
ISSB Meeting

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Project	Research Project - Biodiversity, ecosystems and ecosystem services
Topic	Evidence of effects on an entity's prospects
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Purpose of the paper

1. This paper addresses the ISSB research project on biodiversity, ecosystems and ecosystem services (BEES), investigating the research question ‘Whether, how and to what extent do BEES-related risks and opportunities affect an entity’s cash flows, its access to finance or cost of capital over the short, medium or long term?’¹
2. In this paper, the staff summarises evidence obtained through a literature review and supplemented by stakeholder engagements to provide an understanding of the effects of BEES-related risks and opportunities on an entity’s prospects using the approach and principles outlined in [Agenda Paper 2B Biodiversity, ecosystems and ecosystem services and human capital research projects -Research design and approach](#) in July 2024.
3. The staff is not seeking any decisions from the ISSB.

¹ We refer to the entity’s cash flows, its access to finance and cost of capital as an entity’s ‘prospects’.

Structure of the paper

4. The paper is structured as follows
 - (a) Approach
 - (b) Summary
 - (c) Analysis
 - (i) Drivers of effects on entity prospects – from dependencies and impacts to risks and opportunities
 - (ii) Ways and mechanisms through which BEES-related risks and opportunities potentially affect entity prospects
 - (iii) Evidence of effects on entity prospects
 - (d) Appendix A: Illustrative sector nature dependencies and impacts
 - (e) Appendix B: Water-related risks, opportunities and entity prospects
 - (f) Appendix C: Water-related impacts by GICS industry
 - (g) Appendix D: Case examples of BEES-related effects on entity prospects

Approach

5. The staff's research approach focused on an analysis over 110 publications about the implications of BEES-related risks and opportunities for entity prospects.² For example, an analysis of 42 academic papers (15 peer-reviewed and 27 working papers/pre-print papers) included mostly empirical studies of effects on corporate financial performance

² The findings summarised in this paper are informed by sources that the staff has judged to be credible and relevant. These include peer-reviewed academic studies on which most of the findings have been based as well as academic working papers and pre-print scholarly papers. Reports from multilateral institutions, NGOs, market research, industry reports and news reports from credible organisations were used for general contextual information and specific case examples.

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- or market returns; three of the papers were meta-studies published between 2019 and 2024, which covered a total of over 4,400 individual studies. The empirical studies analysed samples ranging from about 1,200 to 3,000 entities, typically publicly traded companies, covering the period from 2000 to 2023 with one study going back to 1967.
6. The evidence contained in these publications included studies of the statistical relationships between BEES-related risks and either corporate financial performance or stock/bond market returns; analysis of financial effects that entities disclosed through their reporting; and case examples of specific entity-level effects on prospects. We did not find academic studies focused on the effects of BEES-related opportunities, although we reviewed a few non-academic reports and case examples of opportunities.
 7. The staff supplemented this desk research with the findings from the engagements held in conjunction with the investor interest research area and some additional roundtables held with academics and some preparers from June 2024 to January 2025. However, as stated above, we focused on the literature to draw separate insights from our conversations with investors; those investor insights are reflected in Agenda Paper 3 in January 2025, which sets out a summary of the findings on investor interest.³

Summary

8. BEES-related risks and opportunities often arise from an entity's **dependencies** on natural resources and ecosystem services and its **impacts** on nature (e.g., waste, pollution, land use change). BEES-related risks can be categorised as physical (acute or chronic) and transition risks. Both types of risk can affect an entity's prospects, but the effects can vary across sectors and industries due to differing levels and types of nature-related dependencies and impacts. The effects can also vary across jurisdictions due to differing

³ See [Agenda Paper 3 Evidence of Investor Interest in BEES-related risks and opportunities](#) (January 2025).

