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Sustainability

Resilience at Risk: Understanding Climate and Nature Risk Exposures in Investment Portfolios

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About the ISS STOXX Research Institute

The ISS STOXX Research Institute draws on unique and proprietary data, paired with advanced concepts and objective analysis, to deliver actionable insights that help capital market participants navigate risks and identify opportunities.

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Executive Summary

The accelerating twin crises of climate change and nature loss, combined with shifting geopolitical dynamics and rapid technological disruptions, are fundamentally reshaping global economic systems. These changes introduce new and material risks for investors, challenging the effectiveness of traditional risk assessment tools. As these tools are increasingly scrutinized, concerns arise over whether they adequately capture material vulnerabilities embedded within supply chains, ecosystem dependencies, and climate hazards, potentially leaving portfolios exposed to emerging risks and creating blind spots for investors.

Over the past 12 months, the ISS STOXX Research Institute—dedicated to developing cutting-edge and actionable insights for our global institutional investor clients—set out to answer the question:

How can nature-related dependencies and impacts, coupled with climate risk exposure, affect the resilience of investors' portfolios?

Based on extensive primary and secondary research, data analysis, and over 20 interviews with global investors and market participants, the study found that while the economic costs[1] of climate change are becoming increasingly accepted[2], the risks posed by nature degradation are not sufficiently priced into financial models and business decision-making[3].

These risks can affect companies' long-term valuations and financial performance[4], yet many companies and investors still struggle to translate nature-related risks into financial terms. The blind spot is growing—and with it, the potential for material financial losses and missed investment opportunities. What is more, these risks can affect companies' long-term valuations, financial performance, and, ultimately, companies' ability to understand, respond to, and manage risks—in other words, their ability to stay resilient.

This report introduces two case studies leveraging ISS STOXX's Biodiversity Impact Assessment Tool (BIAT) and Climate Physical Risk Solution. The studies highlight how considering ecosystem service dependencies and impacts, alongside climate hazards exposure, is crucial for investors. Results from portfolio, issuer, and asset-level case studies demonstrate the need for a shift from traditional, climate-only assessments toward integrated climate-and-nature analytics.

Through an analysis of a test portfolio, the case studies demonstrated the following:

1. Nature is financially material today, not just in the long term. Within the analyzed universe of companies, more than half of revenue exposure depends on provisioning ecosystem services such as freshwater and raw materials. When these systems deteriorate, operational disruptions, asset damage, and rising mitigation costs can rapidly translate into financial losses.

2. Biodiversity impacts are highly concentrated in land-use activities. Over 99% of the assessed biodiversity impact stems from land transformation and land occupation. This extensive biodiversity impact from land transformation and occupation reveals significant upstream risks embedded in supply chains for commodities such as palm oil, timber, and rubber.

3. An asset-level analysis of 306 major farm assets demonstrated that water stress, flooding, and wildfires are the three major climate-related hazards that could generate financial risk in the test portfolio. This finding, in conjunction with the nature assessment, creates notable concern, as the test portfolio companies' revenues highly depend on water ecosystem services.

While issuer-level and asset-level climate-nature risk and financial impact analyses are important, the Research Institute also recognizes that new developments are required to properly evaluate the relative financial resilience of a portfolio. There is still a lack of visibility into the quantification of nature-related risks through supply chains, ecosystems, and local infrastructure. Current models require deeper development before putting a financial value on nature-related risks with a high level of precision.

Concepts such as transmission channel analysis and landscape-level risk assessment are essential next steps toward continued evolution of valuation and risk management approaches.

The report findings demonstrate how nature-related dependencies and impacts, coupled with climate risk exposure, could affect the financial resilience of investors' portfolios—and that assessing nature and climate in silos leads to meaningful underestimation of potential risks. As more ecosystems deteriorate, non-linear shifts can quickly escalate operational and financial exposures across sectors.

Investors who integrate nature and climate risk analysis into portfolio analysis will be better positioned to identify vulnerabilities, manage long-term valuation risks, and allocate capital toward more financially resilient assets and business models.

Introduction

The global economy is drastically being shaped by evolving geopolitical dynamics, rapid technological disruption, and accelerating climate change and nature loss[5], creating a complex landscape for investors.

While the economic costs[6] of climate change are increasingly acknowledged - with climate change-related economic losses topping 1.5 trillion USD from 2009 to 2019[7] - the costs posed by nature degradation[8] are less understood and therefore are not yet sufficiently priced[9] into financial models and business decision-making. These risks can affect companies' long-term valuations and financial performance[10] and, ultimately, companies' ability to understand, respond to, manage, and mitigate risks—in other words, to stay resilient. Companies and investors' inability to translate nature-related risks into financial terms results in blind spots, and with them, the potential for financial losses and missed investment opportunities.

This flagship report, which was developed by the ISS STOXX Research Institute over the past 12 months and based on extensive primary and secondary research, is intended to answer the following question:

How can nature-related dependencies and impacts, coupled with climate risk exposure, affect the resilience of investors' portfolios?

The report examines the climate and nature relationship and identifies gaps in prevailing investment risk analysis approaches. It also explores an expanded analysis, that imparts equal attention to both climate and nature considerations, to help better understand an increasingly complex risk landscape and better assess the overall impact of emerging risks on investment portfolio performance.

The Evolving Landscape of Investment Risk

While some events, such as heatwaves, may seem to be isolated or one-off natural occurrences, they are part of a broader disruption of the Earth's systems, according to the scientific consensus. [11,12] Climate change can trigger droughts, floods, storms, and other extreme weather patterns that weaken ecosystems and their ability to provide essential services.[13] At the same time, changes in the land and ocean also fuel climate change, reduce the biosphere's resiliency, and exacerbate further environmental impacts.[14] For example, deforestation and habitat destruction release stored carbon, further accelerating global warming.[15]

As the natural world changes, evidence[16] that the nature and climate crisis causes operational and financial risk is becoming harder to ignore, particularly in highly exposed sectors such as agriculture, energy, and

mining. Despite the increased evidence, nature-related realities are not widely factored into risk assessments. Climate and nature risks have yet to be fully accounted for and tend to be analysed in silos resulting in potential blind spots in investment analysis.

The impact of both climate and nature risks on businesses can be seen in the medium-sized agricultural businesses of California's Central Valley.[17] In addition to climate-driven drought and water scarcity, the region is experiencing ecosystem degradation, including declining soil health, reduced groundwater levels, and loss of biodiversity, which affect the agricultural value chain through fluctuating yields, productivity drops, and policy-driven water restrictions.[18]

For example, precipitation—which is determined by climate regulation[19] —has always been variable in Central Valley. But, due to climate change, water availability has become erratic as a result of more frequent and unpredictable floods and droughts. Over the past ten years, these climate-induced changes have driven up crop water demand for producers.[20]

Researchers found that almond-producing land in the Central Valley with access to surface water has seen its farmland productivity (sales in USD/acre) rise by 30%, whereas similar almond acreage that relies primarily on groundwater has experienced a 16% decline from 2018 to 2024.[21] This relative productivity gain for those farmers with access to surface water can be attributed to better water availability, less reliance on groundwater, and policies in place to prevent further groundwater pumping.[22,23] This is an example of how a convergence of climate, nature, and policy-related changes has increased the vulnerability of those farms without primary access to surface water.

