Assessment of the biodiversity impacts and dependencies of globally listed companies

A collaborative multi-tool footprinting approach

Finance *for* Biodiversity Foundation

Report
October 2024

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Key takeaways

ON IMPACTS

- A relatively small number of high-impact companies account for a significant portion of the estimated biodiversity impact within the MSCI ACWI.
- The highest-impact industries are food products, oil, gas and consumable fuels, and chemicals.
- Investor engagement programmes should consider the different portfolio impact profiles, including key drivers of loss and scopes; climate change alone is insufficient to address the biodiverse challenge
- Impact assessment approaches are evolving, with different tools incorporating diverse drivers, scopes, and underlying calculations.

- A few companies have exceptionally high negative impact scores: about two-thirds (67%) of the estimated biodiversity impact, across all scopes, is concentrated among the top 250 highest-impact companies. Nearly half (49%) of the negative impact comes from the top 100 companies, one-third (38%) from the top 50, and the top 10 companies account for over 15% of the total estimated impact.

- Companies' negative impacts on biodiversity are influenced by their size (captured through revenue), value chain position, and industry. Although not covered in this study, the location of company operations is also a crucial impact driver.

- Company and industry impact rankings differ based on whether an absolute approach (total amount of the impact per company or industry) or an intensity approach (impact per revenue) is used. The former informs a strategy to reduce the overall footprint of a portfolio and the latter targets companies with the highest impact per monetary unit.

- The food products industry shows the largest negative impact according to both absolute and intensity approaches, primarily due to the impact of land use in its value chain (scope 3). The industries that follow are the oil, gas and consumable fuels (driven by climate change, scope 3) and the chemicals industry (driven by pollution, scope 3). Among the top 10 highest-impact companies, five are from the food products industry and three from the oil, gas and consumable fuels industry.

- The main drivers of loss, ranked from highest to lowest, are climate change (34%), pollution (31%), land use (23%), and water use (12%). However, material drivers and rankings vary depending on the scope of the assessment, and focusing on a single driver can alter industry and company rankings. For instance, ranking the companies based on land use results in nine different top 10 companies compared to a ranking for climate change, and focusing on water use introduces six new companies compared to a ranking for pollution.

- Nearly 50% of the total impact occurs in the companies' value chains (scope 3), encompassing both upstream and downstream activities, compared to direct operations (scope 1) and energy purchase and use (scope 2). These results show the importance of considering the entire value chain in investor engagement programmes. Dependencies on ES are distributed more evenly across companies than impacts in this study.

ON DEPENDENCIES

- All companies and industries depend on ecosystem services (ES) to some degree.
- Surface and groundwater are the primary ES relied upon; this is especially true for the food products and beverages industries, which exhibit the highest dependencies on ES.
- High dependencies on ES do not inherently constitute a financial risk, but deterioration in these services can lead to nature-related risks impacting financial stability.
- Dependency assessment approaches are less mature than impact assessment approaches.

- The food products industry has the strongest reliance on ES. Among the top 10 companies ranked as having a high dependency, nine belong to the food products industry while one is from the beverages industry —the second most dependent industry after food products. The tobacco industry ranks third, followed by the textiles, apparel and luxury goods industry and the water utilities industry.

- Among the 26 ES assessed, companies and industries show a strong dependence on ground and surface water (provisioning services). These are followed by some regulating ES such as mass stabilisation and erosion control, filtration, flood and storm protection, and water-flow maintenance.

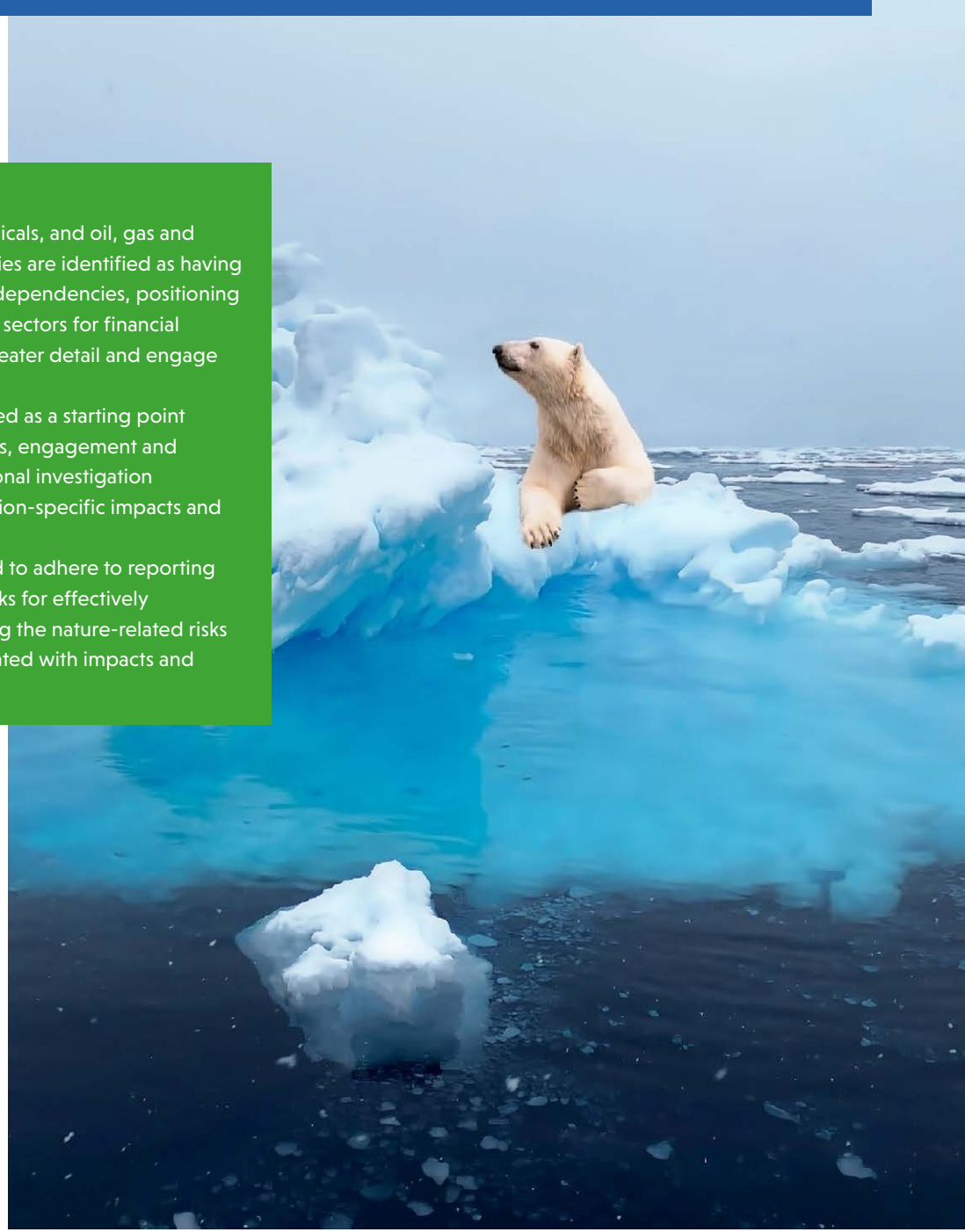
- In companies' value chains, significant dependencies mainly occur upstream (in scope 3), not in direct operations (scope 1). Note that this assessment does not include an assessment of dependencies for scope 2 or scope 3 downstream.

- The physical risks arising from dependencies are spatially explicit, an approach not covered in this study.

- Dependencies on ES are not inherently a problem. They become a concern only when they translate into higher risks for companies and investors, such as when demand for an ES exceeds its supply or when there are potential negative impacts on production processes or stakeholders dependent on those ES.

FINAL OBSERVATIONS

- The food products, chemicals, and oil, gas and consumable fuels industries are identified as having the highest impacts and dependencies, positioning them as potential priority sectors for financial institutions to assess in greater detail and engage with more closely.
- This report must be viewed as a starting point for additional assessments, engagement and prioritisation, with additional investigation required to address location-specific impacts and dependencies.
- Financial institutions need to adhere to reporting and regulatory frameworks for effectively measuring and addressing the nature-related risks and opportunities associated with impacts and dependencies.



Context

Financial institutions are becoming increasingly concerned about biodiversity loss and its associated risks to their investments. This report presents the high-level results and key findings to support, alongside other data and measurement approaches, more informed portfolio management strategies and engagement actions between investors and companies.

Financial institutions are becoming increasingly concerned about the implications of biodiversity loss for their investments and their role in addressing this challenge. The relationship between biodiversity and financial institutions is shaped by their asset allocation and investment decisions. Consequently, the finance sector is intensifying efforts to understand its impacts and dependencies on biodiversity, acknowledging that biodiversity loss presents both risks and opportunities. Many are now actively engaging with companies with significant impacts and dependency exposure, advocating for practices that avoid further biodiversity loss and promote nature restoration.

Aligned with these efforts, the Finance for Biodiversity (FfB) Foundation is leading a call to action and fostering collaboration among financial institutions to reverse nature loss by the end of the current decade. The urgent need for such action is reflected in the Kunming Montreal Global Biodiversity Framework (GBF), adopted by 196 countries at COP15 in December 2022. To contribute to this framework, and building on the success of Climate Action 100, the FfB Foundation initiated together with a group of lead investors Nature Action 100 (NA100) in 2021. NA100 was launched in partnership with Ceres, the Institutional Investors Group on Climate Change, FfB Foundation and Planet Tracker in December 2022. This investor-led programme is designed to elevate corporate ambition and drive meaningful action to reverse nature and biodiversity loss. It accomplishes this by directing investors in their engagement efforts towards those companies with the highest impacts on biodiversity. The NA 100 comprises over 200 investors managing over US$28 trillion in assets and focuses on these 100 companies.

To enable effective interactions between investors and companies, investor engagement initiatives require comprehensive data on impacts on biodiversity and dependencies on ecosystem services (ES). This study contributes by offering estimated impact and dependency results for the majority of the MSCI All Country World Index (MSCI ACWI) companies. The index covers large and mid-cap firms across 23 developed and 24 emerging market countries, representing approximately 85% of the global equity market. This study covers 2,369 stocks, primarily from the MSCI ACWI, along with a few additional companies from the NA 100 initiative that were not included in the MSCI ACWI.

This report is aimed at financial institutions and presents the high-level results and key findings from this study. It is underpinned by detailed company-level data which is shared with the FfB Foundation members to support, alongside other data, more informed and targeted engagement actions between investors and companies. This report is designed to align with key global initiatives, standards and projects in biodiversity assessment and footprinting, including the European Commission's Align Project, EU Business and Biodiversity (B&B) Platform's measurement guides[1] (for companies and financial institutions), the Taskforce on Nature-related Financial Disclosures (TNFD) footprinting approach, the Partnership for Biodiversity Accounting Financials (PBAF) standard, and the 'Step 1. Assess' of the Science Based Targets Network (SBTN), among others.

[1] A new edition of both guides is scheduled for release in October 2024

Approach and considerations

This report is supplemented by a detailed methodological document[2], which provides a comprehensive explanation of the methodology, including the steps followed to obtain the results and the alignment and differences among the footprinting tools, among other aspects. This section summarizes the methodological approach of this study.

We use a biodiversity[3] footprinting approach to estimate the impacts and dependencies of the majority of the MSCI ACWI companies[4] and all the NA 100 companies. This study builds on a pilot study conducted by the FfB Foundation in 2023, which focused on the MSCI World universe. Unlike the previous project, this study encompasses a broader range of companies and includes those from emerging markets. It also expands the analysis to include dependencies on ecosystem services (ES) and provides a more detailed assessment of impacts at the company level, as opposed to the industry-level analysis of the earlier study.