- local contexts, including differences between geographic locations and in laws and regulations.
9. BEES-related opportunities often arise from risk mitigation efforts (e.g., process changes, more efficient use of resources) or new business initiatives (e.g., new products and services, new markets). For example, precision agriculture and related technologies and services present a significant opportunity.
 10. The mechanisms by which dependencies and impacts lead to sustainability-related risks and opportunities and how such risks and opportunities in turn affect an entity's prospects is an area of ongoing academic research. Furthermore, the mechanisms and the exact ways through which entity prospects are affected are highly dependent on the sector and the specific BEES-related issues.⁴
 11. The evidence of the effects of BEES-related risks and opportunities on entity prospects found in the reviewed studies ranges from macroeconomic conditions affecting an entity⁵ to effects on an entity's corporate financial performance (cashflows, income, assets and liabilities) and effects on market returns (stock, bond or other financial assets). Specific case examples of particular entity-level effects were also analysed. This paper focuses on the last three areas of corporate performance, market returns and case examples.

⁴ See Appendices A and C of this paper.

⁵ For example, an entity's prospects may be affected by macroeconomic factors such as overall economic growth, government policies, interest rates and labour market conditions (see The Economics of Biodiversity: The Dasgupta Review (2021) Chapter 17). Literature exploring the macroeconomic effects of nature-related risks typically focuses on the potential impacts of biodiversity loss and ecosystem degradation on economic growth, financial stability, and asset values. Prominent studies include Charlotte Gardes-Landolfini, William Oman, Jamie Fraser, Mariza Montes de Oca Leon, and Bella Yao. (2024). [Embedded in Nature: Nature-Related Economic and Financial Risks and Policy Considerations](#), IMF Staff Climate Notes 002; NGFS (2024). [Nature-related Financial Risks: A Conceptual Framework to guide Action by Central Banks and Supervisors](#); and Ranger, N., Alvarez J., Freeman, A., Harwood, T., Obersteiner, M., Paulus, E. and Sabuco, J. (2023). [The Green Scorpion: The Macro-Criticality of Nature for Finance – Foundations for scenario-based analysis of complex and cascading physical nature-related risks](#). Oxford: Environmental Change Institute, University of Oxford.

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12. The reviewed academic studies tended to focus on BEES-related risks as a component of Environment, Social, Governance (ESG) scores, separate environmental or biodiversity risk measures, or specific risks for a nature-related topic such as water or deforestation.
 13. Academic studies that focused on BEES-related opportunities and their effects on entity prospects were not discovered in our literature review, although several non-academic reports and case examples illustrated the nature of opportunities.
 14. Many of the academic studies reviewed by the staff, including meta-studies, found a statistical inverse correlation between environmental or biodiversity risks and entity financial performance or market return ^{6,7} These studies, for example, found higher credit risk, lower equity prices and greater price volatility in sectors and entities with higher dependency or impacts on ecosystems and ecosystem services and/or that do not manage their BEES-related risk exposures effectively, implying that a biodiversity risk premium is required for higher risk consistent with the risk-return trade-off. A few studies indicated that the benefits of stronger management of nature-related risks and opportunities on entity financial performance accrue over the longer term.
 15. Some studies found a neutral or mixed correlation between environmental risk and financial performance. A few studies cautioned that BEES-related risks may not be fully priced into financial markets at present.⁸

⁶ In this paper the qualifiers of almost all (>90%), most (60-90%), many (40-60%), some (10-40%) and a few (<10%) are used.

⁷ Meta studies aggregate the findings of multiple primary studies using statistical techniques to compute summary effect sizes. Meta-analyses can provide a more accurate estimate of the overall effect by considering the sample sizes and variances of the included studies.

⁸ Financial Stability Board (2024) *Stock take on Nature-related Risks, Supervisory and regulatory approaches and perspectives on financial risk*; Ranger, N., Alvarez J., Freeman, A., Harwood, T., Obersteiner, M., Paulus, E. and Sabuco, J. (2023). *The Green Scorpion: the Macro-Criticality of Nature for Finance – Foundations for scenario-based analysis of complex and cascading physical nature-related risks*. Oxford: Environmental Change Institute, University of Oxford; and Giglio, Stefano; Theresa Kuchler, Johannes Stroebel, Xuran Zeng (April 2023) *Biodiversity Risk*, NBER.

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16. Selected cases of effects on particular entity prospects illustrate financial effects ranging from US\$4 million to US\$20 billion largely in the form of cost increases, revenue losses, asset write downs and some positive effects of opportunities. These effects were attributed in about equal proportions to BEES-related transition risks and physical risks.