Challenges to Incorporating Nature Risk in Investment Decision Making

The Research Institute conducted 22 interviews across investors, market participants, NGOs, and academics globally. The interviews revealed several factors that deter the incorporation of nature-related considerations into investment decision making and thus contribute to the potential mispricing of nature-related risks in investment portfolios. The more prevalent factors were as follows:

1. **Confusion and ambiguity surrounding nature-related data and metrics**
   Nature is inherently more complex than climate[24] — for starters, there is no single metric for nature equivalent to greenhouse gas emissions and global temperature change. Although there is significant nature-related data available, specialized interpretation is necessary to understand its financial impact, as this varies significantly by sector, industry, and geographical location.

> **Investors are struggling with what type of [nature-related] information is useful, [and] how to incorporate [it] in investment models.**
>
> *International Standard Setter*

> **There are so many different [nature-related] metrics and ...[there is] no easy way to navigate them. It is unclear how to use data. Investors do not know which question they are trying to answer.**
>
> *International Not-For-Profit*

2. **Nature valuation and scenario models still nascent**
   Despite significant efforts[25] to advance nature-related financial risk and valuation modelling, the integration of such models into traditional risks assessment is still in its infancy. Approaches to quantify and pre-empt the potential financial impacts of nature loss have not been fully developed and are arguably less integrated[26] than similar approaches for climate change. This limited integration creates a potential oversight: investors may be increasingly exposed to nature-driven shocks, yet they lack a clear mechanism to forecast or price them, particularly when those impacts are indirect (i.e., supply chains).

> **Portfolio diversification allows for an underestimation of nature. Therefore, relatively poor attention is paid to it.**
>
> *Asset Owner, North America*

3. **Mental overload:** Some investors are facing a "mental overload" from the volume of climate-related information and regulatory demands. Additionally, short-term performance pressures tend to outweigh long-term risk considerations, particularly when those risks are systemic in nature.

> **The investment industry has a cognitive overload when it comes to climate. That helps explain the lack of integrated thinking [about] climate and nature.**
>
> *Asset Owner, APAC*

4. **Regulatory and market uncertainty:** Nature-related disclosures remain voluntary and fragmented. Although voluntary frameworks, such as the Taskforce for Nature-related Financial Disclosures (TNFD)[27] and IFRS Foundation's Nature-Related Disclosures efforts[28] are gaining some traction, nature-based regulatory progress is piecemeal globally.

> **The call to action [for nature-related integration in investment decision-making] is very slow and the policy and regulatory front hasn't helped.**
>
> *Asset Manager, Global*

Making the Case for Integrated Nature and Climate Assessments

As planetary boundaries[29] are increasingly crossed and the world's natural systems experience rapid change, climate and nature-related risks are set to become more pronounced. The acceleration of the climate crisis and uncertainty associated with crossing tipping points can further exacerbate financially material risks associated with nature loss in the short-term and strengthen the need for urgent and meaningful action to mitigate those risks within investment portfolios.[30]

This reality is reshaping the role of investment professionals, demanding a dynamic approach that integrates adaptation and resilience into decision-making. Investors who act proactively have an opportunity to stay ahead of risks and capitalize on emerging opportunities. In this evolving landscape, resilience is not just a defensive strategy[31] —it is a source of long-term value creation.[32]

> **[The emphasis on resilience and preparedness] isn't just about dodging risk for safety. It's about staying in the game. Because when fragility hits, the companies that survive—not just look good surviving—are the ones that end up leading. That's not just resilience. That's performance with staying power.**
>
> *"Resilience Is the New Alpha: Rethinking Risk in a Fragile World," CFA Institute Enterprising Investor, 2025 (Frank Fabozzi, CFA)*[33]

Widening the Scope to Nature Dependencies & Impact Analyses

Businesses across sectors both rely on and affect nature through operations and supply chains.[34] For instance, a beverage company depends on groundwater (dependency) and may pollute freshwater ecosystems if it discharges untreated wastewater (impact).[35] Over time, companies can erode the ecosystem services they rely on.[36] However, it is important to note that high dependence on ecosystem services is not inherently a risk.

The risk arises when those ecosystem services begin to decline—whether from overuse, degradation, or reduced availability. In those situations, companies and investors can face financial exposure because the natural systems they rely on are no longer functioning reliably.

> **To take a hypothetical example, a publicly traded chocolate company currently presents to investors a promise of market demand based on consumer trends and other indicators. The company does not adjust that market promise according to its relative ability to deliver, i.e., whether it will have raw materials to fulfil the demand. This promise thus directly impacts the company's market valuation and shareholder pricing, despite nature risks possibly making the necessary raw materials scarce.**
>
> *Asset Manager, North America*

Box B.1: Examples of Nature Dependencies and Risks Associated with Ecosystem Service Decline

Ecosystem Services refers to services provided by ecosystems that are used in economic and other human activities. Groups are divided into a) provisioning services, b) regulating and maintaining services, and c) cultural services.[37]

Ecosystem Services Group[1]	Example of Ecosystem Service at Risk	Type of Risk	Risk Hazard/ Event (Illustrative Examples)	Potential Financial Risk
Regulation & Maintenance services	Pollination	Physical risk	Loss of pollinator services due to bee population decline	Crop yields decline and market scarcity of raw materials, leading to raw material price increases
Provisioning services	Fibers & other materials	Transition risk	Regulation prohibiting trading or sale of deforestation-linked palm oil	Raw material availability/ higher cost
Cultural services	Recreational	Physical risk	Ocean acidification from climate change causing Great Barrier Reef to experience extreme bleaching event	Decline in tourism industry revenues, as well as economic loss for related industries in service of tourism and hospitality

[1] Definitions of "ecosystem services groupings" in Appendix I

Source: U.K. Institute and Faculty of Actuaries[38], ISS STOXX,[39] Australian Government[40]

The Water Crisis

The UN's Global Water Bankruptcy report[41] underscores the growing vulnerability of declining ecosystems services, warning that many regions are now "living beyond their hydrological means," with water systems so degraded that they are "already bankrupt" and unable to return to historical baselines. In practical terms, this means these basins and aquifers can no longer return to historical conditions without transformative change, as decades of overuse, pollution, and climate-driven stress have pushed them past recovery thresholds.

Assessing these risks requires understanding ecosystem types, their condition, their use, and their proximity to operations.[42] This is where a dependency and impact assessment can help investors identify critical ecosystem services and potential disruptions that could affect portfolio companies' performance.

Real world examples already demonstrate the scale of potential financial exposure. For example, a PwC report[43] shows how New Zealand provides a clear illustration of how nature-related dependencies can translate into financial risk at the market level. Analysis of the country's stock exchange shows that approximately 16% of listed market value is exposed to risks associated with declining water-flow regulation. The vulnerabilities are especially pronounced in the construction and real estate sectors: construction faces an estimated 30% of sector GDP at risk from nature's reduced capacity to regulate rainfall, while real estate companies are similarly exposed as deteriorating water-flow regulation—driven by reduced soil and sediment retention—creates material operational and financial challenges.

Climate + Nature = Enhanced Analysis

By introducing nature impact and dependencies assessment alongside climate risk analyses, investors may begin to understand the resilience 'outlook' of their portfolios. The following two case studies provide examples of such analyses, utilizing the data available today.

Case Study Part 1: Nature Dependencies and Impact

The ISS STOXX Research Institute used ISS STOXX's Biodiversity Impact Assessment Tool (BIAT) to analyze a targeted universe of 26 publicly listed companies.