Results are obtained at different levels, including:

- Industries: Using the Global Industry Classification Standard (GICS);
- Companies: 2,369 companies from the MSCI ACWI, excluding financial services;
- Drivers of loss/nature change[5,6]: land use, climate change, pollution, water use;
- Scopes: direct operations (scope 1), energy purchase and use (scope 2), and value chain (scope 3);
- Ecosystem services: 26 ES using the Common International Classification of Ecosystem Services (CICES).

Four biodiversity footprinting tools are used to obtain the companies' estimated impact and **two tools*** are used to estimate their dependency on biodiversity:

- Biodiversity Impact Analytics powered by the Global Biodiversity Score (BIA-GBS)*
- Corporate Biodiversity Footprint (CBF)*
- Biodiversity Footprint Financial Institutions (BFFI)
- Global Impact Database's Biodiversity Impact Data (GID)

The steps undertaken to obtain the results presented in this report are as follows:

1. **Input data collection and treatment:** Obtain the company list (ISIN codes, company names, country and industry codes) from the data provider; receive company-level revenue data from tool developers[7]; address data gaps, harmonize the data and prepare it for the calculations.
2. **Calculations:** Tool developers generate impact results in Mean Species Abundance (MSA) and Potentially Disappeared Fraction of species (PDF) metrics, and express dependency results as a percentage (%), both disaggregated to the previously mentioned levels; FfB Foundation calculates the normalised (on a scale of 0-100) average (across the four tools) impact and dependency scores using the MSA and PDF scores as a basis.
3. **Results analysis:** Figures and tables are generated and results are analysed; multiple quality checks are conducted with tool developers and external reviewers participating throughout the process.

[2] The document is available on the FfB Foundation website (Our Work > Publications > Multi-tool Study)

[3] Although the broader concept of nature may be applicable in various contexts within this report, we specifically use the term biodiversity to align with the terminology of footprinting tools, which adopt a biodiversity-focused approach rather than one centered on nature or natural capital.

[4] The Real Estate Investment Trusts (REIT) industry is excluded from the assessment. For further details, please access the methodology document.

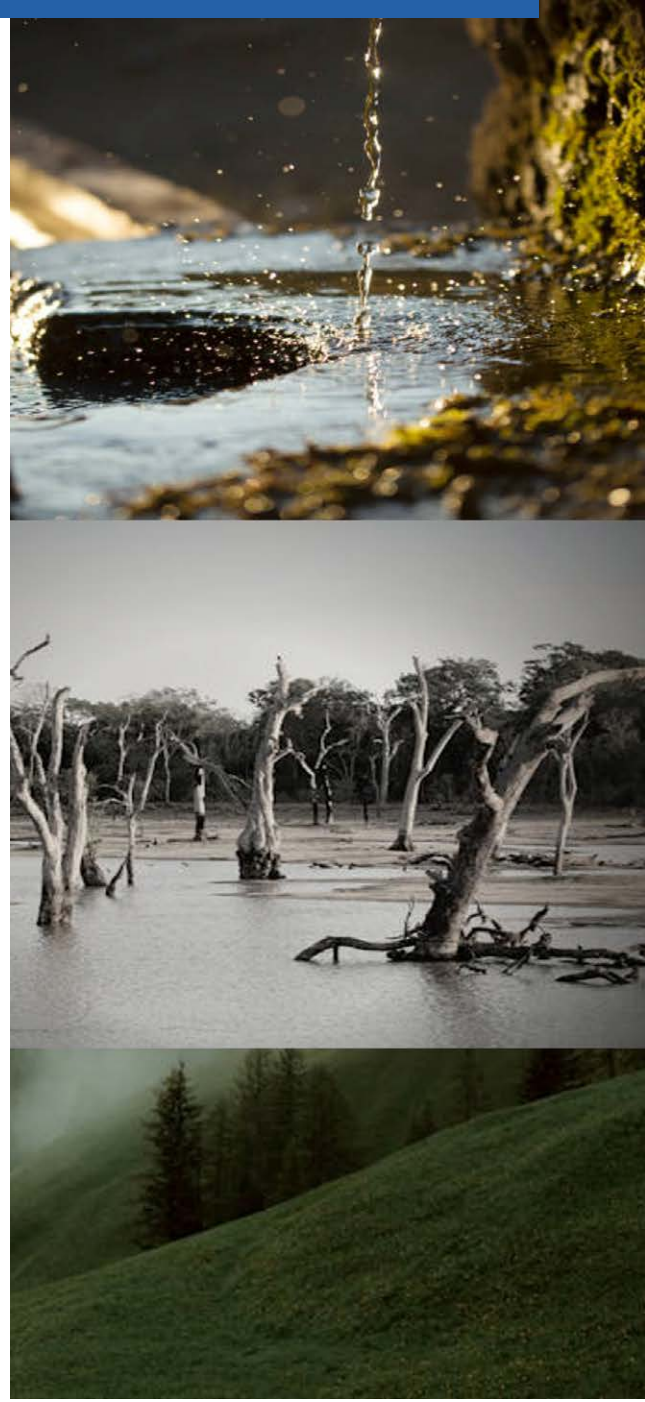
[5] Aiming for simplicity and clarity, in this report the term 'drivers' is employed as a representative of the term direct 'drivers of biodiversity loss' —as stated by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). We also acknowledge the term 'drivers of nature change', consistent with the Recommendations of the TNFD; however, our focus is solely on the negative drivers of biodiversity loss.

[6] This is a subset of the five main IPBES drivers of loss, excluding invasive alien species, changes in sea use, and other marine-related impacts. For further details, please access the methodology document.

[7] Tool developers obtain revenue data from data providers and annual reports.

Lastly, the results of this study must be interpreted bearing in mind the following:

- **Representative sample companies from both developing and developed markets** are drawn from the MSCI ACWI universe, which is used for this purpose rather than to provide a sectoral or company-level MSCI ACWI benchmark.
- **Results are presented as 'average' and 'normalised' scores**, i.e., values between 0 (minimum impact/dependency) and 100 (maximum). This means that: (1) impact and dependency scores are normalised, scaling MSA and PDF scores to a range of 0 to 100; (2) the average of normalised scores across the tools is calculated, thus obtaining one value per industry, company, driver, scope and ES.
- **Results are 'estimates'**, where impact and dependency scores represent potential values rather than actual, on-the-ground measurements. Each tool covers different drivers and scopes, thus not all tools were used for every result.
- **Results are 'relative'** across the sample of companies and industries assessed. Therefore, a company with an estimated impact score of 100 refers to the highest value observed within this study compared to the other companies. This score does not reflect the absolute impact based on empirical measurements.
- **No location-specific information** is integrated within the tools, meaning that the companies' impacts and dependencies are estimated rather than precisely measured. The results should be interpreted with caution and used in conjunction with other assessment methods.
- **Impacts and dependencies are assessed separately**, as they involve distinct methodologies and calculation processes. Additionally, impacts on dependencies are not considered, which is a disclosure requirement under certain reporting frameworks and has implications for social impacts.



Analysis of impacts

This section presents the estimated impacts on biodiversity of the MSCI ACWI companies and industries. The underpinned company-level data set is accessible to the FfB Foundation members

A company's impacts on biodiversity are highly location-specific. As such, the following analysis can be considered as a preliminary step for further assessments of actual, location-specific impact on biodiversity to quantify the exposure to nature-related risks.

This report divides the analysis of impacts into two levels: company-level and industry-level.

Company-level assessment

Table 1 shows that a relatively small number of (high-impact) companies are responsible for a significant part of the estimated biodiversity impact within the MSCI ACWI. This means that by targeting the top 50 companies, financial institutions can address more than one-third of the total estimated impact of the index. Thus, financial institutions can effectively address a significant portion of their portfolio and investment impacts by focusing on a relatively small number of companies. Furthermore, these high-impact companies also represent the largest share of the total revenue among all companies within the MSCI ACWI.

This is not to suggest that investors should avoid engaging with certain (low-impact) companies —as it is crucial to eventually engage with all companies. Rather, as a prioritisation exercise, investors should begin their engagement with the most material companies.

Table 1: Percentage (%) of total revenue and estimated impacts covered by the top 250, top 100, top 50 and top 10 ranked companies from the MSCI ACWI. There is double counting[8] in the impact proportion column.

	Revenue proportion (% of total)	Impact proportion (% of total)
Top 250	49.95%	67.10%
Top 100	30.89%	49.59%
Top 50	19.02%	37.57%
Top 10	6.49%	15.72%

The impact percentages shown in Table 1 refer to the sum of the average normalised[9] impact scores of the top 250, top 100, top 50 or top 10 ranked companies. This is referred to in this study as the **'absolute impact'** score. We also analyse the **'impact intensity'**, which measures the impact per monetary unit (i.e., per unit of revenue). Both approaches —absolute impact and impact intensity— are relevant for financial institutions. The former is important for investors seeking to address substantial portfolio impacts to mitigate overall footprint, while the latter focuses on companies with the highest potential impact per monetary unit, which is relevant for those emphasising impact intensity. An impact-intensity approach allows financial institutions to target those companies with the highest impact on biodiversity per euro invested, focusing on those that appear to have a higher impact than their peers proportional to their revenue.

[8] It is likely that these scores include some degree of double counting, as the value chain impacts (scope 3) of one company may correspond to the impacts exerted through direct operations (scope 1) of other companies. Nonetheless, value chain impacts are crucial and must be factored into impact assessments.

[9] Scores are averaged across the four tools and normalized on a scale from 0 to 100, with 100 representing the highest impact or dependency score.

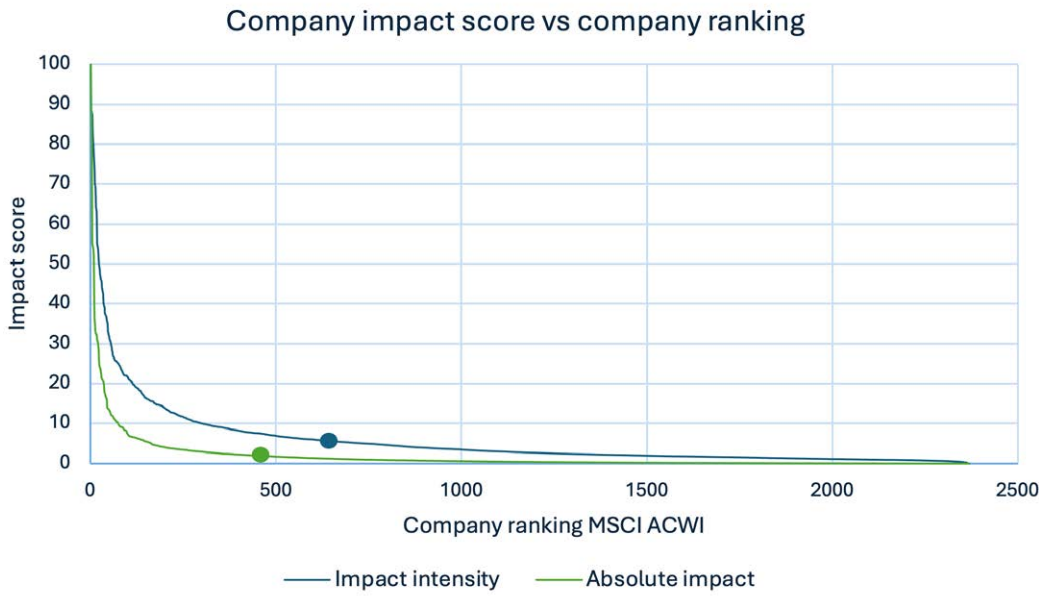


Figure 1: Absolute impact and impact intensity scores compared to the company ranking. The circles represent the average impact score for each approach.