Questions for the ISSB

1. What questions do ISSB members have regarding whether, how and to what extent BEES-related risks and opportunities affect an entity's prospects or about the evidence analysed?
2. Which aspects of the effects of BEES-related risks and opportunities on entity prospects do ISSB members believe warrant further investigation in the research project to adequately prepare and support the ISSB in its considerations and decision making around standard setting?

Analysis

Drivers of effects on entity prospects – from dependencies and impacts to risks and opportunities

17. The conceptual causal chain from an entity's BEES-related risks and opportunities to effects on its prospects starts with an entity's dependencies and impacts on nature.⁹ A key assumption of investors is that high dependencies or impacts on nature are an important indicator of the extent of an entity's BEES-related risks and opportunities. Dependencies and impacts, and hence risks and opportunities, vary across sectors and industries as well as across an entity's value chain. Appendix A shows the relative extent of nature-related dependencies and impacts of various sectors and industries. As a general matter, sectors/industries with high or moderate dependencies on nature often also have high impacts but there are exceptions.
18. An entity's BEES-related risks and opportunities may arise from aspects of:
- (a) an entity's dependencies on nature to provide the natural resources and ecosystem services necessary for an entity's performance,
 - (b) an entity's impacts or the impacts of others on ecosystems or ecosystem services, which may in turn affect an entity through its dependencies on those ecosystems or ecosystem services or through stakeholder responses to such impacts, and

⁹ Dependencies highlight how entities rely on natural resources and ecosystem services to conduct their businesses, while impacts illustrate the environmental consequences of their operations or value chains. For example, an entity's **dependencies** on nature are typically described in terms of the natural resources and ecosystem services an entity uses such as raw materials, water provision, land stabilization, pollination, bioremediation, flood protection, genetic material, fiber and fodder and disease control. In using these natural resources and ecosystem services, an entity invariably **impacts** nature through such actions and outcomes as air pollution, disturbances to nature, freshwater ecosystem use, greenhouse gas (GHG) emissions, land use, ocean use, other natural resource use, soil pollution, solid waste, water pollution, and water use. Ceres. (2024). Exploring Nature Impacts and Dependencies: A Field Guide to Eight Key Sectors. Nature Action 100. Retrieved from <https://www.natureaction100.org/>

- (c) aggregate macroeconomic or systemic BEES-related impacts.¹⁰
19. The mechanisms by which dependencies and impacts lead to sustainability-related risks and opportunities and how those risks and opportunities in turn affect an entity's prospects is an area of ongoing academic research.¹¹ Studies analysed so far point to the cause-and-effect logic that entities both depend on and impact biodiversity, ecosystems and ecosystem services when providing goods and services, which creates related risks and opportunities, for example if the natural resources or ecosystem services that an entity uses or impacts degrade or are preserved or restored. However, these mechanisms and ways through which entity prospects are affected are highly dependent on the sector and the specific BEES-related topics.¹²

Ways and mechanisms through which BEES-related risks and opportunities potentially affect entity prospects

20. The risks and opportunities that may arise from BEES-related dependencies and impacts include both physical risks (acute and chronic) and transition risks and related opportunities.¹³

¹⁰ An entity's BEES-related risks and opportunities, and in turn its prospects, may also be affected by the macroeconomic conditions in which the entity operates. Aggregate macroeconomic impacts, such as slowing economic growth due to broad-scale deterioration in ecosystems and ecosystem services or systemic shocks due to ecosystem tipping points or cascades may induce macro-level changes affecting the business conditions of an entity. These macro-level changes could include such things as structural changes in the economy, asset price shocks, supply shocks, productivity changes, impacts on international trade, and differentiated government responses.

¹¹ OECD (2023) Assessing biodiversity-related financial risks: Navigating the landscape of existing approaches, OECD Policy Paper No. 36.

¹² For example, see Appendices B and C.

