MEB'S REPORT
N°50 MARS 2024

BRIDGING FINANCE AND NATURE

BRIDGING FINANCE AND NATURE: THE ROLE OF BIA-GBS AND GBSFI IN MEASURING BIODIVERSITY-RELATED FINANCIAL RISKS

MISSION ÉCONOMIE DE LA BIODIVERSITÉ

GBS GLOBAL BIODIVERSITY SCORE®

CDC BIODIVERSITÉ | Caisse des Dépôts GROUPE

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PUBLICATION OF THE *MISSION ECONOMIE DE LA BIODIVERSITÉ*, FINANCED BY THE *BANQUE DES TERRITOIRES (CAISSE DES DÉPÔTS).*

REFERENCE: CDC BIODIVERSITE (2024). BRIDGING FINANCE AND NATURE: THE ROLE OF BIA-GBS AND GBSFI IN MEASURING BIODIVERSITY-RELATED FINANCIAL RISKS, BONNET, J., GODEFROY, E., GUENON, V., PRADERE, V., MISSION ÉCONOMIE DE LA BIODIVERSITÉ, PARIS, FRANCE, 58P.

Foreword

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We find ourselves at a juncture in history where environmental consciousness is at an all-time high. Issues like climate change, deforestation, and pollution have permeated public discourse and corporate agendas. Amidst these pressing concerns, there is a growing issue that economic players are increasingly focusing on: biodiversity.

Biodiversity is the rich variety of life that encompasses all living organisms on Earth. It provides us with essential services, such as pollination, water purification, and climate regulation, upon which our economies and societies rely. Yet, despite its undeniable significance, the decline in biodiversity continues unabated, driven by human activities.

Economic players, particularly those in the financial sector, are increasingly recognizing the profound impact that biodiversity loss can have on their operations, portfolios, and the global economy. One of the most significant developments in this regard is the emergence of tools and frameworks to help financial institutions navigate the complex landscape of biodiversity-related risk and opportunity. Among these, the Taskforce on Nature-related Financial Disclosures (TNFD) stands out as beacons of progress.

The TNFD, mirroring its climate-focused counterpart, the Task Force on Climate-related Financial Disclosures (TCFD), is set to provide a comprehensive framework for financial institutions and corporates to assess, manage, and disclose their nature-related risks and impacts. The publication of the first set of recommendations, in September 2023, represents a pivotal step towards integrating biodiversity considerations into mainstream financial decision-making.

To comply with such frameworks, financial institutions require robust tools and data to measure the risks associated with their impacts and dependencies on biodiversity. The Finance for Biodiversity Foundation has been monitoring for several years the emergence of tools enabling financial institutions to grasp the issue and begin to take action. In particular, the Foundation maintains an up-to-date a guide (Finance for Biodiversity 2022) of the tools available for financial institutions, which lists the various functionalities as well as and the level of maturity of these tools.

The Global Biodiversity Score is one of the tools enabling economic players to measure their biodiversity footprint. Financial institutions can take advantage of the various applications of the tool for the financial sector, covering a wide range of asset classes (listed equity, sovereign bonds, private equity...) and use-cases (reporting, engagement...). This tool was also involved in a pilot study (Finance for Biodiversity Foundation 2023) led by the Finance for Biodiversity Foundation to identify the sectors with the greatest impact on biodiversity.

To grasp biodiversity issues, financial institutions need to measure risks using tools that enable them to engage in dialogue with companies based on standardized reporting. Today, such tools exist and continue to develop and improve. It is time to act!

A word from the chairwomen

Marianne Louradour

CDC Biodiversité Chairwomen

Since 2015, CDC Biodiversité has been working on the development of a tool for measuring biodiversity footprints, the Global Biodiversity Score (GBS). It aims at allowing the quantification of impacts and dependencies of all economic activities on biodiversity. Since its launch in 2020, the GBS has been constantly improved, in particular to make it more adaptable to all types of economic player.

Financial institutions have a key role to play in reversing the erosion of biodiversity. The Finance for Biodiversity Pledge was launched in September 2020 by financial institutions around the globe to call and commit to act on biodiversity. This Pledge has since been signed by more than 100 financial institutions, which are committed to measuring their impact on biodiversity. To meet such engagements, the financial sector needs appropriate and specific tools. This is why a great deal of work has been undertaken at CDC Biodiversité to make the GBS a fully operational tool for all financial institutions. CDC Biodiversité has been working closely with financial institutions to road-test the tool, improve it and develop new applications dedicated to the financial sector's issues.

In the year 2021, CDC Biodiversité forged a groundbreaking partnership with Carbon4 Finance to build the BIA-GBS database, that provides information on the impacts and dependencies of listed assets. Updates such as the development of a methodology dedicated to sovereign bonds and the improvement of the coverage have improved the tool for the nearly 30 financial institutions using it to date.

It also appears crucial to cover all asset classes, so that all financial actors may take action. This is why a methodology has been developed from 2021 to measure the impact of real estate assets and loans with the GBS. This initiative was then extended to other sectors in 2022: the aim is to measure the footprint of multi-sector private equity or banking portfolios, for which little public data is available.

In addition to these milestones, CDC Biodiversité took an active participation in the pilots program set in motion by UNEP-FI that aimed at road-testing the LEAP beta-framework of the Task Force on Nature-related Financial Disclosures (UNEP-FI 2023). Three pilot projects, conducted with a bank (Crédit Agricole S.A.) and asset managers (Amundi Asset Management and OFI Invest), provided an opportunity to take a step back and consider the role of the biodiversity footprint in the measurement of biodiversity risks for financial institutions.

As CDC Biodiversité casts its gaze forward, we are filled with optimism about the forthcoming developments which will enable financial institutions to better capture the impacts and dependencies of their portfolios and monitor their performance over time. 2024 will be the year of standardization, with the gradual implementation of the TNFD, and the CSRD in Europe. CDC Biodiversité will continue working towards the integration of reporting mechanisms aligned with such frameworks. Our mission is clear: to leave no stone unturned, ensuring that the comprehensive spectrum of financial activities seamlessly incorporates the Global Biodiversity Score as a powerful compass, guiding us towards a more sustainable economy.

1 Overview of GBS-linked solutions for the financial sector

1.1 The emergence of the Global Biodiversity Score as a solution for financial players

Biodiversity, the planet's living tissue encompassing a variety of species and ecosystems, is facing a distressing decline at rates unprecedented in human history. This loss, driven primarily by habitat loss, climate change, pollution, direct exploitation, and invasive alien species, poses a critical threat to the planet's ecological balance and resilience. Biodiversity not only plays a vital role in supporting ecosystem services on which human societies depend (pollination, soil and water quality, climate regulation, etc.) but it also enhances the ability of ecosystems to handle future disturbances. Biodiversity is crucial to the long-term sustainability of economic activities. Indeed, approximately $44 trillion of economic value generation – over half the world's GDP – is moderately or highly dependent on nature and its ecosystem services (World Economic Forum and PwC 2020). The current erosion of biodiversity therefore also threatens the development and stability of our societies. The involvement of the private sector (corporates and financial institutions) in tackling biodiversity loss is key and has raised great expectations.

Against this backdrop, CDC Biodiversité released the first version of the Global Biodiversity Score (GBS) in 2020, its **biodiversity footprint assessment tool that allows companies and financial institutions to measure their impact and dependency on biodiversity across their entire value chain**. The B4B+ Club (Business for Positive Biodiversity Club), a network of companies and financial institutions wishing to measure quantitatively their impact on biodiversity, has participated closely in the development of the tool. Since then, a first assessment has been carried out by Schneider Electric, quickly followed by several other companies to reach over 55 assessments conducted to date.

To meet the specific need of financial institutions for accurate biodiversity data on listed assets portfolios, the **Biodiversity Impact Analytics powered by the Global Biodiversity Score (BIA-GBS)** database was launched in July 2021 in partnership with Carbon4 Finance, a pioneer and leader in climate data and methodologies. Several methodologies have also been developed by CDC Biodiversité to extend the coverage of biodiversity footprint measurement to a wider range of financial assets: real estate, private equity, infrastructure, etc. (see 1.4). These use cases are grouped under the umbrella term Global Biodiversity Score for Financial Institutions (GBSFI).

Indeed, financial institutions have a key role to play in halting the loss of biodiversity. Through their environmental strategy, they can incentivize sustainable practices and push for enhancements in environmental performance within their investees and loan recipients. They enable the development of financial initiatives such as green bonds, sustainable investment funds or sustainability-linked loans. Therefore, they can play a central role in supporting conservation and restoration efforts. On the other hand, financial institutions must protect themselves against the risks associated with the erosion of biodiversity, by identifying those risks and implementing effective methods to manage them.

1.2 Mitigate or collapse: the importance of biodiversity-related risks

The financial sector faces a variety of biodiversity-related risks. The concept of **double materiality** is based on the recognition of a feedback loop between ecosystems and the financial system, highlighting two main categories: physical risks and transition risks.

On the one hand, **physical risks** arise when natural systems are compromised which affect the ecosystem services organizations depend on. They can be caused by physical shocks like climatic or geologic events or can be longer-term changes in ecosystem equilibria (CISL 2021). The agricultural sector's dependencies on pollination by insects is an example of physical risk exposure. Indeed, the pollination enables a large proportion of agricultural activities to be maintained: it is estimated that pollination services are worth more than EUR 150 billion a year world-wide (Gallai et al. 2009; Svartzman et al. 2021). But when these pollination services are no longer provided effectively, crop yields fall leading to potential monetary losses in agricultural production.

On the other hand, **transition risks** result from a misalignment between an organization's or investor's strategy and management and the changing regulatory, policy or societal landscape in which it operates (NGFS 2021). They can result in a devaluation of assets related to economic activities that are harmful to biodiversity because of major and sudden changes such as legislation. One example is the European Deforestation-Free Regulation[1] which aims to ban imports of products derived from deforestation. It will force companies to adapt by improving the traceability of their products, which will result in tangible and significant additional costs.

The financial system also faces **systemic risks**, which stem from the collapse of the entire system. All those risks are transmitted from non-financial corporations to financial institutions, but also spread through the financial system via contagion between financial institutions and are fed via feedback loops. When a biodiversity risk materializes, these feedback loops can increase the initial source of risk, and create new risks related to biodiversity loss and ecosystem degradation (see Figure 1).

The GBS follows the double materiality approach used to assess those risks in line with the French Article 29 of the Energy-Climate Law and the Taskforce on Nature-related Financial Disclosures (TNFD) framework (TNFD 2023c). In the GBS, **Transition risks** can be approximated by the **measurement of impacts on biodiversity**. Indeed, the impact that companies have on biodiversity and ecosystems can be translated into transition risks, which are driven by societal expectations concerning biodiversity preservation, shifts in consumption habits, and forthcoming regulations. **Physical risks** are approximated by estimating **dependency on ecosystem services**. Since companies depend on the integrity of ecosystems, they are subject to risks associated with the deterioration of ecosystem services that can hinder companies from carrying out their operations effectively (Svartzman et al. 2021).

1.3 Methodology of the Global Biodiversity Score

1.3.1 Key concepts of the GBS

This section describes the key concepts required to understand the Global Biodiversity Score (GBS), but readers can refer to previous publications for further methodological details (CDC Biodiversité 2021c; 2020b; 2019).

The GBS is a **corporate Biodiversity Footprint Assessment (BFA) tool**: it can be used to evaluate the impacts as well as the dependencies of companies and financial portfolios on biodiversity. It is the foundation on which solutions tailored to the needs of financial institutions, described in subsequent sections, are built.

(1) Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010

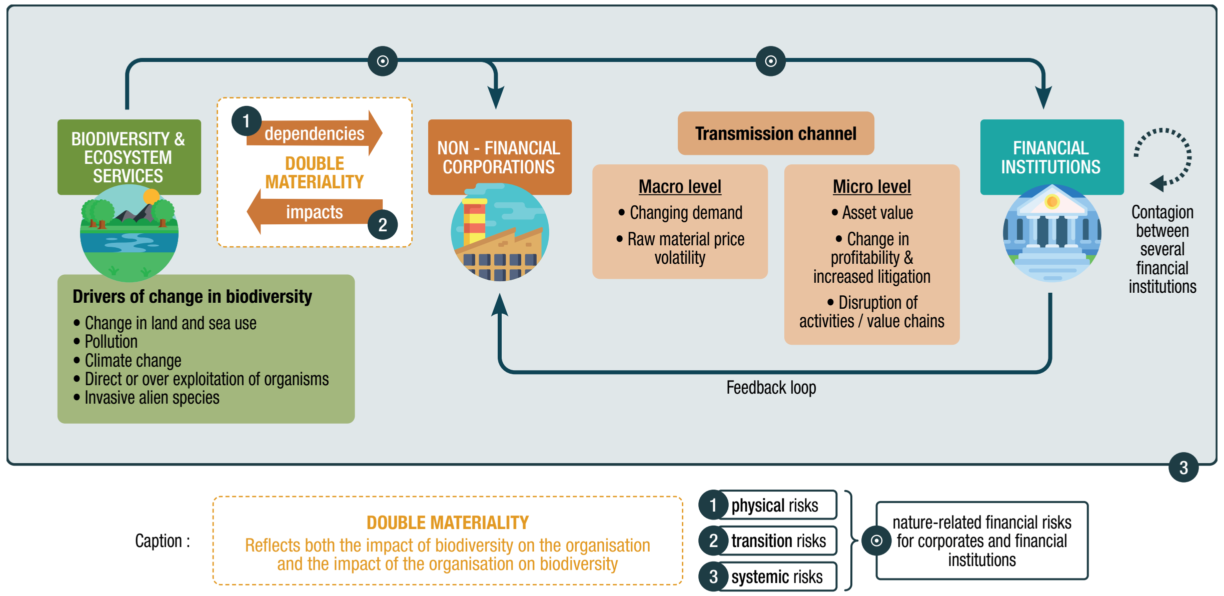


Figure 1: Overview of biodiversity-related risks and their transmission to the financial sphere

METRIC

The results of impact assessments conducted with the GBS are expressed in the **MSA.km² unit**. MSA stands for Mean Species Abundance and is a metric expressed in % characterizing the **integrity of ecosystems**. MSA values range from 0% to 100%, where 100% represents an undisturbed pristine ecosystem. Thus, an impact of 1 MSA.km² is equivalent to the destruction of 1 km² of undisturbed natural areas.

It should be noted that the GBS, through the MSA, measures the ecosystem condition, *i.e.*, the integrity of the ecosystem. To evaluate the overall state of biodiversity, the MSA should thus be used alongside other metrics covering aspects beyond the ecosystem level. Indeed, the footprint measurement provided by the GBS is part of a broader framework presented in section 4.

SCOPES

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.

ACCOUNTING FOR STOCKS AND VARIATIONS OF STOCKS OF BIODIVERSITY

Accounting for impacts on ecological integrity benefits immensely from distinguishing past cumulated impacts up to a given moment and new impacts (negative or positive) during a period. The GBS follows such a stock/variation of stock accounting framework and distinguishes periodic gains or losses ("dynamic impacts") and accumulated negative impacts ("static impacts") (CDC Biodiversité 2020a).

Periodic gains or losses are flows of new impacts occurring within the period assessed while **accumulated negative impacts** are defined so that the sum with remaining biodiversity expressed in percentage equals 100% (Endangered Wildlife Trust 2020). This distinction is also in line with the objective of the Convention on Biological Diversity (CBD) to bend the curve of biodiversity loss, requiring reducing periodic losses to zero and then start reducing accumulated negative impacts by restoring ecosystems.

PRESSURES

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has identified **five major anthropogenic pressures,** that **contribute to the erosion of biodiversity** and the depletion of natural capital: land use change, overexploitation of natural resources, climate change, pollution, and invasive alien species, over three realms: terrestrial, freshwater, and marine. The GBS covers two realms – terrestrial and aquatic biodiversity- and four out of those five pressures, which are further broken down into eleven GBS pressures (CDC Biodiversité 2021c). They are presented in Table 1.

1.3.2 Assessing impacts

To assess corporate biodiversity footprints, the main approach of the GBS is to link data on **economic activity** to **pressures on biodiversity** and to translate these pressures into **changes in the state of biodiversity (impacts)**. A hybrid approach is used to take advantage of the best data available at each step of the assessment. Company specific data on purchases or related to pressures (such as land use changes or greenhouse gas emissions) can be used. In the absence of precise data, a default calculation assesses impacts based on financial turnover data.

IPBES PRESSURE	GBS PRESSURES ON TERRESTRIAL ECOSYSTEMS	GBS PRESSURES ON AQUATIC ECOSYSTEMS
Land/sea use change	- Encroachment - Fragmentation - Land use	Wetland conversion
Direct exploitation *		Hydrological disturbance due to direct water use
Climate change	Climate change	Hydrological disturbance due to climate change
Pollution	- Atmospheric nitrogen deposition - Terrestrial ecotoxicity	- Freshwater ecotoxicity - Freshwater eutrophication - Land use in catchment of rivers / wetlands
Invasive alien species	Not covered	

* Terrestrial Direct exploitation is also covered in the GBS through pressures due to resources extraction (crops, woodlogs, mining…).

Table 1: Pressures covered by the Global Biodiversity Score and associated IPBES impact drivers.

To link economic activity, pressures and impacts, the GBS uses peer-reviewed tools such as EXIOBASE (Stadler et al. 2018), an environmentally extended multi-regional input-output model, or GLOBIO, a model assessing the impact of various pressures on biodiversity intactness (Alkemade et al. 2009; Schipper et al. 2016). The GBS footprint assessment is conducted in three main steps and is flexible enough to feed data at different levels:

- Impacts are estimated from contributions to various pressures on terrestrial and aquatic ecosystems. The GBS translates these pressures into impacts on biodiversity, expressed in MSA.km², using the impact factors provided by the GLOBIO model, developed by the Netherlands Environmental Assessment Agency (PBL). This pressure data can be directly injected in the GBS.
- If pressure data is not available, it can be derived from inventories data (commodities, services or refined products, greenhouse gas emissions, water consumed or withdrawn, pollutant emissions) directly injected into the GBS.
- As a last resort, if inventories are not available, they can be estimated using the input-output model EXIOBASE that converts data on turnover by industry and region into input data such as the of commodities and water or the emission of pollutants.

The key principle of the GBS is to always use the most accurate data. The use of financial proxies is therefore not systematic. This stepwise approach is further developed in a previous publication (CDC Biodiversité 2019).

1.3.3 Assessing dependencies

Although the initial emphasis of the GBS has been on measuring impact, the estimation of **dependencies on ecosystem services** has been added to provide an overview of risk assessment in line with the double materiality approach.

Ecosystem services are services provided by biodiversity that enable or facilitate human activities, particularly economic ones. The Common International Classification of Ecosystem Services (CICES) lists several ecosystem services, classified into three categories: Provisioning services, Regulation and Maintenance services, and Cultural services (Haines-Young and Potschin 2018). An industry is dependent on an ecosystem service when at least one of its production processes depends on this service to function properly.

The GBS allows to estimate dependencies on the 21 ecosystem services listed by ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) (Natural Capital Finance Alliance (Global Canopy, UNEP FI, and UNEP-WCMC) 2021) using two dependencies scores that range from 0% (no known dependency) to 100% (very high dependency). The **average dependency score** measures the company's average dependency on all ecosystem services (CDC Biodiversité 2021c). This dependency score may hide high dependencies on a few ecosystem services if dependencies on all other services are low. For this reason, it is supplemented by a **critical dependency score**, that provides the share of a company that is critically dependent on at least one ecosystem service, *i.e.*, dependent on at least one non-substitutable service (CDC Biodiversité 2023b). Services are considered to be non-substitutable if the dependency appears as high or very high according to ENCORE.