Figure 1 compares the impact scores of all companies with their respective rankings[10], using both absolute impact and impact intensity approaches. The filled circles represent the average impact score among the 2,369 companies covered in this study. The results indicate that there are 490 companies above the average using the absolute impact approach, and 643 companies above the average using the impact intensity approach.

Figure 1 shows that **there are a handful of companies with exceptionally high impact scores**, while a significant number of companies exhibit very low impact scores. More specifically, under the absolute impact approach (i.e., sum of impacts per company), the top-ranked companies contribute a larger proportion of the total estimated impact compared to the impact intensity approach —as demonstrated by the smaller area below the absolute impact line compared to the impact intensity line. As expected, the company size —represented by the company's value chain and revenue in this study— significantly influences biodiversity impact.

These results are significant for financial institutions because they suggest that engaging with a small number of companies has the potential to address a substantial proportion of portfolio and investment impact. This information can inform decision-making by prioritising portfolio companies and industries with a relatively high impact. Eventually, investors should also address the impact of all companies in their portfolios, as even low-impact companies can have significant effects on biodiversity.

[10] Where the top 1 ranked company is the one with the highest estimated negative impact on biodiversity.

Table 2: Top 10 ranked companies under the absolute impact approach (total impact), including companies' country headquarters, first and second dominant driver of loss, and dominant scope.

Absolute impact ranking	Company name	Industry group (GICS Level 2)	Industry (GICS Level 3)	Country headquarter	Dominant driver[11] [12]	Second dominant driver	Dominant scope[13]
1	JBS SA	Food, Beverage and Tobacco	Food Products	Brazil	Land Use	Pollution	Scope 3 Upstream
2	Saudi Arabian Oil Co.	Energy	Oil, Gas and Consumable Fuels	Saudi Arabia	Climate Change	Pollution/water use[14]	Scope 3 Downstream
3	Wilmar International Ltd.	Food, Beverage and Tobacco	Food Products	Singapore	Land Use	Water Use	Scope 3 Upstream
4	Fortum Oyj	Utilities	Electric Utilities	Finland	Climate Change	Pollution	Scope 3 Downstream
5	WH Group Ltd.	Food, Beverage and Tobacco	Food Products	Hong Kong	Land Use	Pollution	Scope 3 Upstream
6	Walmart, Inc.	Consumer Staples Distribution and Retail	Consumer Staples Distribution and Retail	USA	Land Use	Climate change	Scope 3 Upstream
7	Tyson Foods, Inc.	Food, Beverage and Tobacco	Food Products	USA	Land Use	Pollution	Scope 3 Upstream
8	Bunge Global SA	Food, Beverage and Tobacco	Food Products	USA	Land Use	Water Use	Scope 1
9	PetroChina Co., Ltd.	Energy	Oil, Gas and Consumable Fuels	China	Climate Change	Land Use	Scope 3 Downstream
10	China Petroleum & Chemical Corp.	Energy	Oil, Gas and Consumable Fuels	China	Climate Change	Land Use	Scope 3 Downstream

[11] Dominant driver = driver with the highest negative impact per company, considering all scope levels.

[12] The IPBES's five main drivers of biodiversity loss are referred to in the TNFD Recommendations as drivers of nature change, encompassing both negative and positive impacts. This study focuses solely on negative drivers and uses the term "driver" or "driver of loss" to describe them.

[13] Dominant scope = scope level with the highest negative impact per company, considering all drivers

[14] This company shows the same impact score for these two drivers of loss.

Figure 2: Top 10 ranked companies by driver of loss

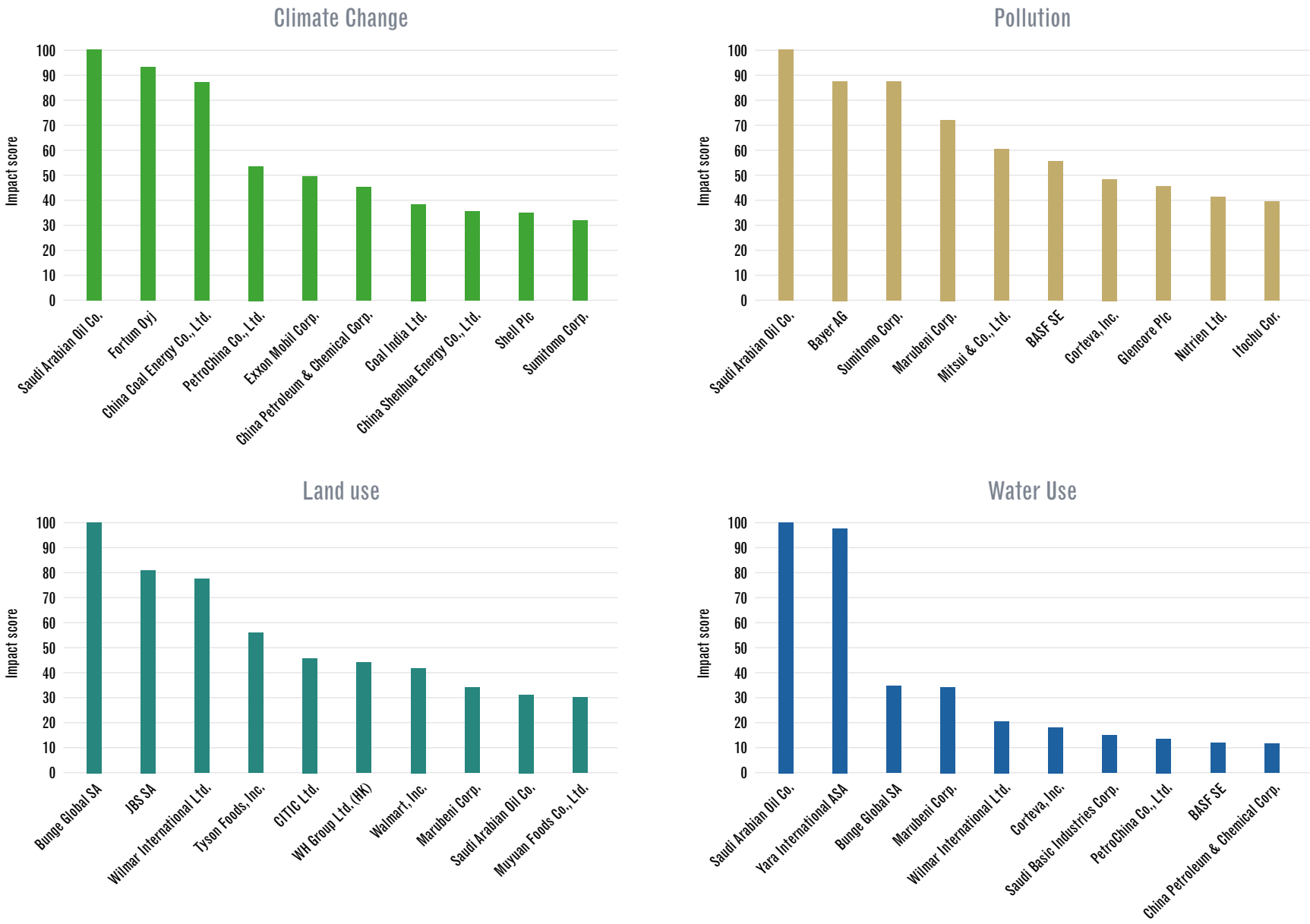


Table 2 shows the top 10 ranked companies under the absolute impact approach. As previously discussed, the estimated absolute impacts are a function of the size of the companies and the intensity of the pressures exerted on biodiversity. **Most companies in the top 10 ranking belong to the food products and oil, gas and consumable fuels industries.** These industries primarily contribute to biodiversity loss through climate change and land use, mainly via scope 3 impacts.

For the oil, gas and consumable fuels industry, the main impact on biodiversity is the result of climate change impacts from greenhouse gas emissions related to extraction and refining of fossil fuels (scope 1), indirect emissions from electricity and heat used in operations (scope 2), and upstream and downstream emissions (scope 3). Land use impacts for this industry include habitat disruption from drilling, mining, and infrastructure development (scope 1), as well as land use changes associated with energy production facilities (scope 2) and with upstream and downstream processes (scope 3). In the food products industry, climate change impacts originate from on-site energy use in agricultural and manufacturing processes (scope 1), electricity consumption (scope 2), and emissions from agriculture and transport (scope 3). Land use impacts arise primarily from direct land conversion (scope 1) and changes related to agricultural practices, inputs, and distribution infrastructure (scope 3).

While climate change and land use are the primary drivers of biodiversity loss among the top 10 ranked companies, pollution emerges as a significant driver alongside climate change for the overall MSCI ACWI. One of the key takeaways from this report is that **results, and consequently rankings, can vary significantly if the ranking is based on a particular selection of drivers.** For instance, Figure 2 shows the top 10 ranked companies (absolute impact) when looking at land use, climate change, pollution and water use separately.

Cross-checking the companies listed in the four different graphs (Figure 2), the rankings vary compared to Table 2. Furthermore, there is little overlap between the companies across the four drivers in Figure 2.

If an investor's engagement strategy prioritises climate change (i.e., if companies chosen for engagement are those with the most significant climate change impact), the group of companies selected would be quite different from the group that would be selected if there were a focus on other drivers. To illustrate this, a focus on land use change brings in nine different companies within the top 10 compared to a focus on climate change, while a focus on water use brings in six new companies compared to a focus on pollution. Hence, shifting from a one-driver-only (e.g., climate change) engagement strategy to one that addresses a broader range of drivers will result in different companies being prioritised for engagement, portfolio management or other decision-making processes. Some investors are focusing efforts on climate change only, believing that in addressing climate change, a key driver of biodiversity loss will be addressed. Although this is true to some extent, our results show that a focus on **climate change alone is insufficient to address the biodiversity challenge**.

Industry-level assessment

Table 3 shows the estimated impacts for the top 10 highest impact industries (GICS Level 3) under the absolute and intensity approaches. Additionally, the table includes the percentage distribution of the absolute impact categorised by driver and scope. The absolute and impact intensity scores for all industries, as well as the number of companies and main drivers and scopes within each, are detailed in *Appendix 1*.

The food products, oil, gas and consumable fuels, and chemicals industries are the top three industries with the highest absolute impact, i.e., the industries with the largest estimated footprint on biodiversity. High absolute impacts could simply be a result of the company being large. When adjustments are made for size of revenue (i.e., impact relative to revenue), the company ranking shows a different set of companies compared to the absolute approach. Although the food products industry ranks as the top impact industry for both approaches, other industries —such as consumer staples distribution and retail (with 50 companies) and trading companies and distributors (with 27 companies)— show lower impact intensity scores and ranking positions. The latter cases can be explained by the presence of large (high revenue) corporations with significant biodiversity footprints (absolute impact) but a relatively modest impact per euro invested.

Financial institutions can use different metrics to measure their exposure to these high-impact industries, such as the amount or percentage of invested or owned assets (for asset owners and managers) and lending volume (for banks), among others.

Table 3: Top 10 highest impact industries (GICS Level 3) under the absolute approach (sum of impacts). Impact intensity scores are also displayed for comparison purposes. The distribution of absolute impacts is presented by driver and scope, where dark green/blue colours represent the highest impact scores within each industry (row).