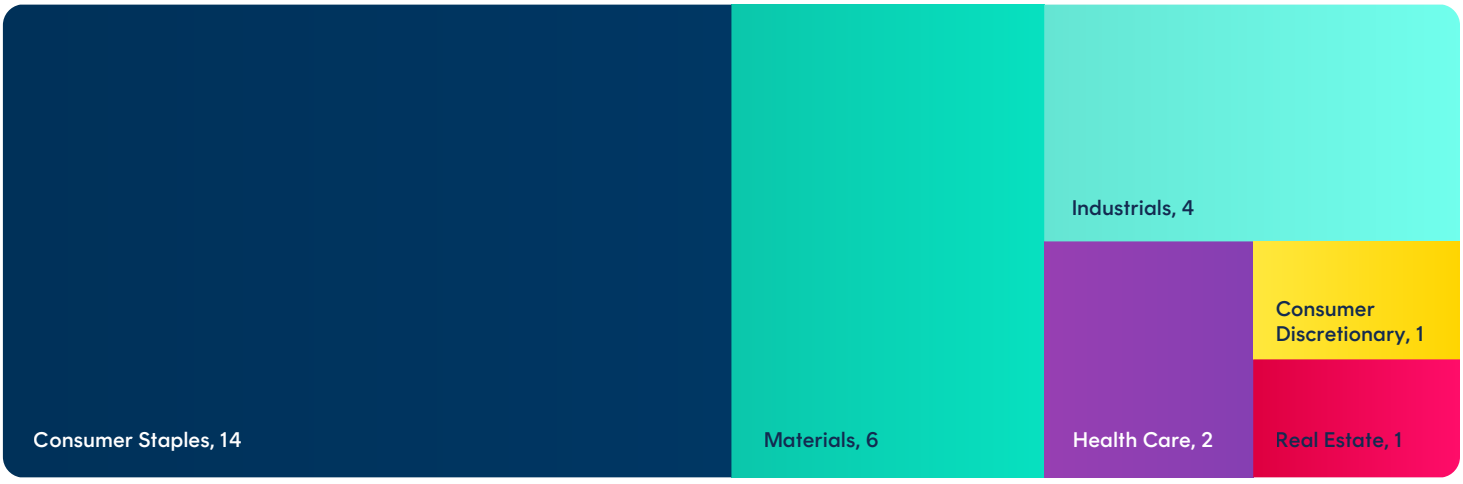
Figure 1: Case Study 1 Universe

*large farm on which a particular crop is grown or an area where trees are grown for wood; such farms might include Tea/Cotton/Rubber/Coffee/Palm farms.

Source: ISS STOXX Research Institute

Issuer-level data was used for Case Study 1 to explore portfolio- and issuer-level nature-related dependencies and impacts. The bulk of the companies represent the Consumer Staples GICs Industry.

Figure 2: Universe of Portfolio Companies, Breakdown by GICs



Note: Data as of March 2026, number of issuers = 26.
Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT)

Nature Dependency Assessment

The following section presents a dependency assessment of the universe above. The assessment assumes an investment of €1 million in the portfolio.

Table 1 shows the breakdown of ecosystem services materiality of the selected universe.

Table 1: Grouped Ecosystem Services by Revenue Dependency (%) of Selected Universe

Ecosystem Services Group	Materiality Classification	Revenue Dependency (%)
Regulation & Maintenance	Low	44%
Provisioning	High	55%
Cultural	Low	1%

Note: Data as of March 2026.
Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT) Methodology

Each ecosystem service is attached to the issuer-level materiality and revenue dependency of the companies within the portfolio.

Table 2: BIAT Factor Definitions

Factor	Definition
Materiality	Assesses an issuer's ability to continue operations if ecosystem service is negatively impacted Categorized by very low, low, medium, high, and very high (e.g., low materiality means no-to-very-limited disruption to operations, while very high means a potentially high degree of disruption)
Revenue dependency (%)	Assesses how much of a company's revenue is dependent on select ecosystem services

Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT) Methodology

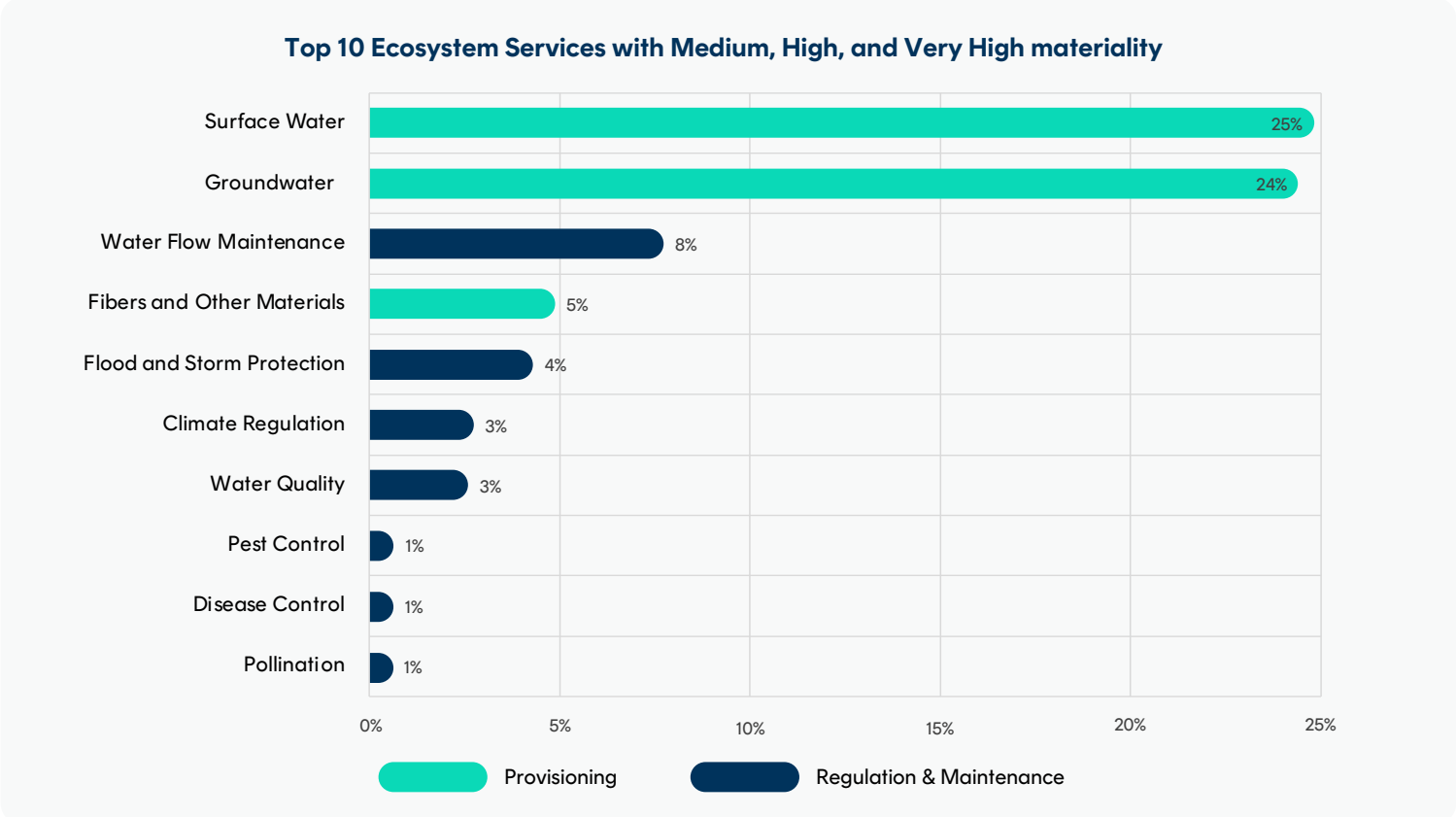
As seen in Table 1, more than half of revenue exposure (55%) depends on provisioning ecosystem services, indicating that a significant share of the universe is commercially reliant on nature's ability to supply raw materials and water. Provisioning ecosystem services is therefore classified as having high materiality for financial performance.

