



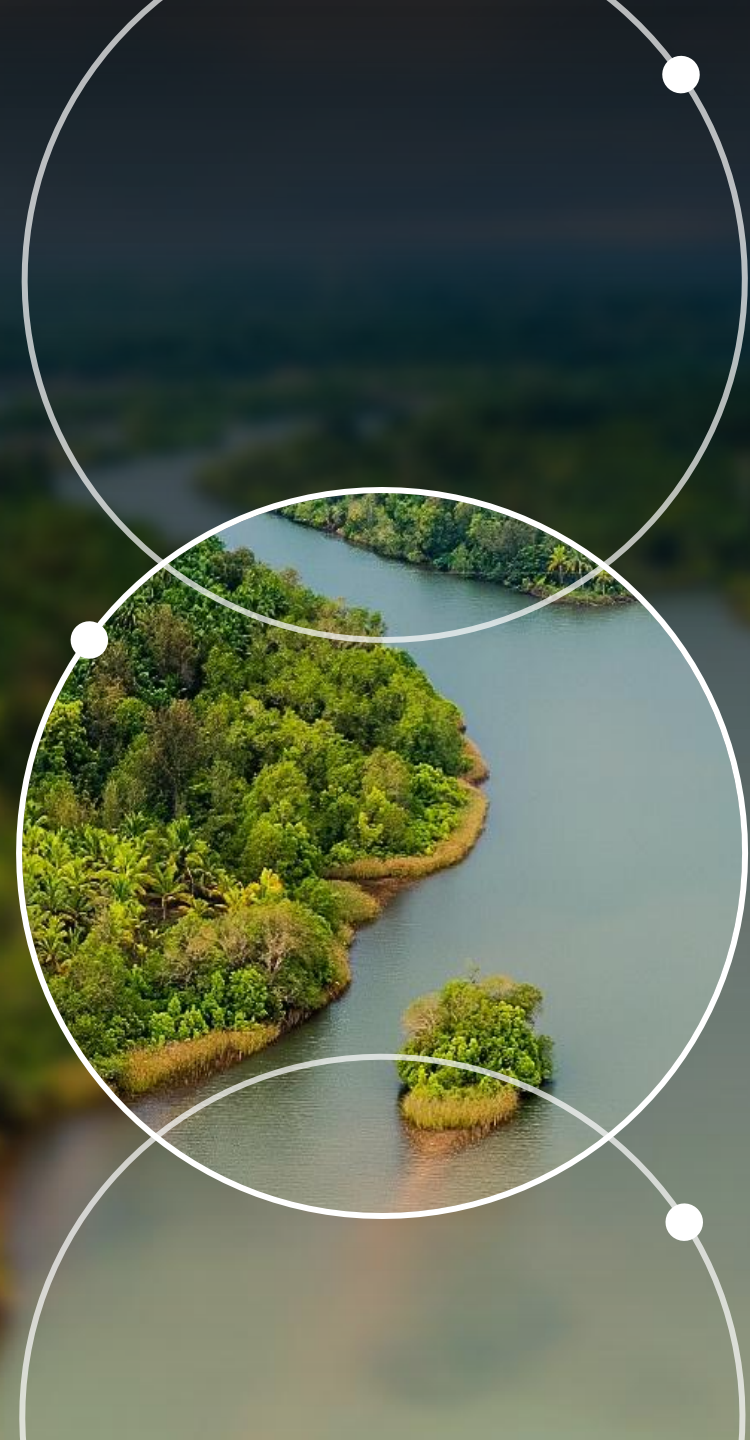
Case study – Part 1

# Identifying nature-related risks

From global portfolios to local risks



Enabled with data from  
the WWF Risk Filter Suite



# Authors

**Nicola Lei-Ravello**

**Partnership Lead**

WWF RFS for Financial Institutions  
WWF Switzerland

**Liam Bailey**

**Geospatial Analyst Risk Filter Suite**

WWF Germany

**Bettina Meyer**

**Nature Modeling Lead**

MSCI

**Thierry Corti**

**Nature R&D Lead**

MSCI

Acknowledgement:

We would like to acknowledge the following people for their input and valuable feedback: Amandine Favier (WWF CH), Regula Hess (WWF CH), Rebekah Church (WWF DE), Nicolas Poolen (WWF Int.), Ariane Laporte-Bisquit (WWF DE), and Maria Walsh (WWF DE).

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# Introduction

**In April 2025, MSCI released the World Wildlife Fund Biodiversity Risk Filter (WWF BRF) indicators mapped to MSCI GeoSpatial Asset Intelligence. The objective of MSCI GeoSpatial Asset Intelligence is to provide an organized global dataset of physical assets and their relevant attributes owned and operated by public and private companies. Together, these data provide transparency and granularity on how nature-related risks affect companies' direct operations, supporting investors in assessing their exposure to nature-related risks across physical assets<sup>1</sup> covered in MSCI's dataset.**

The WWF BRF is an online tool launched in 2023 to help corporate actors and financial institutions identify the nature-related risks — both physical and reputational dimensions — of their operations. Physical risks arise when companies depend on natural resources or well-functioning ecosystems that are at risk of being degraded or scarce. Reputational risks arise when a company's activities negatively affect ecosystems. The tool provides global maps for 33 nature-related indicators, 17 of which have been integrated by MSCI as new layers within MSCI GeoSpatial Asset Intelligence and is primarily focused on physical risks. There are plans to include additional physical and reputational risk indicators in the near future.

At the geospatial level, WWF BRF nature-related indicators consist of two components:<sup>2</sup>

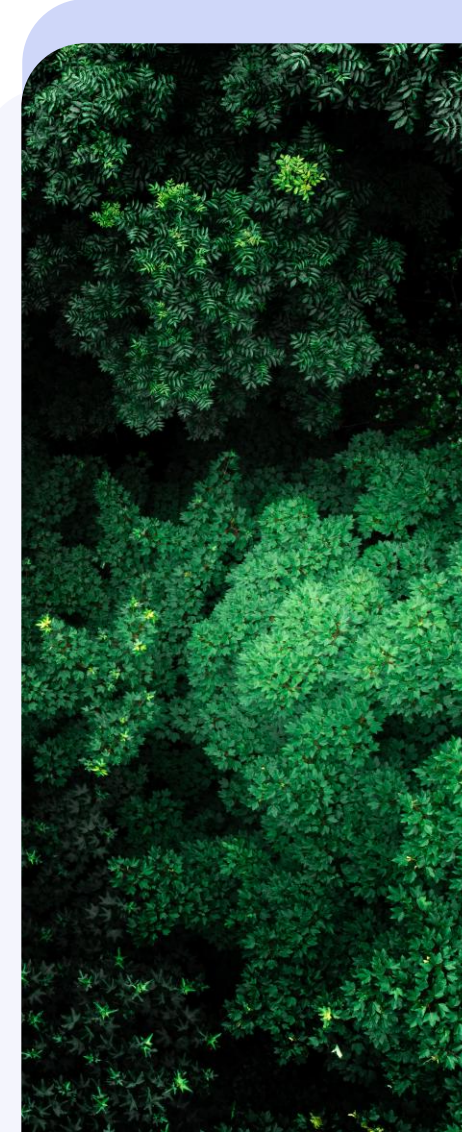
- **State of nature** – the condition of a given indicator within a particular region or watershed.
- **Activity relevance** – the relevance of a given indicator to a specific business activity. This brings the materiality consideration from the broad sector level to the operational level.

This structure ensures that WWF BRF risk indicators are both activity- and location-specific.

Through their integration into MSCI GeoSpatial Asset Intelligence, geospatial data of nature-related risks for assessing exposure to nature-related risks are now more widely accessible to investors. Unlike traditional approaches that rely on country averages or company-wide risk indicators, geospatial analysis evaluates risk exposure<sup>3</sup> at the location where a company operates. This accounts for the local state of a specific ecosystem service on which the respective company activity depends. This “location-specific” perspective is essential because nature-related risks can vary substantially between different locations.

The challenge for investors using a location-specific perspective is the need to consider risk exposure across hundreds or thousands of locations. To help investors transform the wealth of available geospatial data into actionable insights, MSCI Sustainability and Climate (MSCI S&C), with the support of WWF, developed the issuer-level Biodiversity Risk Metrics that aggregate nature-related risk information across all operational assets of a company. These metrics provide a more digestible company-level view that is still grounded in spatial reality, capturing the heterogeneity of local risk profiles across regions and activities.

- **This study begins by introducing the Biodiversity Risk Metrics, then demonstrates their application through a step-wise, top-down approach to identify and analyze nature-related risks in a portfolio. Starting at the portfolio level, it identifies the most material nature-related risks, with water availability and pollution emerging as the key non-climate-related risks.**
- **The analysis then explores how these risks are distributed across sectors, highlighting both those sectors with highest exposure and those where exposure is most widespread.**
- **Building on this, the focus shifts to the company level, assessing potential impacts on profitability and operational concentration to pinpoint companies to whose operations water scarcity may pose the greatest challenges.**
- **The study concludes by translating these findings into engagement and stewardship priorities, outlining how investors can respond to the risks identified.**





# Introducing the company Biodiversity Risk Metrics

The WWF BRF was designed to reflect nature-related risks at operational level, considering asset-specific activities. The company Biodiversity Risk Metrics aggregate this to company level, to understand how the operational risk translates into risk at company and portfolio level.