				Distribution (%) of absolute impact score				Distribution (%) of absolute impact score		
Absolute impact ranking	**Industry (GICS Level 3)**	**Absolute impact score[15]**	**Impact intensity score**	**Climate change**	**Pollution**	**Land use**	**Water use**	**Scope 1**	**Scope 2**	**Scope 3[16]**
1	Food Products	100	100	7%	12%	68%	13%	17%	7%	76%
2	Oil, Gas & Consumable Fuels	88	40	54%	23%	12%	11%	28%	25%	47%
3	Chemicals	33	59	11%	46%	14%	29%	4%	63%	33%
4	Consumer Staples Distribution & Retail	32	12	23%	18%	53%	5%	3%	22%	75%
5	Metals & Mining	25	28	35%	48%	9%	8%	29%	56%	15%
6	Electric Utilities	22	17	59%	31%	6%	4%	30%	49%	21%
7	Trading Companies & Distributors	18	6	22%	55%	14%	9%	38%	10%	52%
8	Pharmaceuticals	18	25	5%	75%	12%	8%	4%	6%	90%
9	Beverages	13	23	9%	13%	52%	26%	2%	14%	84%
10	Hotels, Restaurants & Leisure	12	22	16%	10%	66%	8%	2%	17%	81%

This analysis shows that for four of the highest impacting industries —food products, consumer staples distribution and retail, beverages, and hotels, restaurants and leisure— land use change is a much more significant driver of biodiversity loss. For some industries where the focus of biodiversity management has been on land-related interventions, other drivers such as pollution are also important (e.g., metals and mining, chemicals, trading companies and distributors, and pharmaceuticals).

This analysis is broadly in line with other similar, less quantified assessments of sectors; however, it identifies one industry that is often omitted from such assessments —the chemicals industry— as having a potentially significant impact on biodiversity.

[15] Scores are displayed on a scale from 0 to 100, with 100 indicating the highest impact or dependency score in this study.

[16] Scope 3 covers upstream and downstream.

On the other hand, for the top 10 high-impact industries, the drivers of biodiversity loss are quite similar: land use, pollution, and climate change, with water use playing a lesser role. This does not imply that water use is not a significant driver of biodiversity loss to be taken into account by financial institutions. The primary drivers of biodiversity loss vary depending on whether the focus is on the entire MSCI ACWI, on specific ranges (e.g., top 250, top 10), or on specific companies and industries. For example, the primary driver of biodiversity loss for the second highest ranked company in our study is water use. Additionally, the top 10 high-impact industries include pollution as a main driver in four out of ten industries due to the presence of the chemicals and metals and mining industries. In conclusion, **the relevance of different drivers of loss will vary based on the scope of the analysis and the objectives of financial institutions.**

Another key point from Table 3 is that most of the top 10 ranked industries exert their impact on biodiversity primarily through their value chain (scope 3), with some also contributing through their energy purchases and use (scope 2). These results show **the importance of considering the entire value chain in investor engagement programmes to effectively address the drivers of biodiversity loss to which companies contribute**. Evaluating companies at a more granular level —e.g., by driver or scope— can yield targeted insights and facilitate thematically oriented engagement actions.

The results from Table 3 are also reinforced by Figure 3, which shows that scope 3 has the highest estimated absolute impact, primarily driven by climate change —the main driver within the MSCI ACWI— and pollution —the second driver— with water use and land use following.

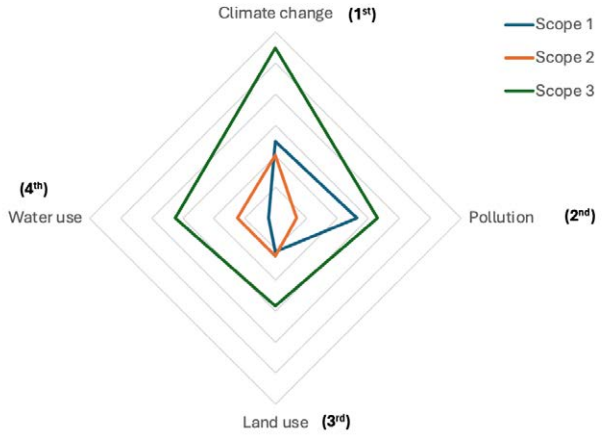


Figure 3: Distribution (%) of absolute impact scores by driver and scope. The ranking of the four drivers of biodiversity loss for the MSCI ACWI is indicated from 1st to 4th.

It should be noted that this figure does not account for the impacts on biodiversity caused by invasive alien species, a driver not addressed by the footprinting tools.

Climate change emerges as the primary driver of biodiversity loss across the MSCI ACWI companies analysed for the following reasons:

i Scientific assessments, including those by IPBES, identify climate change as a key driver of biodiversity loss. Some of the top-ranked companies within the MSCI ACWI are among the primary contributors to climate change, exerting their impacts through various channels: direct operations (scope 1), energy purchases and consumption (scope 2) and upstream or downstream activities (scope 3). As illustrated in Figure 1, a small number of companies account for a significant portion of the total impacts within the index, with most of these companies contributing to biodiversity loss through either direct or indirect greenhouse gas emissions.

ii The oil, gas and consumable fuels industry, a major contributor to climate change, comprises 100 companies within the MSCI ACWI, making it the fourth-largest industry by number of companies, following chemicals, metals and mining, and semiconductors and semiconductor equipment. This industry accounts for 15% of the total revenue within the index, amounting to approximately 5,747 billion euros, the highest among all industries. Consequently, the composition and distribution of companies and revenue within the MSCI ACWI significantly influence the results.

Given that the impact scores of drivers can vary depending on the scope of analysis and the location-specific nature of biodiversity impacts, we argue that **financial institutions should not focus exclusively on climate change when addressing the biodiversity challenge**. This argument is supported by scientific evidence and multiple other publications. In fact, the significance of drivers varies notably when examining the industries and companies with the highest impact. For example, in the food products and chemicals industries, land use change, pollution, and water use are the primary drivers, with climate change playing a much less significant role. Furthermore, climate change is the primary driver for only three of the top 10 highest impact companies and for five of the top 20. This study supports the argument that addressing biodiversity loss requires more than just a focus on climate change.

Analysis of dependencies

This section presents the estimated dependencies on ecosystem services of the MSCI ACWI companies and industries. The underpinned company-level data set is accessible to the FfB Foundation member

According to IPBES (2019), 14 out of the 18 main ES globally have experienced a decline since 1979. A company's reliance on ES can pose physical risks if continued access to these services is threatened, such as when ES become scarce. Additionally, a company's impact on ES can diminish other stakeholders' access to these services, leading to reputational risks (a transition risk). Moreover, a company's impact on ES can also trigger and increase the physical risks the company runs (e.g., the company contributes to water scarcity and depends on the provision of water).

The ENCORE tool has established a framework for understanding the potential relationships between various industry sectors and ES. The dependency results provided by footprinting tools use ENCORE data as a basis which, combined with input-output models, cover the entire value chain and provide results at the company level. This analysis provides initial insights and should be considered as a preliminary step for further assessments of location-specific provision and distribution of ES towards quantifying the exposure to nature-related risks. This study offers an initial step towards more detailed assessments of location-specific ES provision and distribution.

Company-level assessment

The results show that dependency scores are more evenly spread across companies compared to impact scores.

Furthermore, whilst MSCI ACWI companies rely on multiple ES, most companies heavily depend on a select few ES. The main ES are water-related provisioning services —such as surface and groundwater— followed by regulating services, such as mass stabilisation and erosion control, flood and storm protection, filtration of pollutants, and water flow maintenance. The box shows the six ES with the highest dependency scores when added up across all companies. *Appendix 2* provides the definitions of the 26 ES considered as part of this study, according to the Common International Classification of Ecosystem Services (CICES) and ENCORE.

Table 4 sets out the 10 most ES dependent companies within the MSCI ACWI. The table identifies the primary and secondary dominant ES and the primary scope for each company, with ground and surface water being the dominant ES for all companies. This is because all ten companies are part of the food products or beverages industries. The second most dominant ES are all regulatory services, primarily related to the ability of ecosystems and species to shield companies from the impacts of floods and storms, regulate and sustain the hydrological cycle critical to these companies, filter pollutants and other detrimental agents to preserve optimal soil and water conditions, and manage soil loss through erosion.

The six ecosystem services with the highest dependency scores among the analysed companies:

Surface water: surface water is provided through freshwater resources from collected precipitation and water flow from natural sources.

Ground water: water stored underground in aquifers made of permeable rocks, soil and sand. The water that contributes to groundwater sources originates from rainfall, snow melts and water flow from natural freshwater resources.

Mass stabilisation and erosion control: mass stabilisation and erosion control is delivered through vegetation cover protecting and stabilising terrestrial, coastal and marine ecosystems, coastal wetlands and dunes.

Filtration: filtering, sequestering, storing, and accumulating pollutants is carried out by a range of organisms including, algae, animals, microorganisms and vascular and non-vascular plants.

Flood and storm protection: the sheltering, buffering and attenuating effects of natural and planted vegetation.

Water flow maintenance: the hydrological cycle, also called the water cycle or hydrologic cycle, is the system that enables circulation of water through the Earth's atmosphere, land, and oceans. The hydrological cycle is responsible for recharge of groundwater sources (i.e. aquifers) and maintenance of surface water flows.

Table 4: Top 10 companies (GICS Level 3) with the highest dependency on ES, including companies' country headquarters, first and second dominant ES, and dominant scope

Depen. ranking	Company name	Industry group GICS Level 2	Industry GICS Level 3	Country headquarters	Most dominant ES[17]	Second most dominant ES[18]	Dominant scope
1	Bunge Global SA	Food, Beverage & Tobacco	Food Products	USA	Ground and Surface water	Flood and storm protection	Scope 1[19]
2	The Bombay Burmah Trading Corp. Ltd.	Food, Beverage & Tobacco	Food Products	India	Ground and Surface water	Bioremediation; Filtration; Mass stabilisation and erosion control	Scope 3 upstream
3	Nestlé SA	Food, Beverage & Tobacco	Food Products	Switzerland	Ground and Surface water	Flood and storm protection	Scope 3 upstream
4	United Spirits Ltd.	Food, Beverage & Tobacco	Beverages	India	Ground and Surface water	Water flow maintenance	Scope 3 upstream
5	Wilmar International Ltd.	Food, Beverage & Tobacco	Food Products	China	Ground and Surface water	Water flow maintenance	Scope 3 upstream
6	Foshan Hai Tian Flavouring & Food	Food, Beverage & Tobacco	Food Products	China	Ground and Surface water	Water flow maintenance	Scope 3 upstream
7	Universal Robina Group	Food, Beverage & Tobacco	Food Products	Philippines	Ground and Surface water	Flood and storm protection	Scope 3 upstream
8	PPB Group	Food, Beverage & Tobacco	Food Products	Malaysia	Ground and Surface water	Water flow maintenance	Scope 3 upstream
9	Marico Ltd.	Food, Beverage & Tobacco	Food Products	India	Ground and Surface water	Filtration; Mass stabilisation and erosion control	Scope 3 upstream
10	PT Indofood Sukses Makmur Tbk	Food, Beverage & Tobacco	Food Products	Indonesia	Ground and Surface water	Dilution by atmosphere and ecosystems	Scope 3 upstream

[17] Groundwater and surface water are distinct ES; however, they are grouped together as both refer to the provision of water resources.

[18] If one or more ES obtained equal scores, these are placed together as secondary ES.

[19] Results for scope 3 upstream for this company are not available; therefore, the maximum value obtained is derived from scope 1.

The primary concern for financial institutions should not be the number of ES a company relies on, but the associated nature-related risks[20] of its dependencies on these ES. **It is not inherently problematic for companies to depend on multiple ES; rather, the focus should be on the nature-related risks this reliance entails.** These risks become significant when declines in ES within the areas where industries operate lead to their scarcity, thereby disrupting the production processes that depend on them. Additionally, potential risks emerge when the industry affects ES and, thus, makes them unavailable to other stakeholders who rely on them. Investors should focus their engagement efforts on these instances. Furthermore, financial institutions should inquire about the actions companies are taking to mitigate or prevent the scarcity or absence of ES.