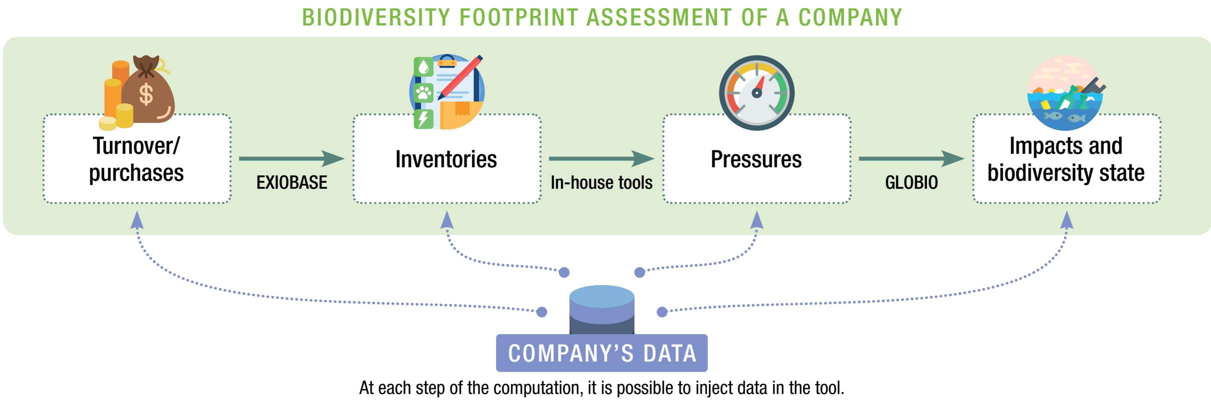


Figure 2: The methodology follows a step-by-step approach and allows several types of data to be used as input

1.3.4 An aggregated score on biodiversity impacts: the MSAppb*

In the GBS, the impacts are divided in two realms (terrestrial, aquatic) and two accounting categories (static, dynamic). Therefore, **four impact figures are required to obtain a comprehensive overview of the biodiversity footprint of a company or a portfolio**.

For financial institutions dealing with extensive portfolios seeking to rank assets by impact, summarising the information into a single score may seem necessary. In many cases, such as building a trajectory to align with the Global Biodiversity Framework or engaging with a financed company to reduce its pressures on biodiversity, it is necessary to consider the detailed information provided by the breakdown of terrestrial dynamic and static impacts and aquatic dynamic and static impacts. But for a few cases, assets need to be **ranked along a single axis**, for instance to build an index of companies including only the best in class for some sectors.

An **aggregated score** was introduced in BIA-GBS to provide such a single figure linked to biodiversity impacts: the **MSAppb***[2]. This score allows to **obtain a first overview of the biodiversity performance** of numerous companies of a portfolio, before deep diving into the results in MSA.km². It can also be used at the company or asset level.

This underlying weighting of each component of the aggregated score is as follows:

First, the **weighting of aquatic and terrestrial ecosystems** applied in the MSAppb unit, introduced in the latest GBS technical update report (CDC Biodiversité 2023b), reflects the following rationale: aquatic and terrestrial have the same importance and losing 1 km² of freshwater ecosystem is more problematic than losing 1 km² of terrestrial ecosystem because the global surface area of freshwater ecosystem is smaller. In practice, the **weight of aquatic impacts is approximately 13 times higher than that of terrestrial impacts**.

Then, **dynamic impacts are weighted 50 times higher than static impacts** in an imperfect attempt to compare the relative importance of additional impacts today and historic cumulated impacts (in practice static impacts are divided by 50 before being summed to dynamic impacts)[3].

The **aggregated score of an asset is the sum of its four components of impacts**, weighted as explained above (Figure 3).

(2) "ppb" stands for "Parts per Billion".

(3) This weighting matches the restoration time of ecosystems of non-forest biomes: they recover their integrity state after 50 years after land abandonment (Schipper et al. 2016). It also matches the assumption related to ecosystem recovery in the ASN bank report (CREM and PRé Consultants 2016).To some extent, a static impact can be seen as an opportunity cost, *i.e.*, the persistence of the impact hindering biodiversity gains and this opportunity cost can be considered equal to the biodiversity gain which would occur over the period (here, one year) if the impact stopped.

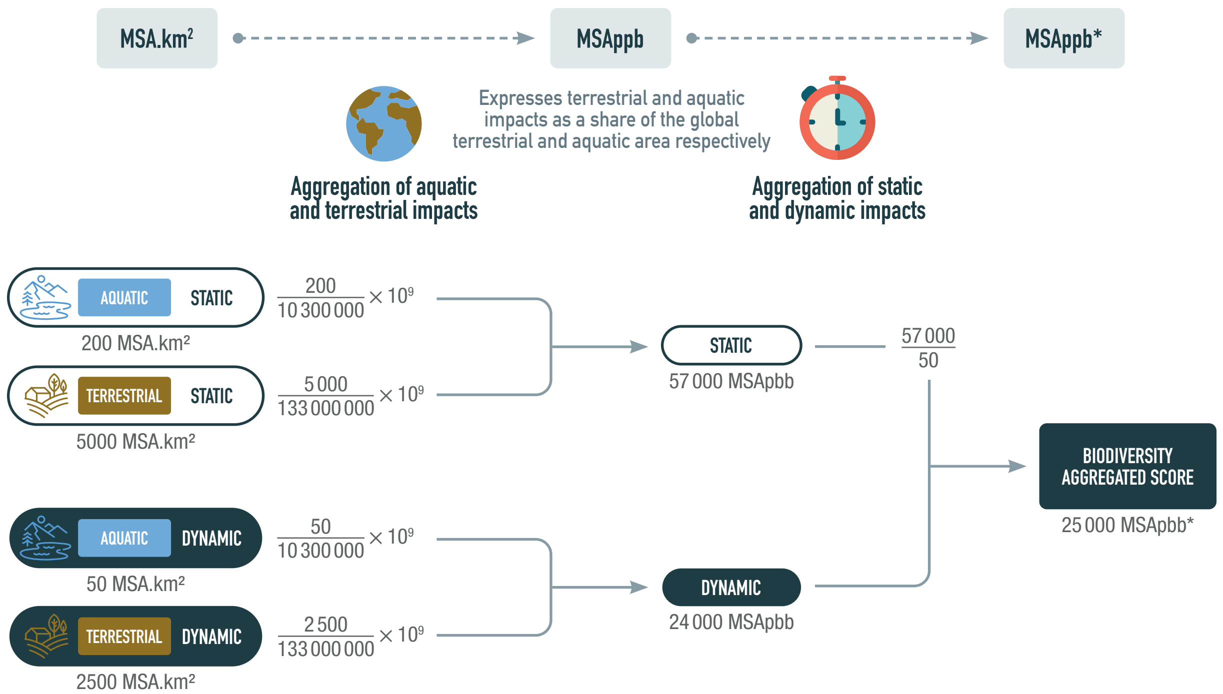


Figure 3: Construction of the MSAppb aggregated score*

However, the aggregation of the four results creates bias that should be kept in mind when using the aggregated score:

- Climate change static impacts are usually **not calculated** during assessments conducted with the GBS[4] and the **uncertainty of aquatic dynamic impact** assessment significantly **distorts the scoring** compared to a situation where they would both be properly assessed and included.
- Since dynamic impacts have a higher weight, *i.e.* 1 MSA.km² dynamic loss represents more MSAppb* than a static impact of 1 MSA.km², companies will tend to prioritize actions which reduce dynamic losses or lead to dynamic gains[5]. **The current aggregated score thus leads to prioritise dynamic impacts over static impacts**. Figure 4 below illustrates this effect with a simplified example considering only terrestrial impacts: by the end of the year, company A and company B will both have a static terrestrial impact of 11 MSA.km² since dynamic impacts accumulate into static impacts at the end of each assessment period, but their MSAppb* scores are very different.
- Furthermore, the weighting of aquatic *versus* terrestrial ecosystems (approximately 13 versus 1) **may lead to stakeholders favouring restoring one or the other** to maximise their MSAppb* gains if the ratio of restoration cost between aquatic or terrestrial ecosystems differs significantly.

1.4 GBS-linked solutions for portfolio's Biodiversity Footprint Assessment

CDC Biodiversité offers several types of **GBS-based solutions for financial institutions**. The Biodiversity Impact Analytics powered by the Global Biodiversity Score (BIA-GBS) database, co-developed with the data provider Carbon4 Finance (C4F), is designed to address **listed corporates assets and sovereign bonds**, and is presented in section 2. Non-listed assets are assessed with the Global Biodiversity Score for Financial Institutions (GBSFI), an umbrella term which covers the uses of the GBS for tailor-made solutions for financial institutions, encompassing a **wide range of asset classes.** Several GBSFI use cases are presented in section 3.

(4) If BIA-GBS does not include Climate change static impacts, they have been included in some recent Biodiversity Footprint Assessments.

(5) By construction, the use of MSAppb* breaks the accounting rule that the static impact of year n+1 is equal to the addition of static and the dynamic of year n. That leads to incoherent situations from an accounting perspective.

	TERRESTRIAL IMPACTS			
	① Static impact at the beginning of the period (MSA.km²)	② Dynamic impact (MSA.km²)	③ Static impact at the end of the period (MSA.km²) ③ = ① + ②	Aggregated score (MSAppb*)
Company A	10	+1	11	$\frac{10}{133\,000\,000}\times 10^9 \times \frac{1}{50} + \frac{1}{133\,000\,000}\times 10^9 =$ ***9,0 MSAppb****
Company B	11	0	11	$\frac{11}{133\,000\,000}\times 10^9 \times \frac{1}{50} + 0 =$ ***1,7 MSAppb****

Figure 4: Calculation of an aggregated score for two companies, example for terrestrial impacts

Figure 5: Financial institutions having benefited from BIA-GBS and GBSFI services as of October 2023.

** GBSFI was used by Crédit Agricole S.A. in a TNFD Pilot on agriculture in France*

Financial institutions are presented with a diverse range of options encompassing various asset classes, presented in Figure 5. These solutions include for example listed corporates assets, sovereign bonds, real estate assets and loans, or investment in private companies. Their adaptability allows financial institutions to fine-tune their biodiversity footprint assessment to align with specific goals, described in the "needs addressed" section of the Figure 6. These needs are intricately linked to the business applications from the EU Business and Biodiversity Platform (Lammerant 2022) as shown in Figure 6. Those applications and how to appropriately respond to them are further detailed in section 4.2.

The spectrum of choices starts with a Screening, which relies heavily on financial data, such as outstanding or investment amount, turnover, Enterprise Value Including Cash (EVIC). The Screening is calculated using information about the sectors and countries involved in the financing. It can be carried out via the BIA-GBS database in the case of listed assets, or directly with the GBS for unlisted assets, using data provided by the financial institution.

On the other hand of the spectrum, more advanced approaches call for a higher level of data granularity, asking for up to a hundred physical indicators to be collected. Those in-depth methods, while requiring greater effort from the financial institution to collect the data, enable a nuanced response to precise needs. For instance, they allow financial institutions to collaborate with issuers to establish comprehensive action plans, thereby facilitating a deeper level of engagement and commitment to biodiversity. These approaches can also be used to identify best-in-class players, including for the construction of biodiversity funds if combined to qualitative analyses beyond ecosystem integrity.

This flexibility of the approach allows financial institutions to tailor their biodiversity assessments in a manner that best serves their objectives and aligns with the level of involvement they seek in mitigating biodiversity-related risks.

	BIA-GBS	GBS-FI – Loans and Equity		
TYPE OF ASSESSMENT	Screening		Advanced Screening	Simplified Biodiversity Footprint Assessment
Asset class	Listed corporates (equities and bonds), sovereign bonds	All types of portfolios	Real estate, private companies, project finance	Infrastructure, private companies (Small to mid-caps)
Data collected by the end-user	ISIN and invested amounts	Sector and country of the financing Outstanding or investment amount Turnover, EVIC	Screening data + Less than 20 portfolio-specific physical indicators(1) (GHG, land occupation, raw materials…)	Screening data + Less than 100 refined physical indicators (GHG, land occupation, raw materials…)
Cost of the assessment	Subscription with annual fee	~25-35k€	~35-45k€	~15-30k€ / company ~15-40k€ / infrastructure(2)
Time required to obtain impacts and dependencies	Immediate (access to a database)	3-5 months(3)		
Needs addressed	• Identification of hotspots of sectoral impacts and risks: key sectors and/or issuers for further analysis • Ground for engagement with corporates		• Identification of best-in-class players • Monitoring of portfolios' biodiversity performance	• Identification of hotspots of impacts • Definition of action plan for the issuer
Business applications			Assessment of current biodiversity performance BA 1 (partial)	Assessment of current biodiversity performance BA 1
			Assessment of future biodiversity performance BA 2 (partial)	Assessment of future biodiversity performance BA 2
				Tracking progress to targets BA 3
	Comparing options BA 4			
	Assessment / rating of biodiversity performance by third parties, using external data BA 5			
	Screening and assessment of biodiversity risks and opportunities BA 7			

N.B. The Advanced Screening approach provides only a partial response to BAs 1 and 2, while the Simplified Biodiversity Footprint Assessment approach is more suited to addressing these BAs.

(1) Physical indicators, or input data indicators, are the different types of data to be collected. For example, if commodities quantities are collected, each commodity type is considered as a physical indicator. Core indicators number aim to stay below 100 but it may vary based on the use case: more than 3 000 products can be covered by the Global Biodiversity Score and this granularity can prove valuable for assessing some sector.

(2) on top of a cost to develop a sector-specific or infrastructure-specific methodology

(3) depending on the sector, the amount of data on hand for the assessment and the availability for data collection

Figure 6: Multi-purpose biodiversity assessments provided by the GBS for the financial sector: from databases to tailor-made solutions for various asset classes, data granularities, and ranges of cost. Business applications from Lammerant (2022).

N.B.: When assessing the biodiversity impact of a financial institution's portfolio, these impacts must be reported among the Downstream Scope 3 of the financial institution itself. However, to facilitate a clearer understanding of the methodology and of the cases presented, the reminder of this publication will adopt an investee's perspective presenting the impacts under the different Scopes within the investee reference.

2 Assessing impacts and dependencies of listed equities and bonds

2.1 BIA-GBS, a database on listed assets in partnership with Carbon4 Finance

2.1.1 Key concepts of BIA-GBS

Carbon4 Finance (C4F) and CDC Biodiversité co-developed BIA-GBS (Biodiversity Impact Analytics powered by the Global Biodiversity Score), a database launched in 2021 to measure the **impact of companies**, **sovereign entities** and **financial portfolios** on ecosystems, as well as their dependency on ecosystem services, enabling financial institutions to better understand their exposure to biodiversity-related risks. CDC Biodiversité's expertise in assessing the biodiversity footprint is enhanced by Carbon4 Finance's expertise in environmental data.

BIA-GBS covers **corporates (listed equity and bonds), financial institutions (listed equity and bonds) and sovereigns (*i.e.*, sovereign bonds)**: 330 000+ instruments involving 7 200 issuers are currently covered. The database thus covers the main indices, including MSCI World, S&P 500 and STOXX Europe 600. It is built by combining the GBS's impact factors with C4F's data on the distribution of turnover in terms of sector and country provided by the Climate Risk Impact Screening (CRIS) database and with greenhouse gas emissions data for Scope 1, 2 and 3 from C4F's Climate Impact Analytics (CIA) database. Data can be accessed directly via a user-friendly web platform, SFTP data feeds, and can be exported as Excel files. Results are obtained from simple and easy-to-access data such as ISIN numbers and amounts invested. Portfolios can also be uploaded on the dedicated platform to run and explore the results.

The current **broad coverage of BIA-GBS** makes it possible to evaluate the exposure to impacts of a large number of listed assets and associated portfolios, and to understand which sectors and companies are responsible for major pressures on ecosystems and are the most at risk in a portfolio. By measuring impacts and dependencies on biodiversity, it allows to assess both **transition and physical risks** arising from biodiversity loss, with the approach described in section 1.2. The results are available with a granularity of 163 sectors and 49 regions, and the database covers direct operations and the value chain - Scope 1, 2, and 3[6] - for both terrestrial and aquatic freshwater ecosystems.

BIA-GBS was used in particular in a study of the Banque de France a to assess the biodiversity risks of the French financial system (see section 5.3 for the case study). BIA-GBS also aims at complying with the reporting framework, in particular the French regulatory requirements of **Article 29 of the Energy Climate Law** for which standardized reports have been developed by Carbon4 Finance and CDC Biodiversité. BIA-GBS can thus be used for **reporting** but also as ground for **engagement** with companies.

BIA-GBS can also contribute to the construction of biodiversity **thematic funds**, but this should be done in combination with other analyses. Indeed, in the current version of BIA-GBS, the data used is company-specific data for the Climate Change pressure only, and financial data (*e.g.*, breakdown of sales by sector and country) for the other pressures. Consequently, within the same sector, the differences in results will come from the **breakdown of the turnover by sub-sector and country**[7] and the company's Scope 1, 2 and 3 **greenhouse gas emissions**, obtained from Carbon4 Finance CIA database. As a result, BIA-GBS remains **limited for refined intra-sector comparisons** in the sense that two companies with the exact same EXIOBASE sectors and the same countries of activity will only be differentiated by their climate performance. In addition, there are the other limitations of the tool, such as the lack of coverage of marine ecosystems and exotic alien species.

(6) Upstream Scope 3 impacts are systematically covered for all pressures, and Downstream Scope 3 impacts are only those stemming from the Climate change pressure to date.
(7) The final granularity of BIA-GBS is that of EXIOBASE, *i.e.* 163 sectors and 49 regions, which are countries or groups of countries.

More broadly, BIA-GBS measures the performance of a portfolio in terms of the **condition and extent of ecosystems**, an analysis that must be complemented by one of the many other **facets of biodiversity:** species diversity, Protected Areas, Key Biodiversity Areas, etc. (Figure 16).

Consequently, BIA-GBS must be completed by **qualitative analyses of the investees** (*e.g.* on their policies on biodiversity pressures, such as deforestation) and **other type of biodiversity-related data** (*e.g.* Integrated Biodiversity Assessment Tool, or IBAT, data which covers Protected Areas, KBA and species extinction risk) **within a more in-depth analysis covering all the aspects of biodiversity with company-specific data allowing to distinguish the best in class**, if a financial institution wants **to build a biodiversity thematic fund.**

2.1.2 Methodology

METHODOLOGY AND INPUT-DATA

The database BIA-GBS uses the GBS tool (version 1.1.0 as of October 2023) with input data provided by Carbon4 Finance. The core structure of the GBS and how it assesses the company's biodiversity footprint, as well as how Carbon4 Finance's data is integrated, are illustrated in Figure 7.

STEP 1 - ECONOMIC ACTIVITIES: Carbon4 Finance provides the mapping between instrument identifiers (ISIN) and the issuer, as well as the breakdown of companies' revenues by sector of activity and by geographic location. The data comes from the CRIS (Climate Risk Impact Screening)[8] database, a methodology developed by Carbon4 Finance to analyze a portfolio's exposure to physical climate risks.

STEP 2 - PHYSICAL INVENTORIES: EXIOBASE is an Environmentally Extended Multi-Regional Input-Output Model (EEMRIO), indicating the economic and physical interdependencies between economic sectors and geographical regions (Stadler et al. 2018). EXIOBASE version 3.4 is used to map the value chain of economic activities and translate sector and country specific revenue data into inventories, which are physical amounts of materials and flows necessary to perform the company's activities. Hence, BIA-GBS considers the whole upstream value chain of companies in its biodiversity impact analysis.