For every company in the MSCI ACWI Investable Market Index (IMI) and each risk indicator of the WWF BRF, the following key indicators are provided:

1.

**High-Risk Output Share:** Share of a company's revenue generated at assets that are exposed to high nature-related risk (underlying WWF BRF indicator value > 3.4)
2.

**Risk Flag:** Binary flag (TRUE or FALSE) indicating substantial revenue exposure to specific nature-related risks (> 5% of company revenue exposed to high risk)
3.

**High-Risk Asset Count:** Count of asset locations exposed to high risk (WWF BRF indicator value > 3.4)

The Biodiversity Risk Metrics use the latest methodology from MSCI that estimates how much of the total company revenue is generated at each physical asset.<sup>4</sup> This approach provides investors with a financially material view of nature-related risk, integrating the business relevance of individual operations to reflect potential impacts on revenue

generation and cash flow. Similar levels of High-Risk Output Share do not translate into the same frequency and severity of financial loss across indicators. Financial quantification of the actual revenue loss requires more information, e.g., on vulnerability and mitigation practices.

Exhibit 1 illustrates the Biodiversity Risk Metrics for a major beverage company. Out of 1,155 company assets, 396 locations (34%) show exposure to high *Water Condition* risk.<sup>5</sup> Estimated values for the output share of each asset approximate that up to 73% of the company's total revenue is generated at assets exposed to high Water Condition risk; making scarcity of clean freshwater a critical vulnerability for both the company's revenue and its investors. The Risk Flag (TRUE or FALSE) supports rapid screening for companies whose exposure to nature-related risks exceeds 5% of the company revenue, enabling risk managers to quickly identify the material risks.

These metrics are intended for use by front-office teams, providing investment analysts and portfolio managers with clear, financially relevant indicators of operational exposure. Linking the abstract risk scores with financial exposure and business continuity makes them highly relevant for investment decision-making.

Exhibit 1: Dashboard illustrating the Biodiversity Risk Metrics for an example company

| Company X: Biodiversity Risk Metrics    |                        |           |                       |
|-----------------------------------------|------------------------|-----------|-----------------------|
| Indicator                               | High Risk Output Share | Risk Flag | High Risk Asset Count |
| BRF Water Availability                  | 26%                    | TRUE      | 200                   |
| BRF Timber Provision                    | 0%                     | FALSE     | 2                     |
| BRF Soil Condition                      | 0%                     | FALSE     | 2                     |
| BRF Water Condition                     | 73%                    | TRUE      | 396                   |
| BRF Air Condition                       | 2%                     | FALSE     | 55                    |
| BRF Ecosystem Condition, Dependency     | 0%                     | FALSE     | 3                     |
| BRF Pollination                         | 0%                     | FALSE     | 3                     |
| BRF Landslides                          | 10%                    | TRUE      | 147                   |
| BRF Wildfire Hazard                     | 17%                    | TRUE      | 287                   |
| BRF Herbicide Resistance                | 0%                     | FALSE     | 3                     |
| BRF Extreme Heat                        | 51%                    | TRUE      | 511                   |
| BRF Tropical Cyclones                   | 28%                    | TRUE      | 320                   |
| BRF Land, Freshwater and Sea Use Change | 0%                     | FALSE     | 54                    |
| BRF Forest Canopy Loss                  | 0%                     | FALSE     | 47                    |
| BRF Invasive Species                    | 20%                    | TRUE      | 177                   |
| BRF Pollution                           | 39%                    | TRUE      | 286                   |
| BRF Ecosystem Condition, Impact         | 0%                     | FALSE     | 5                     |

Risk Flag is triggered if High Risk Output Share > 5%

# Headquarter analysis

## The need for geospatially informed company data

To illustrate why geospatially informed company metrics are essential, this report compares the High-Risk Output Share metric with exposure data derived from WWF BRF country-level risk averages at company headquarter locations. While company headquarter proxies are useful for raising awareness, they are not precise enough to base investment decision on, due to two limitations:

- High spatial variability:** Nature-related risks can vary dramatically within a single country, especially for larger countries where the different states of nature can vary across different climate zones and ecoregions. For example, the country-average data have estimated the *Water Availability* risk for the U.S. at 2.11 (out of 5), which masks the severe water stress in the western states by averaging it with wetter regions in the east.
- Globalized operations:** Many companies rely on offshore production, meaning their exposure often lies in foreign high-risk regions, not the country where their headquarters are located.

For all companies in the MSCI ACWI IMI, the analysis compares the High-Risk Output Share metric with the risk level at the headquarters' location. This second metric is often applied due to the lack of more granular data, even though it reflects the very rough assumption that the entire company's revenue is exposed to the country-average risk corresponding to the headquarters' location. A difference between the two metrics reflects spatial variability of risks within countries and relevance of offshore production.

Since the High-Risk Output Share and country-level risk levels are expressed in different units, buckets are defined for 'low', 'medium', and 'high' risk exposure, based on which of the two metrics can be compared. For the country-level data assessed at headquarter locations, the categorization follows the buckets defined by the WWF BRF methodology at a 1–5 scale: low risk: < 2.2, medium risk: 2.2–3.4, high risk: > 3.4. The High-Risk Output Share metric is categorized in the following buckets: Low risk: < 5%, medium risk: 5%–10%, high risk: > 10%.

This results in a 3 × 3 matrix (Exhibit 2). Exposure to water risk is likely to be underestimated for almost 35% of the companies when considering country averages.

- More than 17% (i.e., 1,290 out of 7,372) of companies in the MSCI ACWI IMI are classified as low risk exposure by country averages, while having high risk exposure based on geospatial revenue metrics. This indicates a severe underestimation of risk.
- For roughly 15% of the companies, risk is mildly underestimated — such as low vs. medium and medium vs. high — with 417 and 696 companies, respectively.

Exhibit 3 shows the market capitalization of the assessed companies. A headquarter-based assessment likely underestimates the risk exposure of approximately 40% of the portfolio value, including 28% that is severely underestimated.

This demonstrates the potential for misestimating exposure when relying on country-level proxies instead of geospatially informed metrics, which can improve the precision of risk assessments. At the same time, the reliability of such analysis depends on the completeness and quality of underlying asset-level data; gaps in coverage may affect the accuracy of the results.

Exhibit 2: Percentage of companies per risk category, comparing Water Availability risks exposure based on country averages (rows) vs. geospatially based Biodiversity Risk Metrics

Percentage of Companies Per Risk Categories

| Country Average / High-Risk Output Share | Low (<5%) | Medium (>5% & <10%) | High (>10%) |
|------------------------------------------|-----------|---------------------|-------------|
| Low (<2.2)                               | 42%       | 6%                  | 17%         |
| Medium (>2.2 & <3.4)                     | 20%       | 1%                  | 9%          |
| High (>3.4)                              | 3%        | 0%                  | 1%          |
| Total Underestimated                     |           |                     | 33%         |

Exhibit 3: Percentage of market value per risk category combination, comparing Water Availability risks exposure based on country averages (rows) vs. geospatially based Biodiversity Risk Metrics

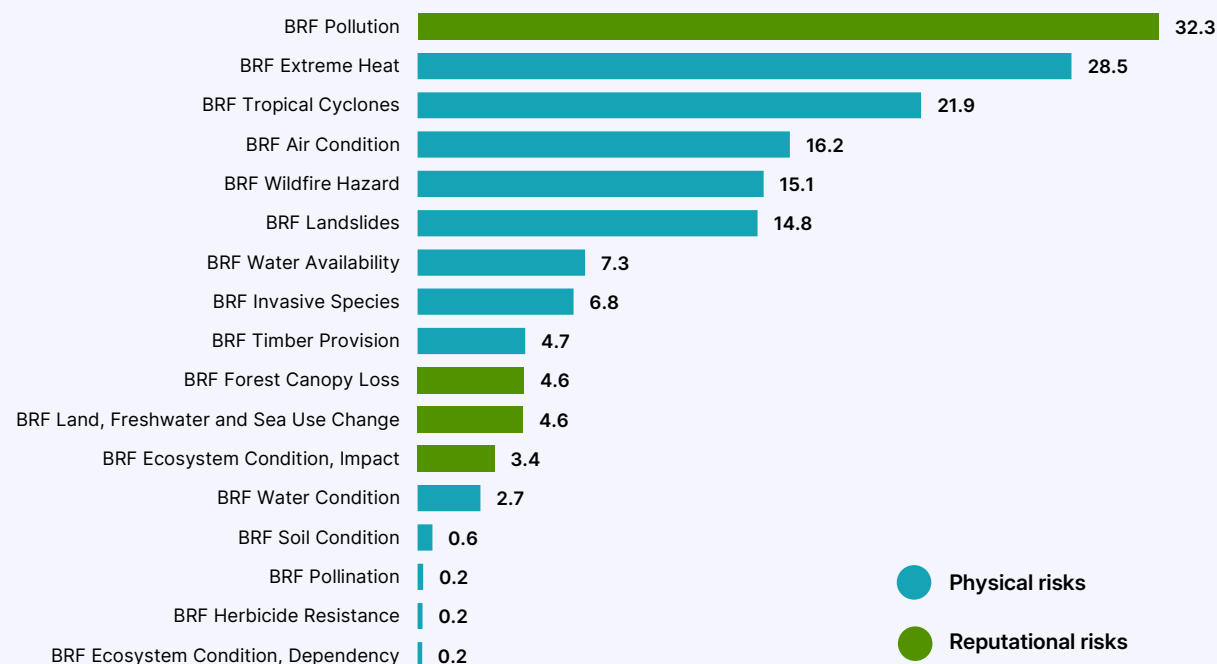
Market Portfolio Value per Per Risk Categories

| Country Average / High-Risk Output Share | Low (<5%) | Medium (>5% & <10%) | High (>10%) |
|------------------------------------------|-----------|---------------------|-------------|
| Low (<2.2)                               | 43%       | 7%                  | 28%         |
| Medium (>2.2 & <3.4)                     | 13%       | 1%                  | 5%          |
| High (>3.4)                              | 1%        | 0%                  | 2%          |
| Total Underestimated                     |           |                     | 40%         |

## Screening a global financial portfolio

The case study starts with a portfolio-level analysis of nature-related risks, considering a hypothetical portfolio based on constituents of the MSCI ACWI IMI. This serves both as an example of a portfolio analysis and, given the global coverage of the MSCI ACWI IMI, as a proxy for market exposure (see Section 4).