The results of this study could serve as a basis for prioritizing companies for further location-specific, comprehensive assessments focused on identifying the potential threats —for companies and, thus, for financial institutions— linked to the distribution and provisioning of ES. For instance, the ten most ES-dependent companies from this study show a high reliance on surface and groundwater. To understand the risk these dependencies pose, financial institutions need to understand whether the facilities that depend on these ES are located in water-stressed areas (e.g., using the state of land, soil, and water dataset from the Food and Agriculture Organization (FAO)). If so, this presents a potential physical risk for the companies, which could translate to transition risks for financial institutions, including reputational and market risks, as outlined in the Recommendations of the TNFD. Additionally, and considering the significance of scope 3 upstream dependencies highlighted in this study, water scarcity (and any other pressures on ES) should not be assessed solely based on the location of companies' facilities. The location of the entire supply chain, which can be complex and involve numerous small suppliers across various regions, is equally important. Financial institutions should seek detailed information from companies about their suppliers to know the extent to which these suppliers are situated in sensitive locations for biodiversity[21], including areas of high water risk.

Industry-level assessment

This analysis highlights patterns of ES dependencies across industries for direct operations (scope 1) and for upstream suppliers (scope 3 upstream). Scope 2 and scope 3 downstream are not included in the assessment performed in this study —see the methodology document for further information.

This analysis offers insights into industry-level dependencies that need to be further refined to understand the underlying nature-related risks. Such refinement is beyond the scope of this current project, yet it is important for meeting current reporting and regulatory frameworks.

Table 5 shows the top 10 highest average ES dependency industries. It also sets out the top 5 ES on which these industries depend and the division (in percentages) of these dependencies across scope 1 and scope 3 upstream.

The average dependency scores for all industries, as well as the number of companies and main ES and scope within each, are detailed in *Appendix 3*.

The average dependency scores show that besides the food products industry —which has been highlighted as highly dependent on nature by several similar studies— dependency scores are quite similar across most industries. Similar to what was found in the analysis of impacts, Table 5 shows the importance of going beyond the direct operation (scope 1) and considering the entire value chain (scope 3) when assessing dependencies.

[20] Location-specific risks are beyond the scope of this study.

[21] These include areas important for biodiversity (including species), areas of high ecosystem integrity, areas of rapid decline in ecosystem integrity, areas of high physical water risks, and areas that are important for ecosystem service provision (including benefits to Indigenous Peoples and Local Communities).

Table 5: The 10 industries (GICS Level 3) with the highest dependency on ES (top 5) within the MSCI ACWI and the distribution of absolute impact scores by scope, where bold green colour represents the highest impact scope per industry.

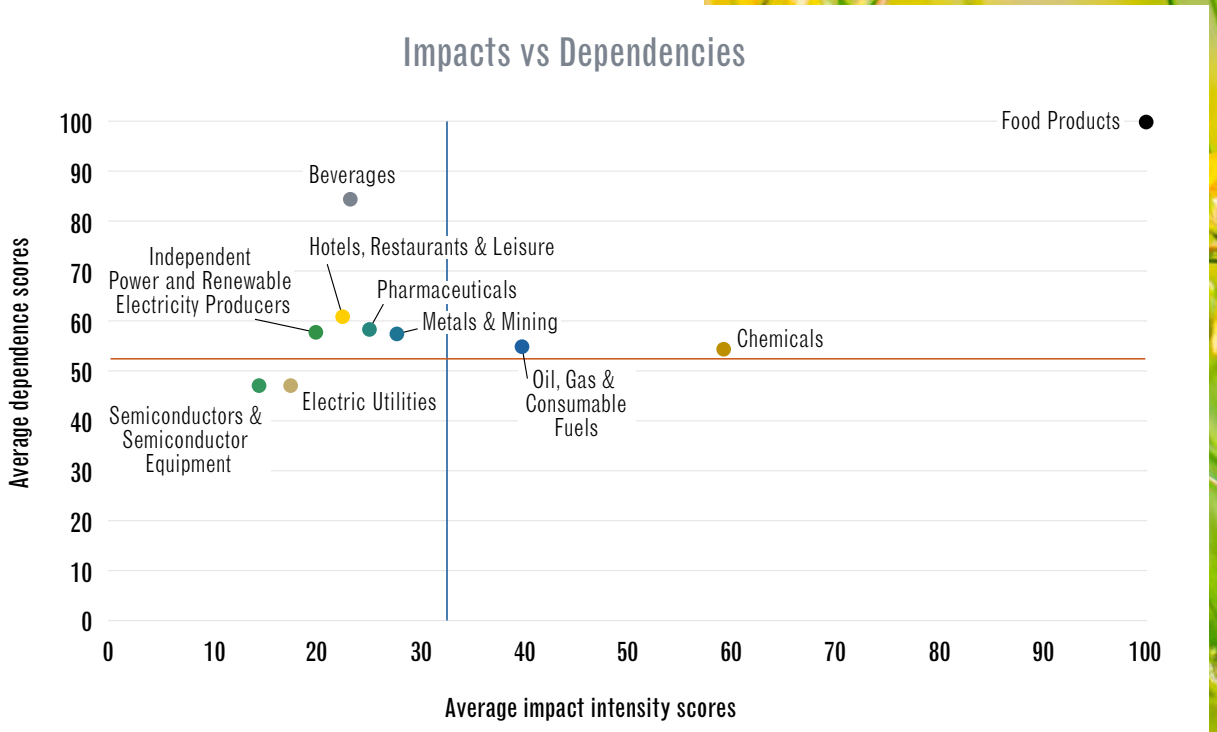
Depen. ranking	Industry (GICS Level 3)	Average depen. score	1st dominant ES	2nd dominant ES	3rd dominant ES	4th dominant ES	5th dominant ES	Scope 1 distribution (%)	Scope 3 Upstream distribution (%)
1	Food Products	100	Ground and Surface water	Flood and storm protection	Mass stabilisation and erosion control	Filtration	Water flow maintenance	37%	**63%**
2	Beverages	85	Ground and Surface water	Water flow maintenance	Flood and storm protection	Mass stabilisation and erosion control	Filtration	40%	**60%**
3	Tobacco	73	Ground and Surface water	Mass stabilisation and erosion control	Filtration	Water flow maintenance	Flood and storm protection	39%	**61%**
4	Textiles, Apparel & Luxury Goods	71	Ground and Surface water	Water flow maintenance	Mass stabilisation and erosion control	Filtration	Flood and storm protection	47%	**53%**
5	Water Utilities	70	Ground and Surface water	Water flow maintenance	Mass stabilisation and erosion control	Filtration	Flood and storm protection	**60%**	40%
6	Household Products	66	Ground and Surface water	Mass stabilisation and erosion control	Filtration	Water flow maintenance	Flood and storm protection	45%	**55%**
7	Leisure Products	65	Ground and Surface water	Water flow maintenance	Flood and storm protection	Mass stabilisation and erosion control	Filtration	**52%**	48%
8	Personal Care Products	64	Ground and Surface water	Water flow maintenance	Flood and storm protection	Mass stabilisation and erosion control	Filtration	40 %	**60%**
9	Air Freight & Logistics	64	Ground and Surface water	Flood and storm protection	Mass stabilisation and erosion control	Filtration	Climate regulation	**52%**	48%
10	Machinery	64	Ground and Surface water	Flood and storm protection	Water flow maintenance	Mass stabilisation and erosion control	Filtration	47%	**53%**

Although the study does not aim to compare impacts and dependencies, financial institutions may simultaneously consider both types of interactions when making decisions. Figure 4 illustrates the distribution of the top 10 ranked industries (GICS Level 3) according to their absolute impact looking at their average dependency score (y-axis) and their average impact intensity score (x-axis). Consistent with the other graphs in this report, a score of 100 represents the highest estimated value within this study and not the maximum impact/dependency an industry could achieve.

The food products, chemicals, and oil, gas and consumable fuels industries are the only industries located on the top-right corner of the graph (highest impact intensity, highest dependency), which indicates that they are potential priority industries for financial institutions from an impact intensity and dependency perspective. As previously mentioned, relevant metrics that financial institutions can use to measure their exposure to these industries are the amount or percentage of invested or owned assets (for asset owners and managers) and lending volume (for banks), among others. Additionally, the vertical and horizontal lines represent the average MSCI ACWI score for impacts (34) and dependencies (53), respectively. Most of the other industries from the MSCI ACWI (see *Appendix 1* for a full list) are located within the bottom-left part of the graph (lowest impact intensity, lowest dependency).

Again, targeting a small number of industries can enable prioritisation of efforts for both dependencies and impacts. The two require a different focus. Furthermore, both require a more detailed analysis, including location-specific data, of prioritised industries to fully comprehend their actual impacts and dependencies.

Figure 4: Average dependency and impact intensity scores at the industry level (GICS Level 3). Vertical (blue) and horizontal (orange) lines represent the average scores, respectively.



Recommendations

This section addresses the gaps within the biodiversity measurement and data domains, highlighting connections to other key aspects such as collaboration among parties, reporting, and nature transition plans. Furthermore, general recommended steps for financial institutions to measure impacts and dependencies are provided.

Practical recommendations for financial institutions using data from this report

The information contained in this report provides estimated and potential data; therefore, we encourage its use to be both prudent and responsible. We recommend that investors use the data from this report in conjunction with data from other methodologies, especially those providing insights into location-specific company impacts and dependencies, to evaluate the effects and dependencies of their investments. While this data is not suitable for reporting, it can be valuable for internal decision-making.

The following information outlines general steps that financial institutions can follow to measure impacts and dependencies from the start. The various measurement approaches applicable to each of these steps are available in the FfB Guide on biodiversity measurement approaches (4th Edition):

- **Initial industry-level screening:** Investors can use this assessment or established sectoral screening tools to conduct a materiality screening and identify priority industries in their portfolio. Understanding industry specific impacts enables targeted actions and efficient use of resources.
- **Deepening assessment at the company-level for selected industries:** Investors can proceed to the next phase by conducting detailed company-specific and, if feasible, location-specific impact assessments for investees within priority industries.
- **Understanding the nature-related risks associated with dependencies and impacts:** At this stage, investors will have a comprehensive understanding of how their investments interact with biodiversity. The results from this report and established methodologies can be used for an initial understanding of nature-related risks and opportunities associated with high-dependency and high impact companies. Although only a very limited number of tools enable the quantification of nature-related risks and opportunities directly based on impact and dependency results, there are indicators and metrics that can be populated with data to determine the value or extent of assets, liabilities, and revenue exposed to these risks and opportunities (see the Recommendations of the TNFD for additional information).
- **Engagement:** This assessment can enable prioritisation of investor engagement efforts. Financial institutions should focus on high-impact companies, based on absolute impact and/or impact intensity scores (as determined internally), and high dependency companies where they have the potential to drive significant nature-related risks. Engagement can also be used to improve or complement the impact and dependency scores of this report and of additional assessments, such as through access to more refined, on-the-ground studies conducted by the companies before or during the engagement process.

Improving data and measurement approaches

Table 6 addresses the challenges, implications, and recommendations from this study on biodiversity measurement and data domains, focusing on tool developers, data providers, companies, and financial institutions.