Although regulation and maintenance services are classified as low materiality, the 44% dependency highlights a substantial reliance on ecosystems' ability to regulate water flows, soil stability, and climate conditions. If disruptions to these ecosystem functions occur, the resulting operational interruptions, asset damage, and rising compliance or mitigation costs can quickly translate into significant financial impacts.

Portfolio-Level Revenues from Selected Ecosystem Services

When looking at overall ecosystem service materiality for the test portfolio, surface water and groundwater have the greatest revenue dependency (Figure 3 below).

Figure 3: Selected Universe Revenues Associated with Ecosystem Services



Notes: Data as of March 2026. Very low to low materiality data has been removed, and the focus is solely on medium to very high materiality. More granular data is available when using ISS STOXX BIAT.
Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT) Methodology

Figure 3 illustrates not only which ecosystem services the portfolio depends on most but also why these dependencies rise to the level of financial materiality for investors. The dominance of surface water (25%) and groundwater (24%) underscores that significant shares of portfolio revenues are directly tied to the continued availability of freshwater. Because these are provisioning services essential for production, any disruption—whether from scarcity, contamination, regulatory tightening, or ecosystem decline—can affect output, cost structures, and ultimately earnings.

At the same time, the portfolio shows meaningful reliance on regulation and maintenance services such as water-flow regulation, climate regulation, and flood and storm protection. These services protect companies from operational volatility by moderating water quality, stabilizing soils, preventing storm-related damage, and ensuring predictable hydrological flows. When these functions weaken due to ecosystem degradation, companies could face higher operating costs, capex requirements, disruption exposure, and insurance-related financial impacts.

Nature Impact Assessment

The following section presents an impact assessment of the selected universe. The tables in this section illustrate and define a non-exhaustive list of Impact-driver indicators.

BIAT makes it possible to break down impact by biodiversity drivers, using 10 environmental impact categories based on the Life Cycle Impact Assessment (LCIA) from the IMPACT World+ model.[44]

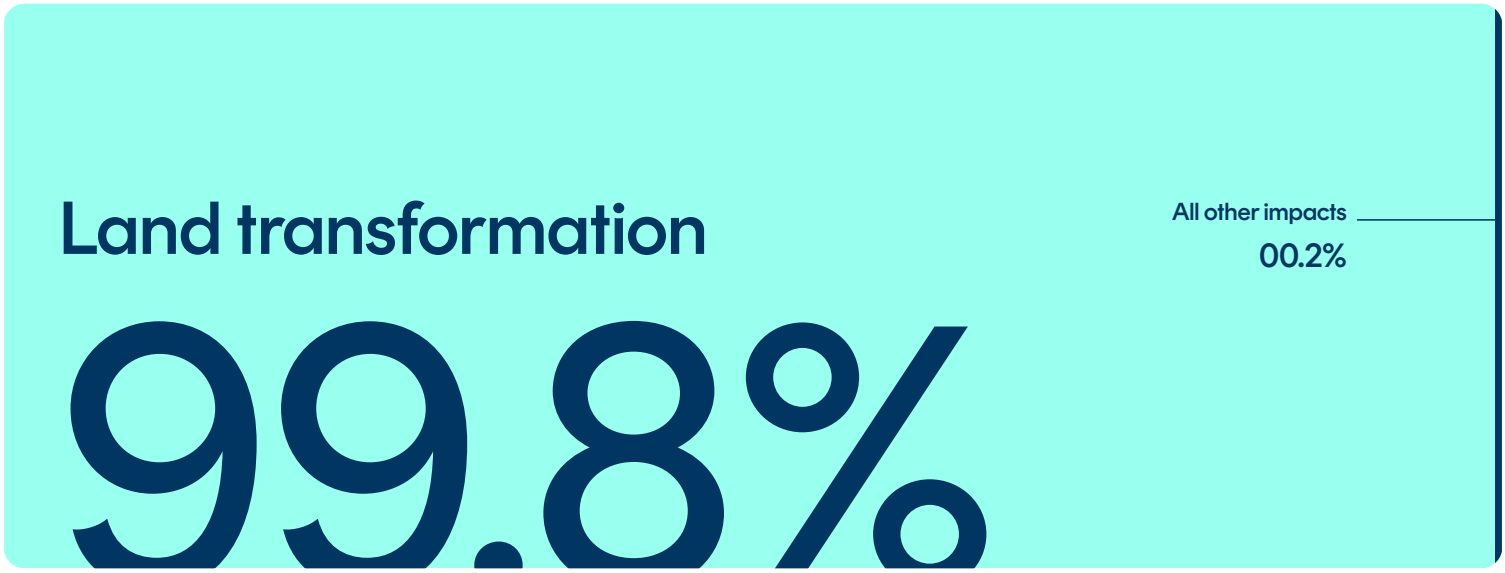
Table 3: Examples of LCIA Environmental Impact Categories (non-exhaustive list)

Indicator	Definition
Climate Change Ecosystem Quality	Greenhouse gas emissions and long-term warming potential (GWP over 100)
Marine Acidification	Ocean pH reduction caused by CO2 uptake, affecting coral and marine biodiversity
Freshwater Acidification	Acidifying compounds such as SOx and nitrogen impacting freshwater ecosystems
Water Availability	Impact of water consumption and scarcity on freshwater ecosystems
Land Transformation	Biodiversity loss from converting natural land to human managed use
Land Occupation	Ongoing land use affecting biodiversity and ecosystem services

Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT) Methodology

The impact assessment of the selected universe shows that land transformation and land occupation account for 99.8% of the impact the universe of companies has on nature.