Data from the CIA (Carbon Impact Analysis) database - developed and maintained by Carbon4 Finance, provides companies' GHG emissions on all Scopes, based on a comprehensive bottom-up analysis. It is used to replace statistical GHG emissions derived from EXIOBASE, thus delivering a refined impact assessment. This data allows to cover the Climate Change impact of the entire value chain (including upstream and downstream Scope 3).

STEP 3 - BIODIVERSITY PRESSURES: In-house tools developed by CDC Biodiversité estimate each physical flow's contribution to biodiversity pressures, as defined by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). BIA-GBS encompasses four IPBES pressures out of five, broken down into eleven GBS pressures (CDC Biodiversité 2021c). The contribution of ecotoxicity within the macro-pressure Pollution is not included in BIA-GBS, as uncertainties were too high.

(8) Financial data used in the CRIS database, such as revenues per sector and geographical location, is sourced from FactSet and refined by Carbon4 Finance.

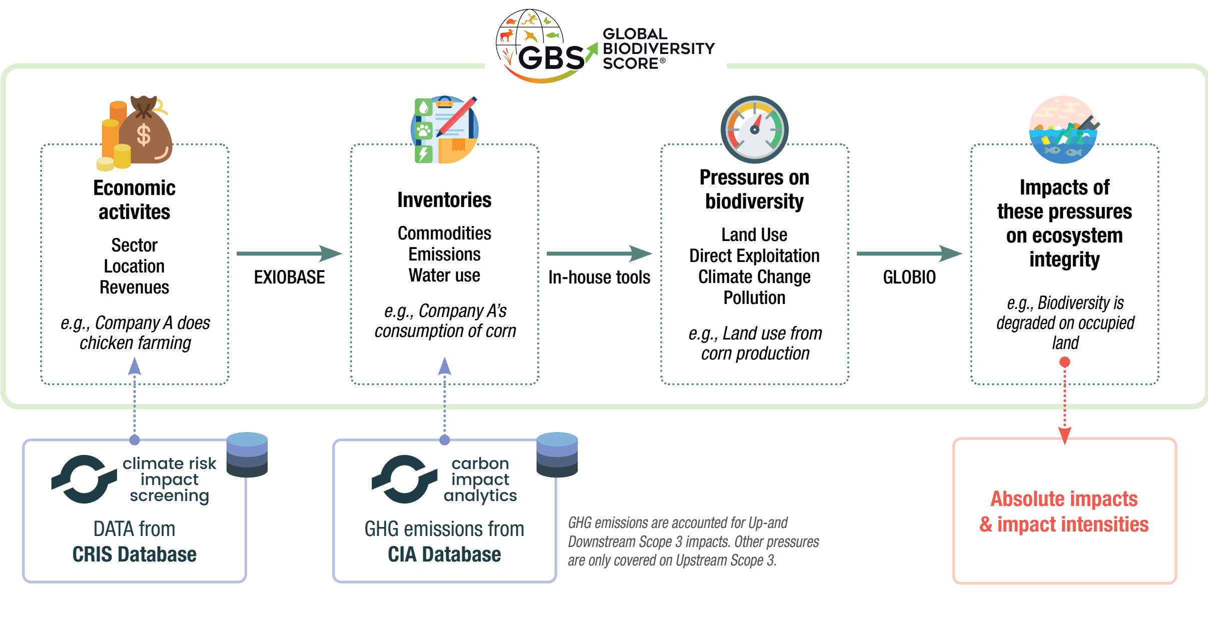


Figure 7: Input data used in BIA-GBS for impact calculation and links to the GBS

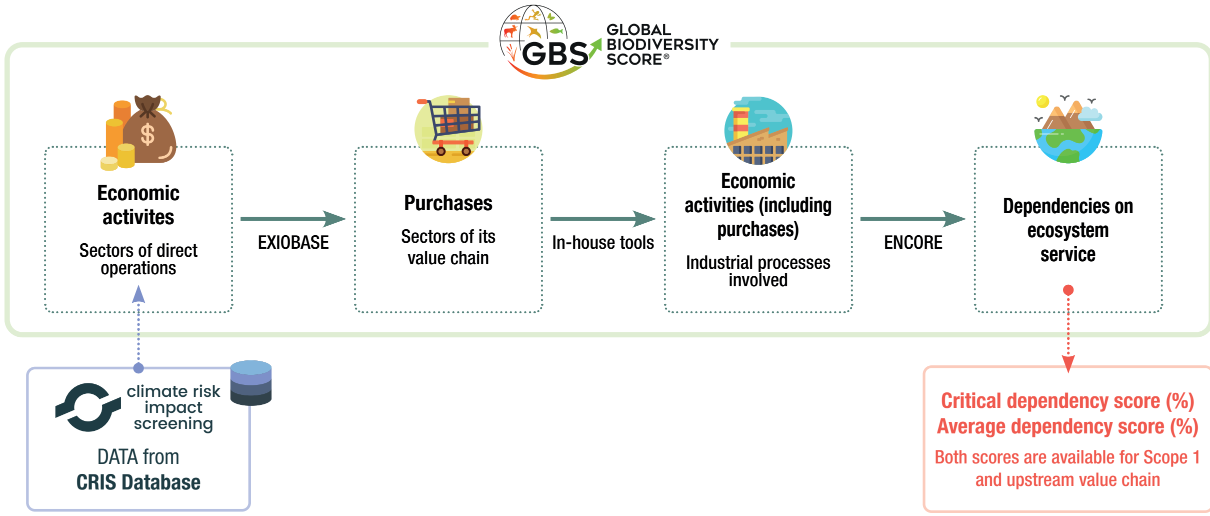


Figure 8: Input data used in BIA-GBS to assess the dependency on ecosystem services

STEP 4 - IMPACTS: By using the GLOBIO model and its pressure-impact relationships, the GBS translates each pressure into impacts on ecosystem integrity, expressed in MSA.km^2. A score in MSAppb* is then derived from the impacts (see details in section 1.3.4).

The database BIA-GBS also includes the dependencies on biodiversity of the entities, as illustrated in Figure 7. The dependencies are calculated using the methodology described in section 1.3.3. The split of the entity's revenue by sector is extracted from Carbon4 Finance's CRIS database.

OUTPUTS AND METRICS

BIA-GBS provides indicators at both entity and portfolio level. The absolute biodiversity impacts are expressed in **MSA.km^2** per accounting category (static or dynamic) and per realm (terrestrial or aquatic). An absolute aggregated score in **MSAppb***[9] by pressure and Scope is also provided. Section 5.1 provides examples of results obtained with the BIA-GBS database.

In addition to absolute impacts, BIA-GBS provides impact intensities using two approaches:

The "**value approach" represents the impact par euro invested.** It is primarily used to allocate an issuer's impact to a portfolio: the impact figures are divided by a metric representing the financial value of the issuing entity at a given point in time.

The "**activity approach" represents the intensity of the issuer independently from the financial institution.** It is primarily used as a metric to assess an issuer's performance and compare it with its peers: the impact figures are divided by a metric representing the economic activity over a period.

Both types of intensities are available for the aggregated score (in MSAppb*/bEUR) and the impacts expressed in MSA.km^2. Figure 9 shows the use case of the two different intensities for a corporate.

For corporates or banks as issuers, different financial metrics are used to represent their assets' value or their economic activity, which are the denominators of the two intensities (see Table 3). The asset value used for the value approach are:

- For corporates, the **EVIC** of the firm is used[10], instead of solely market capitalisation. Thus, the total impact of the firm is allocated proportionally between its equity, debt, and cash. One euro of equity has the same impact intensity as one euro of debt.
- For banks, their **total financing** of the economy is used. Since only impacts from financing activities to individuals, companies, and sovereign entities are measured, only these financial items are considered in their asset value. Considering other items in the bank's balance sheet would dilute the footprint.
- For sovereigns, the total debt is used.

(9) This score is called a "Normalized score" in the BIA-GBS database.
(10) This approach is in line with recommendations of the Partnership for Biodiversity Accounting Financials (PBAF 2022)

APPROACH	USE CASE	CALCULATION (for a corporate)
Activity approach	Compare issuers	$\textit{Company's Impact Intensity (Activity approch)} = \frac{\textit{Absolute impact}}{\textit{Turnover}}$
Value approach	Allocate impact to the financial institution	$\textit{Company's allocated impact} = \textit{Share of EVIC owned by the FI*} \times \textit{Company's Impact Intensity (Value approch)}$ $= \textit{Share of EVIC owned by the FI*} \times \frac{\textit{Absolute impact}}{\textit{EVIC}}$ ** FI = Financial Institution*

Figure 9: Use case of the impact intensities, and calculation for a corporate

ISSUER TYPE	VALUE APPROACH	ACTIVITY APPROACH
Corporate (excluding banks)	Enterprise Value Including Cash (EVIC)	Turnover of the issuer
Banks	Total Financing	Turnover of the issuer
Sovereign debt	Total Debt	GDP of the issuer

Table 2: Financial metrics used to calculate intensities, depending on the issuer type

2.1.3 Future developments

Originally, BIA-GBS was created with a **semi-statistical approach,** also referred to as top-down approach, presented in section 2.1.2 above, combining financial and GHG emission data. This allows financial institutions to evaluate the impacts and dependencies of their portfolio, to spot highly impacting entities and to compare the performance of different sectors. However, within the same EXIOBASE industry and region, two entities will only be differentiated by their climate performances, as the GHG emissions are the only company-specific input data used in the database. In practice, since entities never have exactly the same sector and country split, they still have unique impact intensities on all pressures.

Nevertheless, this highlights the necessity to include **company-specific inventories of commodities or final products** which can be used to calculate more specifically the impact on all pressures. However, this type of data is for now partial and fragmentary and not available for all companies. CDC Biodiversité and Carbon4 Finance therefore experimented with a new approach for one sector: in this so-called **bottom-up approach**, economic data is replaced by inventory data to evaluate impacts with company-specific information on all pressures. These inventories are collected, verified and if necessary recalculated by Carbon4 Finance, using reports published by companies. GHG emissions data from the CIA database are still used to calculate the Climate change impact. Figure 10 details the articulation of the different data used for the two approaches. As it is responsible for almost half of the global impact on biodiversity (CDC Biodiversité 2020b), the bottom-up approach was first developed for the Agriculture and Agrifood sector. This pilot covered 98 companies, using tonnages of final products as input data.

With the bottom-up approach, it is possible to differentiate the impact of two companies within the same sector and country. Their impact will depend on the type of product manufactured or used by the company, with a methodology allowing to consider the impact of more than 2,400 products. The impact factors of these products were developed using the Agribalyse database version 3.0.1 ('AGRIBALYSE Data v3.0.1' 2022).

Therefore, the bottom-up approach allows a real intra-sectoral comparison of the biodiversity impact, and not only the climate impact. The bottom-up approach also allows to improve the coverage of the Downstream Scope 3 impacts on all pressures, and not only Climate Change. The bottom-up approach was used in a TNFD pilot conducted by CDC Biodiversité with Amundi Asset Management and Ofi Invest Asset Management. The methodology and main results of this pilot are described in section 5.2.

Finally, BIA-GBS will continue to progress to provide more answers to the biodiversity challenges of the financial sector. CDC Biodiversité and Carbon4 Finance are constantly working to improve the database, and in 2023 the screening of biodiversity dependencies as well as the impact of sovereign bonds were added to the platform.

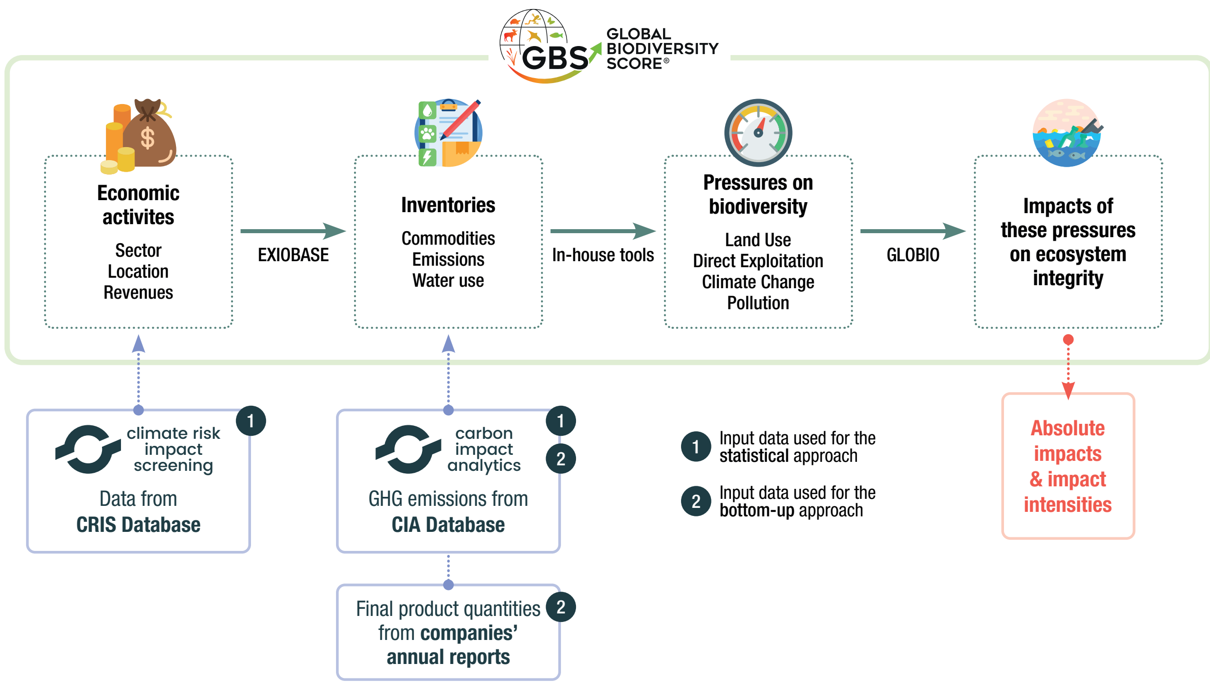


Figure 10: Simplified methodology of BIA-GBS

2.2 Biodiversity footprint of bonds from sovereign entities and public authorities

Since the launch of the GBS and of the BIA-GBS database, a major focus of development has been the methodology to measure the impacts and dependencies of sovereign entities and public authorities with the GBS, to be able to capture the biodiversity performance of all issuers in BIA-GBS. This methodology is relevant for the following stakeholders, which are bond issuers:

- Local authorities, *e.g.*, the City of Paris,
- Regional authorities, *e.g.*, the Province of Quebec,
- National authorities, *e.g.*, France,
- Supranational authorities, *e.g.*, the European Union.

There are two options when measuring the impacts and dependencies of these entities, related to the way of considering the responsibility of financial institutions holding these bonds on the biodiversity impacts. They relate to:

- The responsibility: "Economic Agent" or "Regulator";
- The approach: "Consumption" or "Production".

The sections below present the choices made and their justifications. The decisions are compared to the recommendations from the Partnership for Carbon Accounting Financials (PCAF) and the Partnership for Biodiversity Accounting Financials (PBAF) in Table 3.

2.2.1 Perimeter of responsibility

The perimeter of responsibility designates the perimeter considered to be under the responsibility of the sovereign entity. The first approach is to treat the entity as an Economic Agent. In this approach, only the economic activities of the public sector are considered (employees' activities, associated offices...). The second approach considers the sovereign authority as a Regulator, and consequently considers the impacts and dependencies of the area under its jurisdiction, *i.e.*, of the public sector, but also of private companies and households (for example, the impacts of activities under the jurisdiction of the French government for France). The PBAF is in favour of the Economic Agent approach (PBAF 2022). However, this position may change, particularly as it is not aligned with the PCAF, which favours a Regulator approach (PCAF 2022).

In BIA-GBS, the choice has been made to offer both approaches, while encouraging the adoption of the Regulator approach, which appears to be the most comprehensive and consistent with existing climate methodologies.

2.2.2 Approach

Two approaches can be used to allocate biodiversity impacts to a sovereign entity. The Production approach takes into account the impacts and dependencies associated with the production of goods and services within the perimeter of responsibility of the sovereign entity. The Consumption approach assesses the impacts and dependencies associated with the production of all goods and services consumed within the perimeter of responsibility of the sovereign entity. Figure 11 below illustrates the Consumption approach and its link to the Production approach. The PBAF is in favour of the Consumption approach (PBAF 2022).

These two approaches also differ in their Scope definitions:

- For the Production approach, the Scope 1 impacts are due to the direct operations of the production of goods and services, and the Upstream Scope 3 are linked to the purchases needed for this production. The Production approach therefore includes the impacts of the production of goods and services by the sovereign entity, for both local consumption and exports.
- For the Consumption approach, the Scope 1 of the sovereign entity includes the direct operations of the production of goods and services consumed within the perimeter of responsibility of the sovereign entity (*e.g.*, the production of cheese produced in another country, imported, and consumed within the perimeter of responsibility, and the production of paper produced and consumed within the perimeter of responsibility). Upstream Scope 3 impacts stem from the purchases needed for this production (*e.g.*, the milk needed for the cheese and the wood logs required for the paper of the previous examples). As illustrated in Figure 11, the Consumption approach therefore includes the impacts of the production of goods and services both produced and consumed within the sovereign entity and produced outside (imported) but consumed within the sovereign entity.
- The Consumption approach is preferred to the Production approach, as the leakage of impacts[11] is a well-identified limitation of the latter, especially in a changing context where more and more countries are positioning themselves to assess and monitor imported impacts.

2.2.3 Impact and dependency calculations

The turnovers associated with the production of territorial consumptions and imports are used to calculate the impacts and dependencies of sovereign entities.

For local and regional entities, such as municipalities, the impact is estimated from the total impact of the country encompassing these entities, in proportion to the GDP generated within the local or regional entity. Therefore, the impact intensity of these local entities is equal to the impact intensity of the country. For supranational entities, the impact is equal to the sum of the impacts of all the national entities included in this supranational entity.

(11) The leakage of impacts is the transfer of impacts of highly impacting industries from highly regulated countries to countries with less strict regulations.

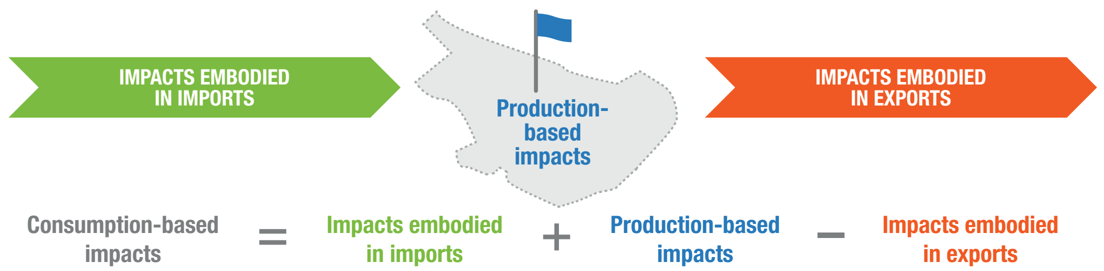


Figure 11: Description of the methodology for the consumption approach

	RESPONSIBILITY		APPROACH	
	REGULATOR	ECONOMIC AGENT	PRODUCTION	CONSUMPTION
BIA-GBS	✓	✓	✗	✓
PBAF	✗	✓	✗	✓
PCAF	✓	✗	✗	✓

Table 3: Overview of the methodological choices made in the BIA-GBS database and the recommendations from the PCAF (PCAF 2022) and the PBAF (PBAF 2022)

3 Evaluating non-listed assets impacts and dependencies with GBSFI solutions

GBSFI solutions are applications of the GBS methodology to non-listed financial assets, based on data specifically collected for the assets assessed. They can cover a wide range of non-listed assets, through equity and debt: real estate (construction and exploitation of buildings), companies that are not listed on public stock exchanges or even infrastructures. The main difference with listed assets lies in access to the data used for assessing the biodiversity footprint. As public data is not available, **data must be collected directly from the financial institution or from the investee**. The assessment methods are thus tailored to each need to take into account the specific data availability and the specificity of the assets covered. This tailoring led to developing several approaches to use GBSFI solutions on non-listed portfolios: Screening, Advanced Screening, and Simplified Biodiversity Footprint Assessment. Each approach is detailed in the following sections.