**Exhibit 4:** Total revenue generated by asset locations operated by constituents of the MSCI ACWI IMI that are exposed to high nature-related risks (USD trillion)



By combining a company's High-Risk Output Share (in %) with its total revenue, the absolute revenue generated by assets exposed to high nature-related risks can be calculated for each type of nature-related risk (i.e., for any of the 17 BRF nature-related indicators onboarded to MSCI GeoSpatial Asset Intelligence). These numbers can be aggregated to portfolio level, as illustrated in Exhibit 4.

Such an overview allows one to identify the major risks to which the portfolio is exposed. The risks appearing with the highest portfolio-aggregated high-risk revenue values, such as the climate-related risks of Heat Hazard, Tropical Cyclones or Wildfire Hazard, are relevant for most companies and across all sectors. Other risks, such as Soil Condition, Pollination or Herbicide Resistance, may appear less relevant at the portfolio level but are highly material for specific sectors such as agriculture.

These sectoral dynamics are explored in greater detail in the next sections, with a focus on purely nature-specific risks: Water Availability as a major physical risk and Pollution as a reputational risk. A similar analysis can be replicated on any given portfolio — where in a more local distribution of companies the sectoral distribution may be the main cause of differentiation in risks.

## Sectoral exposure

Similar to the portfolio-level analysis, the Biodiversity Risk Metrics can be aggregated at the sector level to provide insights into financial exposure by sector.

This perspective is aligned with disclosure frameworks such as the recommendations by the Taskforce on Nature-related Financial Disclosures (TNFD),<sup>6</sup> while offering a more granular view because it is grounded in asset-specific information on activities and geographic location.

Analyzing again the hypothetical portfolio based on constituents of the MSCI ACWI IMI, Exhibit 5 presents the percentage of revenue generated by assets exposed to high nature-related risks for each Global Industry Classification Standard (GICS) sector and across all indicators.

Exhibit 5: Sectoral breakdown of percentage of revenue that is exposed to nature-related risks

| Categories               | GICS / BRF Scores                       | Energy | Materials | Industrials | Consumer Discretionary | Consumer Staples | Health Care | Financials | Information Technology | Communication Services | Utilities | Real Estate | Total |
|--------------------------|-----------------------------------------|--------|-----------|-------------|------------------------|------------------|-------------|------------|------------------------|------------------------|-----------|-------------|-------|
| Air & Water Dependencies | BRF Water Availability                  | 24.4%  | 23.3%     | 11.7%       | 8.4%                   | 13.7%            | 11.2%       | 0.8%       | 12.3%                  | 5.0%                   | 38.3%     | 7.1%        | 11.8% |
|                          | BRF Water Condition                     | 0.0%   | 9.9%      | 1.6%        | 5.1%                   | 21.3%            | 4.4%        | 0.3%       | 0.1%                   | 3.8%                   | 2.1%      | 9.2%        | 4.4%  |
|                          | BRF Air Condition                       | 29.2%  | 23.0%     | 25.3%       | 18.8%                  | 12.5%            | 8.4%        | 45.2%      | 26.7%                  | 27.9%                  | 26.0%     | 37.1%       | 26.2% |
| Resources Dependencies   | BRF Timber Provision                    | 44.7%  | 36.0%     | 4.7%        | 3.4%                   | 5.8%             | 2.9%        | 0.6%       | 1.0%                   | 1.5%                   | 36.7%     | 0.5%        | 14.2% |
|                          | BRF Soil Condition                      | 0.0%   | 23.8%     | 2.2%        | 5.2%                   | 2.2%             | 0.0%        | 1.0%       | 0.1%                   | 18.2%                  | 1.5%      | 6.6%        | 4.4%  |
|                          | BRF Ecosystem Condition, Dependency     | 0.0%   | 21.3%     | 1.6%        | 0.3%                   | 2.1%             | 0.0%        | 0.0%       | 0.1%                   | 10.5%                  | 0.1%      | 0.0%        | 2.7%  |
|                          | BRF Pollination                         | 0.0%   | 26.8%     | 2.4%        | 0.3%                   | 2.3%             | 0.0%        | 0.0%       | 0.1%                   | 11.5%                  | 0.1%      | 0.0%        | 3.4%  |
|                          | BRF Herbicide Resistance                | 0.0%   | 21.7%     | 0.7%        | 0.0%                   | 2.0%             | 0.0%        | 0.0%       | 0.1%                   | 0.1%                   | 0.2%      | 0.0%        | 1.5%  |
| Climate Dependencies     | BRF Landslides                          | 17.7%  | 24.4%     | 23.6%       | 24.3%                  | 20.5%            | 17.5%       | 23.3%      | 33.7%                  | 31.4%                  | 27.6%     | 37.4%       | 23.9% |
|                          | BRF Wildfire Hazard                     | 28.3%  | 29.8%     | 23.4%       | 20.3%                  | 28.1%            | 22.4%       | 23.0%      | 24.0%                  | 28.4%                  | 25.5%     | 18.0%       | 24.3% |
|                          | BRF Extreme Heat                        | 50.9%  | 41.1%     | 46.1%       | 38.9%                  | 38.8%            | 45.8%       | 56.5%      | 37.9%                  | 44.8%                  | 49.8%     | 58.7%       | 46.0% |
|                          | BRF Tropical Cyclones                   | 29.8%  | 41.4%     | 38.1%       | 32.8%                  | 33.3%            | 37.5%       | 35.2%      | 39.6%                  | 26.9%                  | 35.6%     | 50.8%       | 35.4% |
| Impact Drivers           | BRF Land, Freshwater and Sea Use Change | 37.6%  | 15.6%     | 12.0%       | 0.9%                   | 0.6%             | 0.6%        | 0.3%       | 3.0%                   | 2.4%                   | 12.7%     | 0.7%        | 7.4%  |
|                          | BRF Forest Canopy Loss                  | 26.3%  | 22.4%     | 10.7%       | 2.9%                   | 0.3%             | 1.0%        | 0.3%       | 1.5%                   | 4.3%                   | 29.5%     | 3.1%        | 7.5%  |
|                          | BRF Invasive Species                    | 20.7%  | 16.7%     | 17.2%       | 18.8%                  | 22.7%            | 7.6%        | 1.4%       | 10.3%                  | 13.6%                  | 5.5%      | 17.9%       | 14.6% |
|                          | BRF Pollution                           | 81.0%  | 83.7%     | 60.9%       | 63.5%                  | 54.8%            | 72.1%       | 4.6%       | 60.8%                  | 17.6%                  | 72.7%     | 24.9%       | 52.1% |
|                          | BRF Ecosystem Condition, Impact         | 24.3%  | 15.7%     | 5.2%        | 0.3%                   | 0.2%             | 0.6%        | 0.3%       | 0.3%                   | 1.9%                   | 31.4%     | 0.2%        | 5.4%  |

## Sectoral exposure (cont.)

Several patterns emerge:

- **Climate-related risks** are largely sector-agnostic and affect all sectors.
- **Water Availability risk** is most pronounced in the utilities sector, where more than 38% of revenue is generated by assets exposed to high Water Availability risks. Similarly high values are also observed for the energy and materials sectors.
- **Energy, materials and utilities** stand out as sectors that exhibit the largest financial exposures to reputational risks related to Land-Use Change, Forest Canopy Loss, and Ecosystem Condition Impact. This is consistent with their extractive nature and operations in biodiversity-sensitive regions. The materials sector stands out in particular, with substantial exposure across nearly all risk indicators. This will be discussed in more detail.