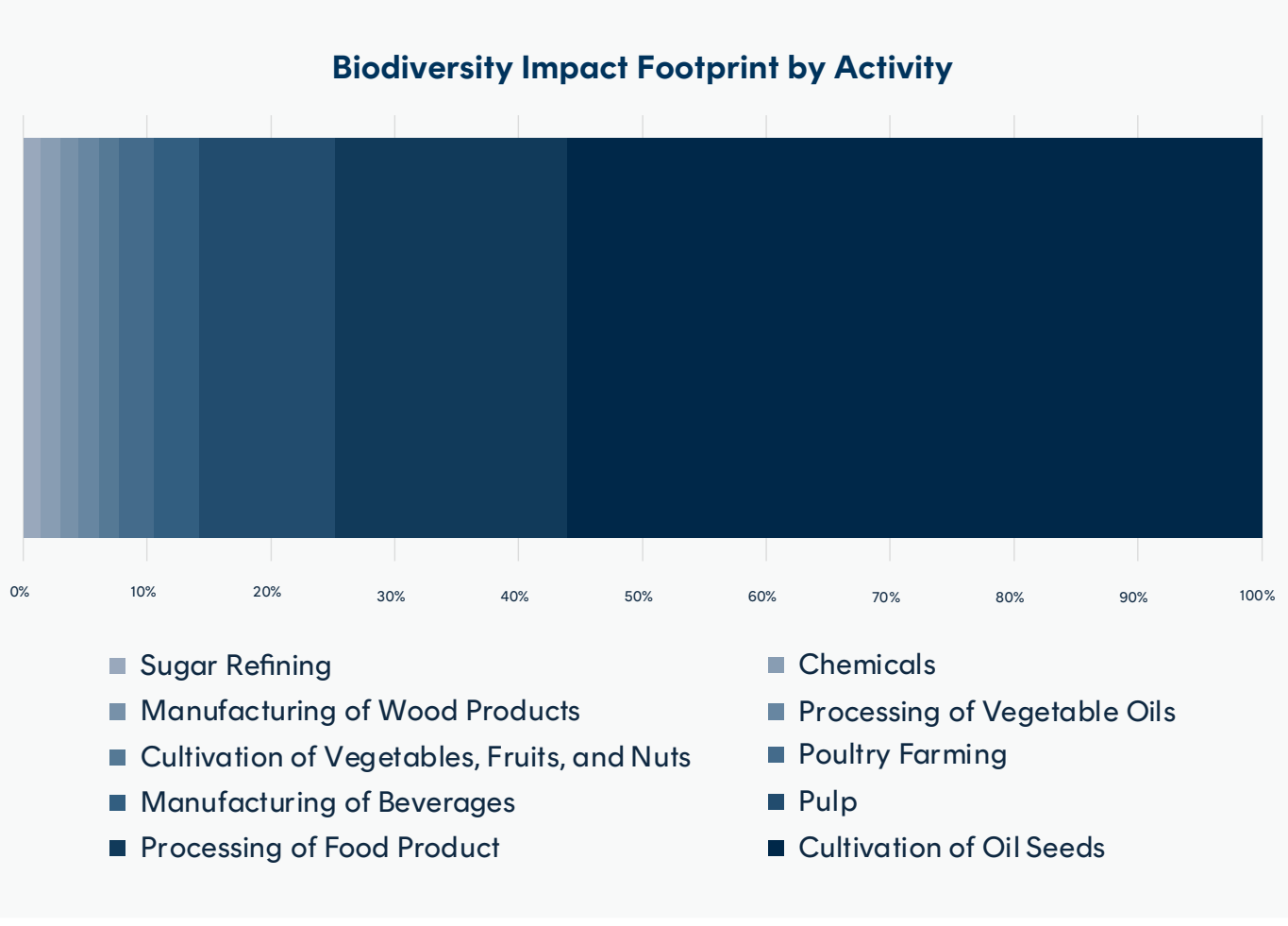
Figure 4: Breakdown of Nature Impact of Test Portfolio



Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT)

Figure 5 shows the activities associated with the largest biodiversity-related impacts for the universe:

Figure 5: Top 10 Activities with the Largest Impact in the Test Portfolio



Note: Data as of March 2026.
Source: ISS STOXX Biodiversity Impact Assessment Tool (BIAT) Methodology

The impact assessment reveals a highly concentrated pattern. As shown in Figure 5, a small group of activities drives most of the biodiversity impact in this test portfolio, with cultivation of oil seed, processing of food product, and pulp production dominating the top three positions, respectively. The high biodiversity impact assigned to food cultivation reflects the upstream agricultural impacts embedded in the commodities purchased by processors, rather than the direct footprint of processing facilities themselves.

This analysis reflects a core dynamic of nature-related risk: even when companies themselves operate with relatively small direct footprints, the embedded impacts of the commodities they source—such as palm oil, rubber, timber, and other agricultural products—carry substantial upstream biodiversity consequences.

Assessing Portfolio Vulnerability

The above nature dependency and impact assessments show that investors can face concentrated and often under-recognized exposure to ecosystem services. While ecosystem service dependencies may appear abstract or distant from financial outcomes, the analysis demonstrates how closely company revenues—particularly in land use-intensive sectors—are tied to the stability of natural systems.

These risks are also dynamic. As ecosystems deteriorate, their ability to provide essential services weakens nonlinearly, meaning that certain nature-related risks may appear low in the short term, but they can escalate into operational disruption, higher input costs, or asset stranding.

By providing both dependency and impact visibility at the issuer and activity level, this type of analysis gives investors a clearer view of where their portfolios may be most vulnerable and where engagement and risk management can be most effective.

Takeaways

Issuer and portfolio-level analysis of:

✓ **Dependencies**

Percentage of revenues dependent on select ecosystem services

Case study results: More than half of revenue exposure (55%) depends on provisioning ecosystem services, indicating that a significant share of the universe is commercially reliant on nature's ability to supply raw materials and water.

✓ **Impacts**

Breakdown of the ten Life Cycle Impact Assessment (LCIA) impact drivers

Case study results: The impact assessment of the selected universe shows that land transformation and land occupation account for 99.8% of the impact the universe of companies has on nature.

Percentage of negative impact by company activities and processes

Case study results: Farm-level activities accounted for more than 60% of the portfolio's biodiversity impact, specifically cultivation of oil seeds, poultry farming, and pulp production.

Case Study 2: The Risk of a Water-Dependent Investment Portfolio in a Water "Bankrupt" World

This section examines what climate-related risks are most relevant for the test portfolio above and questions if water-related exposure to climate hazards could cause financial risks for the portfolio from an asset-level perspective.

Case Study 2 looks at the test portfolio from an asset-level perspective to understand climate-related hazard exposures in the portfolio. The universe includes 306 large farm assets owned by 36 companies.

Figure 6: Case Study 2 Universe

*large farm on which a particular crop is grown or an area where trees are grown for wood; such farms might include Tea/Cotton/Rubber/Coffee/Palm farms.

Source: ISS STOXX Research Institute

Through examination of this distinct group of farm sites, the section offers a location-specific perspective on climate hazards, independent of the corporate ownership metrics applied in the earlier analysis.

These assets were identified using the ISS STOXX geospatial database, which maps physical farm locations independently (Figure 7).

Figure 7: Geographical Distribution of Portfolio's Farm Assets

Source: Sust Global, part of ISS STOXX

This analysis takes a special interest in the climate-nature nexus of the hydrological cycle as the portoflio depends heavily on surface and ground water. Seventy percent of the world's freshwater withdrawals are consumed by agriculture,[45] making water access a critical operational factor for farms. Crops require large amounts of irrigation, from seed to harvest.[46] Water demand can be amplified by poor soil quality, which reduces water retention and thus requires additional irrigation.

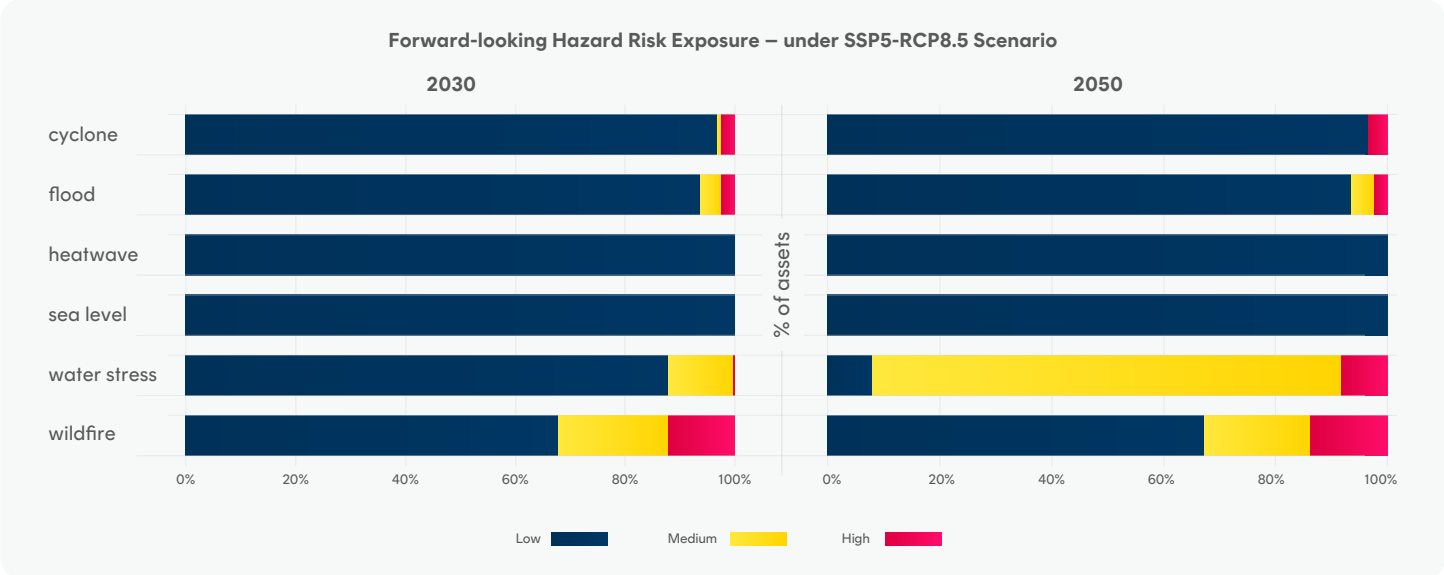
Soil quality has deteriorated over time, a trend examined in the ISS STOXX report *The State of Regenerative Agriculture in 2025: Food Products Industry.*[47] Soil quality decline is due to multiple factors, with the most common[48] being the following:

1. Drought and water stress
2. Land degradation caused by extreme weather events
3. Industrial farming
4. Chemicals and pollution
5. Intensive farming practices

As climate change intensifies, hydrological hazards such as water stress,[49] cyclones, flooding, and drought[50] are expected to become more severe and widespread, impacting agricultural productivity and supply chains globally. For instance, in a recent report from Howden, European Union-specific annual average crop losses from drought "could increase by 87% to almost € 17.9 billion"[51] under a high emissions scenario (SSP5-RCP 8.5) by 2050.

Figure 8 shows the distribution of farm assets exposed to different climate hazards over two time periods, from the near (2030) to medium/long (2050) future, under the High Emissions Scenario (Box B.3).[52]

Figure 8: Asset-Level Exposure to Climate Hazards under the High Emissions Scenario, over Two Time Horizons



Note: Data as of March 2026. Risk Exposure categorization is calculated based on the probability of hazard (for wildfire, flood, and cyclone), a risk distribution score (for water stress), number of heat-related events (for heatwave), and relative change in meters (for sea level).

Source: Sust Global, part of ISS STOXX

Box B.3: The Importance of Selecting the Right Climate Scenarios for Investment Decision-Making

Assessing financial resilience relies on identifying what potential futures could be realized and how those futures could positively or negatively impact the financial trajectory of an investor's portfolio. Scenario selection is a pivotal requirement for integrating climate into long-term investment decision making. Different climate and socioeconomic scenarios can widely impact physical risk exposure and financial risk outputs at all levels (asset-, issuer-, and portfolio-level).

To ensure consistency across climate models, researchers use a set of standardized pathways known as the Shared Socioeconomic Pathways (SSPs). These scenarios represent coherent narratives about potential trajectories of global development that are based on assumptions about socioeconomic trends and their implications for future emissions and climate outcomes.

The following case study leverages the High Emissions SSP5-RCP 8.5 Scenario. The RCP8.5 scenario envisions a future marked by rapid economic growth, high energy demand, and continued reliance on fossil fuels. This scenario projects a global temperature rise of approximately 4.3°C by 2100.

The RCP8.5 High Emissions Scenario has been selected for the subsequent case study to represent a high-risk future. Such a high-risk focus makes it possible to uncover potential vulnerabilities that may be underestimated in more moderate scenarios, offering a sharper view of long-term exposure to physical risks. The Research Institute's decision to follow RCP 8.5 also mirrors the European Commission's calls to pivot their reference scenario for adaptation planning to 4°C.

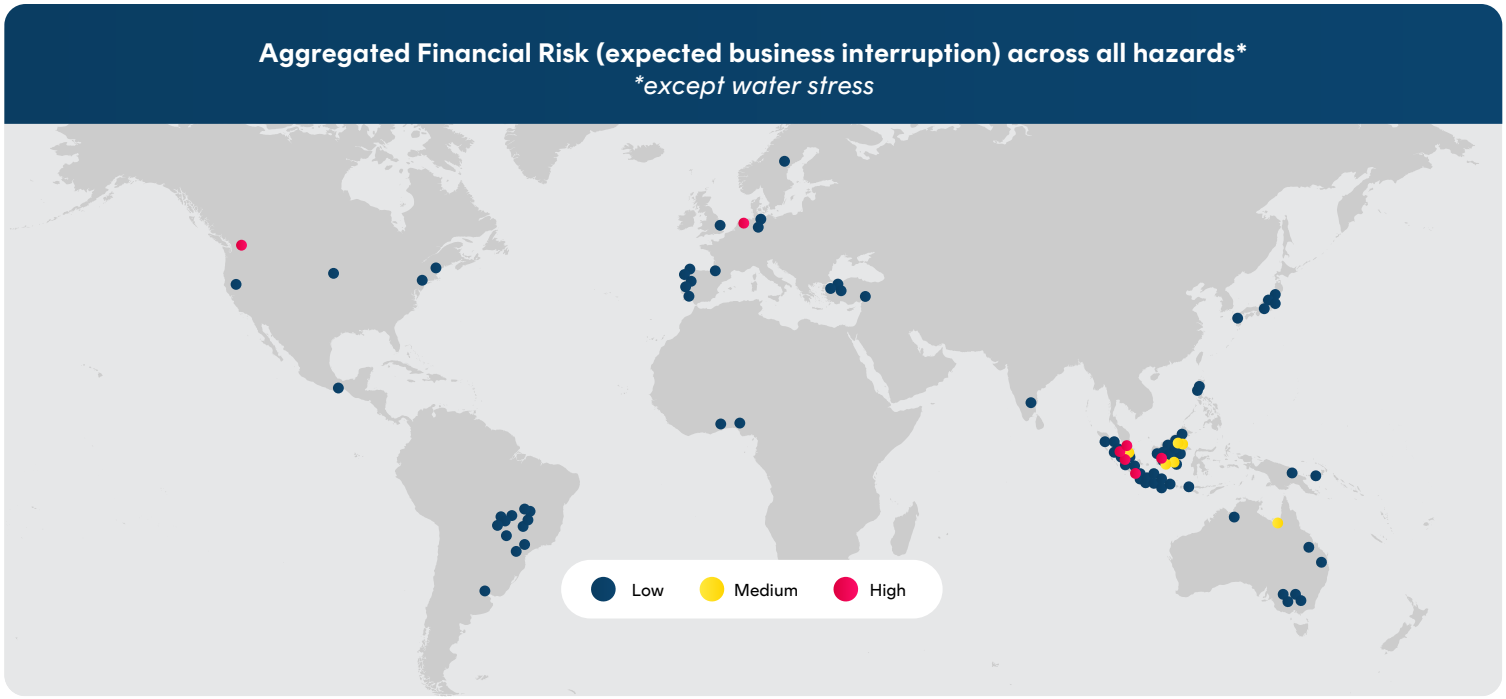
From an exposure standpoint, an investor may be interested in continuing their analysis primarily on wildfire, water stress, and flood.

With a special focus on water, under the High Emissions Scenario, water stress exposure for farm assets intensifies over time. In 2030, only 11% of farm assets (n=306) had medium-level exposure. That number jumped to 57% by 2050. High-risk assets jump from 1 asset in 2030 to 17 in 2050.

Risk and resilience depend not only on exposure but on how *vulnerable* a company's assets are to these hazard exposures. The financial risk from a climate hazard could occur from business interruptions and/or structural damage to an operational site.