3.1 Screening non-listed portfolios' biodiversity footprint with the GBS

3.1.1 Context and data available

When a portfolio of companies is not covered by BIA-GBS or similar databases, a Screening of impacts and dependencies can be conducted with the GBS in order to identify the hotspots of impacts of the portfolio. The data typically necessary to conduct a Screening is the **turnover** of the companies in the portfolio associated to their **economic sector** and **country of operation**. Data related to the **outstanding amount,** or the **amount invested**, as well as the **Entreprise Value Including Cash** (EVIC) of the company must also be indicated in order to allocate the impacts of the companies to the financial institution.

The **turnover data** allows to estimate average inventories data (such as water consumed or tonnages of raw commodities consumed, see section 1.3.2) for the companies in the portfolio, which in turn, through sectoral impact factors from the GBS, allows to estimate **impacts** and **dependencies** on biodiversity for the whole supply chain of the companies. However, turnover data for the companies in the portfolio is not always available to financial institutions. Moreover, depending on the type of asset, this data might not be relevant to the portfolio assessed (*e.g.,* for infrastructure). In the absence of turnover data, a methodology was developed to measure the biodiversity footprint of such assets.

3.1.2 Developing a screening methodology aligned with PBAF

The **Partnership for Biodiversity Accounting Financials** (PBAF) is a foundation aiming to offer a **standardized accounting framework on biodiversity for financial institutions**. The "PBAF Standard" is being developed by 40 financial institutions supporting PBAF (PBAF 2022). This standard aims at making sure that the biodiversity footprint measurements conducted by financial institutions on their loans and investments follow a robust methodology, guaranteeing a satisfactory level of confidence in the results. This confidence is necessary to be able to determine appropriate action plans to reduce biodiversity impacts. PBAF is closely linked to its sister-initiative PCAF (Partnership for Carbon Accounting Financials).

When the turnover data is not available or for project finance, the only financial data that can be used for a Screening of the biodiversity impacts and dependencies can be the outstanding amount or amount invested. A methodology was developed by CDC Biodiversité to transform this data into a "theoretical" turnover data, following the recommendations of PBAF**.** This theoretical turnover data represents **the turnover that would statistically be generated in an associated sector and country** by the outstanding amount or amount invested and can be feed directly into the GBS.

As no methodology on that topic was yet available for PBAF, CDC Biodiversité relied on the methodology presented in the PCAF Standard, considering that the methodological concepts would remain similar for biodiversity. In its standard, PCAF lists the different possibilities to compute a carbon footprint for unlisted portfolios according to the data available for the measurement, as shown in Table 4. These possibilities can be applied to the context of a biodiversity footprint measurement. The case where the only financial data available is outstanding amount or amount invested is covered by one of the possibilities, which was the basis of the methodology developed by CDC Biodiversité.

Score 1	Option 1: Reported emissions	1a	Outstanding amount in the company and EVIC are known. Verified emissions of the company are available.
		1b	Outstanding amount in the company and EVIC are known. Unverified emissions calculated by the company are available.
Score 2	Option 2: Physical activity-based emissions	2a	Outstanding amount in the company and EVIC are known. Reported company emissions are not known. Emissions are calculated using primary physical activity data of the company's energy consumption and emission factors specific to that primary data. Relevant process emissions are added.
Score 3		2b	Outstanding amount in the company and EVIC are known. Reported company emissions are not known. Emissions are calculated using primary physical activity data of the company's production and emission factors specific to that primary data.
Score 4		3a	Outstanding amount in the company, EVIC, and the company's revenue are known. Emission factors for the sector per unit of revenue are known (*e.g.*, $tCO2^{eq}$ per euro or dollar of revenue earned in a sector).
	Option 3: Economic activity-based emissions	3b	Outstanding amount in the company is known. Emission factors for the sector per unit of asset (*e.g.*, $tCO2^{eq}$ per euro or dollar of asset in a sector) are known.

Table 4: Overview of approaches available to estimate financed impacts (PCAF 2022)

The possibilities are associated with data quality scores ranging from "Score 1" when using data which offers the highest level of reliability, to "Score 5" when using data which offers the lowest level of reliability (but still fits the requirements of the methodology). When only outstanding amount or amount invested data is available, the methodology corresponds to the "Score 5"[12].

For this "Score 5" category, in addition to the outstanding amount or amount invested, it is also necessary to have asset rotation ratios for the sector, to connect the input data to a hypothetical turnover, as described in Figure 12. Finally, this turnover feed into the GBS to assess the Screening. The methodology is further described in the following section.

3.1.3 Translation of outstanding amounts and amounts invested into GBS' input data

The asset rotation ratio allows to estimate an average amount of turnover associated to a certain outstanding or invested amount for a specific sector. It is possible to compute sectoral asset turnover ratios by using data from a **sample of companies of the sector** for which reliable data is available, or they can be computed using **national data with averages per economic sector**. For instance, in France, INSEE (French Statistics Institute) offers many data related to the performance of the economic sectors (ESANE). The asset turnover ratio is computed for each sector as follows:

EQUATION TO COMPUTE THE ASSET ROTATION RATIO FOR EQUITY AND LOANS
$$\frac{\textit{Average turnover of the sector}}{\textit{Average balance sheet* of the sector}}$$

Table 5: Calculation of the asset rotation ratios for equity and loans
** the balance sheet can be approximated by the sum of debt and equity*

This methodology covers the financing provided by the bank or financial institution, whether it be the outstanding amount, or the amount invested. It does not cover the whole impact of the company or project financed, but only the impacts due to the investment or the loan. There is thus no need to add an **allocation** methodology.

(12) Table 4 is mainly reproduced here to show that the different calculation approaches allowed by PCAF. It also provides Data quality scores, which are not directly used in GBS-based approaches. The concept of Data quality score is close to the one of Data quality tiers used in the GBS (CDC Biodiversité 2021c)

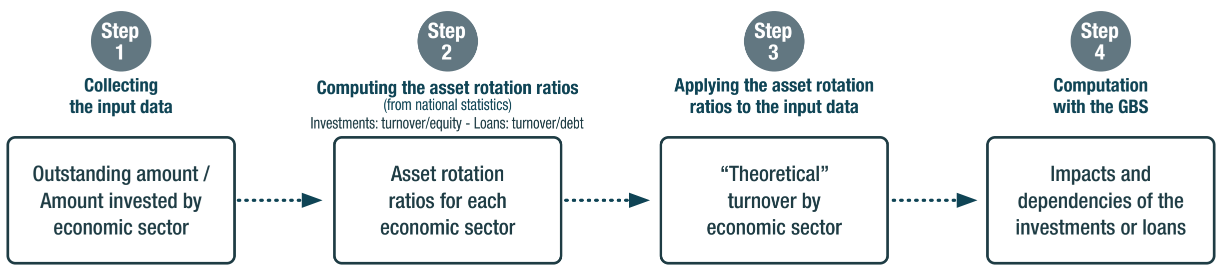


Figure 12: The four steps to assess impacts and dependencies on biodiversity of a portfolio with the GBS, using only outstanding amounts or amounts invested

The equation to compute the impacts related to the portfolio is therefore:

$$\textit{Impact of an investment} = \textit{Amount invested} \times \textit{Sectoral asset rotation ratio} \times \textit{Sectoral impact factor}$$

$$\textit{Impact of a loan} = \textit{Outstanding amount} \times \textit{Sectoral asset rotation ratio} \times \textit{Sectoral impact factor}$$

The methodology to compute the dependencies of the portfolio is identical. It also requires reconstructing "theoretical" turnovers, using sectoral asset rotation ratios. As for the impacts, the dependencies are computed using the "theoretical" turnovers associated with their economic sector.

3.1.4 Limits and recommendations for financial institutions to improve assessment accuracy.

To facilitate these assessments, as for all applications of the Global Biodiversity Score, it is recommended for financial institutions to organize their financing data with a sectoral breakdown either in **NACE**, that is used for the European taxonomy, or directly in **EXIOBASE sectors**.

The methodology allows to work around limited available financial data. This methodology is only recommended to compute a first level of assessment with a low level of granularity, as it **introduces degrees of uncertainty**.

To obtain more accurate results, it is recommended to work with additional data such as refined financial data, inventories or even pressure data, as is the case for the methodology of the Advanced Screening presented below.

3.2 Monitoring biodiversity-related risks at the portfolio level: methodology for Advanced Screening

The **Advanced Screening methodology** goes beyond the standard Screening process that relies on financial data, sector, and geographical location of operation. Instead, this method integrates an array of supplementary data, including physical indicators. The scope of the data remains selectively constrained, typically less than **twenty different physical indicators**. The specific data to be collected may vary and be adapted to the economic sectors of the portfolio under consideration.

The objectives of this approach may be to monitor the **biodiversity performance** of portfolio or the **identification of best-in-class players**, a pivotal step in aligning investments with ecological responsibility. This latter can extend beyond financial performance when it comes to the construction of biodiversity funds, by being combined with qualitative analyses.

This Advanced Screening methodology can be applied for instance on loan et investment in private companies or some infrastructures. The first Advanced Screenings were conducted for real estate portfolios, in equity (MAIF 2021) and debt (La Banque Postale 2022). For this application, the collected data closely aligns with what is typically used for a **carbon footprint**, simplifying the data collection process for the financial institution. This data is supplemented by some data specific to biodiversity, mainly relating to **land use**, which is one of the main pressures on biodiversity and a blind spot of carbon footprinting. Figure 13 presents the range of data that may be required for an Advanced Screening of real estate assets. This effective way of optimizing data collection allows to calculate the biodiversity footprint of such assets with fairly simple data collection. These assessments have already been conducted with both **asset managers** and **banks**.

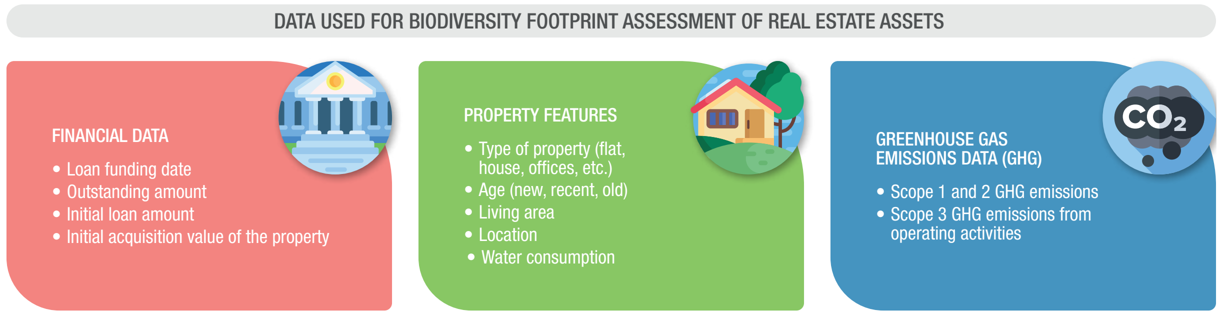


Figure 13: Example of data used for an Advanced Screening of real estate assets

3.3 Assessing impacts and dependencies of non-listed assets with a refined approach: the Simplified Biodiversity Footprint Assessments

As exemplified in the previous sections, GBSFI solutions allow to cover a wide range of assets with a variety of methodologies, depending on the financial asset assessed. The Screening allows for a first overview of the hotspots of impacts of a portfolio. The Advanced Screening improves the granularity of the Screening and allows a first identification of best-in-class practices but is not precise enough to determine action plans. It is thus useful for some priority assets to deepen the analysis with a Simplified Biodiversity Footprint Assessment (SBFA). This approach is especially relevant for Private Equity or banking portfolios. To test the application of the Global Biodiversity Score through a SBFA, an experimentation was conducted by CDC Biodiversité in partnership with the biodiversity working group of France Invest[13].

Four Private Equity managers, members of France Invest's biodiversity working group, chose to work together with CDC Biodiversité in this innovative project: **Andera Partners**, **Azulis Capital**, **Eurazeo** and **IDIA Capital Investissement**. Each Private Equity manager chose one company from its portfolio to test the Simplified Biodiversity Footprint Assessment methodology (see Figure 6). The four companies studied belonged to three economic sectors: renewable energy (Andera Partners), cosmetics (Azulis Capital and Eurazeo) and manufacture of food products (IDIA Capital Investissement, which chose a large cap). In the remainder of this section, "*the company*" or "*the companies*" will mean the investees that were the subject of the assessment.

3.3.1 Simplified Biodiversity Footprint Assessment: methodological adaptations

In addition to the usual complexities faced by financial institutions who manage portfolios comprised of a multitude of assets, **the unlisted segment has specific challenges that require an adequate approach.** This approach should take into account the specificities of this segment, which are linked to the relatively small size of the companies assessed. Indeed, they are usually subject to less extensive reporting obligations, which leads to fewer data available. This specificity created various constraints. Moreover, the company might have very limited **human resources to dedicate to the biodiversity footprint measurement**, therefore **slowing access to relevant data**.

Thus, the SBFA's goal is to adapt the data collection process used in comprehensive BFAs to the limited resources available to non-listed companies. For the test of the methodology with France Invest, this goal was achieved through methodological adaptations, presented below.

While streamlining the biodiversity footprint exercise as much as possible, this methodology makes it possible to consider **specific practices** of the company that may reduce its biodiversity footprint, depending on the availability of the data needed to measure these practices.

(13) France Invest is a French professional organization promoting good practices in the Private Equity sector, and providing advice, trainings, and studies to its near 600 members. France Invest released a Biodiversity Guide for the Private Equity sector in 2022 (France Invest 2022)

BOX 1

Organization of the experimentation

The project was separated into three main phases:

- A framing phase: during this phase, data collection questionnaires were created for each company, and the necessary assumptions were elaborated and validated by the Private Equity managers.
- A data collection phase: during this phase, the data collection questionnaires were filled by the companies and/or the Private Equity managers. When necessary, additional assumptions were also elaborated during that phase.
- An analysis phase: during this phase, impacts and dependencies of the companies were estimated, and an analysis of the results was provided to the Private Equity managers.

BOX 2

Methodological adaptations for the non-listed companies

- When necessary, assumptions were formulated between CDC Biodiversité and the company to create proxies based on available data. This allowed to estimate impacts for which the data directly needed was not available.
- Some activities of the companies were excluded from the perimeter of the assessment, when necessary, due for example to a lack of data available, or because the resources necessary to gather data were not proportional to the importance of the impact. For example, it was decided to exclude the maintenance of the solar panels from the Scope of the assessment of the company belonging to the renewable energy sector, as these impacts were anticipated to be relatively low compared to the production of the solar panels.
- A sectoral approach was adopted. Before the evaluation, for each sector, the most important impacts were identified as much as possible to prioritize the data corresponding to these impacts during the data collection phase. A data collection grid was created specifically for each sector. This grid asked to collect data in priority for the most important impacts identified, and specified the additional data that could be collected to refine the analysis if internal resources allowed it. For instance, the grid created for the cosmetics sector had a focus on the purchases of the companies assessed, as the supply chain was identified as the most material source of impacts for the companies.

The first two "adaptations" are also carried out as part of a comprehensive Biodiversity Footprint Assessments, but the difference lies in the level of granularity and precision that is attainable: comprehensive BFAs seek to achieve higher accuracy and therefore limit the number of assumptions made. The prioritisation of the data requested based on the most important data for the sector is the differentiating factor compared to a comprehensive BFA: it limits the workload for the assessed companies.

3.3.2 Overview of the results – Experimentation conducted with France Invest

The ability to reflect the specific company practices depends on both the data available and the methodology used. For example, some blind spots exist for agricultural practices which fall between the practices covered by the GBS such as "intensive agriculture" and "extensive agriculture" (*e.g.,* regenerative agriculture). The blind spots can partly be covered by using additional data (*e.g.,* data on fertilisers, phytosanitary products, water consumption...). CDC Biodiversité is also working to continue to increase the number of practices that can be measured.

It can be qualitatively estimated that the results from this methodology have more uncertainties than the results from a comprehensive Biodiversity Footprint Assessment, given the simplification of the data collection. Quantified measures of the **uncertainties** of the results will be added to the GBS in the future, especially regarding the purchases of a company. This will allow the comparison of uncertainties between this methodology and a comprehensive Biodiversity Footprint Assessment.

SECTOR	MANUFACTURE OF FOOD PRODUCTS	ENERGY UTILITY (PHOTOVOLTAIC)	COSMETICS (TWO COMPANIES)
Value chain boundaries covered by the assessment	Production of the raw materials used as ingredients and food processing	Installation of power stations. The exploitation phase of the power stations was excluded from the assessment.	Production of the ingredients and the cosmetics
Results	The hotspots of impacts for this sector were situated in the supply chain, mainly due to the production of the main agricultural raw material as well as some additional agricultural products purchased as ingredients.	The impact lies upstream in the value chain during the production of the solar panels sourced by the company, in particular the extraction of the raw materials used in the panels and structures purchased.	For both companies, the impacts were mostly due to their upstream value chain (production of the ingredients purchased). An experimentation was conducted to assess the ecotoxic impacts of the products after their use, as the downstream pollution caused by such products can be an important source of impacts.
Limits	Agroecological practices put in place by the suppliers of the company were only partly distinguished from average agricultural practices. It was due to a lack of data on the practices of the suppliers.	The biodiversity footprint measurement only used data from the carbon footprint. For instance, data related to the tonnes of steel used to install solar panels are available in the carbon footprints of the company and were used.	The experimentation on exotoxic impacts was led for only one of the two companies, due to a lack of data.

Table 5bis: Overview of the results of the experimentation of a Simplified Biodiversity Footprint Assessment conducted on non-listed companies

3.4 Course of action for developing a biodiversity measurement process for unlisted portfolios

The relationship of financial institutions with their investees and loan recipients allows to encourage them to start their biodiversity journey and accompany them along the way, by providing expertise and resources. This pilot has made it possible to determine a course of action for measuring the biodiversity footprint of non-listed portfolios.

One of the key drivers of success is the choice of the company to be evaluated. Priority companies will be those with high biodiversity risks, but also with characteristics that make the exercise feasible.

Capitalizing on climate experience

One of the key drivers of success for the simplified Biodiversity Footprint Assessment is **to adapt the methodology to fit the internal resources of the assessed companies**, while remaining accurate. This means optimizing the data collection process to lighten the workload of the assessed companies. A major way to achieve this is by prioritising companies which have already completed an assessment of their carbon footprint. Indeed, the data collected for a carbon footprint can be useful for measuring a biodiversity footprint. If some data is specific to biodiversity, its materiality depends on the sectors. It is especially important to collect data in addition to the carbon footprint assessments for sectors which have large surface occupations (agrifood, mining, oil & gas, etc.).

The road ahead: what is next for the assessment of unlisted assets?

The next steps to develop this methodology would include replicating the approach for other sectors than the three piloted so far. Furthermore, streamlining data collection is critical to improve accuracy and efficiency: it must be a priority area for progress in the years to come. The upcoming deployment of the CSRD – and the extension of the number of companies covered by non-financial reporting obligations – could help greatly.

BOX 3

Portfolio assessment steps

How to assess an unlisted portfolio's biodiversity footprint?