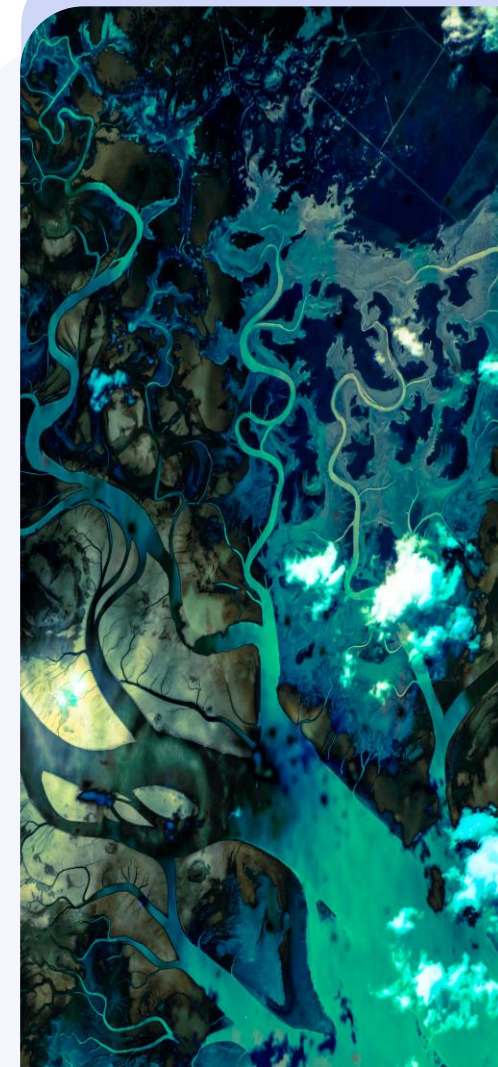
Interestingly, the financials sector, often perceived as “asset-light,” is not immune to nature-related risks. Around 45% of its revenue is generated at assets exposed to high Air Pollution risk, and approximately 55% at assets exposed to high Heat Hazard. Both indicators relate to adverse impacts of degraded ecosystems and climate change on human health and labor efficiency. While only a portion of this exposed revenue may be expected to translate into direct financial losses, managing these risks may require companies to implement adaptation measures to safeguard employees and maintain

appropriate working conditions—potentially resulting in additional costs. This underlines that service-oriented and office-based sectors are not fully shielded from nature-related risks, even in their direct operations.

It is important to emphasize that the materials sector also includes the production of other commodities, such as minerals or chemicals. This highlights the need for greater sectoral granularity to differentiate sub-industries with distinct nature-related risk profiles. Moving to GICS industries or sub-industries can help investors to more accurately identify and differentiate exposure, and to better understand where nature-related risks are concentrated.

These results enable two complementary perspectives: they highlight the sectors with the greatest exposure — such as the materials sector in this example — and identify the most relevant risk indicator across all sectors — such as Pollution and Water Availability. Overall, these sectoral insights are essential for portfolio risk management and align with TNFD reporting requirements.

**By combining the sectoral portfolio weights with the revenue-based estimates of financial exposure for sectors with high nature-related risks, investors can develop a refined view of their sectoral exposure to risky cash flows.**





## Identifying individual companies for engagement and risk mitigation

**Nature-related risks are so widespread across activities and geographies that it is difficult to build a portfolio of companies unaffected by them. Stewardship and engagement are among the most effective ways to mitigate exposure to nature-related risks in portfolios.**

The Biodiversity Risk Metrics are designed to support investors in screening portfolios for exposure to nature-related risks and identify priority companies for engagement and risk mitigation. The metrics answer two critical questions:

- Which companies are most exposed to nature-related risks?
- What specific nature-related risks are material for those companies?

Best practices for stewardship processes have been put forward that focus on individual aspects and then can be extended over time. Such practices entail focusing on: (i) a subset of companies representing a large portfolio allocation, or the companies with the most risks;<sup>7</sup> (ii) a specific sector, such as the *materials* sector;<sup>8</sup> or (iii) a single risk, such as water availability.<sup>9</sup>

This section focuses on option (i). Using again a hypothetical portfolio based on constituents of the MSCI ACWI IMI, it showcases how a subset of high-value companies with the greatest exposure to nature-related risks can be identified. Options (ii) and (iii) are discussed in Sections 3.4 and 3.5. Option (ii) relies on first identifying a focus sector

(see Section 3.4), to then single out particularly vulnerable companies within that sector. Option (iii) focuses on a specific risk, where Sections 3.4 and 3.5 explore two methodologies using *Water Availability* as an example. Section 3.4 selects companies where high-risk exposure has the greatest relative impact on profitability. Section 3.5 identifies companies that may be particularly vulnerable based on the geographic concentration of revenue-relevant operations.

Exhibit 6 (overleaf) presents a heat map of the Risk Flag metrics for the 50 largest companies in the MSCI ACWI IMI by market capitalization. This flag is triggered when more than 5% of a company's revenue is exposed to a specific high-risk indicator.

This heat map addresses the guiding questions as follows:

- Several firms exhibit exposure to a wide range of risks, with about a dozen companies having eight or more flags triggered, meaning that more than eight different nature-related risks are relevant to them. These companies represent a good starting point for further analysis and engagement. If the number of identified companies should be further narrowed down, the Risk Flag can be combined with the High-Risk Output Share to quantify the level of risk exposure.
- Extreme weather hazards dominate once again, with risk flags triggered across almost all companies. These risks are mitigated by healthy ecosystems more generally, as a healthy state of nature acts as a buffer against the consequences of extreme weather, while any degradation of nature further reinforces these risks.

**Given the potential financial implications of nature-related risks, asset managers should aim to manage exposure to all such risks across all companies and sectors. Building such capacities, however, requires time and resources.**

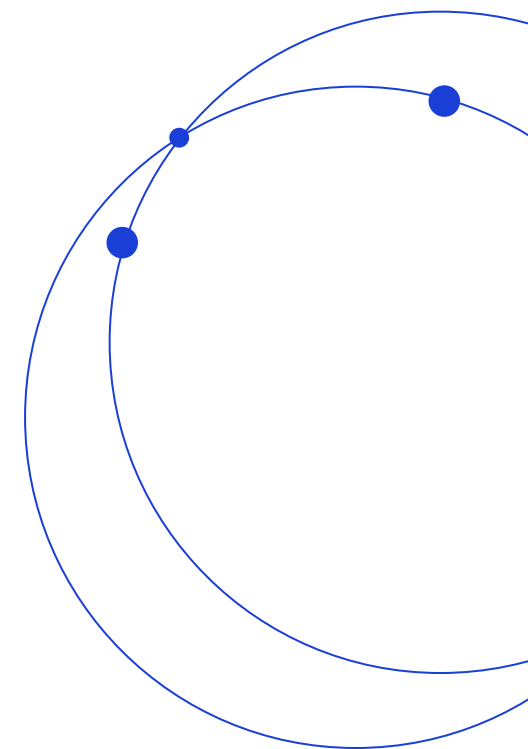


Exhibit 6: Heat map of Risk Flags for 50 biggest companies within the MSCI ACWI IMI.

|                        | BRF Water Availability | BRF Timber Provision | BRF Soil Condition | BRF Water Condition | BRF Air Condition | BRF Ecosystem Condition, Dependency | BRF Pollination | BRF Landslides | BRF Wildfire Hazard | BRF Extreme Heat | BRF Tropical Cyclones | BRF Land, Freshwater and Sea Use Change | BRF Forest Canopy Loss | BRF Invasive Species | BRF Pollution | BRF Ecosystem Condition, Impact | # Flagged Indicators |
|------------------------|------------------------|----------------------|--------------------|---------------------|-------------------|-------------------------------------|-----------------|----------------|---------------------|------------------|-----------------------|-----------------------------------------|------------------------|----------------------|---------------|---------------------------------|----------------------|
| Information Technology | 1                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 0                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Information Technology | 0                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 6                    |
| Information Technology | 1                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 0                    | 1             | 1                               | 9                    |
| Communication Services | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |
| Consumer Discretionary | 0                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Information Technology | 1                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 1                    | 1             | 1                               | 10                   |
| Energy                 | 1                      | 1                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 1                    | 1             | 1                               | 11                   |
| Communication Services | 0                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 4                    |
| Consumer Discretionary | 1                      | 0                    | 0                  | 0                   | 0                 |                                     |                 | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Information Technology | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 0                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 1                               | 5                    |
| Financials             | 0                      | 0                    | 0                  | 0                   | 0                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 5                    |
| Financials             | 0                      | 0                    | 0                  | 0                   | 0                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 4                    |
| Health Care            | 0                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 5                    |
| Consumer Staples       | 0                      | 0                    |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 6                    |
| Communication Services | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |
| Information Technology | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |
| Financials             | 0                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 0                               | 4                    |
| Information Technology | 1                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 8                    |
| Financials             | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 0                               | 5                    |
| Information Technology | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 0                               | 5                    |
| Energy                 | 1                      | 0                    | 0                  | 0                   | 1                 | 0                                   | 0               | 0              | 1                   | 0                | 0                     | 1                                       | 1                      | 1                    | 1             | 1                               | 9                    |
| Communication Services | 0                      | 0                    | 0                  | 0                   | 0                 |                                     |                 | 1              | 1                   | 0                | 0                     | 0                                       | 0                      | 0                    | 1             | 0                               | 3                    |
| Health Care            | 1                      | 0                    | 0                  | 0                   | 0                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Information Technology | 1                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 7                    |
| Information Technology | 1                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 7                    |
| Consumer Staples       | 0                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 6                    |
| Consumer Discretionary | 0                      | 0                    | 0                  | 0                   | 1                 |                                     |                 | 0              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 6                    |
| Financials             | 0                      | 0                    | 0                  | 0                   | 1                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |
| Financials             | 0                      | 1                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 1                               | 7                    |
| Consumer Discretionary | 0                      | 0                    |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 6                    |
| Health Care            | 1                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Financials             | 0                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |
| Consumer Discretionary | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Consumer Discretionary | 1                      | 1                    | 0                  | 0                   | 1                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 9                    |
| Consumer Staples       | 1                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 7                    |
| Industrials            | 1                      | 0                    |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 1                    | 1             | 1                               | 9                    |
| Information Technology | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 0                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 4                    |
| Consumer Discretionary | 1                      | 0                    | 0                  | 0                   | 1                 |                                     |                 | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 8                    |
| Information Technology | 0                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 0                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 1                               | 5                    |
| Energy                 | 1                      | 1                    |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 1                    | 1             | 1                               | 10                   |
| Health Care            | 1                      | 0                    |                    | 1                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 7                    |
| Information Technology | 1                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 1                      | 1                    | 1             | 1                               | 10                   |
| Consumer Staples       | 1                      |                      |                    | 1                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 1             | 1                               | 9                    |
| Information Technology | 0                      | 0                    | 0                  | 0                   | 1                 | 0                                   | 0               | 0              | 0                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 4                    |
| Financials             | 0                      | 0                    |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 4                    |
| Financials             | 0                      | 0                    |                    | 0                   | 1                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 0                               | 5                    |
| Industrials            | 1                      | 0                    | 0                  | 0                   | 1                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 7                    |
| Information Technology | 1                      |                      |                    | 0                   | 1                 |                                     |                 | 1              | 0                   |                  | 1                     | 1                                       | 0                      | 0                    |               | 1                               | 6                    |
| Health Care            | 1                      |                      |                    | 0                   | 0                 |                                     |                 | 1              | 1                   |                  | 1                     | 1                                       | 0                      | 0                    | 0             | 1                               | 6                    |
| Financials             | 0                      | 0                    | 0                  | 0                   | 1                 | 0                                   | 0               | 1              | 1                   | 0                | 1                     | 1                                       | 0                      | 0                    | 0             | 0                               | 5                    |