Overall, when analyzed through a High Emissions Scenario, the test portfolio shows an increase in the probability of exposure to water stress, flooding, and wildfire from 2030 to 2050, while at the same time, most assets continue to exhibit low financial risk. When the analysis is layered with geospatial considerations, the high-risk assets appear to be concentrated in Southeast Asia (Figure 9).

Figure 9: Geographical Distribution of Financial Risk by 2050, High Emissions Scenario



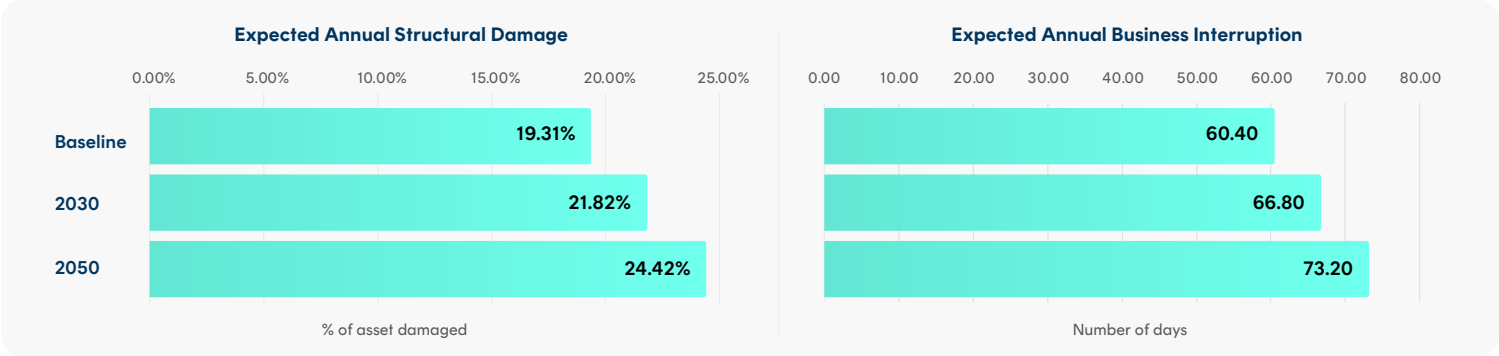
Notes: Data as of March 2026.
Source: Sust Global, part of ISS STOXX

Despite flooding and wildfire-exposed assets demonstrating low financial risk for the most part, a portfolio could be weighted toward the high financial risk assets in question. Consider this situation through the lens of "Asset A" in the portfolio.

Asset A is a part of an Indonesia-based palm oil company that has a heavy weighting in the portfolio. The asset has an overall high financial risk when climate hazard probabilities on structural damage and business interruptions are aggregated across sea-level rise, flooding, wildfire, cyclone, and heatwave.

From a current baseline to 2050, under the SSP5-RCP8.5 scenario, the expected structural damage and business interruption increase by 26.4% and 21.5%, respectively, for the asset. These percentages are primarily driven by flood hazards (Figure 10).

Figure 10: Expected Annual Structural Damage and Business Interruption for Asset A



Source: Sust Global, part of ISS STOXX

This additional context allows an investor to pinpoint what the main climate exposures are for assets belonging to heavily weighted companies in the test portfolio. Investors can then evaluate how these exposures may affect a company's financial performance by considering the likelihood and potential impact of asset damage or business disruption.

An investor can look further into the portfolio, from both an issuer- and asset-level, to establish whether the portfolio is resilient, by investigating the vulnerabilities of high-risk issuers and locations through the evaluation of portfolio companies' preparedness and adaptation measures that could protect their future valuation against climate and nature hazards.

Takeaways

Asset-level analysis of:

✓ **Climate-related Hazard Exposure**

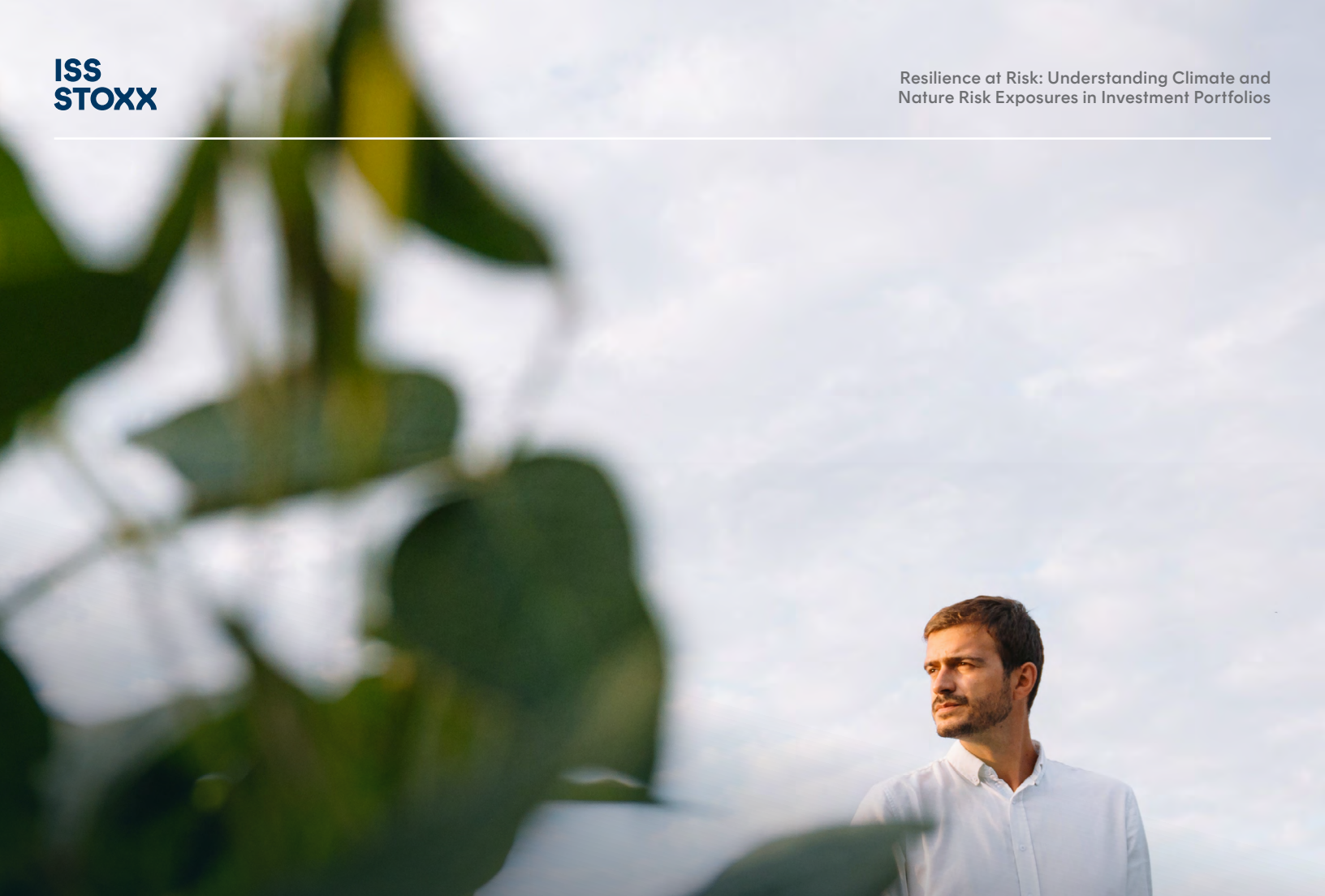
Case study results: In 2030, only 11% of farm assets (n=306) had medium-level exposure. That number jumped to 57% by 2050. High-risk assets jump from 1 asset in 2030 to 17 in 2050.