1 - Conduct a Screening of the portfolio to identify the hotspots of impacts using the GBS, exclusively with financial data, or an Advanced Screening, if feasible.

2 - Deepen the analysis with a Simplified Biodiversity Footprint Assessment of companies identified with the highest potential impacts based on the screening. To have a comprehensive vision of biodiversity issues, this assessment should ideally be supplemented by an analysis of priority locations, with indicators on species extinction risks and protected areas, for example (see Figure 16 for a full list of the elements to cover). Additional qualitative analysis could also be carried out to inform on the full extent of the company's links to biodiversity. For instance, a risk and opportunity analysis could be achieved through a variety of methodologies (materiality matrixes, scenario analysis). This additional qualitative analysis would identify the biodiversity-related risks and opportunities and as such it would allow to respond to the LEAP approach of the Taskforce on Nature-related Financial Disclosure (TNFD). The LEAP approach includes four phases: Locate, Evaluate, Assess and Prepare. See part 5.2.2 for a description of the LEAP approach and of the TNFD.

3 - Engage with companies to define action plans aimed at reducing their biodiversity footprint.

4 - Engage with companies to improve the availability of data to facilitate and increase the accuracy of their performance monitoring.

5 - If conditions allow: after up to 4 years, conduct a full-scale BFA and repeat steps 3/ and 4/. The previous steps will gradually lead to a more detailed assessment, at an acceptable level of effort for the company.

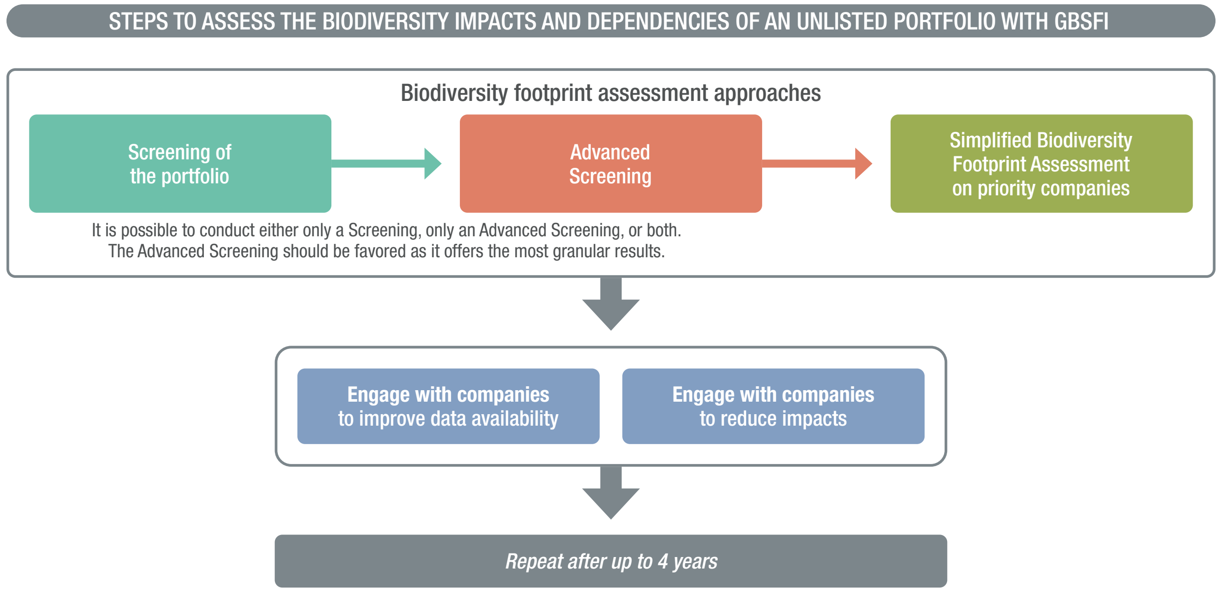


Figure 15: Steps to assess the biodiversity impacts and dependencies of an unlisted assets with GBSFI and/or BIA-GBS

FOUR SELECTION FACTORS FOR SELECTING COMPANIES TO ASSESS

Selection factor	List of possible criteria for each factor (non-exhaustive)	
Maturity of the company	• Very few human resources • Very few existing reporting processes • No carbon footprint available	• Sufficient human resources • Many existing reporting processes • Availability of an exhaustive carbon footprint
Estimated impact	• Low impacts within the portfolio estimated from the screening results	• Largest impacts within the portfolio estimated from the screening results
Sectoral specificities	• Insufficient maturity of the methodology for this sector (for instance because of high impacts on marine biodiversity, with material pressures related to invasive alien species, or complex specificities *e.g.*, linear infrastructure, fisheries, distribution, waste, and waste management, etc.).	• Sufficient maturity of the methodology for this sector (*e.g.*, Agrifood, Energy, Raw materials extraction, Electrical and electronic equipment, etc.).
Complexity of the activity	• Many different activities • Diversified value chain	• Sectoral unity of the activity • Simple value chain

Table 6: How to select a Private Company for a Simplified Biodiversity Footprint Assessment?

DATA USUALLY AVAILABLE IN CARBON FOOTPRINTS	DATA GATHERED OUTSIDE OF CARBON FOOTPRINTS
• Turnover • Purchases, including energy • GHG emissions • Office space (rarely available) • Commodities or refined products purchased or extracted (sometimes available)	• Surface occupation associated to suppliers • Emissions of nitrogen and phosphorus (to estimate concentration in water) • Water consumption • Ecotoxic emissions (*e.g.*, of phytosanitary products)

Table 7: Data synergies with carbon footprint assessments

4 Assessing biodiversity-related risks: role of the GBS in the measurement landscape

4.1 Measuring biodiversity-related risks: a wide range of metrics needed

A comprehensive biodiversity assessment should incorporate measurements about ecosystems, genetic biodiversity, and biodiversity significance, including the identification of key biodiversity areas, protected areas, endangered species, species richness and ecosystem services, in line with the goals of the Kunming-Montreal Global Biodiversity Framework (CBD 2022). Figure 16 presents the whole spectrum of biodiversity measurements that should be carried out, as well as related metrics when available. It includes:

Ecosystems: An ecosystem is defined as a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (United Nations 1992, 2). Ecosystem extent and ecosystem condition are emerging as key elements to measure the impacts of business activities on biodiversity within many key initiatives (UNEP-WCMC et al. 2023). The measurement of ecosystem conditions in metrics such as the MSA[14] can be combined with the measurement of ecosystem extent, *e.g.*, expressed in km^2, to measure the condition-weighted area of an ecosystem asset state in $MSA.km^2$.

Genes: They represent the foundation of biodiversity. Their diversity *i.e.*, the inherited genetic and trait difference that vary among individuals and populations within a species, is crucial for species' adaptability to environmental changes (Hoban et al. 2021). However, adequate and comprehensive metrics are lacking to measure the impacts of companies on intra-specific genetic diversity. eDNA technology currently spots differences species and is for instance able to provide an estimate of species richness, but not of genetic diversity within species.

Ecosystem condition metrics can quantify biodiversity losses or gains, but the significance of these changes may vary from one location to another. Complementary indicators of **biodiversity significance** are proving valuable to assess the varying importance of certain areas or species in terms of their contribution to biodiversity:

Protected areas: A protected area is defined by the International Union for Conservation of Nature (IUCN) as a clearly defined geographical space, recognised, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with association ecosystem services and cultural values (Dudley 2013). They are classified into several categories, ranging from strict nature reserves to sustainable use areas. To assess this subset of biodiversity, a reasonable approach is to establish a default buffer zone of 50 km from protected areas, although a shorter distance may be justified in specific cases (UNEP-WCMC and Fauna & Flora International 2022). The extent of overlap with the company's or asset's own sites, and ideally with all locations involved in the value chain, is then assessed. Sites are reported according to the category of protected area with which they overlap. The metric chosen to express these measurements can be either hectares, indicating the area of overlap, or the number of protected areas (referred to as # in Figure 16).

(14) Other metrics exist to measure ecosystem condition (CDC Biodiversité et al. 2023)

Key Biodiversity Areas: Key Biodiversity Areas (KBA) are sites contributing significantly to the global persistence of biodiversity (IUCN 2016). Conservation organizations like the Key Biodiversity Area Partnership provide guidelines for the KBA identification and monitoring. The methodology and metrics used to assess key biodiversity areas are the identical to those used for protected areas.

Species: Species diversity corresponds to the number of different species in a given area and their relative abundance (Baillie and Upham 2012), and helps to maintain the balance of the ecosystems. Tools such as the Red List of Threatened Species help to draw attention to the magnitude and importance of threatened biodiversity, by providing information on species' range, population size, habitats, and threats at specific locations. The assessment can be based on the location of company sites or assets by overlapping the endangered species present (see the approach described for protected areas). When it comes to including species' risk of extinction in a corporate biodiversity assessment, the STAR (Species Threat Abatement and Restoration) metric offers a useful approach by estimating the potential reduction in species extinction risks that can be achieved. It is calculated from the number of threatened species, their level of threat and their Area of Habitat (IUCN 2020).The IBAT tool enables the identification, for a given location, of the protected areas, KBA and threatened species (from the IUCN Red List) in a nearby area.

Ecosystem services: Ecosystem services are the benefits provided by ecosystems to humans. Aggregated scores can measure the reliance of economic activities to ecosystem services. Such scores are provided by tools such as the GBS (see 1.3.3 for the methodology of the dependency score) but are nevertheless based on qualitative evaluations. For enhanced precision, having a quantitative metric tailored to each ecosystem service proves valuable. These metrics have yet to be entirely determined and they do not necessarily fully cover the ecosystem service they relate to, but they can be used as a proxy with some limits to their interpretation. For instance, the ecosystem service "Soil quality" reflects the health and functionality of soil. It involves fertility, soil structure and decomposition processes. Soil organic carbon stocks can be used as a proxy to assess the state of soil quality. They represent the amount of organic carbon stored in soil organic matter and reflect the biological activity and processes within the soil, such as the level of decomposition, nutrient cycling, and are indicators of the overall health of the soil ecosystem. Tools like the Global Soil Information System (GLOSIS) provide access to this data.

Other aspects may be included in the significance measurements, such as the risks of ecosystem collapse, as assessed by the IUCN Red List of Ecosystems for example (Bland et al. 2017).

BOX 4

International frameworks reflecting the need to address biodiversity components as a whole and to include a wide range of metrics.

Integrating additional indicators into the biodiversity measurement process aligns with the diverse reporting framework and requirements set forth by international standards. The **Taskforce on Nature-Related Financial Disclosure** (TNFD 2023c) requires the evaluation of both impacts, through ecosystem condition measurements for example, and dependencies to ecosystem services. Elements relating to ecosystem significance should be included in the assessment, particularly during the Locate phase, reflecting a broader perspective than the ecosystem condition. The **Global Reporting Initiative** (GRI)'s draft updated biodiversity standard lists indicators on ecosystem condition and extent (GRI 2022), but also distance to protected areas among other indicators. Furthermore, the **Science-Based Targets Network** (SBTN) recommends an array of biodiversity metrics, encompassing ecosystem integrity and condition, species extinction risks, delineated areas of importance for biodiversity like Key Biodiversity Areas (KBA) and protected areas, and nature's contributions to people, which include ecosystem functions and services in line with Goal B of the Global Biodiversity Framework (Science Based Target Network 2023). In the European Union, certain regulations also include various biodiversity indicators. The **Sustainable Finance Disclosure Regulation** (SFDR) requires that asset managers and investment funds disclose activities that may have adverse effects on biodiversity-sensitive areas, by sharing the percentage of investments in companies with sites or operations located in or near such areas. Meanwhile, the **Corporate Sustainability Reporting Directive** (CSRD) lists ecosystem condition and the number of sites in or near protected areas or KBAs among the impact metrics related to biodiversity and ecosystems change.

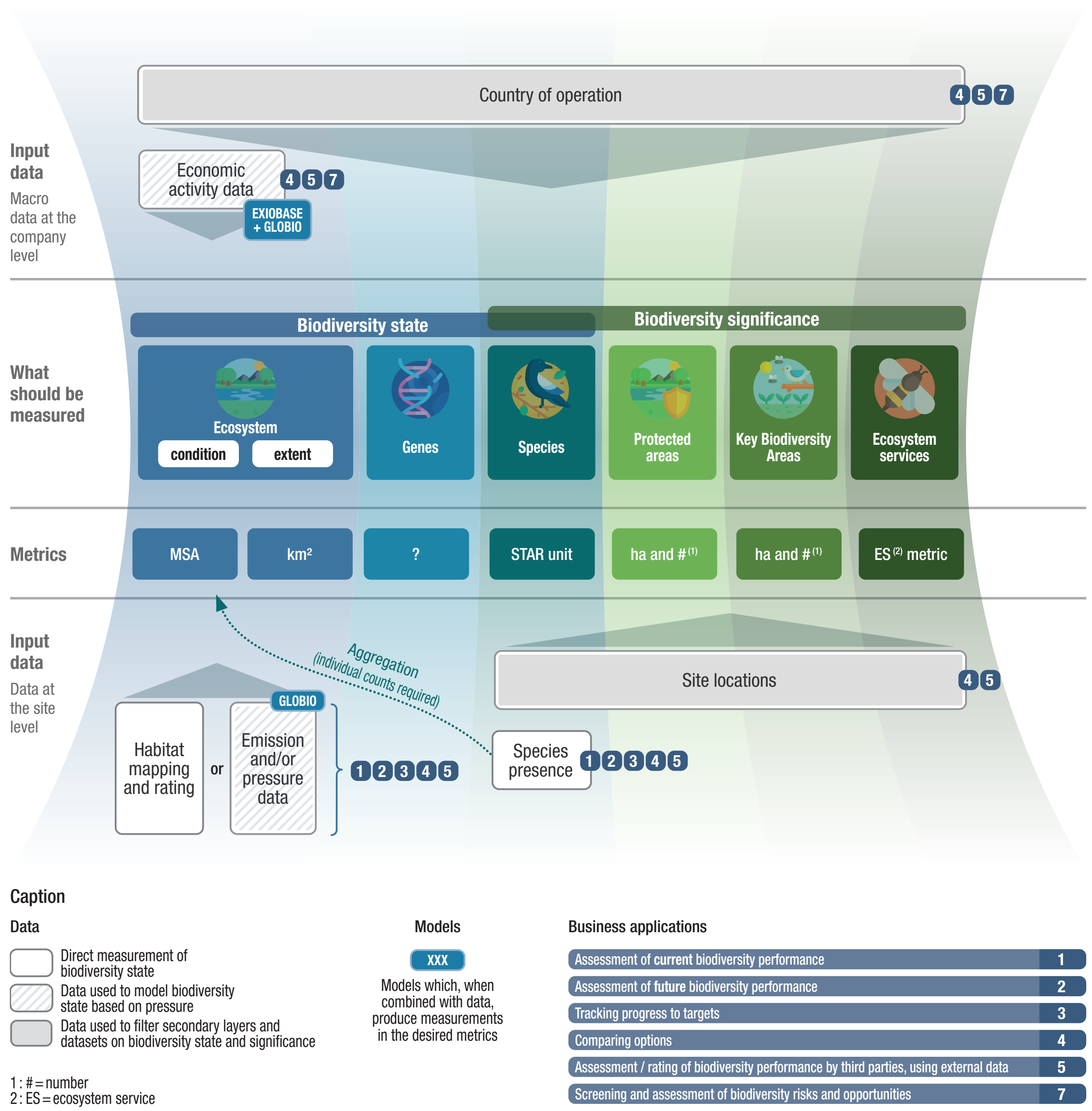


Figure 16: Elements to measure to comprehensively assess biodiversity-related risks and uses of site-level or corporate-level data. Business applications from Lammerant (2022).

The central part of the graph outlines the key indicators identified for corporate-level reporting, and a metric suitable for the measurement.

The indicators fall into two categories: biodiversity state indicators encompassing the condition and extent of ecosystems, species and genes, and biodiversity significance indicators which reflect the varying importance of certain areas or species in terms of their contribution to biodiversity.

When conducting a biodiversity assessment, several approaches can be chosen depending on the specific needs and the questions to be tackled, labelled with "Business applications" symbols on the graph:

The first method aggregates site-level data up to the corporate level and is represented in the lower box of the figure.

The second method uses aggregated data at the corporate level and illustrated by the data in the upper box of the figure.

The measurement of the Ecosystem subset is presented within the context of the GBS, but pressure impact models other than GLOBIO (*e.g.*, LC Impact) or environmentally-extended multi-regional input–output other than EXIOBASE (*e.g.*, Eora) can be used.

There are synergies between the different biodiversity facets and the data used to measure them. An example is the calculation of the Mean Species Abundance (MSA, used in the GBS and its applications for financial institutions), an ecosystem condition metric, which can in theory be calculated bases on counts of individuals for each originally occurring species counts, *i.e.* based on species data (Figure 16 illustrates that by linking species data to the Ecosystem condition metric).

4.2 Different needs of input data granularity for different business applications

Financial institutions should first ask themselves what their needs are, what questions they seek to answer, when conducting a biodiversity assessment. Depending on the business applications (BAs), the data required will be different. This section first describes the assessment approaches involved to cover all six elements of biodiversity analyzed in section 4.1 (ecosystems, species, etc.) depending on the data available. Then, it analyses how that influences the BAs that can be covered. This is summarized in Figure 16, which on top of listing "what" should be measured (detailed in the previous section), also illustrates "how" it can be measured: either by aggregating impacts based on site-level data up to the corporate level, or by directly using data aggregated at the corporate (or business unit) level[15]. Figure 16 also lists the BA achievable with each type of data, using a typology of BA from (Lammerant 2022).

4.2.1 Two types of input data connecting to the set of metrics

A first approach to measuring biodiversity impacts and dependencies is to rely on **"macro-level" data related to a company's economic activities, available at the business unit level or even fully aggregated at the corporate level**. It can encompass financial data such as turnovers and purchases broken down by industry and region, or inventory information such as commodities or consumed products inventories. Such data can be combined to impact factors, for instance the impact factors from the GBS, based among other sources on EXIOBASE and GLOBIO, to provide measurements of potential impacts on ecosystems. Data on the country of operation can also be linked to global datasets and global layers to screen potential interfaces with endangered species, protected areas, Key Biodiversity Areas or dependencies on ecosystem services.

Another approach involves using **data collected directly on a company's sites**. In some cases, the data constitute a direct measurement of biodiversity state (*e.g.,* habitat mapping and rating, survey of species presence). In other cases, such as emission or pressure data, the data collected still need to be fed into pressure-based models (such as GLOBIO) to assess the biodiversity state. Finally, some site level data such as their locations can be used to tap into datasets or layers to screen the potential biodiversity significance of the sites.

4.2.2 Data addressing varied financial institutions needs

Financial institutions seeking to conduct a **Screening and assessment of biodiversity risks and opportunities (BA 7)**, *i.e.,* making investment choices between several business options, in the context of due diligence assessments or biodiversity risk assessment, need to understand where hotspots of impacts or dependencies and thus of risks lie. **"Macro-level" data which provide impacts based on sector averages are sufficient for this business application**. As **site locations** tap into regional or global datasets and thus also provide an information about the average situation at a relatively broad spatial scale around the site location, they are also relevant for **BA 7**. To handle these business applications, the Screening method introduced in section 1.4 can be used, either with BIA-GBS for listed corporates and sovereign bounds, or GBSFI for loans and non-listed equity.