■ means the flag is True, ■ means the flag is False, and blank indicates that a given indicator is not relevant for the respective company (no sector materiality).

## Prioritization based on impact on profitability

**Assessing a company's share of revenue exposed to nature-related risks provides an important indication of where to focus engagement efforts. Further insights may come from assessing financial vulnerability — if revenues are lost, which companies are likely to see the biggest impact on profitability, cash flow and overall financial health? Focusing on companies that are both exposed to potential revenue loss and financially vulnerable could allow for a more efficient use of limited engagement resources.**

A real-world example of a substantial impact on profit margins due to nature-related risks happened in 2024, when a major Porsche supplier experienced severe flooding in Southern Switzerland, shutting down a key aluminum plant for several months. The disruption forced Porsche to revise revenue expectations downward by EUR 2 billion (–4.7%), triggering a 7.7% intraday share price drop.<sup>10 11</sup> At the end of the 2024 fiscal year, Porsche reported an operating profit of EUR 5.64 billion — a significant decrease from EUR 7.28 billion in 2023. While it is difficult to quantify the exact impact of the water-related incident, it is reasonable to assume that it meaningfully affected the year-on-year decline in profit. In any case, the EUR 2 billion revenue revision represented a substantial portion (27.4%) of Porsche's 2023 profits.

To investigate systematically how much a company's profitability — not only revenue — is potentially exposed to nature-related risks, this section compares companies' High-Risk Output Share metric with their EBITDA margin.<sup>12</sup> The EBITDA margin is a widely used measure of operating profitability across sectors. Both metrics are a fraction of the overall revenue and thus allow for a straightforward comparison. To this end, the following Delta Risk indicator is introduced:

$$\text{Delta Risk} = \left( \frac{\text{High Risk Output Share}}{\text{EBITDA Margin}} \right)$$

The Delta Risk indicator provides a simple measure of the share of a company's profitability that may be exposed to nature-related risks, offering investors an indication of how much cash flow could be at stake. If a company's High-Risk Output Share exceeds its EBITDA margin, the revenue potentially exposed to high risk is greater than its entire profitability, resulting in a Delta Risk above 100%. The real-world impact of lost revenue on a company's profitability will depend on multiple factors, but this simple metric can provide investors with a first indication of which companies may be most financially vulnerable, particularly when comparing within sub-industries.

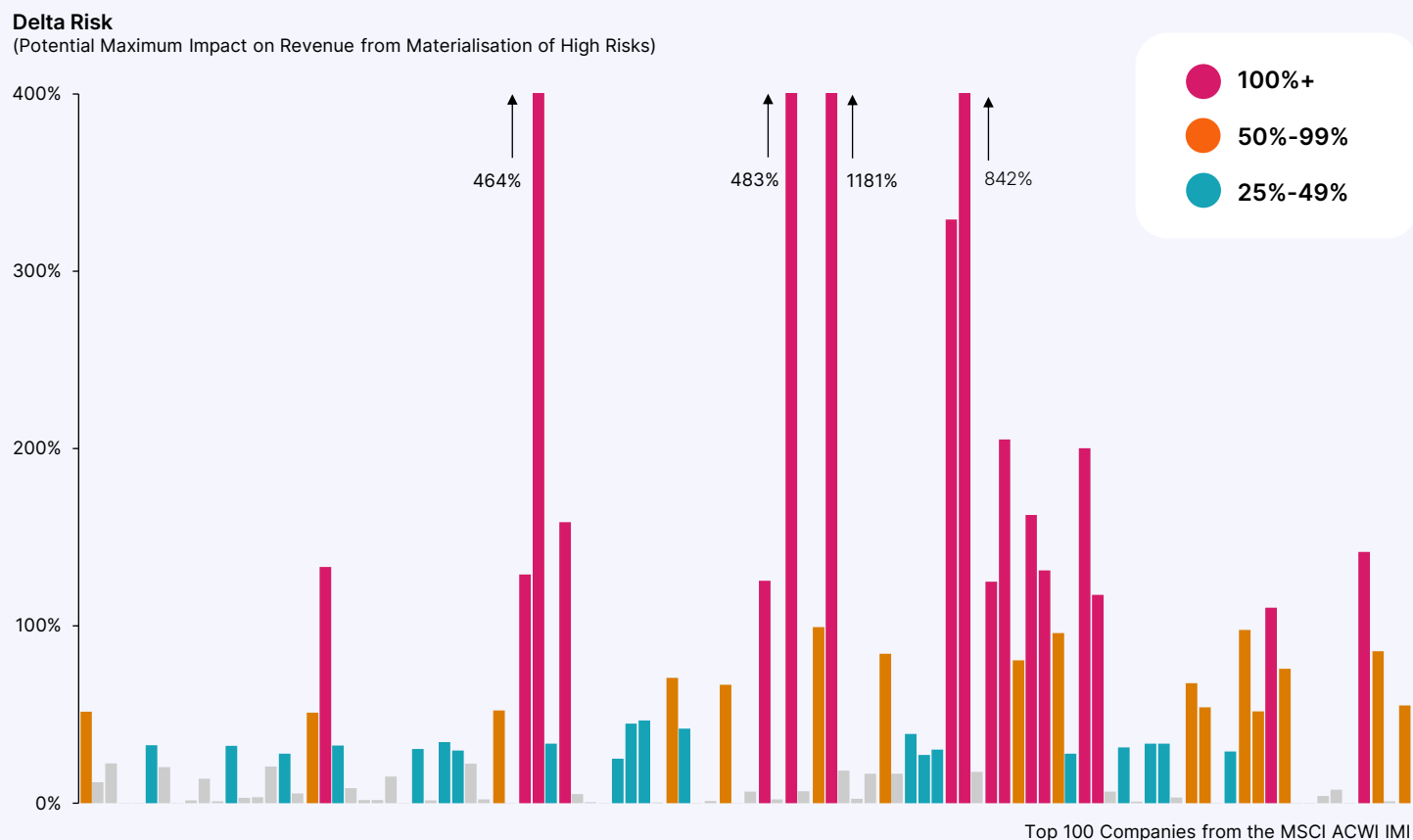


## Prioritization based on impact on profitability (cont.)

Focusing on Water Availability risk, we apply the above analysis to the 100 largest companies by market capitalization within the MSCI ACWI IMI. Figure 2 illustrates the Delta Risk indicator for this group of companies. Exhibit 7 shows the proportion of each company's profits that could potentially be exposed to high Water Availability risk, representing an upper-bound estimate of potential losses, i.e., the loss expected if the risk were to materialize across all operational assets simultaneously.

Highlighted in ■ are the 17 companies where the Delta Risk indicator is larger than 100%, i.e., companies whose revenue at risk surpasses EBITDA. A further 16 companies, highlighted in ■, have revenue at risk between 50% and 100% of EBITDA, while 20 companies, highlighted in ■, have exposed revenues equivalent to between 25% and 50% of EBITDA.