Table 6: Challenges, implications and recommendations for tool developers, data providers, companies and financial institutions on the biodiversity measurement and data domains

MEASUREMENT, DATA and DISCLOSURE		
Challenge	**Implication**	**Recommendation**
Combine footprinting, spatial and response approaches and datasets While footprinting is valuable, it requires further refinement to address certain (location-specific) aspects effectively.	• Some risks (e.g., operational, reputational) linked to impacts on sensitive locations for biodiversity may be overlooked, as they are not currently part of footprinting approaches. • Integrating location-specific data into company assessments is vital for investor engagement due to the geographic nature of biodiversity impacts and dependencies. • Additionally, incorporating response data, like management system quality, provides insight into whether corporate actions align with and adequately address their potential impacts and dependencies.	• Footprint assessments should be combined with other company-level, location-specific approaches to better understand company risk exposure —in the same way as several sources of information are used when analysing financial data. Spatially-explicit tools, such as the Integrated Biodiversity Assessment Tool (IBAT) or WWF's Biodiversity Risk Filter, can be used for that purpose. • Investors should encourage companies to start sharing location data of their operational assets and significant value chain assets, i.e., scope 3 upstream and downstream where relevant, particularly in sensitive locations. Reporting and disclosure frameworks, such as ESRS E4 Biodiversity and Ecosystems, the GRI 101: Biodiversity 2024, and the Recommendations of the TNFD, among others, already require/recommend data points related to location-specific data. • Relevant metrics that financial institutions can use to measure their exposure to sensitive locations for biodiversity are the amount or percentage of invested or owned assets (for asset owners and managers) and lending volume (for banks), among others.
More granular data on dependencies More robust company-level data on dependencies is needed.	• Tools providing ES data rely on ENCORE (industry-level data), which may lack the level of granularity needed. • Effective engagement requires company- and location-specific data (including the value chain) on ES dependencies. This is necessary for a better understanding of physical and transition risks.	• Enhance the collaborative efforts to improve disclosures on company location and ES dependencies, supported by key disclosure frameworks, such as the Recommendations of the TNFD and the PBAF Standard – Dependencies. • Collaboration between companies and sectoral screening tools (e.g., ENCORE), to allow adjustment of current sectoral dependency scores with actual company data.
Support and enhance data disclosure and reporting Companies and data providers do not share and disclose sufficient information for financial institutions to access high-quality and robust data.	• Current levels of corporate biodiversity reporting, above all the disclosure of biophysical data related to biodiversity and nature, are insufficient for performing comprehensive assessments of impacts and dependencies. • This hinders access to accurate information, limiting financial institutions' ability to engage effectively and take appropriate actions.	• Investors should encourage companies to adopt and report according to harmonized and detailed corporate disclosures aligned with the TNFD, ESRS, and GRI, among others. • Similarly, through investor engagement programmes and actions, financial institutions could help improve and drive changes in the quality of information disclosed and shared by companies. Investors should encourage data providers to disclose and share company- and location-specific data. • Unified data initiatives and efforts, such as the European Single Access Point (ESAP), TNFD Nature-related Public Data Facility, and the Global Ecosystem Atlas, among others, are essential "meeting points" between data providers, financial institutions, and companies, to improve the access to biodiversity-related data.

MEASUREMENT, DATA and DISCLOSURE		
Challenge	**Implication**	**Recommendation**
Assurance of compliance with best practices and standards Investors are not always using data that complies with good practice measurement standards.	• Investors need confidence that companies adhere to established reporting frameworks and standards, to ensure the reliability and credibility of the information used for decision-making. • Without this assurance, there is a risk of relying on data that may not meet the necessary quality or standards, potentially leading to inaccurate assessments of impacts, dependencies, risks and opportunities.	• Data providers should be verified to ensure they comply with established best practice measurement frameworks and standards, such as the TNFD's LEAP approach, SBTN's 'Assess' step and PBAF Standard, among others. • This would help ensure that the data used for investment decisions is reliable, accurate, and aligned with industry standards.
Support nature transition plans There is a need for companies to produce data driven comprehensive transition plans that fully address the complexities of nature.	• Companies subject to reporting frameworks, such as ESRS E4, are required to develop nature transition plans outlining their strategies to become resilient against nature-related risks. • These plans are crucial for stakeholder engagement; yet may not be consistently utilized by financial institutions as a key tool. • Without detailed and data-driven transition plans, investors might lack critical insights needed for effective engagement with companies.	• Financial institutions should request comprehensive nature transition plans from the companies they engage with, ensuring these plans are detailed and data- and science-driven. • This approach would improve engagement programmes and actions, as it would provide clear strategies on how companies address nature-related impacts and dependencies. • The TNFD and the Glasgow Financial Alliance for Net Zero (GFANZ) are currently constructing guides for companies and financial institutions on how to successfully build and implement nature transition plans.

BIODIVERSITY FOOTPRINTING		
Challenge	**Implication**	**Recommendation**
Footprinting's reliance on modelled data Reliance on potential, rather than actual impact and dependency measures, may result in biodiversity risks and opportunities being overlooked.	• Impacts and physical risks arising from dependencies are location-based and, therefore, may be under or overstated when location characteristics are not considered. • Some risks (e.g., operational and reputational) may not be identified using modelled data. • When assessing large portfolios, some footprinting tools are using company data for greenhouse gas emissions, while other pressures are addressed using models linked to revenue data.	• Tool developers should use company-level biophysical input data as much as possible to yield results that more accurately reflect companies' impacts and dependencies. • Companies should improve the quantity, quality and robustness of the data disclosed, above all for assets in sensitive locations for biodiversity. The organisations managing reported data should also contribute by making this data available.
Agree on a basic driver coverage Drivers vary across tools and some of these are sometimes omitted.	• Some drivers, such as resource exploitation beyond water use and alien invasive species, are usually omitted. • Existing frameworks (e.g., TNFD) and standards (e.g., PBAF) suggest the coverage of the five main drivers of loss/nature change (IPBES/TNFD). • The lack of coverage for certain drivers, such as alien invasive species, results in incomplete and potentially unrealistic disclosures. This poses risks for financial institutions.	• Tool developers should agree on a basic driver coverage, including climate change, land use, water use and pollution, thus covering the main drivers stipulated by IPBES and current reporting frameworks. • The PBAF Standard recommends that tools undertake a qualitative assessment of those drivers that cannot be included in the quantitative assessment (only if the drivers are deemed material for the company or industry after using other materiality tools, such as ENCORE).

BIODIVERSITY FOOTPRINTING		
Challenge	**Implication**	**Recommendation**
Agree on a basic scope coverage Scopes 1, 2 and 3 are applied differently for different industries across tools, and not all the tools cover all the scopes.	• This may result in some investors using one footprinting tool to prioritise different companies and issues for engagement, while others use a different tool, causing inconsistencies and confusion amongst companies and investors. • In the early stages of company engagement, the current scope inconsistency and lack of clarity across tools may result in significant resistance from companies, as they may feel that the analysis goes too far within their value chains (i.e., beyond their responsibility).	• Tool developers should agree on a common scope coverage across different industries, including scope 1 (direct operations), scope 2 (energy purchase and use) and scope 3 (upstream and downstream). • Results could be cross-checked to enhance databases on potential impacts and dependencies of different industries to identify anomalies. • In the absence of this, data providers should be transparent on the scopes addressed by impact and dependency data
Misalignment in the use of revenue data Inconsistencies in the use of revenue data across tools, challenges in splitting revenue data by sector, and data gaps.	• Footprinting tool developers and data providers use various sources to obtain revenue data for companies, which are crucial for calculating impacts across large portfolios. • While other factors also contribute to misalignment across tools when calculating company impacts, the lack of consistency in revenue data use and its division across different countries and industries is a key challenge and can impact the resulting in footprint.	• Collaboration is needed across tool developers to engage with revenue data providers and companies to ensure consistency in the use of revenue data and determine methods to assign corporate revenue data across different countries and industries.
Engage with developers of key models Footprinting tools use external pressure-impact models to estimate biodiversity impacts.	• Different versions of these models are sometimes used by tool developers with proprietary adjustments. • Gaps in data within these models result in the understatement of some impacts, for example, impacts on the marine environment and impacts of industries through alien invasive species.	• Footprinting tool developers should engage with developers of key models to improve alignment and robustness. • This could enhance the coverage of missing drivers or realms by model builders, including marine impacts, which are underrepresented across all models.
Measurement and inclusion of the mitigation hierarchy and positive outcomes Models do not yet comprehensively account for the outcomes of corporate actions across all mitigation hierarchy levels, including net gains.	• Footprinting results reflect potential impacts before mitigation and do not yet account for the positive effects of corporate actions within or beyond their value chains, unless primary company data is available. Demonstrating improvement of investment over time using these approaches is challenging. • PBAF recommends that investors should not claim positive impact from an investment unless the geographic location is known. • The SBTN, TNFD, and others stress that companies should drive transformational change, not just reduce impacts. Initial frameworks, such as the 'Nature Positive: Building a working model for the financial sector' (FfB Foundation and UNEP FI), 'Measuring Contributions to Nature Positive' report (Align Project), IUCN's Measuring Nature-Positive or Booth et al. 2024, are emerging, but definitions and measurements of transformative change remain unclear.	• Footprinting tools should begin incorporating the positive effects of corporate actions on biodiversity and ES, such as pressure reduction and ecosystem restoration. In particular, tools should work towards giving the option to integrate mitigation hierarchy actions and the overall positive impacts of corporate actions; for instance, by reflecting improvements in MSA or PDF scores based on the contribution of companies to restoration and offsetting projects. • Once definitions and measurement approaches for transformative change have been established, footprinting tools should work to integrate them into their models.

Looking ahead

This report presents one of the first quantitative datasets on company and industry-level impacts and dependencies related to biodiversity. Tailored to investors, it aims to inform engagement strategies and portfolio decision-making, enabling prioritisation. The insights provided can help financial institutions identify material companies and industries from an impact and dependency perspective, serving as a foundation for further measurement assessments, including location-specific approaches.

Biodiversity footprinting is an evolving field with a keen interest in enhancing methodologies and data quality. This is evidenced by increased cooperation between tool developers, data providers and key actors, such as the FfB Foundation, EU B&B Platform, PBAF, and TNFD, among others. Collaboration is crucial to align approaches, address data gaps, and enhance the credibility of biodiversity footprinting, thereby supporting financial flows towards biodiversity conservation and sustainable use.

The accuracy, granularity, and consistency of results must be enhanced through robust scientific backing. Some challenges identified in this study stem from gaps in the biodiversity and corporate data market, which affect both general data offerings and those specific to biodiversity footprinting. Addressing these issues requires collaborative efforts among standard setters, tool developers, investors, and other stakeholders to develop robust quantitative solutions. Gaps in marine biodiversity coverage, invasive species, and corporate location data require targeted, science-based solutions.

Integrating bottom-up approaches, like biodiversity surveying, with top-down approaches will be crucial. Just as harmonisation of financial data took years and continues to rely on significant investments and data providers, biodiversity data requires similar focus and investment to improve quality and use. The market must become familiar with new indicators to ensure financial flows effectively reduce biodiversity impacts, manage dependencies on ES, and support the drive to develop a nature-positive economy.

The FfB Foundation will remain fully dedicated to guiding financial institutions in assessing their impacts and dependencies on biodiversity, as demonstrated by its third FfB Pledge Commitment. As part of that commitment, the FfB Foundation publishes regular updates of the 'Guide on Biodiversity Measurement Approaches' —which helps investors gain a clearer understanding of the current measurement and tools landscape—, collaborates on international projects and initiatives within the measurement field, and organises webinar series, workshops and meetings to enhance the collaboration between tool developers, data providers and investors, among other relevant actions. Looking ahead, the FfB Foundation will continue to drive innovation and leadership in biodiversity assessment.