Conversely, financial institutions wishing to **track progress to targets (BA 3)**, including for instance No Net Loss or Net Positive Impacts targets, cannot rely on sectoral or regional averages and need more granular data to be able to understand whether a financed asset is following a trajectory in line with its targets. **Data collected at the site level on pressures or emissions** provide the granularity to assess asset-specific impacts. This holds true even if those site-level data have been aggregated at the corporate level and it is those aggregated data which are used for the assessment. The data used for BA 3 can also be used for **the assessment of current biodiversity performance (BA 1)** and **the assessment of future biodiversity performance (BA 2)**, which also requires to understand the specific performance of an asset, and not just get a figure based on sector averages. To ensure a thorough response to these requirements, conducting a comprehensive biodiversity footprint assessment for the entire portfolio would be the most adequate approach. Given feasibility constraints, a hybrid approach is suggested instead for the financial institutions, like the **Advanced Screening** or **Simplified Biodiversity Footprint Assessment** approaches introduced in section 1.4. However, it's important to note that the Advanced Screening approach might not fully meet the requirements of these business applications, while the Simplified Biodiversity Assessment approach proves more suitable by requiring more granularity in input data. Simplified Biodiversity Footprint Assessment are recommended for private companies or as a first step for larger companies.

The capacity to use the same metrics (such as the MSA) for both the "macro-data" and site-level approaches create bridges: it makes comparisons, aggregations, and seamless integrations of data at the different levels possible (*e.g.,* some data may be provided at the site level, others at the corporate level, and both can be used to assess a corporate biodiversity footprint). It also allows to use the best data available at each step and scale. Conversely, BA 1, 2 and 3 may require response metrics going beyond the state of biodiversity metrics listed in Figure 16. Those response metrics would cover the blind spots of metrics which sacrifice some granularity to gain the flexibility of being usable at both the corporate and site levels.

(15) These two methods align with a "bottom-up" approach when based on site-level data and "top-down" approach when starting from data aggregated at the company level. However, these specific terms are deliberately omitted in this section to prevent any potential confusion with the distinct "bottom-up" related to BIA-GBS and described in section 2.1.4 and implemented in the study case 5.2.

5 Case studies

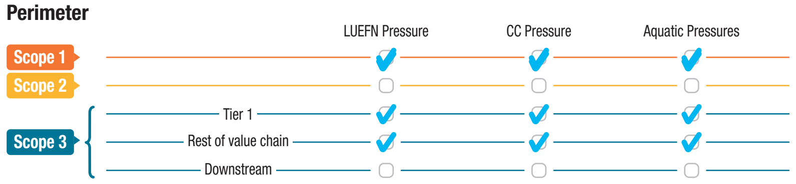
Case study Summary sheet

Context

CASE STUDY

Footprint use category: Financial assets
Assessment time: Based on the most recent data available for each company (often 2020)
Business application: Assessment/rating by and for third parties with external data

Perimeter



COMPANY'S IDENTITY

Financial asset's identity
N/A: study conducted by CDC Biodiversité and Carbon4 Finance

Asset class
Listed equity

Underlying entities
STOXX Europe 600's entities

Asset under Management (AuM)
N/A: 1 billion euro of turnover achieved by STOXX Europe 600 companies, broken down according to the respective weight of each issuer in the index

Why?

Provide a benchmark for a widely used listed equity index against which other assets can compare, and demonstrate the use of BIA-GBS to evaluate such an index.

When?

Computation in fall 2021 based on the most recent composition of the index (2021) and data available in the unerdlying database (CRIS and CIA) for each company (often 2020).

How often?

One off

What?

Terrestrial and freshwater impacts provided by BIA-GBS for 1 billion euro in turnover, divided between the STOXX Europe 600's components, based on their weighting in the index.

For who?

Managers and owners of assets comparable to the STOXX Europe 600 in terms of industries and geographies, as well as financial institutions seeking benchmark values more broadly.

How detailed?

Results are presented at the sector level, with information on the predominant pressures and the drivers of impact.

DATA COLLECTED

Item	Description	Source
Financial data	Turnover by sector and country	Carbon4 Finance's CRIS database
GHG emissions data	GHG emissions on all Scopes	Carbon4 Finance's CIA database

Footprint analysis

RESULTS

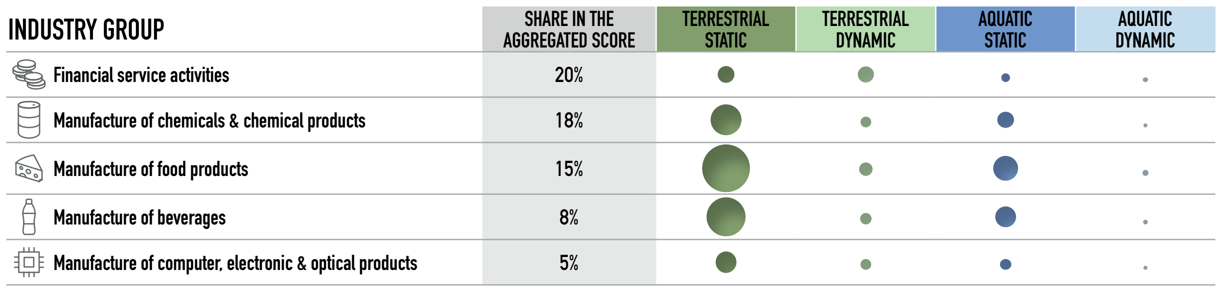


Figure 17: Breakdown of impacts per realm and accounting category for the five industry groups with the highest share of aggregated score
Source: Biodiversity Impact Analytics powered by the Global Biodiversity Score database, GBS 1.3.0, 09/21, Carbon4 Finance

KEY MESSAGES

- BIA-GBS provides data needed by the financial sector the data it needs to start on its biodiversity journey and identify hotspots of impacts: detailed analysis of the impact of portfolios on biodiversity, with multiple explanatory variables (ventilation per sector, pressure, and biodiversity realm).
- The impacts are driven by the weight of the sectors in the index and their intensities in terms of biodiversity pressures.
- The predominant pressures of the companies are either Land use or Climate change, depending on the sector.

LIMITATIONS / IMPROVEMENTS

- New methodological developments for BIA-GBS are under way to use company-specific inventories data for all pressures rather than financial data, which will allow best-in-class selection, beginning with the agri-food sector.
- A first threshold of low-impact activity on average was defined, based on the impacts calculated in MSA.km². It should be considered only as an initial guidance that will need to be refined in the future.

5.1 Analysis of the impact of a STOXX Europe 600 portfolio on biodiversity using BIA-GBS

5.1.1 Context and objectives

This case study is an extract from a study published by Carbon4 Finance and CDC Biodiversité in July 2023 (CDC Biodiversité 2023a). It provides an in-depth analysis of the results provided by BIA-GBS for 1 billion euro in turnover, divided between the STOXX Europe 600's components, based on their weighting in the index.

The purpose of this exercise is to analyse the impact on biodiversity of a portfolio that replicates the STOXX Europe 600 Index. With 600 components, the STOXX Europe 600 Index represents large, mid, and small capitalization companies across 17 European countries.

5.1.2 Methodology

This study evaluates the impact of 1 billion euro of turnover achieved by STOXX Europe 600 companies, broken down according to the respective weight of each issuer in the index. Issuers from the construction sector were excluded from this study due to an insufficient coverage of impacts in the GBS, which is part of the ongoing improvements of the tool. Thus, the final sample includes 571 issuers accounting for 98% of the STOXX Europe 600 in monetary terms. The results were computed with version 1.3.0 of the GBS with the composition of the STOXX Europe 600 by the end of 2021. The sectoral distribution of the turnover using the 57 EXIOBASE Industry Groups is displayed in Figure 19.

All results are expressed in terms of intensity per euro of weighted turnover, *i.e.*, an average of the issuers' intensity of impact per euro of turnover weighted by their share in the portfolio. The impacts include the Scope 1, 2, Upstream Scope 3 and Downstream Scope 3 for the impacts related to Climate change. Static and dynamic impacts on the one hand, and aquatic and terrestrial impacts on the other hand are reported separately. However, the MSAppb* score has been used in this analysis to screen for impact hotspots by aggregating the four associated compartments (static, dynamic, aquatic, terrestrial).

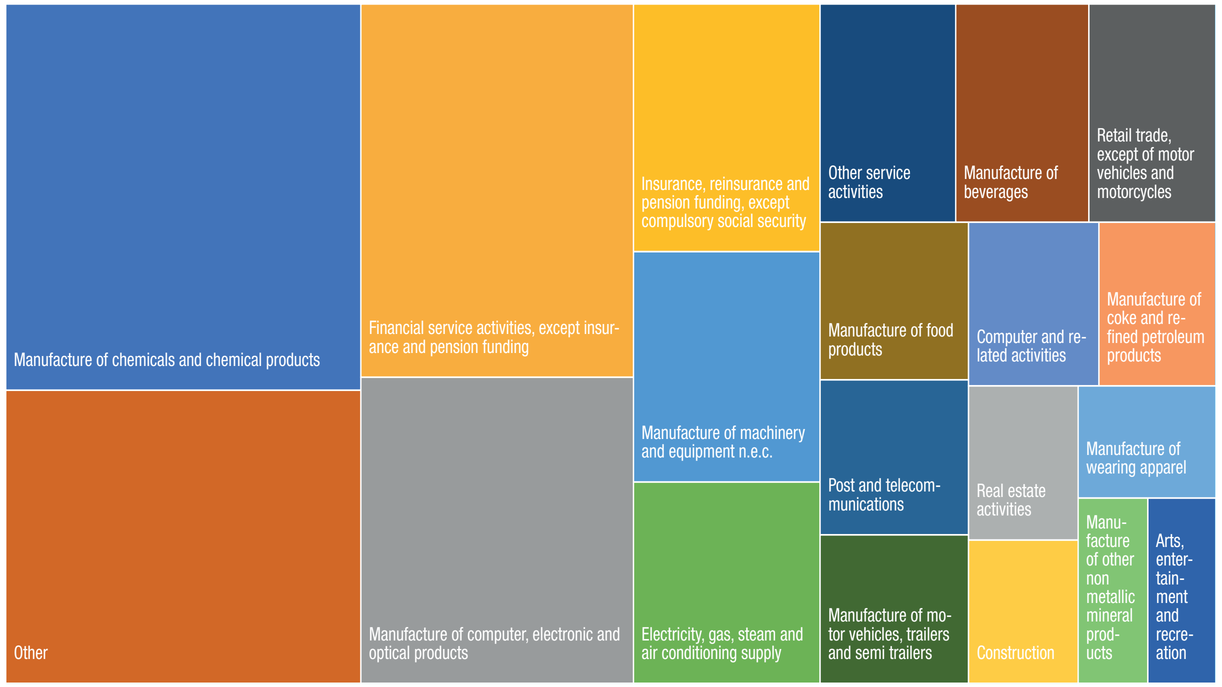


*Figure 18: Distribution of the turnover per EXIOBASE industries for € 1b of turnover achieved by STOXX Europe 600 companies**
* "Other" include for instance Land transport and transport via pipelines, Human health and social work activities or Mining of metal ores.

5.1.3 Results and discussion

Using the aggregated score in MSAppb* summed up on the value chain (Scope 1, 2, Upstream Scope 3 and Downstream Scope 3 related to climate change), the four most impactful sectors in the portfolio are financial service activities, Manufacture of chemicals and chemical products, Manufacture of food products and Manufacture of beverages.

In addition, and to better understand the impact of the portfolio on biodiversity, it is useful to zoom out of the aggregated score and come back to MSA.m^2/kEUR to break down the intensities into their elementary components. Some sectors, such as Manufacture of leather & related products, have an important accumulated impact on land use and therefore a predominant static impact. On the other hand, dynamic impacts linked to the Climate change pressure stand out for financial service activities, as the downstream impact of financed emissions on the Climate change is included.

BIA-GBS also reveals that most of the impacts of the portfolio are generated within the issuers' (upstream and, for climate change only, downstream) Scope 3, which accounts for between 91 % and 97 % of the total impact in MSA.km² depending on the realm (terrestrial or aquatic) and the accounting category (static or dynamic).

80 % of the average aggregated score intensity per turnover is explained by the Land use and Climate change pressures. Figure 18 shows the distribution of the ten most intensive sectors according to the share of these two pressures in the aggregated score.

The Climate change pressure is predominant for four of the ten largest sectors in terms of contribution to the aggregated score. More than 95 % of the score of the financial service activities sector derives from the Climate change pressure. This raises the predominance of this pressure at the portfolio level as this sector accounts for 20 % of the portfolio's intensity and 12 % of its financial weight. This significant share of Climate change in the biodiversity impact of the financial sector is explained on the one hand by the inclusion of its Downstream Scope 3 GHG emissions (those caused by the companies financed by financial institutions) and associated Climate change impacts, and on the other hand by the current lack of assessment of other pressures (such as Land use) for Downstream Scope 3 in BIA-GBS.

The Land use change pressure is the main driver for five out of ten of these sectors, including the agri-food and leather industries. These activities, in green in the Figure 18, are associated to significant land occupation (and thus high Land use static intensities), required to grow crops and grass for humans and for livestock.

5.1.4 Lessons learnt

BIA-GBS can be used to assess an index and provide benchmark values for financial assets benchmarking against those indexes.

This study introduced a new concept of "low impact threshold" across realms and accounting categories, that showed to be useful, but it needs to be refined to be more based on planetary boundaries, including for dynamic impacts.

The analysis has displayed quantitatively two main groups of industries: those causing mainly Land use impacts (leather, crops etc.) and those causing mainly Climate change impacts (Financial services, etc.).

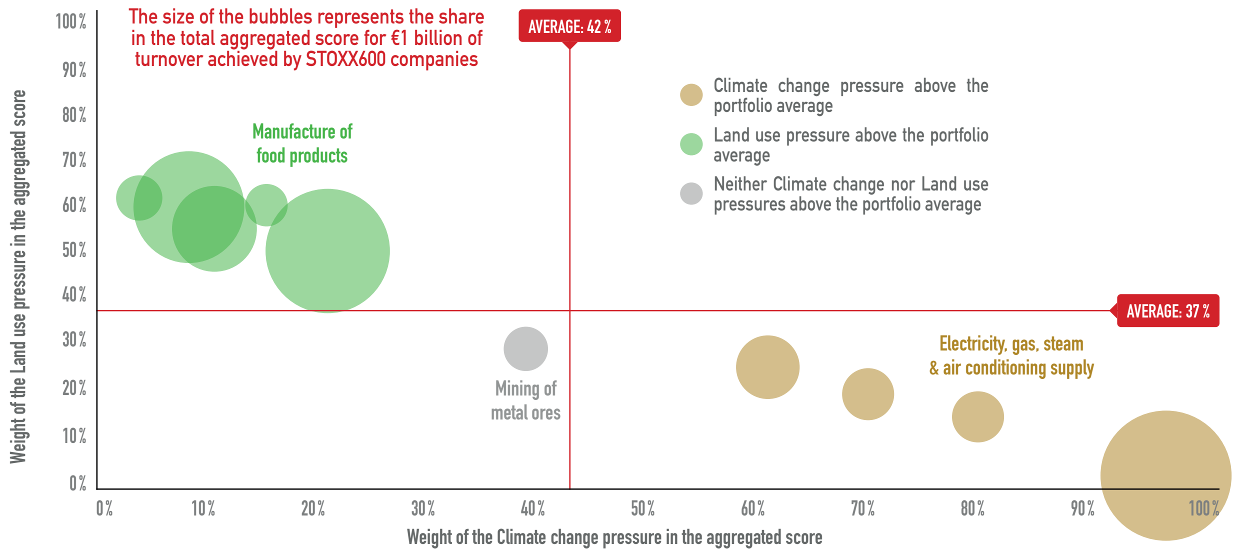


Figure 19: Share of the Land use and Climate Change pressures in the aggregated score of the ten most intensive sectors, for 1 billion euro in turnover of STOXX600 companies. Source: Biodiversity Impact Analytics powered by the Global Biodiversity Score database, GBS 1.3.0, 09/21, Carbon4 Finance*

* Mining involves disturbance to surrounding ecosystems, which is captured by the Encroachment pressure that therefore represents a much higher share of Mining's impacts than for other industries. The pressure linked to water use is also higher than the average.

Case study Summary sheet

Context

CASE STUDY

Footprint use category: Financial assets
Assessment time: Based on the most recent data available for each company (often 2020)
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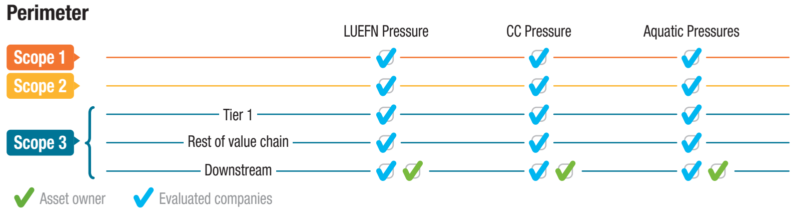
Perimeter



COMPANY'S IDENTITY

Amundi ASSET MANAGEMENT
Ofi invest Asset Management

Financial asset's identity
Two fictionnal portfolios of 10 companies, selected by Amundi Asset Management and Ofi Invest Asset Management

Asset class Listed equity

Underlying entities
20 listed companies of the sector "Agriculture and fisheries in Europe"

Asset under Management (AuM)
EUR 25 billion

Why?

Apply the LEAP approach of the TNFD at two different levels (company and portfolio) and report on the main challenges and limits.

When?

Computation in January 2023 based on the most recent data available for each company (often 2020).

How often?

One off

What?

Interface with nature, e.g. overlap of sites with protected areas, biodiversity impacts and dependencies, nature related risks and opportunities.

For who?

Internal use

How detailed?

Results are available at company and portfolio levels, broken down by Scope, pressure and product.

DATA COLLECTED

Item	Description	Source
Land occupation	Turnover by sector and country	Carbon4 Finance's database CRIS
GHG emission data	CO2-eq emissions by company and by Scope	Carbon4 Finance's database CIA
Tonnes of final products	Tonnages of final products produced by the companies, e.g., milk, butter, cereals...	Data collected by Carbon4 Finance using annual reports and public sources
Other	Company locations, biodiversity strategies	Data collected by CDC Biodiversité using annual reports and public sources

Footprint analysis

RESULTS

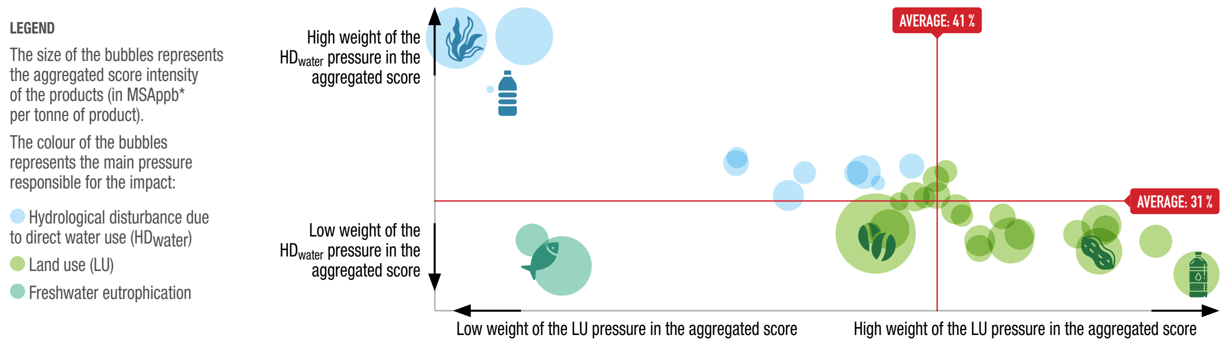


Figure 20: Contribution of the Land Use and Hydrological disturbance due to direct water use (HD_{water}) pressures to the aggregated score for the different products of the portfolios (Source: Trial version of BIA-GBS, GBS 1.1.0 computation, Feb. 2023, Julie BONNET)

KEY MESSAGES

- Even focusing on only a couple of companies, conducting an exhaustive Locate phase is challenging, as it requires the location of all sites involved in direct operations and the supply chain. However when the locations are known, existing tools like IBAT are relevant to study the interface with nature.
- Biodiversity footprinting is relevant to conduct the Evaluate phase of the LEAP approach. The bottom-up approach of the BIA-GBS database allows for an important granularity in the results, by distinguishing impacts between companies, realms, Scopes, pressures and even products.