**Exhibit 7: Revenue exposed to underlying Water Availability risks as a percentage of EBITDA**





## Prioritization based on impact on profitability (cont.)

There are four outlier companies with Delta Risk greater than 400%.<sup>13</sup> For these companies, the revenue share generated by assets exposed to high Water Availability risks is at least four times higher than their profitability. For example, a large energy company generated 92.2% of its revenue through high-risk assets, while its EBITDA ratio is only 7.8%, yielding a Delta Risk indicator of 1,180.8%. This means that the assets face underlying water-scarcity risks that put at stake almost 12 times the company's annual profitability. Exhibit 8 lists the companies with the highest Delta Risks in this analysis.

When defining significant exposure as having an associated Delta Risk of more than 25%, more than half of the top 100 largest companies in the MSCI ACWI IMI exhibit significant profit exposure to water-scarcity risks.

It is important to remember that the High-Risk Output Share metric represents the potential share of revenue exposed to high nature-related risks. The Delta Risk measure therefore reflects an upper-bound estimate of the financial exposure to high-risk operations, rather than a precise quantification of the underlying risk. For a precise quantification of the impact on profit, further details on a company's financial and operational structure would be necessary: What are profitability margins at an asset level, and how are variable vs. fixed costs distributed? How geographically diversified are a company's operations?

**Exhibit 8: Companies with the highest Delta Risks from the top 100 largest companies in the MSCI ACWI IMI**

| #          | Sectors                | Market Cap (USD) | Revenue Share (%) | EBITDA Margin | Delta Risk |
|------------|------------------------|------------------|-------------------|---------------|------------|
| Company 1  | Energy                 | 235,195,364,214  | 92%               | 8%            | 1181%      |
| Company 2  | Industrials            | 207,957,950,371  | 46%               | 5%            | 842%       |
| Company 3  | Energy                 | 239,867,068,139  | 81%               | 17%           | 483%       |
| Company 4  | Health care            | 302,359,872,970  | 17%               | 4%            | 464%       |
| Company 5  | Information technology | 208,826,581,577  | 14%               | 4%            | 329%       |
| Company 6  | Communication services | 201,584,341,356  | 19%               | 9%            | 205%       |
| Company 7  | Health care            | 192,920,307,887  | 48%               | 24%           | 200%       |
| Company 8  | Consumer staples       | 196,350,041,519  | 26%               | 16%           | 163%       |
| Company 9  | Consumer staples       | 292,380,353,195  | 42%               | 26%           | 159%       |
| Company 10 | Health care            | 151,440,484,098  | 51%               | 36%           | 142%       |
| Company 11 | Information technology | 421,371,363,849  | 25%               | 19%           | 133%       |
| Company 12 | Industrials            | 195,533,368,821  | 16%               | 12%           | 131%       |
| Company 13 | Energy                 | 315,380,557,126  | 28%               | 22%           | 129%       |
| Company 14 | Consumer staples       | 247,904,902,483  | 25%               | 20%           | 126%       |
| Company 15 | Information technology | 202,522,277,200  | 44%               | 35%           | 125%       |
| Company 16 | Information technology | 189,369,871,322  | 37%               | 31%           | 118%       |
| Company 17 | Health care            | 159,516,616,451  | 44%               | 40%           | 110%       |
| Company 18 | Industrials            | 237,370,264,612  | 13%               | 13%           | 99%        |
| Company 19 | Industrials            | 161,023,788,687  | 19%               | 20%           | 98%        |
| Company 20 | Information technology | 194,996,880,000  | 43%               | 44%           | 96%        |

## Risk amplification from geographic concentration of operations

This section demonstrates how the Biodiversity Risk Metrics can be used to take a deep dive into a specific nature-related risk, based on the example of Water Availability, while also considering geographic risk concentration. The analysis is based on the premise that risk exposure may be amplified for companies that generate a substantial share of their revenue at a small number of assets located in high-risk areas. This case study demonstrates how this perspective can help further narrow a set of high-risk companies into a subset of companies to focus on for engagement and deeper analysis.

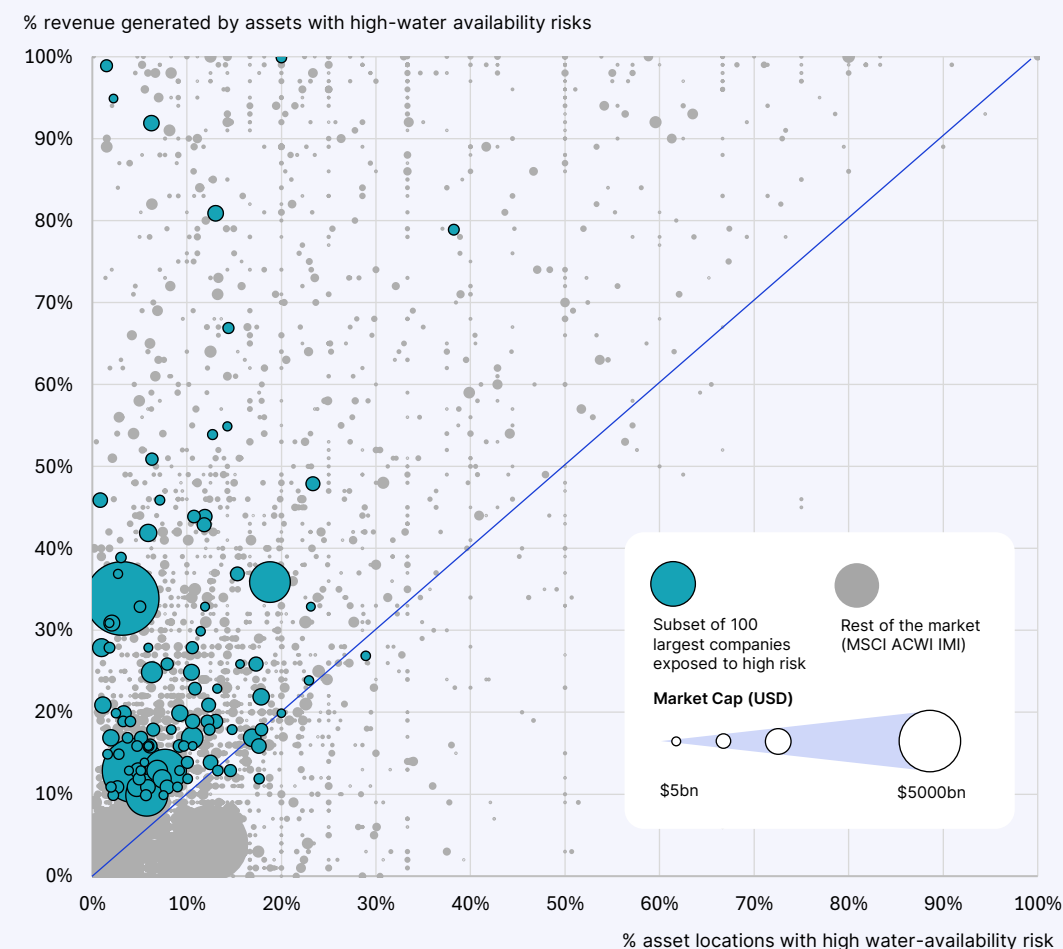
To this extent, the analysis compares the percentage of a company's assets — the High-Risk Asset Count (in relative terms)<sup>14</sup> — to the percentage of company revenue generated by these assets — the High-Risk Output Share — for Water Availability across all companies in the MSCI ACWI IMI. This comparison shows whether a company's revenue exposure to high water risk is concentrated in a limited number of assets or spread more evenly across operations. Exhibit 9 illustrates this relationship. Each dot represents a company, and the dot size reflects the company's market capitalization to highlight the largest players in the market.

Investors may choose to prioritize companies with the highest positions in their portfolios and where a substantial portion of cash flow is exposed to risk. To this extent, the analysis here focuses on companies with market capitalization above USD 75 billion and with more than 10% of their revenue exposed to high Water Availability risk; resulting in a subset of 100 companies that can serve as a foundation for engagement, similar to initiatives such as Nature Action 100 or Climate Action 100. It provides a simple way to identify high-value engagement opportunities with the greatest potential for risk mitigation. The

geospatially based metrics ensure these targets are selected based on robust, location-specific risk insights. This company sample is highlighted in orange and stands out against the rest of the market, which is marked in gray in the background. This background includes both smaller companies with high risk exposure and large companies with low or moderate risk exposure.

Among the 100 companies highlighted, 51 generate between 10% and 20% of their revenue from assets with high exposure to Water Availability risk. Another 39 have High-Risk Output Shares between 20% and 50%, while 12 exceed even that threshold. Notably, two well-known mega-cap companies in the information technology and consumer discretionary sectors stand out with revenue shares of 34% and 36%, respectively. Exhibit 10 gives more details about the 20 largest companies with revenue shares above 20%. It indicates that this approach not only validates known high-risk companies in the water space, but also uncovers new companies that may have previously gone under the radar — potentially expanding the scope of existing stewardship practices.

**Exhibit 9: Identifying companies with amplified Water Availability risk due to geographic concentration of revenue generation in high-risk areas**



## Risk amplification from geographic concentration of operations (cont.)

Comparing the two metrics in Exhibit 9 allows identification of companies that generate a large portion of their revenue at a small number of assets. Any significant difference between the proportion of assets with high-risk values (x-axis) versus the proportion of revenue these assets generate (y-axis) suggests that some assets are more financially productive than others. For any company plotted above the 45-degree dotted line (in the top-left of the plot), the data indicates that the company's high-risk assets contribute more to overall revenue than its low- and medium-risk assets. The further a company appears toward the top-left corner, the more concentrated its revenue generation is in a few high-risk assets.

