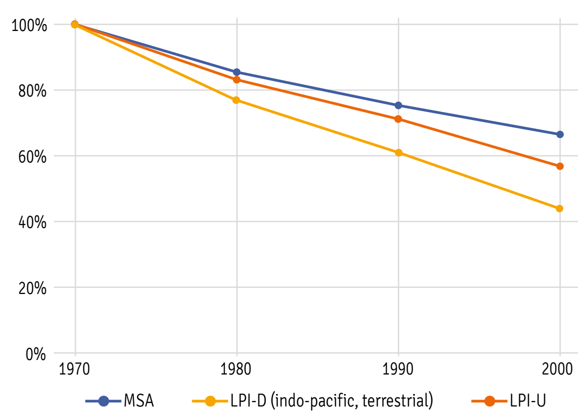

Figure 39: *Comparison of the trends for MSA, LPI-U and LPI-D based on a common dataset of populations*

5.2 What is the level of uncertainty of the GBS outputs?

The Aligning Biodiversity Measures for Business initiative highlights that uncertainties can be generated at several levels: inventory data, data in models and modelled assumptions (Lammerant 2019). A reporting framework is being built for BFA using the GBS (CDC Biodiversité 2020h), and the quality assurance work conducted by BFA assessors and auditors requires that the uncertainty associated with each level of uncertainty should be assessed as much as possible. The GBS embeds a system of central, optimistic and conservative values at each level (inventory data, data in models and modelled assumptions) to facilitate this assessment (CDC Biodiversité 2020a). In the GBS 1.0, optimistic and conservative values are rarely filled, but the system will be expanded in future versions. This system will help quantify the uncertainties in the biodiversity impacts assessed with the GBS.

The superposition of models (defined broadly) also raises the risks of inaccuracy in the results, cumulating the uncertainties of each layer of modelling. To bring transparency on the number of layers of modelling involved in calculations and to communicate the information in a simple manner, a data quality tier system has been introduced (CDC Biodiversité 2019b), with tiers ranging from 1 (at least three layers of modelling) to 5 (no modelling, direct measurement of biodiversity state)[63].

In short, the GBS 1.0 should be primarily seen as a compass indicating to companies in which direction to go rather than as a weighting scale. In other words, it provides insights on which strategic actions to take to reduce corporate impacts rather than measures accurately the changes in the state of biodiversity (*i.e.* biodiversity impacts). Future updates of the GBS should however bring it closer to a "weighting scale" role.

Besides and as noted in the Quality assurance GBS review document (CDC Biodiversité 2020h), to ensure reasonable accuracy, results from assessments using the GBS should be reported only for entities with a cumulated surface area of at least 100-1000 ha, related to the uncertainties embedded in some GLOBIO's cause-effect relationships for smaller areas, or with a turnover of more than 10-100 million euros, which more or less translates into impacts over areas of 100-1000 ha.

(63) Using a characterisation factor rated as having a data quality tier of 5 however does not mean that the impact assessment is perfectly accurate if the data are collected inaccurately, *e.g.* with insufficient line transects, then the assessment may still be inaccurate.

5.3 Does the GBS also offer a qualitative assessment of the biodiversity performance of companies?

Yes, BFAs conducted using GBS will include a screening phase going beyond the impacts assessed with the GBS and a qualitative analysis phase. This is in line with the common ground built with ACTIAM, ASN Bank and Finance in Motion (CDC Biodiversité, ASN Bank, and ACTIAM 2018).

5.4 Are regulatory compensation measures taken into account in the GBS?

The GBS is not a substitute for existing tools and approaches for applying the regulatory mitigation hierarchy sequence. Those specific tools and approaches will remain necessary to comply with regulatory requirement to avoid, minimize, restore and offset impacts on biodiversity.

The co-benefits for ordinary biodiversity of the implementation of the mitigation hierarchy can however be assessed with the GBS, outside the mitigation hierarchy framework. This is illustrated by the GRTgaz case study in section 4.2.

5.5 Can the GBS integrate field survey data to verify results?

Field survey data (data quality tier 5) can be used to verify the coherence of impacts assessed with data quality tier 1 to 4 inputs (*i.e.* through some modelling based on pressures, inventories or economic quantification of human activities). As detailed in Table 5, such direct measurements of biodiversity state have to be very comprehensive to be useful. The case study conducted with the AFD (section 4.1) illustrates how such data can be used to assess biodiversity impacts.

Ongoing development and the road ahead

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ONGOING DEVELOPMENT AND THE ROAD AHEAD

Tremendous progress has been achieved to prepare the release of the GBS 1.0 and for many industries, the most material impacts on biodiversity are covered. However, significant work lies ahead. **CDC Biodiversité plans to keep developing and updating the GBS for the years to come**. In **2020**, technical developments will focus on **consolidating and improving existing modules and CommoTools**, building on the feedback received during the critical review of the GBS. The impact of some **extractive materials** (such as uranium) which are not currently covered will be added, while the assessment of impacts of **non-metal minerals** will be refined and impact factors will be developed to better reflect the pressures caused by different **energy sources**. Further ahead, new impact factors will be built specifically to reflect the **specificities of some agricultural practices**, attribution rules will be established for impacts related to the fragmentation caused by **infrastructures** and impact factors for **water and waste services** will be developed. The overall objective of the GBS is to properly cover all industries, all impacts on biodiversity and as many specific practices as possible.

Following the release of the GBS 1.0 in May, a new ecosystem will emerge around the GBS (Figure 3). **Trainings starting during the summer and technical support webinars for B4B+ Club members will allow companies to conduct BFAs**, internally or with the help of consultants and non-financial rating agencies. CDC Biodiversité plans to conduct half a dozen BFAs shortly after the release of the GBS 1.0 and to support several dozens a year (conducted mainly by trained assessors) in subsequent years. The emergence of rating agencies providing data on corporate physical flows (land occupation, GHG emissions, water consumption, raw material consumption, etc.) and biodiversity data to investors will be an important event to watch in 2020.

Collaboration will remain key in 2020 and beyond: the GBS team will continue to support the **Aligning Biodiversity Measures for Business** collaboration and will join forces with other developers using the MSA and PDF metrics in a **technical group building common ground** on corporate data inputs, and on methodological issues. The development of the **Biological Diversity Protocol** will be followed closely.

By our next publication, in about a year, two major biodiversity events will have been held, the IUCN World Conservation Congress and the CBD COP15, and we are hopeful that by then, we will have clear international objectives for biodiversity and will be on track to bend the curve of biodiversity loss.

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What are the options to reduce the on-site and value chain-related biodiversity impacts of a business? How can financial institutions assess the risks related to the biodiversity impacts of their activity and that of the businesses they finance? How can such information be incorporated into their risk management policy? Can businesses set quantitative targets to reduce their impact on biodiversity as they do for climate?

The Global Biodiversity Score (GBS) is a corporate biodiversity footprint assessment tool which seeks to answer these questions. It assesses the biodiversity impacts of economic activities across their value chain, in a robust and synthetic way. It is developed with the support of about 35 businesses and financial institutions gathered in the Business for Positive Biodiversity Club (B4B+ Club) and through collaborations with academics, NGOs and other corporate biodiversity footprint initiatives.

This 2019 update provides an overview of how the GBS can support the post-2020 global biodiversity framework, updates previous mappings of where the GBS sits compared to other tools and presents the biodiversity footprint ecosystem, transparently describes the latest technical developments, shares the results of four more case studies of companies who road tested the tool, and completes the existing FAQ with more common questions about the GBS.

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