✓ **Financial Risk of Selected Hazards**

Case study results: Overall, when analyzed through a High Emissions Scenario, the test portfolio shows an increase in the probability of exposure to water stress, flooding, and wildfire from 2030 to 2050, while at the same time, most assets continue to exhibit low financial risk.

When the analysis is layered with geospatial considerations, the high financial risk assets appear to be concentrated in Southeast Asia for both business interruptions and structural damages.

For Asset A, owned by an Indonesia-based palm oil producer, financial risk increased, with expected structural damage and business interruption increases of 26.4% and 21.5%, respectively, from baseline to 2050 under SSP5-RCP8.5.



Integrated Climate and Nature Risk Analysis: From a 2-D to a 3-D Analysis

As discussed across the various case studies above, data and models concerning an issuer's dependencies, impacts, and even asset-level exposure to nature and climate risks are useful to create more comprehensive analyses that include relevant data points for the evaluation of long-term resiliency in investment portfolios.

These assessments will continue to evolve through technological and data-related innovation. The future of investment risk analyses includes the addition of more granular *transmission channel* and *landscape analyses*. Both of these would factor into the models that drive fundamental value-at-risk analyses. As most of these risks are interconnected and systemic, these additional analyses could help offer investors an opportunity to fold in more interconnected and non-linear data points into a dynamic investment decision-making process.

Transmission Channels

DEFINITION:

"Transmission channels for nature-related risks are pathways through which nature-related hazards translate into physical and transitions risks that can affect the economy at micro, sectoral/regional and macro levels." — Taskforce for Nature-related Disclosures,[53] adapted from the Network for Greening the Financial Systems[54]

Consider two companies in the Software & Diversified IT Services Industry that are both heavily investing in Artificial Intelligence through data center development.

Companies A and B have both invested in data center developments in water-stressed areas. Water is an essential ecosystem service for data centers due to the cooling[55] required to keep systems' performance optimal. In 10 years, the water stress in the areas where they developed data centers has intensified, and the government has decided to put extra ordinances and fines on excessive water use.

Company B spent additional capital to ensure their operations use water-saving technology and this has paid off in a water-strained world. At the same time, Company A, which did not consider alternative cooling technologies, faces a decline in valuation, since its financial performance has been negatively impacted as it takes on additional operating costs related to overheating equipment. This hypothetical scenario is an example of the benefits of running a transmission channel analysis that considers nature dependencies at the asset level.

The Taskforce for Nature-related Disclosures (TNFD)[56] found that most research around transmission channels is completed at the macroeconomic level or sectoral level. For transmission channel analyses to grow in the investment space, there will need to be more research on entity-level financial impacts.

> For corporate assets (equities, bonds, and loans), the transmission of physical risk to the financial institution is more difficult to assess. In these cases, the value of the financial asset depends on the overall health of the counterparty, not just a single physical asset. The full exposure of the counterparty needs to be understood, but the necessary information is often lacking.
>
> "Leveraging Physical Climate Risk Data," Network for Greening the Financial System[57].

Landscape Analysis

DEFINITION:

Landscape analysis is a risk assessment approach that evaluates how environmental, social, and economic factors interact on a particular location to reveal interconnected and compounding risks that may impact a company's operational risks and long-term valuation.

In 2011, a flood in Thailand[59] inadvertently caused the operating profits of automobile companies in Japan to shrink by 55%[60] because the flood caused both the supply and transport of car parts to be delayed due to facility closures in Thailand. This example highlights how sustainability risks are rarely straightforward and can cause compounding and non-linear impacts.

A landscape analysis is an emerging risk analysis framework that adds to the transmission channel component above and can eventually become part of traditional fundamental research.

Although some unknown, unpredictable economic, social, or environmental changes will inevitably evade risk models, landscape analyses have the advantage of being context and location specific, allowing for more precise comparisons of equities' value at risk.

> Fortress of solitude: If you build your own facility to be resilient, but the surrounding infrastructure community doesn't follow, you can end up with a fortress of solitude. It may be operational, but workers and supplies cannot reach it post disaster.
>
> Building Resilience through Climate Adaptation, JP Morgan[58]

Conclusion

Climate change and nature loss are evolving investment risks that are becoming harder for investors to dismiss. The objective of this report is to answer:

How do nature-related dependencies and impacts, coupled with climate risk exposure, affect the resilience of investors' portfolios?

The analysis shows initial steps needed to assess the financial implications of nature-related risks, such as declining water availability, soil instability, and biodiversity loss. While some nature dependencies appear low risk in the short term, degradation of these services can rapidly drive operational disruption, increase input costs, and create stranded assets within a single investment cycle. Over the long term, these risks can compound, reshaping supply chains and eroding business models that rely heavily on ecosystem stability.

Crucially, the findings illustrate that nature-related risks do not operate independently. The same assets and sectors exposed to nature degradation are often those simultaneously vulnerable to physical climate hazards such as water stress, heatwaves, and wildfires.

For investors, these insights reinforce the need to evolve from climate-only analysis toward an integrated climate-and-nature framework. By including nature-related data into investment assessments, investors can broaden their view of potential risks beyond only climate-related risks. The inclusion of nature enables sharper identification of material vulnerabilities, better long-term valuation, and more strategic allocation toward financially resilient equities and assets.

Appendix I: Supplemental Information

Table A: Ecosystem Services Groupings

Ecosystem Services Grouping	Definition	Example service(s)
Provisioning services	Ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems	• Groundwater • Fibers & other materials • Genetic materials
Regulation & Maintenance services	Ecosystem services resulting from the ability of ecosystems to regulate biological processes and to influence climate, hydrological, and biochemical cycles, and thereby maintain environmental conditions beneficial to individuals and society	• Flood and storm protection • Climate regulation • Disease control
Cultural services	Experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contributes to a range of cultural benefits.	• Ecotourism • Recreation • Mental health benefits

Source: System of Environmental Economic Accounting

Appendix II: Methodology

This flagship report, developed by the ISS STOXX Research Institute, examines the climate and nature dynamic and identifies gaps in prevailing risk analysis approaches. It shifts the focus from a climate-only view to an integrated climate-and-nature assessment.

Specifically, the report looked to answer the following question:

How can nature-related dependencies and impacts, coupled with climate risk exposure, affect investor portfolios' resilience?

The 12-month practitioner-led, independent research gathered input from the following sources:

1. Over 22 bilateral meetings, conducted online and in person between March 2025 and January 2026, with market participants across Asset Owners, Asset Managers, Insurers, Investment Consultants, NGOs, and Industry Organizations.

Interview distribution by geography and organization type	
AMERICAS	**9**
Insurer	1
Asset Manager	5
Industry Organization	2
Asset Owner	1
APAC	**9**
Asset Manager	4
Industry Organization	1
Asset Owner	4
EMEA	**4**
Investor Consultant	1
Asset Manager	2
Industry Organization	1
Grand Total	22

Note: Asset Owners and managers' AUM = 4.77 Trillion USD (approx.)
Source: ISS STOXX Research Institute

2. Literature review (see list of references), sourced from academic studies, news sources, and participant-shared resources.

3. Data analyses that examine three different universes of companies and leverage ISS STOXX data solutions to perform different types of analyses:

   Section 1/Universe A.1: Nature-related dependency and impact assessment, with a universe formed by companies that own farm-related assets.

   Section 2/Universe A.2: Climate Risk Exposure analysis, with a universe formed by 306 large farm assets. Location-specific assets are not tied to corporate ownership metrics (used for the climate risk exposure analysis).

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