Interestingly, more companies lie above the 45-degree line (top-left quadrant) than below it (bottom-right quadrant), indicating a systemic bias toward revenue concentration in a small number of high-risk assets across the market. This tendency can be explained as the combination of different effects: (i) companies tend to concentrate their production and manufacturing activities in a small number of assets, in contrast to retail and office work, which are typically spread across many assets; (ii) production-related assets are more often exposed to high risks, since production-related activities tend to have higher dependencies (see the activity relevance matrix); and (iii) the MSCI exposure model attempts to assign revenue shares based on where revenue is produced — rather than where sales occur — resulting in these assets being assigned a larger proportion of the company revenue. In combination, these factors lead to the tendency that high-risk company revenue shares are concentrated in a small number of assets, as visible in Exhibit 9.

A few companies exhibit strong revenue concentration: For example, one large energy company generates more than 90% of its revenue in only 6% of its assets which have high exposure to water availability risk. A large mining company similarly produces almost all of its revenue in very few high-risk assets. Such concentration in high-risk locations creates extreme operational fragility, exposing companies to significant disruption if those assets fail. Using MSCI GeoSpatial Asset Intelligence, enables investors to pinpoint these vulnerable assets to incorporate this insight into stewardship and engagement strategies. Part 2 of this study (to be published later in 2026) will explore how investors can use this data to challenge companies on critical operations exposed to high nature-related risks on the ground.

Geographic diversification can substantially reduce the financial impact on a company level: If most of a company's revenue is generated by assets concentrated in the same location, a local change in the underlying state of nature (e.g., the occurrence of a drought event) could disrupt all operations. Conversely, geographically dispersed operations are less likely to be affected simultaneously by similar events.

**Part 2 of this study will further illustrate how investors can mitigate nature-related risks by investing in companies with globally diversified operations.**

**Exhibit 10: Identifying companies with amplified Water Availability risk due to geographic concentration of revenue generation in high-risk areas**

| #          | Sector                 | Market Capitalization (USD) | % of Revenue Generated by Assets Exposed to High Water Availability Risks |
|------------|------------------------|-----------------------------|---------------------------------------------------------------------------|
| Company 1  | Information Technology | 5,027,184,000,000.00        | 34%                                                                       |
| Company 2  | Consumer Discretionary | 1,557,713,923,247.79        | 36%                                                                       |
| Company 3  | Information Technology | 421,371,363,848.85          | 25%                                                                       |
| Company 4  | Energy                 | 315,380,557,126.20          | 28%                                                                       |
| Company 5  | Consumer Staples       | 292,380,353,194.65          | 42%                                                                       |
| Company 6  | Information Technology | 263,442,778,414.50          | 22%                                                                       |
| Company 7  | Health Care            | 260,276,113,883.35          | 21%                                                                       |
| Company 8  | Consumer Discretionary | 257,439,900,106.49          | 20%                                                                       |
| Company 9  | Communication Services | 250,756,154,692.30          | 31%                                                                       |
| Company 10 | Consumer Staples       | 247,904,902,482.82          | 25%                                                                       |
| Company 11 | Energy                 | 239,867,068,138.91          | 81%                                                                       |
| Company 12 | Energy                 | 235,195,364,213.76          | 92%                                                                       |
| Company 13 | Consumer Staples       | 222,582,308,653.84          | 20%                                                                       |
| Company 14 | Industrials            | 207,957,950,370.72          | 46%                                                                       |
| Company 15 | Information Technology | 202,522,277,200.00          | 44%                                                                       |
| Company 16 | Consumer Staples       | 196,350,041,519.20          | 26%                                                                       |
| Company 17 | Information Technology | 194,996,880,000.00          | 43%                                                                       |
| Company 18 | Health Care            | 192,920,307,887.33          | 48%                                                                       |
| Company 19 | Information Technology | 189,369,871,322.17          | 37%                                                                       |
| Company 20 | Information Technology | 188,257,000,000.00          | 21%                                                                       |

# Portfolio analysis

Given its broad global coverage, the analysis of MSCI ACWI IMI constituents in Section 2 can be interpreted as a proxy for overall market exposure to nature-related risks. The analysis shows that globally, high percentages of revenue values are exposed to both physical and reputational nature-related risks.

The MSCI ACWI IMI captures large-, mid-, and small-cap companies across developed and emerging markets, representing the majority of global listed equity market capitalization. In this context, “market exposure” refers to the share of total revenues generated by these listed companies that is associated with assets located in areas facing elevated nature-related risks. While this does not represent the entire global economy — including private companies or sovereign exposures — it provides a broad and diversified view of how nature-related risks may be distributed across public equity markets worldwide.

**Physical risks** arise when companies depend on natural resources or well-functioning ecosystems that are at risk of being degraded or scarce.

- **Air Condition** stands out, with approximately USD 16 trillion of market revenues exposed to high risks, accounting for over 25% of the total revenue generated by constituents in the MSCI ACWI IMI. This elevated exposure reflects the geographic extent of air pollution globally and its cross-sectoral impact. Poor air quality can affect all types of labor — ranging from industrial and outdoor workers to office-based employees — through its health-related impacts on workforce.
- **Climate-related hazards** — such as Extreme Heat, Tropical Cyclones, Landslides, and Wildfire — represent a substantial financial exposure with an estimated USD 15 trillion to USD 28 trillion of revenues exposed to these risks. This highlights the scale and materiality of climate-related impacts for companies and investors.

Note, however, that the WWF BRF focuses on climate-related hazards with impacts that can be reduced by the maintenance or restoration of healthy ecosystems. Therefore, these numbers can also be viewed as a market opportunity. Nature-based solutions can offer cost-efficient and effective ways to reduce climate-related risks and mitigate their impacts, and companies are already developing offerings, such as the development of sponge cities.<sup>15</sup>

- Risks linked to **Water Availability** stand out with USD 7.3 trillion in exposed revenues, showing the financial impact of operating assets with high water-scarcity risks. This is a consequence of reliable freshwater access being fundamental to virtually all economic activities — across sectors and geographies — even if the degree of dependence varies. At the same time, large parts of economically significant areas, including the U.S., the Mediterranean and parts of Asia, experience elevated water stress. This broad geographic exposure increases the systemic relevance of water-related risks for global markets.
- Highlighting economic dependency on natural resources, the analysis also identifies substantial financial exposure to **Timber Provision**, where companies depending on wood supply in their manufacturing processes could lose up to USD 4.69 trillion in revenue.
- Other risks, such as **Soil Condition, Pollination or Herbicide Resistance**, may appear less relevant at the portfolio level but are highly material for specific sectors such as agriculture. This report explores these sectoral dynamics in greater detail in the next section.





### Portfolio analysis (cont.)

**Reputational risks** arise when a company's activities negatively affect ecosystems. Where business activities contribute to pollution, degradation or other forms of environmental harm, companies may face public scrutiny, increased regulatory attention or challenges to their social license to operate, all of which can translate into financial consequences. Within the BRF, reputational risk is considered high for companies that engage in activities with substantial potential environmental impact or emissions in areas where ecosystems are already under significant pressure. In such contexts, even incremental harm can trigger heightened stakeholder concern and reputational exposure.

- **Pollution** accounts for more than USD 32 trillion (approximately 52%) of exposed market revenues, showing that it is a significant impact driver and a major reputational risk. This aligns with high Air Condition values on the physical risk side. The BRF Pollution indicator covers various types of pollution, including excess nitrogen, pesticides and plastics, and acts as an overall signal of whether a company operates in a polluted environment. Even where companies are not the primary source of pollution, operating in heavily polluted areas — or being associated with pollution-intensive activities — can heighten stakeholder scrutiny, regulatory pressure and public opposition, potentially affecting long-term business resilience.
- Risks linked to **Invasive Species** are noticeable with USD 6.8 trillion of exposed revenue. These risks may stem from different activities: (i) certain agricultural products and wood can be vectors of disease; (ii) activities such as agriculture that import materials like mulch, fertilizer or feed through their supply chains can facilitate the transmission of invasive species; and (iii) the shipment of products or resources from one asset location to another may further spread invasive species to other watersheds under some conditions (for example, through ballast water from shipping).
- **Other major reputations risks** linked to Forest Canopy Loss and Land, Freshwater or Sea Use Change could cost companies more than USD 4.5 trillion in exposed revenue if assets affected by these impact drivers are decommissioned due to public outcry. These risks are typically tied to extractive sectors like energy, materials or utilities and illustrate the potential financial burden of financing these activities.

At the market level, these results clearly indicate that the scale of financial exposure becomes undeniable when nature-related risks are assessed through a geospatial lens. With trillions of USD in revenues potentially at stake, these findings suggest that nature-related risks may warrant closer attention within investment processes.

For investors, understanding the relevance of these risks at the global market level can serve as a starting point for assessing exposure within their own portfolios. The specific risk profile, however, may differ from the market-wide patterns presented here as it depends on portfolio characteristics such as geographic allocation and sector composition.