IMPROVEMENTS

- For the Locate phase, the interface with nature was only studied on one site for both focus companies. Indeed, applying the Locate phase to a portfolio is very time-consuming and unrealistic and faces challenges to access relevant location data.
- The bottom-up approach of the BIA-GBS database for the Agrifood sector allows to differentiate companies depending on the products they manufacture, but does not yet take into account specific practices, such as the use of less intensive farming techniques or deforestation free commitments.

5.2 How BIA-GBS can be used to disclose in line with the TNFD framework? The case of agriculture and fisheries in Europe

5.2.1 Context and objectives

The Taskforce on Nature-related Financial Disclosure (TNFD) was set up to develop a risk management and disclosure framework for organisations. As financial institutions are an important end-user of this framework, it is crucial to assess the feasibility of the framework for them. In this context, CDC Biodiversité and Carbon4 Finance took part between September 2022 and March 2023 in the pilot testing conducted by UNEP FI on the sector "Agriculture and fisheries in Europe", with Amundi Asset Management and Ofi Invest Asset Management, two asset managers. The objective of this TNFD pilot programme was to assess the feasibility of v0.2 and v0.3 of the TNFD beta framework for financial institutions (TNFD 2022; 2023a). The first version of the TNFD recommendations was then published in September 2023 (TNFD 2023c), but the lessons learnt during this pilot and disclosed in this publication are still relevant. Different outcomes were expected in this pilot:

- To apply the LEAP approach at **two different levels**: for each asset manager, a **portfolio of 10 companies of the agri-food sector** and a **"focus company" within this portfolio** were selected. The two focus companies were MOWI ASA for Amundi Asset Management, and Danone SA for Ofi Invest Asset Management;
- To study the role of biodiversity footprinting in the TNFD framework;
- To test possible future features of the GBS tool and the BIA-GBS database, such as the overfishing module and the bottom-up approach;
- Report on the **main challenges and limits** of the TNFD framework as part of the TNFD piloting.

The availability and quality of data is a key challenge for financial institutions when evaluating their interactions with biodiversity, as very little public data on companies and biodiversity is available. The assessment was made using data publicly available, *i.e.*, annual or sustainability reports. The associated data is self-reported and can thus be partial, *e.g.*, only part of the Scope 3 reported.

The absence of asset-level databases[16] for the agrifood sector made the Locate phase particularly complex to achieve. Most of the impact of the sector occurs in the production of raw ingredients, in the upstream value chain of the companies of the portfolio, which are mostly manufacturing or processing companies and not agriculture companies, thus further complicating the data collection.

5.2.2 Methodology

The methodology for this pilot follows the TNFD's LEAP approach, which is separated in four phases: Locate, Evaluate, Assess and Prepare (TNFD 2023b). Each phase is then separated in different steps. An overview of the methodology used for each phase is presented in Figure 21.

The **Locate** phase focuses on identifying and studying the **interface with nature**. The preliminary Scoping phase for financial institutions, referred to as LEAP-FI in the TNFD drafts, allowed to skip the Locate phase for listed equity, as it would require exhaustive data on the location of the entire value chain of the entire portfolio. It was however decided to conduct this phase for one site of the two focus companies, to go beyond the TNFD's recommendations and conduct a proof of concept for this Locate phase.

The **Evaluate** phase focuses on **impact and dependencies** and was conducted both at the portfolio and company level, on the entire value chain. Indeed, assessing only Scope 1 impacts would lead to an important underestimation of the risks, as all the impacts and dependencies related to agriculture would not have been considered. The dependencies were assessed with the BIA-GBS database (see section 2.1.2 for the methodology), and the impacts with the BIA-GBS database with a bottom-up approach (see section 2.1.3 for the methodology). This new bottom-up approach is still exploratory and was used in the context of this pilot to go further and allow for intra-sectoral analysis. However, the underlying data used still needs to be consolidated, and results should be taken with caution.

The **Assess** phase focuses on **risks and opportunities** and was conducted at the company level. First, the risks and opportunities of the focus company were assessed qualitatively. Then, the nature-related risks were assessed quantitatively using the beta-version of a stress-test methodology developed by CDC Biodiversité, which will be detailed in a future publication.

5.2.3 Results

LOCATE

By consulting companies' activity reports, partial information can be found on production sites, or on the supply chain, like the location of Danone's palm oil suppliers, and therefore partially complete the Locate phase. However, the level of data available varies greatly between companies. In this pilot, the IBAT tool was used for one site of each focus company, and allowed to identify the protected areas, Key Biodiversity Areas and endangered species in a perimeter of 50 km around the site. If this analysis was replicated across the portfolio, sites could be prioritised depending on different criteria, like the number of protected areas, and their importance.

(16) Databases listing the locations of companies' factories, offices, cropland areas, etc.

EVALUATE

The Evaluate phase consists in the identification and measurement of impact and dependencies. Considering the dependencies, the companies of the two portfolios have activities in four different EXIOBASE industries of the Agrifood sector, which correspond to two ENCORE processes: “Processed food and drink production” and “Alcoholic fermentation and distilling”. Their average Scope 1 dependency scores are presented in Figure 22, with a distinction between the different ecosystem services. The highest dependencies are to water-related ecosystem services, such as surface water, ground water and water quality, which are crucial to manufacturing activities. Furthermore, the upstream dependencies are high for these sectors: between 65 and 75 % of their upstream supply chain is critically dependent on at least one ecosystem service.

Considering the impacts, Figure 23 shows for instance the impact of the five drink companies in the portfolios. The impact per tonne of product sold varies greatly depending on the products. Distilled alcohols have the highest impact intensities, followed by beer, and finally non-alcoholic drinks which have a relatively lower impact intensity. This highlights the interest of the bottom-up methodology: it allows to differentiate between these five companies in the same sector, which would not be possible using the statistical methodology of BIA-GBS, described in section 2.3.2.

The pressures contributing the most to the portfolio aggregated score are **Land use** and **Hydrological disturbance due to direct water use (HD_{water})**, due to water consumption and withdrawal. These two pressures account for 72 % of the overall aggregated score of the portfolios, highlighting that land occupation and water consumption are crucial for the agrifood sector. Since the bottom-up approach allows for comparison at product level, the share of the two pressures was studied for each product in Figure 20.

The Land use pressure is the main driver for 22 products associated with a high land occupation such as coffee and butter. On the other hand, HD_{water} is the main pressure for 11 products associated with intensive water use such as algae or bottled water. Finally, the main pressure identified for fish products is freshwater eutrophication[17]. The most intensive products can be associated with animal products or a high deforestation rate, like fish, butter, coffee, or vegetable oil[18]. No meat products, such as beef or pork, were present in the portfolios, explaining why they are not represented on the graph.

5.2.4 Lessons learnt

This pilot was an important first step to highlight the current feasibility of the LEAP approach for financial institutions, and the role of biodiversity footprinting within this framework:

- This pilot confirmed that applying the Locate phase to a listed equity portfolio is very time-consuming and unrealistic and faces challenges to access relevant location data, for the agrifood sector at least. It however demonstrated a methodology to start addressing this challenge.
- It was the opportunity to test the bottom-up approach of the BIA-GBS database for the Agrifood sector, which will keep being improved. It allows to evaluate the impacts on biodiversity of the industry more accurately and provides valuable insights on the most significant pressures.

(17) Fish products also have a high impact on marine biodiversity, which is not yet evaluated in BIA-GBS.
(18) These products are partly included in the SBTN's High Impact Commodity List, under the following names: wild capture seafood, dairy (derived from Cattle), coffee (bean), oil palm and rapeseed oil.

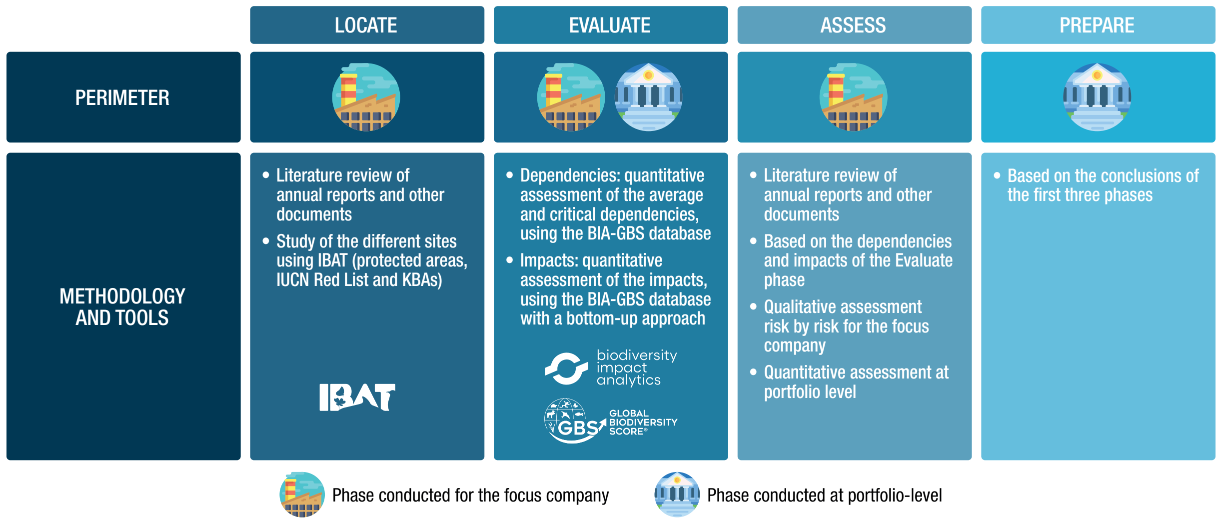


Figure 21: Overview of the methodology used for each phase of the pilot

- The quantitative analysis led with BIA-GBS needs to be completed by a qualitative analysis at the company level to assess the magnitude and likelihood of nature-related risks. The analysis led for the Assess and Prepare phases will be further described in future publications.

The pilot also contributed to improving the TNFD framework as the following challenges were reported for v0.3 and v0.4 of the framework, and taken into account for the v1 version:

- The **scope of the evaluation in terms of the value chain** was not clearly specified in the LEAP approach. **It was therefore recommended to specify that the entire LEAP process must be carried out over the entire value chain**. The framework now specifies that the objective should be to consider the entire value chain, and to report openly on the perimeter considered.
- It was **regrettable that the Evaluate phase should only be carried out on the priority areas,** defined as ecosystems of low integrity, high biodiversity importance and/or areas of water stress. Indeed, some impacts in low priority areas may have **spill-over effects** into priority areas, or companies can have important impacts on **pristine ecosystems.** In the v1, the areas where an entity has **important impacts and dependencies** also need to be included in the Evaluate phase.

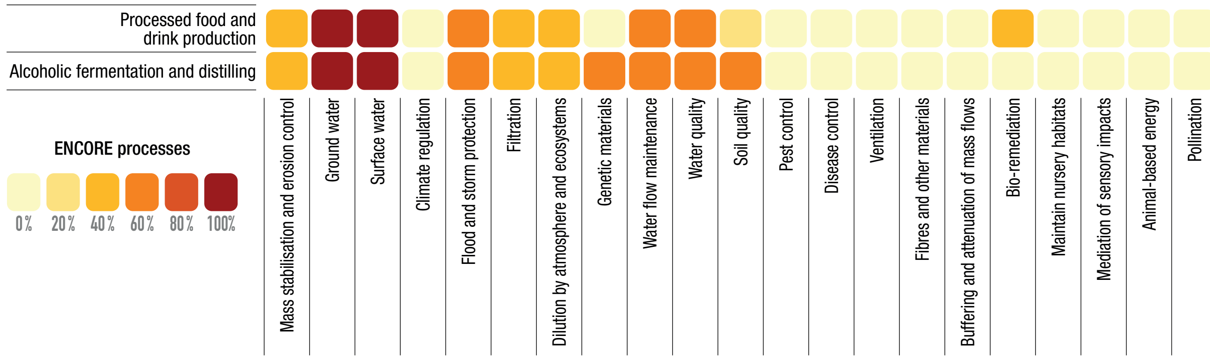


Figure 22: Heatmap of the Scope 1 average dependencies of the sectors (Source: GBS 1.1.0 computation, Feb. 2023, Julie BONNET)

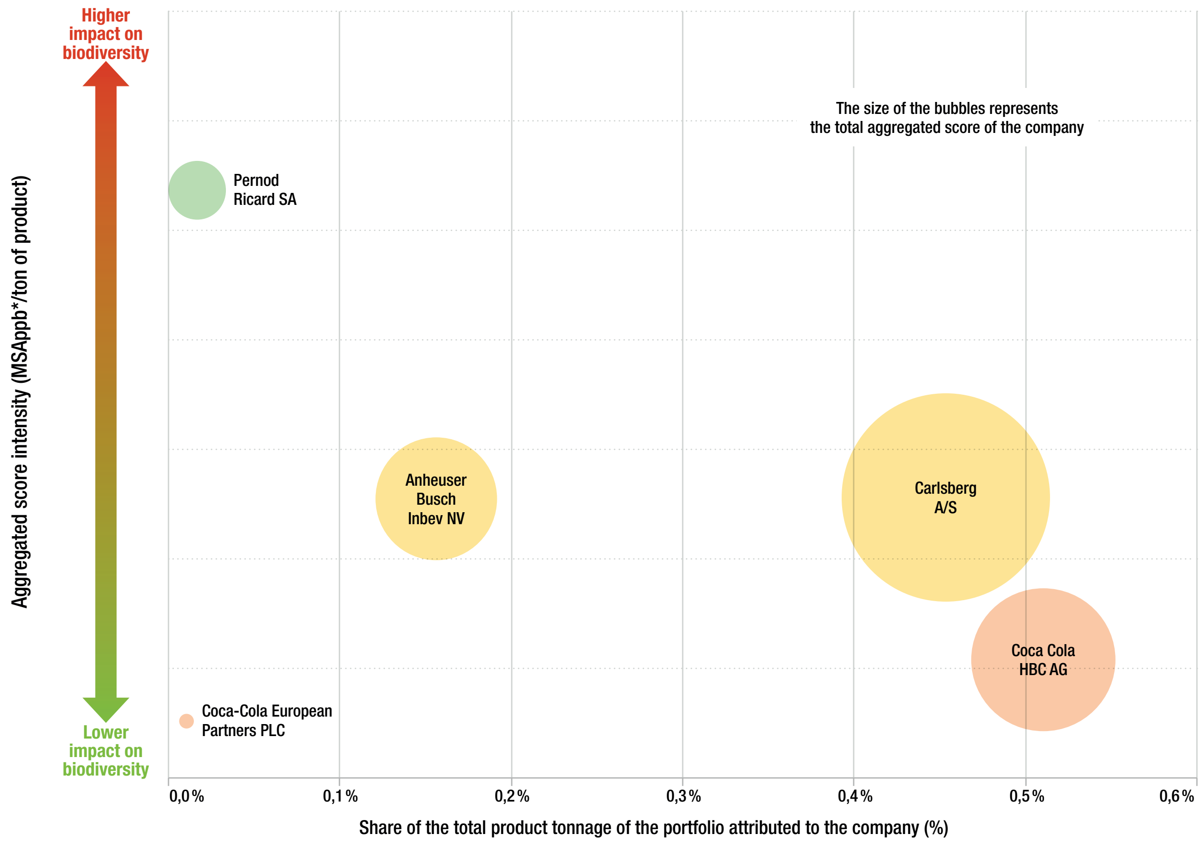


Figure 23: Aggregated score of the drink companies in the portfolios (Source: Trial version of BIA-GBS, GBS 1.1.0 computation, Feb. 2023, Julie BONNET)

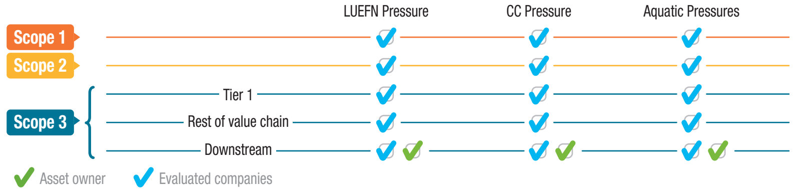
Case study Summary sheet

Context

CASE STUDY

Footprint use category: Financial assets
Assessment time: 2019
Business application: Assessment / rating of biodiversity performance by third parties, using external data
Screening and assessment of biodiversity risks and opportunities

Perimeter



COMPANY'S IDENTITY

Financial asset's identity
Securities held by French financial institutions (Listed shares, short-term and long-term debt securities)

Asset class Listed equity, corporate and sovereign bonds

Underlying entities
1 443 issuing companies (French and foreign corporations)

Asset under Management (AuM)
EUR 1.055 trillion

Why?

Provide the foundation for future research on the assessment of biodiversity related physical and transition risks

When?

Computation in 2020 based on data French financial institutions held at the end of 2019

How often?

One off

What?

Quantitative estimates of the impacts and dependencies of the French financial system with BIA-GBS

For who?

Central banks, financial supervisors, financial institutions and public authorities which seek information on the hotspots of biodiversity risks.

How detailed?

Results are summed and aggregated over all securities (called the "portfolio") and are broken down by Scope and pressure

DATA COLLECTED

Item	Description	Source
Financial data - Securities level	Data on the securities held by French financial institutions (ISIN identifiers, the charcteristics of the issuing company and the value held in aggregate by French financial institutions)	Securities Holding Statistics by Sector (SHS-S) database (2019)
Financial data - Issuer level	Turnover breakdown by sector and country for each issuer based on ISIN identifiers	Carbon4 Finance's database CRIS
GHG emission data	CO_2-eq emissions by company and by Scope	Carbon4 Finance's database CIA

Footprint and dependencies analysis

RESULTS

Results for the whole portfolio

42%
of the value of securities held by French financial insitutions comes from issuers that are highly or very highly dependent on one or more ecosystem services for their direct operations (Scope 1)

Total Static footprint
130 000 MSA.km²
or about 24% of metropolitan France

Total Dynamic footprint
+4 800 MSA.km²
or about 48 times the area of Paris

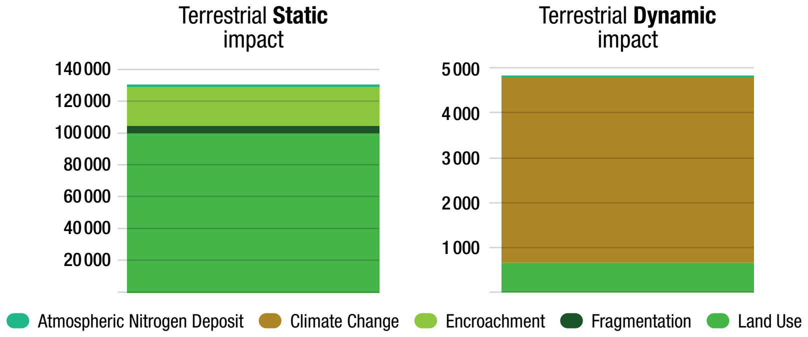


Figure 24: Terrestrial static (left) and dynamic (right) impact in MSA.km² of the Securities held by French financial institutions (Listed shares, short-term and long-term debt securities) broken down by pressure

KEY MESSAGES

- Displaying different approaches and aggregating data at different levels put forward a comprehensive understanding of the dependencies
- A large share of the static footprint originated from sectors related to food processing but the top sectors contributing to the dynamic footprint are mostly related to the manufacture and refining of fossil fuels, chemicals and trade.
- Considering the sectors' entire value chain is key to properly estimate the impacts and dependencies of portfolios

IMPROVEMENTS

Additional analyses could be performed, for example:

- Future studies should develop tailored biodiversity-related scenario analyses for financial risk assessment, offering detailed insights into shock nature and transmission channels.
- Specific methodologies are needed to capture biodiversity-related risks across sectors and financial institutions, acknowledging limited substitutability and tipping point risks
- Conceptual frameworks like double materiality should be used to assess financial institutions' alignment with biodiversity goals

5.3 Assessing the Biodiversity-Related Financial Risks of the French financial institutions with BIA-GBS

5.3.1 Context and objectives

In response to the growing awareness of the economic impacts associated with biodiversity decline and ecosystem degradation, financial institutions are increasingly paying attention to **biodiversity-related financial risks (BRFRs).** In this context, a 2021 joint study by the Banque de France, the French Biodiversity Office (OFB), the French Development Agency (AFD), Carbon4 Finance and CDC Biodiversité proposed a **first exploration of those risks for the French financial system** (Svartzman et al. 2021). This study highlighted the challenges associated with the assessment of interactions between biodiversity and the economy and provided the first estimation of financial risks for the French financial system based on data on the debt securities and listed shares issued by non-financial corporations and held by French financial institutions.