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Definitions, acronyms and abbreviations

Definitions

Average normalised impacts/dependencies: Averaged values across various tools and standardized on a scale from 0 to 100, enabling comparison between tools and adjustment for differences in metrics. The average normalised score of company or industry, for both impacts and dependencies, is calculated as:

$$X = \frac{\text{Impact/dependency score of company x}}{\text{Impact/dependency score of company ranked \#1}} \times 100$$

Biodiversity: The variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and ecosystems. *(CBD, Article 2, 1992)*

Dependencies: Aspects of environmental assets and ES that a person or an organisation relies on to function. A company's business model, for example, may be dependent on the ES of water flow, water quality regulation and the regulation of hazards like fires and floods; provision of suitable habitat for pollinators, who in turn provide a service directly to economies; and carbon sequestration. *(TNFD, 2023, adapted from SBTN, 2023 SBTN Glossary of Terms)*

Drivers of biodiversity loss / Drivers of nature change: Human activities that directly and indirectly change the state of the environment. The five main direct drivers of biodiversity loss outlined by IPBES are: land and sea use change, climate change, pollution, direct exploitation of resources, and invasion of alien species. In this report we also refer to the five drivers of biodiversity loss (IPBES) as 'drivers of nature change' consistent with the TNFD recommendations. Our focus is exclusively on the negative drivers, while recognizing that the TNFD framework encompasses both negative and positive impacts. *(IPBES Glossary; TNFD Glossary – Recommendations of the TNFD)*

Ecosystem services: Ecosystem services, or nature's contributions to people, are the benefits ecosystems provide for human activities. They are categorised into provisioning services, which include essential products like food, water, and timber; regulating-supporting services, which maintain ecosystem processes that regulate environmental conditions and support other services, such as climate regulation and pollination; and cultural services, which offer non-material benefits contributing to cultural, spiritual, and recreational values, including tourism and cultural heritage. *(TNFD, 2023, from United Nations et al. (2021) System of Environmental-Economic Accounting – Ecosystem Accounting)*

Footprinting: Measurement of the quantified impact of a portfolio, asset class or company measured in terms of biodiversity change as a result of production and consumption of particular goods and services. *(PBAF Standard V2, 2022)*

Impacts: Changes in the state of nature (quality or quantity), which may result in changes to the capacity of nature to provide social and economic functions. Impacts can be positive or negative. They can be the result of an organisation's or another party's actions and can be direct, indirect or cumulative. A single impact driver may be associated with multiple impacts. *(SBTN Glossary of Terms)*

In this study, impacts are categorised into absolute impact —the total impact of a company or industry, accounting for all drivers and scopes— and impact intensity —the absolute impact divided by the total yearly revenue of the company or industry, reflecting the impact per unit of economic output.

Nature: The natural world, with an emphasis on the diversity of living organisms (including people) and their interactions among themselves and with their environment. *(Adapted from Díaz, S et al. (2015) The IPBES Conceptual Framework – Connecting Nature and People)*

Nature-related risks: Potential threats (effects of uncertainty) posed to an organisation that arise from its and wider society's dependencies and impacts on nature. Nature-related risks are categorised as system risks —arising from the breakdown of the entire system—, transition risks — risks to an organisation that stem from a misalignment of economic actors with actions aimed at protecting, restoring, and/or reducing negative impacts (e.g., policy risks, liability risks, reputational risks, market risks, technology risks)— and physical risks —risks resulting from the degradation of nature and consequential loss of ES.
(Recommendations of the TNFD, 2023)

Scopes: Scope 1: all direct impacts on biodiversity; Scope 2: indirect biodiversity impacts from consumption of purchased electricity, heat or steam; Scope 3: other indirect impacts on biodiversity not covered in Scope 2 that occur in the value chain of the reporting company, including both upstream and downstream impacts).
(Adapted from TCFD Glossary, 2021)

Tool developers: Entities involved in the development and implementation of biodiversity footprinting tools.
(Finance for Biodiversity Foundation, 2024)

Acronyms and Abbreviations

BFFI: Biodiversity Footprint for Financial Institutions
BIA-GBS: Biodiversity Impact Analytics powered by the Global Biodiversity Score,
CBF: Corporate Biodiversity Footprint
CICES: Common International Classification of Ecosystem Services
COP: Conference of the Parties
ENCORE: Exploring Natural Capital Opportunities, Risks, and Exposure
EU B&B Platform: European Business and Biodiversity Platform
ES: Ecosystem services
ESAP: European Single Access Point
ESRS: European Sustainability Reporting Standards
FAO: Food and Agriculture Organization
FfB Foundation: Finance for Biodiversity Foundation
GBF: Global Biodiversity Framework
GFANZ: Glasgow Financial Alliance for Net Zero
GICS: Global Industry Classification Standard
GID: Global Impact Database
GRI: Global Reporting Initiative
IBAT: Integrated Biodiversity Assessment Tool
IIGCC Institutional Investors Group on Climate Change
IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
MSA: Mean Species Abundance
MSCI ACWI: Morgan Stanley Capital International All Country World Index
NA 100: Nature Action 100 (see 'Definitions')
PBAF: Partnership Biodiversity Accounting Financials
PDF: Potentially Disappeared Fraction of species
REIT: Real Estate Investment Trusts
SBTN: Science Based Targets Network
TNFD: Task Force on Nature-related Financial Disclosures
UNEP FI: United Nations Environment Programme Finance Initiative
WWF: World Wide Fund for Nature

Acknowledgments

The project has been conducted by the Finance for Biodiversity Foundation.

Lead author of the report and project coordinator
- Julen González Redín, FfB Foundation

Contributing author and project collaborator
- Annelisa Grigg, Globalbalance

Tool developers and technical assistance
The biodiversity footprint tools used in this study and the companies that own them are:
- CDC Biodiversité and Carbon4 Finance – Biodiversity Impact Analytics powered by the Global Biodiversity Score, BIA-GBS
- Iceberg Data Lab – Corporate Biodiversity Footprint, CBF
- PRé Sustainability and CREM – Biodiversity Footprint for Financial Institutions, BFFI
- Impact Institute – Global Impact Database, GID

The project also benefited from the technical assistance of Mark Wildschut (Wildcap).

Data provider
We appreciate the valuable data provided by Morgan Stanley Capital International (MSCI).

Reviewers
We extend our gratitude to the project reviewers for their valuable contributions during meetings and their review of the methodology document and this report:

Experts and stakeholders
- Johan Lammerant (EU B&B Platform – Methods Workstream)
- Wijnand Broer (PBAF)
- James d'Ath (TNFD)
- Jacob Bedford (UNEP-WCMC)
- Miriam van Gool (SBTN)

Technical reviewers (tool developers)
- Emma Godefroy, Alice Cros (CDC Biodiversité); Souheila Mgaieth (Carbon4 Finance)
- Delphine Bartre, Clément Molinier (Iceberg Data Lab)
- Colette Grosscurt, Rudri Mankad (PRé Sustainability)
- Anne Mesguich, Chiara Cassataro, Hans Baumers (Impact Institute)

FfB Foundation members
- Steve Freedman (Pictet AM)
- Clinton Adas (HSBC GAM)
- Charlotte Apps (Fidelity International)

Project funding
We are grateful for the funding and support by the Global Commons Alliance Accountability Accelerator (GCAAA) for this project.

Appendix 1:

Industries (GICS Level 3) within the MSCI ACWI ranked by absolute impact scores. The table also includes the number of companies, the impact intensity scores, the main (highest) driver of loss and the main (highest) scope.

Industries (GICS Level 3)	Number of companies	Absolute impact	Impact intensity	Main driver	Main scope
Food Products	80	100.0	100.0	Land use	Scope 3 Upstream
Oil, Gas & Consumable Fuels	100	88.4	39.7	Climate change	Scope 3 Downstream
Chemicals	136	33.1	59.5	Pollution	Scope 2
Consumer Staples Distribution & Retail	50	32.4	12.5	Land use	Scope 3 Upstream
Metals & Mining	106	24.5	27.8	Pollution	Scope 2
Electric Utilities	58	22.4	17.4	Climate change	Scope 2
Trading Companies & Distributors	27	18.5	5.8	Pollution	Scope 3[22]
Pharmaceuticals	81	17.7	25.0	Pollution	Scope 3 Downstream
Beverages	50	12.7	23.2	Land use	Scope 3 Upstream
Hotels, Restaurants & Leisure	63	11.5	22.5	Land use	Scope 3 Upstream
Health Care Providers & Services	44	11.2	4.5	Pollution	Scope 3 Upstream
Broadline Retail	27	11.1	5.2	Land use	Scope 3 Upstream
Industrial Conglomerates	38	10.0	8.2	Climate change	Scope 3 Downstream
Automobiles	50	9.8	3.6	Climate change	Scope 2
Independent Power and Renew. Electr. Produc.	37	9.6	19.9	Climate change	Scope 1
Construction & Engineering	30	8.1	3.3	Climate change	Scope 1
Specialty Retail	42	6.5	6.2	Land use	Scope 3 Upstream
Machinery	83	6.3	10.6	Climate change	Scope 3 Downstream
Technology Hardware, Storage & Peripherals	38	5.6	3.0	Climate change	Scope 2
Paper & Forest Products	12	4.9	10.0	Land use	Scope 3 Upstream
Semiconductors & Semiconductor Equipment	106	4.6	14.5	Pollution	Scope 2
Construction Materials	20	4.3	7.3	Climate change	Scope 2
Electrical Equipment	58	4.1	9.5	Climate change	Scope 3

[22] When scope 3 does not distinguish between upstream and downstream, it means that only the combined upstream and downstream values make scope 3 the highest scope for this industry, surpassing scope 1 and scope 2. In these cases, if upstream and downstream were evaluated separately, either scope 1 or scope 2 would exceed each individually.

Industries (GICS Level 3)	Number of companies	Absolute impact	Impact intensity	Main driver	Main scope
Gas Utilities	18	4.1	5.2	Climate change	Scope 1
Real Estate Management & Development	69	4.1	6.9	Climate change	Scope 2
Containers & Packaging	13	4.0	4.8	Land use	Scope 3 Upstream
Personal Care Products	18	3.9	6.0	Land use	Scope 3
Electronic Equip., Instrum. & Comp.	80	3.9	8.6	Climate change	Scope 2
Multi-Utilities	20	3.9	3.9	Climate change	Scope 2
Household Products	12	3.7	4.3	Land use	Scope 3 Upstream
Interactive Media & Services	22	3.7	1.5	Climate change	Scope 2
Marine Transportation	14	3.4	2.9	Pollution	Scope 1
Aerospace & Defence	37	3.4	3.9	Climate change	Scope 3 Downstream
Household Durables	31	3.1	2.8	Climate change	Scope 3
Air Freight & Logistics	16	3.0	1.6	Pollution	Scope 3 Downstream
Biotechnology	37	2.9	9.2	Pollution	Scope 3 Downstream
Textiles, Apparel & Luxury Goods	27	2.9	4.4	Land use	Scope 3 Upstream
Automobile Components	32	2.6	3.1	Climate change	Scope 3
Diversified Telecommunication Services	38	2.4	2.1	Climate change	Scope 2
Tobacco	9	2.4	5.6	Land use	Scope 3 Upstream
Ground Transportation	29	2.1	3.8	Climate change	Scope 2
Energy Equipment & Services	8	1.9	2.4	Climate change	Scope 3 Downstream
Wireless Telecommunication Services	26	1.6	4.5	Climate change	Scope 2
Health Care Equipment & Supplies	50	1.6	3.4	Pollution	Scope 3 Upstream
Software	69	1.5	3.6	Climate change	Scope 2
Building Products	25	1.5	2.6	Climate change	Scope 2
Transportation Infrastructure	24	1.3	11.2	Climate change	Scope 1
Passenger Airlines	21	1.3	2.4	Climate change	Scope 1

Industries (GICS Level 3)	Number of companies	Absolute impact	Impact intensity	Main driver	Main scope
Entertainment	42	1.2	2.6	Land use	Scope 2
IT Services	42	1.1	1.7	Climate change	Scope 2
Media	23	1.0	1.3	Land use	Scope 2
Professional Services	27	0.8	1.6	Climate change	Scope 3 Downstream
Commercial Services & Supplies	21	0.7	3.4	Climate change	Scope 2
Life Sciences Tools & Services	27	0.7	2.3	Pollution	Scope 3 Downstream
Communications Equipment	16	0.7	1.0	Pollution	Scope 2
Distributors	5	0.6	0.3	Climate change	Scope 3 Downstream
Leisure Products	5	0.2	0.5	Climate change	Scope 3 Downstream
Water Utilities	7	0.2	0.8	Climate change	Scope 2
Diversified Consumer Services	6	0.1	0.6	Land use	Scope 3 Upstream
Health Care Technology	2	0.0	0.1	Pollution	Scope 3 Downstream

Appendix 2:

The following table presents, in alphabetical order, the definitions of the 26 ecosystem services discussed in this study. These definitions were sourced from ENCORE, which uses a simplified interpretation of the CICES framework, and were also provided by the FfB Foundation Secretariat team for cultural ecosystem services.