# Sector analysis

The following section highlights risks that are sector-specific or show high variation across sectors. Again, one can differentiate between physical and reputational risks. To conclude, the materials sector — identified as the sector exposed to the widest range of risks — is discussed in greater detail, with a particular focus on its exposure to forestry- and agriculture-related risks.

### Physical risks:

- **Water Availability** remains a critical dependency across multiple sectors, with many experiencing double-digit revenue exposure. Recent disruptions — such as those affecting TSMC (Taiwan Semiconductor Manufacturing Company Limited)<sup>16</sup> or Constellation Brands<sup>17</sup> — demonstrate how a lack of water can readily materialize into a financial loss.
- In contrast, **Water Condition** becomes relevant only for specific sectors, namely consumer staples and materials. For consumer staples, more than 20% of revenues generated by related companies within the MSCI ACWI IMI are exposed to high Water Condition risk. This dependency arises mainly through activities related to food and beverage production. The materials sector is slightly less exposed, with approximately 10% of revenues exposed, mainly introduced through companies that are active in chemicals industries.
- **Timber Provision and resource dependencies** relevant for agricultural and forestry activities — namely, Soil Condition, Ecosystem Condition Dependency, Pollination and Herbicide Resistance — are only material for a few sectors, among which the materials sector shows the widest exposure. This reveals that forestry-related activities and their risks are better represented within the MSCI ACWI IMI constituents than agricultural activities, as the latter often operate within the supply chain instead of direct operations.

### Reputational risks:

- **Pollution** is a significant impact driver and reputational risk across all sectors; some sectors, however, face elevated exposure levels, with more than 80% of revenue exposed for sectors related to extractive operations (e.g., materials). In contrast, values are lower for sectors with more office-based activities.
- **Invasive Species risks** are also an increasing concern for investors, as many traded goods across various sectors contribute to their global spread and the consequential severe degradation of local habitats. Revenue exposure to these impacts is often in double digits and can exceed 20% for heavily traded sectors such as energy (20.7%) and consumer staples (22.7%). While operations in these sectors may not be directly impacted by invasive species, sales and trade may be affected by biosecurity requirements that aim to limit invasive species movement.

### Forestry- and agriculture-related risks:

The significant exposure of the materials sector to forestry- and agriculture-related risks such as **Timber Provision, Soil Condition, Ecosystem Condition, Pollination, and Herbicide Resistance** can largely be attributed to sub-industries linked to forestry and forestry products, including pulp, paper, and fiber production. These indicators capture essential ecosystem services on which timber plantations depend: supporting growth through soil structure and fertility, preserving healthy ecosystems to regulate water flows and purification, protecting crops from plant diseases, and ensuring effective weed control through herbicides to reduce competition for resources like water. Together, these services help prevent crop loss and contamination. Sectoral revenue exposure to these risks is substantial, with estimates ranging from approximately 20% to over 35%. Managing these dependencies maintains both ecological integrity and financial performance within forestry-related activities.

# Limitations and conclusions

## Summary

**This study followed two primary objectives. First, it set out to demonstrate the availability of nature-related risk data and the practical application of the geospatially aggregated Biodiversity Risk Metrics to generate actionable insights. Second, by applying these metrics to a global equity universe, it demonstrates that nature-related risks are financially relevant at scale.**

The Biodiversity Risk Metrics can support investors with practical, decision-ready tools across the investment process — to screen portfolios, identify risk exposure and prioritize engagement strategies. The showcase section provides concrete examples of how the Biodiversity Risk Metrics can be integrated into existing workflows and transformed into decision-useful insights by investment analysts.

Together, the findings highlight two central messages:

- **Geospatially based data now enable increasingly robust measurement of the exposure to nature-related risks with geospatial precision.**
- **These risk exposures can be financially material and should not be ignored.**

## Limitations

The Biodiversity Risk Metrics represent the potential exposure of revenue share to high nature-related risks. In other words, the High-Risk Output Share indicates the proportion of revenue a company could potentially lose if the specific nature-related risk materializes at all asset locations at the same time, causing all high-risk assets to stop generating revenue. The metrics therefore reflect an upper-bound estimate of the financial exposure to high-risk operations rather than a precise quantification of the underlying risk. In reality, it is unlikely that all high risks would materialize at the same time.

Furthermore, the analysis considers only companies' direct operations. As a result, it does not capture risks associated with supply chains or subsidiaries.<sup>18</sup> This is specifically relevant for sectors such as agriculture, where production is often carried out by dispersed, small-scale farmers, which only appear within the supply chains of international, publicly listed companies analyzed in this study. Actual risks could be significantly higher when considering supply chains and subsidiaries.

Additionally, potential incompleteness and biases in the underlying geospatial database can lead to both an over- or underestimation of a company's risk. Generally, the geospatial data shows a bias toward the Northern and Western Hemisphere, where corporate disclosure tends to be more transparent. This means that nature-related risks in the Global South may be overlooked. Production in these regions is frequently offshore and relocated near areas of high biodiversity importance — where nature-related risks are also significantly greater.

## Outlook

This analysis serves as a starting point for a broader series exploring how nature-related risks can be integrated into investment decision-making. The next installment will demonstrate how combining the MSCI GeoSpatial Asset Intelligence with the WWF BRF can help identify the precise locations of potentially exposed assets and support more targeted stewardship and engagement. Additional work will follow as new insights and methods emerge.

**Despite its limitations, this profit analysis can be used as a first step in assessing how nature-related risks may affect a company's cash flow. It highlights the versatility of the Biodiversity Risk Metrics, allowing an easy comparison to profit margins. Such an analysis can help investors identify exposure to nature-related risks early, to support action before it materializes into financial losses.**

# References

1. Throughout this report, we use the term “physical asset” (or simply “asset”) to refer to a company’s operational assets — such as a factory, mine, farm, or office. This should not be confused with the financial definition of an asset, which refers to ownership of something of value (e.g., stocks, bonds, currency). We refer to these as “financial assets.”
2. WWF. WWF Biodiversity Risk Filter Methodology Documentation version 2.0, October 2024. <https://doi.org/10.5281/zenodo.13768225>
3. The WWF BRF assesses the potential risk an asset is exposed to, based on the local likelihood of threads emerging at a certain severity level (e.g., the local state of various aspects of biodiversity) and the degree to which an activity is vulnerable to these threats. It does not, however, account for companies’ risk management and mitigation measures. See Section 4 in: WWF. WWF Biodiversity Risk Filter Methodology Documentation version 2.0, October 2024. <https://doi.org/10.5281/zenodo.13768225>. For simplicity, this report refers to “nature-related risks” rather than “potential nature-related risks.”
4. See the methodology document: MSCI GeoSpatial Asset Intelligence — Corporate Asset Locations (Module 1)
5. Water Condition risk occurs when a company’s activity depends on access to water resources (either freshwater or marine) that are fit for use by humans and ecosystems. Assets with high Water Condition risk are those in areas with poor water condition (due to, e.g., nutrient, pesticide, or plastic pollution)
6. Taskforce on Nature-related Financial Disclosures (TNFD). (2023). Recommendations of the Taskforce on Nature-related Financial Disclosures (see Sector Guidance for Financial Institutions).
7. Example: the investor engagement initiative Nature Action 100 (NA100) focuses on a subset of high-risk companies across the most risky sectors, and most relevant nature-related risks; <https://www.natureaction100.org>
8. Example: the Fair Initiative focuses on the agri-food sector; <https://www.fairr.org>
9. Example: the Ceres Valuing Water Finance initiative focuses on water-related risks; <https://www.ceres.org/water/valuing-water-finance-initiative>
10. <https://www.supplychaindive.com/news/porsche-supplier-facility-flooding-aluminum-shortage/722685/>
11. <https://www.swissinfo.ch/eng/porsche-warns-on-profit-as-supply-chain-hit-slows-production/84710675>
12. EBITDA = Earnings before interest, tax, deduction and amortization
13. We decided to break the graphs at -400% to make sure these outliers do not distort the results of the rest of the analysis, and so that the readers can still clearly see the impact on profitability for most of the companies
14. MSCI provides both the number of assets with high-risk scores and the total number of assets for each company. This allows users to have both an absolute and relative measure of how many assets face high risks. In this analysis, we preferred to use the relative measure in percentage so we can better compare it with the revenue share generated by high-risk assets, which is also in percentage
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18. The analysis was re-run to include subsidiaries and no substantial differences in the average portfolio-level values were found when considering the High-Risk Asset Count metric





The partnership between the WWF and MSCI provides financial institutions with nature-related data and risk management tools to integrate nature considerations into investment decisions and corporate stewardship. Through this collaboration, nature-related data from the WWF Biodiversity Risk Filter (BRF) is combined with asset-level data from MSCI's GeoSpatial Asset Intelligence, enabling investors to analyze nature-related risks from company-level to asset-level. WWF acts as data provider and technical advisor for nature-related data.

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The World Wide Fund for Nature (WWF) is one of the world’s largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF’s mission is to stop the degradation of the planet’s natural environment and to build a future in which humans live in harmony with nature, by conserving the world’s biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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### Contact us

#### AMERICAS

|        |                             |
|--------|-----------------------------|
| US     | +1 888 588 4567 (toll free) |
| Canada | +1 416 628 1007             |
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#### ASIA PACIFIC

|             |                                 |
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| China       | +86 21 61326611                 |
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