The **physical risk** was approximated by a measure of the **dependencies** of the economic activities financed by French financial institutions, and the **transitions risks** are approximated with measures of **impacts on terrestrial and freshwater biodiversity** of economic activities. The results were computed using Biodiversity Impact Analytics powered by the Global Biodiversity Score (**BIA-GBS**), jointly developed by Carbon4 Finance and CDC Biodiversité (version 1.1 of the GBS).

5.3.2 Methodology

The data collected to assess dependencies and impacts consists of the **list of securities held**, with their ISIN identifiers, the characteristics of the issuing company and the aggregated value held by French financial institutions, by type of institution. The data on the securities comes from Securities Holding Statistics by Sector (SHS-S) database. Three types of securities were studied: listed shares, short-term debt securities, and long-term debt securities. The sample was restricted by taking 1 443 issuing companies accounting for 95 % of the total value of securities held (hereafter referred to as the "portfolio").

The first step was to **connect the securities** held by French financial institutions **to their issuing company**. BIA-GBS methodology allows to link the ISIN identifier of each security with the issuer of the security. Following this mapping process, the final coverage encompassed 90% of the total market value of listed shares and debt securities held by French financial institutions.

The next step was the **evaluation of each issuer's dependency on ecosystem services** (with an average dependency score in %, see section 1.3.3 for the methodology) **and its biodiversity footprint** (in MSA.km²). The calculation of dependency scores and impacts is based on the specific sector and region in which the issuer's production activities take place. BIA-GBS provides a sectoral and geographical decomposition of each issuing company's turnover (through Carbon4 Finance's CRIS database), before converting the production activities and regions to the EXIOBASE format and plugging them into the GBS. GHG inventory data are derived from Carbon4 Finance's CIA database which computes greenhouse gas emissions from a comprehensive bottom-up analysis and fed directly as input into the GBS (see section 2.3 for more details on BIA-GBS's methodology).

Once the dependencies and impacts were assessed at the issuer level, the final step was **to aggregate these dependencies and impacts at the portfolio level**. For this purpose, the quantity of securities held by French financial institutions for each issuer was combined with the issuer's dependency score ("DS") and impacts ("Footprint") as follow:

For each ecosystem service:

$$DS_{portfolio} = \sum_{issuer\ i} DS_i \frac{\text{market value of securities issued by } i \text{ in portfolio}}{\text{total amount securities in portfolio}}$$

And for the impact:

$$Footprint_{portfolio} = \sum_{issuer\ i} Footprint_i \frac{\text{market value of securities issued by } i \text{ in portfolio}}{\text{enterprise value of the security issuer*}}$$

* The enterprise value is computed by adding the market capitalisation of equity shares to the market value of debt and minority interests (investment in another company).

5.3.3 Results and discussion

DEPENDENCIES

The dependencies of securities held by French financial institutions were assessed using several approaches and different levels of results: at portfolio level, disaggregated by ecosystem service and by economic sector.

First, the assessment of dependencies at portfolio level gives low or medium dependency score (below 50%) on each ecosystem service, for Scope 1. These relatively low dependencies can be explained by an averaging effect: when a sector dependency is assessed, the average of the dependency levels of all the production processes involved is used, which tends to mitigate the dependency of the whole sector (if one process is highly dependent but the others low). An alternative would have been to assign the sector the highest level of dependency of the business processes used, rather than the average. Dependencies are then analysed by looking at the proportion of the portfolio with high dependencies on one or more ecosystem services. The results suggest that a **significant proportion of the portfolio could be affected by the disruption of ecosystem services**: 80% of the amount in the portfolio are issued by companies that are at least moderately dependent (dependency score > 40%) on at least one ecosystem service in their direct operations (see first bar in Figure 22), 42% by companies that are at least highly dependent (dependency score >60%) on at least one ecosystem service (second bar), and 9% by companies that are very highly dependent (dependency score >80%) on at least one ecosystem service (third bar).

Since the case study was conducted, a new dependency score has been developed, which would have been highly relevant for this study: the critical dependency score (see 1.3.3). Instead of measuring the average dependency on all ecosystem services at portfolio and company level, this approach highlights isolated high dependencies and indicates the **proportion of the portfolio or the company that is critically dependent on at least one ecosystem service** (dependency score higher than 80%).

Going beyond this analysis of direct operations and considering the upstream dependencies on ecosystem services, the analysis revealed that all issuers are at least slightly dependent on all ecosystem services through their value chains.

When high dependency scores are observed within the portfolio, the question remains as to whether this can be explained by a few specific ecosystem services or whether they are dispersed among several. A breakdown of the dependency scores by ecosystem service shows that the very high dependency scores (>80%) are mainly concentrated on two ecosystem services: **surface water and ground water.**

Finally, the analysis by economic sector highlights sectors that depend on a large number of ecosystem services and are therefore particularly exposed. This is the case for **issuers that rely on agricultural production directly** (*e.g.*, growing crops or rearing animals for meat) or **indirectly** (*e.g.*, food and drink manufacturing).

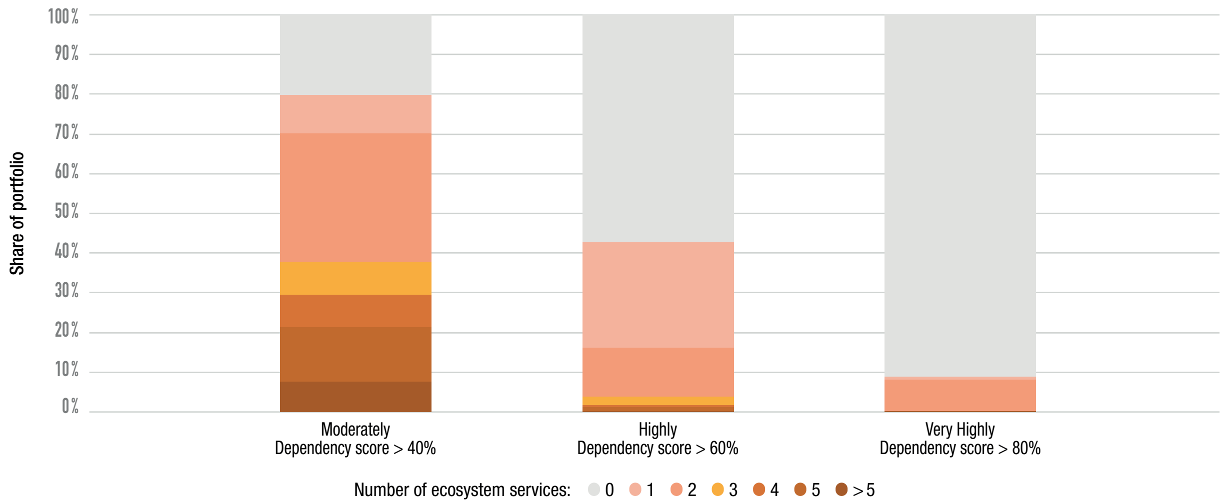


Figure 25: Share of the portfolio dependent (through Scope 1) on n ecosystem services at least Moderately, at least Highly and at least Very Highly

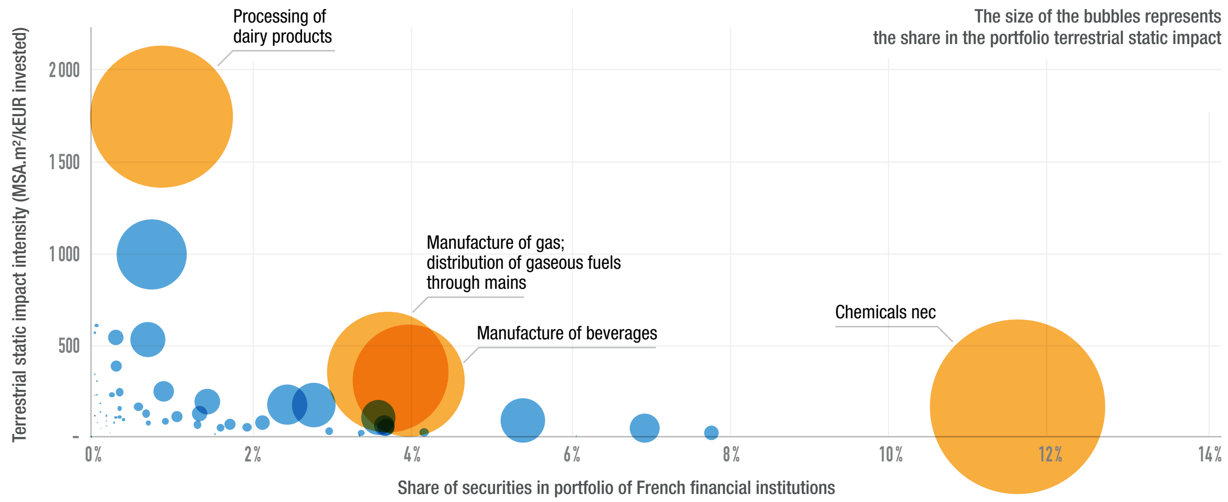


Figure 26: Terrestrial static impact on biodiversity per EXIOBASE sector of the portfolio. The orange bubbles represent the sectors with the greatest impact (together accounting for more than 50% of total terrestrial static impact)

IMPACTS

The **terrestrial static impact** on biodiversity of the French financial system reaches 130 000 MSA.km² which is equivalent to the destruction of 24% of the area of metropolitan France. The biodiversity intensity of the portfolio is 130 MSA.m²/k€ of securities held.

Most of the static terrestrial impact comes from upstream activities, and 42% of this impact comes from direct suppliers (Tier 1 of Upstream Scope 3 impacts). Land use change is by far the main pressure explaining these results [19].

Several economic sectors[20] contribute substantially to the footprint including Chemicals nec, Processing of dairy products, Manufacture of beverages and Manufacture of gas, and are illustrated in Figure 24. However, a distinction must be drawn between sectors that have a high impact because they account for a large proportion of the portfolio of financial institutions, *e.g.*, Chemicals nec for instance, and those that have a high impact intensity per invested amount [21](in MSA.m²/kEUR of invested amount) such as the agri-food sectors, including Processing of dairy products or Manufacture of beverages.

Static aquatic impacts are not discussed here, not for a lack of materiality, but because the analyses are similar to those for the terrestrial static impacts: they are mainly due to the issuers' upstream value chain and driven by the chemicals, gas, and food processing sectors.

The portfolio has a **terrestrial dynamic impact** of +4 800 MSA.km², equivalent to the annual destruction of twice the size of Luxembourg. Climate change is largely responsible for this impact, accounting for 86% of it. The proportion of Scope 1 impacts is higher for the dynamic than for the static accounting category, mainly due to climate change impacts which are significant in direct operations of manufacturing and processing industries.

While a large part of the static footprint comes from sectors linked to food processing, the main sectors contributing to the dynamic footprint are rather linked to the manufacture and refining of fossil fuels, chemicals and trade, as these are sectors with high greenhouse gas emissions (see Figure 27).

(19) Note that climate change is not included as a static pressure on biodiversity in this methodology.

(20) The sectors mentioned are the EXIOBASE sectors. A correspondence table between the NACE and EXIOBASE sectors is available here: https://ntnu.app.box.com/s/ziox4zmkgt3cdsg549brr0qaecskgjsd/file/682195219009

(21) This intensity depends on the intensity of the sectors per kEUR of turnover as well as on the ratio of turnover to enterprise value including cash (EVIC).

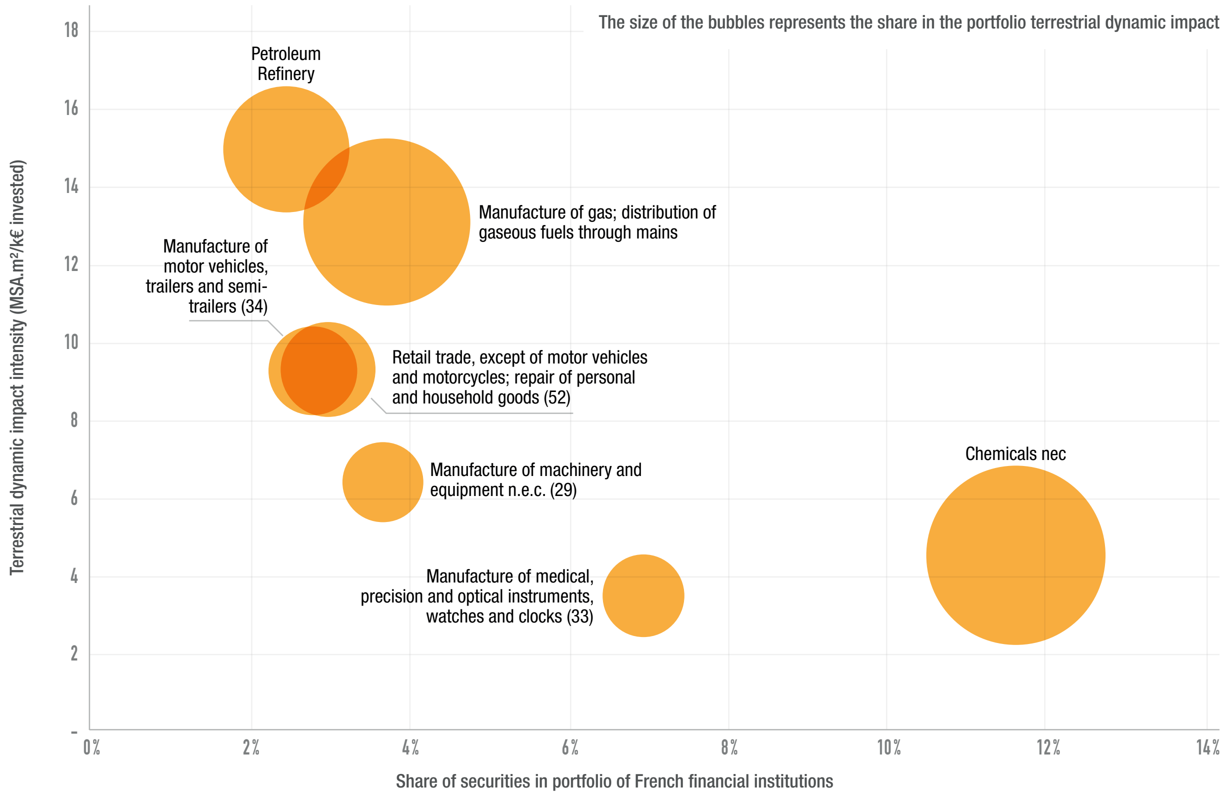


Figure 27: Terrestrial dynamic impact on biodiversity per EXIOBASE sector for the most impactful sectors (accounting for more than 50% of total dynamic terrestrial impact)

5.3.4 Lessons learnt

By quantitatively estimating and analysing dependencies and impacts of the securities held by French financial institutions, this study provided the **foundation for future research on the assessment of biodiversity related physical and transition risks**. BIA-GBS proved highly relevant and allowed to evaluate the dependencies and impacts of the portfolio of French financial institutions with a **large coverage**, over 90% of the securities selected for the study.

Assessing dependencies using several approaches and combining data at different levels (portfolio level, broken down by ecosystem services and by economic sectors) has provided a first insight into the results. The analysis highlighted the need to understand the distribution of high and very high dependencies to ecosystem services, which is now captured in the critical dependency score.

However, it is essential to bear in mind that this study shares similar limitations to those of the GBS considered throughout this publication, particularly regarding the coverage of pressures and ecosystem (refer to section 1.3.1).

Finally, this study could be supplemented by additional analyses. The data could be analyzed with more granularity since it is available at company level but has only been used here aggregated at the portfolio level. Critical sectors or businesses could be identified and examined. Biodiversity-related scenarios and analyses of responses to specific shocks are also necessary to move forward in the understanding of biodiversity-related financial risks and the Network for Greening the Financial System is working towards developing such scenarios and analyses (NGFS 2023).

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CDC Biodiversité is a French consulting and engineering firm specialized in positive actions for biodiversity, biodiversity sustainable management, and measurement of corporate biodiversity footprint. It is a private subsidiary of the *Caisse des Dépôts et Consignations* Group, the biggest public financial institution in France. The *Mission Economie de la Biodiversité (MEB)*, a research initiative of the *Banque des Territoires* dedicated to the links between economy and biodiversity, translates its work through publications and various communications.

From 2012 to 2021, the MEB's work was published in two collections (*BIODIV'2050* and *Cahiers de BIODIV'2050*), but since 2022, it publishes its work within a single unified collection, the "MEB's reports". All of this work can be found on CDC Biodiversité's website.

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COVER PHOTO: ©HELLORF ZCOOL/SHUTTERSTOCK

PUBLICATION OF THE *MISSION ECONOMIE DE LA BIODIVERSITÉ*, FINANCED BY THE *BANQUE DES TERRITOIRES (CAISSE DES DÉPÔTS)*.

REFERENCE: CDC BIODIVERSITE (2024). BRIDGING FINANCE AND NATURE: THE ROLE OF BIA-GBS AND GBSFI IN MEASURING BIODIVERSITY-RELATED FINANCIAL RISKS, BONNET, J., GODEFROY, E., GUENON, V., PRADERE, V., MISSION ÉCONOMIE DE LA BIODIVERSITÉ, PARIS, FRANCE, 58P.

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How can financial institutions assess physical and transition risks related to the biodiversity impacts and dependencies of the assets they finance? What is the role of biodiversity footprinting in such biodiversity-related risks assessment?

The Global Biodiversity Score (GBS) is a corporate biodiversity footprint and dependency assessment tool which assesses the biodiversity impacts of economic activities across their value chain, in a robust and synthetic way. It is developed with the support of over 50 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.

The GBS can be applied to several economic activities. This publication focuses on the use cases of the tool for financial institutions, through two main solutions: BIA-GBS and GBSFI. It describes how the financial sector can assess both impacts and dependencies on biodiversity at the portfolio level, with different business applications depending on the quality of the input data. The role of biodiversity footprinting in the measurement landscape and the various existing metrics are also explained. Finally, it also shares the results of three case studies: the analysis of a STOXX Europe 600 portfolio, a TNFD pilot-project on an agrifood portfolio and finally the assessment of biodiversity-related financial risks of the French financial sector.

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THE *MISSION ECONOMIE DE LA BIODIVERSITÉ* IS FINANCED BY:

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