Ecosystem service	Overview
Aesthetic information	This service encompasses the appreciation of the beauty and appearance of natural landscapes, which contributes to the mental and emotional well-being of individuals. It involves the visual enjoyment of landscapes, seascapes, and other natural features that people find attractive or inspiring.
Animal-based energy	Physical labour is provided by domesticated or commercial species, including oxen, horses, donkeys, goats and elephants. These can be grouped as draught animals, pack animals and mounts.
Bio-remediation	Bio-remediation is a natural process whereby living organisms such as micro-organisms, plants, algae, and some animals degrade, reduce, and/or detoxify contaminants.
Buffering and attenuation of mass flows	Buffering and attenuation of mass flows allows the transport and storage of sediment by rivers, lakes and seas.
Climate regulation	Global climate regulation is provided by nature through the long-term storage of carbon dioxide in soils, vegetable biomass, and the oceans. At a regional level, the climate is regulated by ocean currents and winds while, at local and micro-levels, vegetation can modify temperatures, humidity, and wind speeds.
Dilution by atmosphere and ecosystems	Water, both fresh and saline, and the atmosphere can dilute the gases, fluids and solid waste produced by human activity.
Disease control	Ecosystems play important roles in regulation of diseases for human populations as well as for wild and domesticated flora and fauna.
Fibres and other materials	Fibres and other materials from plants, algae and animals are directly used or processed for a variety of purposes. This includes wood, timber, and fibres which are not further processed, as well as material for production, such as cellulose, cotton, and dyes, and plant, animal and algal material for fodder and fertiliser use.
Filtration	Filtering, sequestering, storing, and accumulating pollutants is carried out by a range of organisms including, algae, animals, microorganisms and vascular and non-vascular plants.
Flood and storm protection	Flood and storm protection is provided by the sheltering, buffering and attenuating effects of natural and planted vegetation.
Genetic materials	Genetic material is understood to be deoxyribonucleic acid (DNA) and all biota including plants, animals and algae.
Ground water	Groundwater is water stored underground in aquifers made of permeable rocks, soil and sand. The water that contributes to groundwater sources originates from rainfall, snow melts and water flow from natural freshwater resources.
Information for cognitive development	This refers to the contributions of ecosystems to education and learning. Natural environments serve as resources for formal and informal education, providing opportunities for scientific research and cognitive development through direct interaction with nature.
Inspiration for culture, art and design	Ecosystems provide inspiration for cultural expressions, including art, folklore, national symbols, and design. This service captures the role of nature in inspiring creative works and cultural practices, which are essential components of human culture.
Maintain nursery habitats	Nurseries are habitats that make a significantly high contribution to the reproduction of individuals from a particular species, where juveniles occur at higher densities, avoid predation more successfully, or grow faster than in other habitats.

Ecosystem service	Overview
Mass stabilisation and erosion control	Mass stabilisation and erosion control is delivered through vegetation cover protected and stabilising terrestrial, coastal and marine ecosystems, coastal wetlands and dunes. Vegetation on slopes also prevents avalanches and landslides, and mangroves, sea grass and macroalgae provide erosion protection of coasts and sediments.
Mediation of sensory impacts	Vegetation is the main (natural) barrier used to reduce noise and light pollution, limiting the impact it can have on human health and the environment.
Pest control	Pest control and invasive alien species management is provided through direct introduction and maintenance of populations of the predators of the pest or the invasive species, landscaping areas to encourage habitats for pest reduction, and the manufacture of a family of natural biocides based on natural toxins to pests.
Pollination	Pollination services are provided by three main mechanisms: animals, water and wind. The majority of plants depend to some extent on animals that act as vectors, or pollinators, to perform the transfer of pollen.
Recreation and tourism	This service includes the benefits people derive from recreational activities and tourism in natural environments. It encompasses activities like hiking, birdwatching, and visiting parks and natural reserves, which contribute to physical health, relaxation, and social well-being.
Soil quality	Soil quality is provided through weathering processes, which maintain bio-geochemical conditions of soils including fertility and soil structure, and decomposition and fixing processes, which enables nitrogen fixing, nitrification and mineralisation of dead organic material.
Spiritual experiences and sense of place	Ecosystems contribute to spiritual enrichment and provide a sense of place. This service involves the use of natural sites for religious and spiritual activities, and the deep emotional connection people have with certain landscapes or ecosystems that are integral to their cultural identity and heritage.
Surface water	Surface water is provided through freshwater resources from collected precipitation and water flow from natural sources.
Ventilation	Ventilation provided by natural or planted vegetation is vital for good indoor air quality and without it there are long term health implications for building occupants due to the build-up of volatile organic compounds (VOCs), airborne bacteria and moulds.
Water flow maintenance	The hydrological cycle, also called water cycle or hydrologic cycle, is the system that enables circulation of water through the Earth's atmosphere, land, and oceans. The hydrological cycle is responsible for recharge of groundwater sources (i.e. aquifers) and maintenance of surface water flows.
Water quality	Water quality is provided by maintaining the chemical condition of freshwaters, including rivers, streams, lakes, and ground water sources, and salt waters to ensure favourable living conditions for biota.

Appendix 3:

Industries (GICS Level 3) within the MSCI ACWI ranked by average dependency scores. The table also includes the number of companies, the dependency scores, the main (highest) ES and the main (highest) scope.

Industries (GICS Level 3)	Number of companies	Average dependencies	Main ES	Main scope
Food Products	80	100,0	Surface water	Scope 3 upstream
Beverages	50	85,4	Surface water	Scope 3 upstream
Tobacco	9	73,4	Surface water	Scope 3 upstream
Textiles, Apparel & Luxury Goods	26	71,5	Surface water	Scope 3 upstream
Water Utilities	7	70,3	Surface water	Scope 3 upstream
Household Products	12	65,7	Surface water	Scope 3 upstream
Leisure Products	5	65,0	Surface water	Scope 3 upstream
Personal Care Products	18	64,4	Surface water	Scope 3 upstream
Air Freight & Logistics	16	64,3	Surface water	Scope 3 upstream
Machinery	82	64,0	Surface water	Scope 3 upstream
Gas Utilities	18	63,8	Surface water	Scope 3 upstream
Hotels, Restaurants & Leisure	62	62,8	Groundwater	Scope 3 upstream
Construction Materials	20	62,1	Surface water	Scope 3 upstream
Building Products	25	60,3	Groundwater	Scope 3 upstream
Automobiles	49	60,2	Surface water	Scope 3 upstream
Transportation Infrastructure	24	59,6	Climate regulation	Scope 3 upstream
Health Care Equipment & Supplies	48	59,3	Surface water	Scope 3 upstream
Pharmaceuticals	81	59,2	Surface water	Scope 3 upstream
Independent Power and Renew. Electr. Produc.	37	12,3	Surface water	Scope 3 upstream
Energy Equipment & Services	8	58,6	Groundwater	Scope 3 upstream
Paper & Forest Products	12	58,2	Surface water	Scope 3 upstream
Metals & Mining	106	57,9	Surface water	Scope 3 upstream
Aerospace & Defense	37	57,4	Surface water	Scope 3 upstream
Construction & Engineering	29	57,3	Surface water	Scope 3 upstream
Industrial Conglomerates	38	57,1	Surface water	Scope 3 upstream

Industries (GICS Level 3)	Number of companies	Average dependencies	Main ES	Main scope
Electrical Equipment	56	57,1	Surface water	Scope 3 upstream
Containers & Packaging	13	56,8	Surface water	Scope 3 upstream
Life Sciences Tools & Services	26	56,6	Surface water	Scope 3 upstream
Chemicals	132	56,5	Surface water	Scope 3 upstream
Electronic Equipment, Instruments & Compon.	78	56,5	Surface water	Scope 1
Passenger Airlines	19	55,9	Mass stabilization and erosion control	Scope 1
Oil, Gas & Consumable Fuels	100	55,6	Surface water	Scope 3 upstream
Ground Transportation	29	55,5	Surface water	Scope 3 upstream
Semiconductors & Semiconductor Equipment	92	55,3	Surface water	Scope 3 upstream
Biotechnology	37	54,5	Surface water	Scope 3 upstream
Household Durables	30	52,3	Surface water	Scope 3 upstream
Marine Transportation	14	52,2	Surface water	Scope 1
Real Estate Management & Development	68	51,6	Surface water	Scope 3 upstream
Multi-Utilities	19	51,0	Mass stabilization and erosion control	Scope 3 upstream
Communications Equipment	16	48,9	Surface water	Scope 3 upstream
Specialty Retail	42	48,8	Mass stabilization and erosion control	Scope 3 upstream
Interactive Media & Services	22	48,7	Surface water	Scope 3 upstream
Distributors	5	48,7	Mass stabilization and erosion control	Scope 3 upstream
Technology Hardware, Storage & Peripherals	38	48,4	Surface water	Scope 3 upstream
Wireless Telecommunication Services	26	48,2	Climate regulation	Scope 1
Electric Utilities	58	47,7	Mass stabilization and erosion control	Scope 3 upstream
Trading Companies & Distributors	27	45,6	Mass stabilization and erosion control	Scope 3 upstream
Entertainment	41	45,3	Mass stabilization and erosion control	Scope 3 upstream
Health Care Providers & Services	43	44,5	Surface water	Scope 3 upstream
Diversified Telecommunication Services	37	44,4	Climate regulation	Scope 1

Industries (GICS Level 3)	Number of companies	Average dependencies	Main ES	Main scope
Consumer Staples Distribution & Retail	49	43,8	Mass stabilization and erosion control	Scope 3 upstream
Professional Services	27	43,7	Surface water	Scope 3 upstream
Commercial Services & Supplies	21	43,5	Surface water	Scope 3 upstream
Automobile Components	32	42,9	Mass stabilization and erosion control	Scope 3 upstream
Diversified Consumer Services	6	41,5	Mass stabilization and erosion control	Scope 3 upstream
Health Care Technology	2	41,4	Surface water	Scope 3 upstream
Software	66	41,4	Mass stabilization and erosion control	Scope 3 upstream
Broadline Retail	26	41,3	Mass stabilization and erosion control	Scope 3 upstream
Media	22	38,3	Mass stabilization and erosion control	Scope 3 upstream
IT Services	41	37,4	Mass stabilization and erosion control	Scope 3 upstream

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This report provides the main figures and messages from the study. The underlying company-level data set is exclusively available to FfB Foundation members.

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