¹³ Physical risks are sources of potential losses in production, service delivery and financial performance/position of an entity caused by direct shocks associated with biodiversity loss, ecosystem degradation or ecosystem services decline. These risks can be chronic (such as a gradual deterioration in soil health and crop yields over time), acute (such as more extreme floods due to land use changes) or both. Transition risks are factors that force entities to adapt to a changing socio-economic environment, including policy changes, shifts in consumer or investor preferences, technological

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21. Both physical and transition risks and BEES-related opportunities may affect an entity's prospects in various ways. Risks, for example, may affect an entity's prospects through supply chain and production disruptions, destruction, damage or decommissioning of assets, provisions for environmental claims and reputational damage among other effects. In turn, these risks may ultimately have financial consequences such as increases in expenses related to raw material prices and availability, additional compliance costs and penalties, increases in legal liabilities, accelerated depreciation, impairment, or write-offs of assets, reductions in brand value or goodwill impairment, decreased sales and/or reduced cashflows. These financial effects will be reflected in an entity's statement of profit or loss and other comprehensive income, statement of cash flows, and/or statement of financial position (also known as the "balance sheet").¹⁴
22. Opportunities that affect an entity's prospects may arise through risk mitigation efforts (thus reducing costs or improving other financial effects) or through new or enhanced sources of income. For example, precision farming practices can contribute to increased efficiency, reduced environmental impact and improved yields. Precision agriculture technologies can reduce input costs by up to 15% while increasing crop yields by 13%. Precision farming has been especially helpful in tackling fertiliser loss, a concern for farmers as nitrogen fertiliser is one of their biggest expenses. Nitrogen fertiliser is also a major contributor to water pollution and climate change.¹⁵
23. The financial effects of an entity's BEES-related risks and opportunities may be transmitted in different ways and eventually translate into credit, market, liquidity and

developments. In the case of BEES-related issues, this means socio-economic changes leading to a transition to nature positive business models that contribute to international goals such as the [Global Biodiversity Framework](#). Examples of BEES-related transition risks include new land use or biodiversity protection regulations, customer preferences for deforestation-free or water-saving products, investor demand for 'green' investments and technological developments such as water-saving technologies or circular manufacturing technologies.

¹⁴ OECD (2023), A supervisory framework for assessing nature-related financial risks: Identifying and navigating biodiversity risks, OECD Business and Finance Policy Papers.

¹⁵ See also Bloomberg NEF (2024) [Opportunity Blossoms: The Business of Curbing Nature Loss](#).

underwriting risks for investors. Investors, in turn, must assess these risks and potential entity effects to determine their potential investment risks and returns when providing economic resources to an entity. For example, if an entity's ability to generate profits is damaged by higher costs from BEES-related risks and opportunities, its cashflows and ability to service debt may be adversely affected, resulting in a higher probability of default and higher borrowing costs. Similarly, lower earnings may depress an entity's stock price raising an entity's cost of capital. Collectively, these investment considerations may affect the risk-adjusted returns that investors demand for the equity and bonds of the entity, affecting the entity's access to and cost of finance and capital.

24. However, the causal chain from dependencies/impacts to risk/opportunities to effects on an entity's prospects is still poorly understood in terms of mechanisms and transmission channels. This is particularly true for the interpretation of the risk implications of BEES-related information which lacks well-developed risk assessment methodologies and models. As will be shown below, this results in BEES-related financial risks and opportunities remain to some degree unpriced or underpriced in the financial markets.¹⁶

Evidence of effects on entity prospects

25. This section summarises the evidence of effects on entity prospects that the staff has obtained from its literature review and set in the context of evidence of investor interest in BEES-related risks and opportunities.¹⁷ In addition to the evidence in this section, Appendix B provides an analysis of the evidence on the effects on entity prospects from water-related issues.

¹⁶ OECD (2023) Assessing biodiversity-related financial risks: Navigating the landscape of existing approaches, OECD Policy Paper No. 36.

¹⁷ See [AP-3 Evidence of Investor Interest in BEES-related risks and opportunities](#), January 2025.

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26. The potential macroeconomic effects of BEES-related risks and opportunities are widely discussed in the literature.¹⁸ For example, some studies show that more than half of global GDP—equivalent to about US\$58 trillion—is moderately or highly dependent on nature.¹⁹
 27. The academic literature that we reviewed²⁰ differed in the measures used to account for BEES-related risks, ranging from overall ESG scores, the disaggregated E component to specific biodiversity risk measures. The academic literature also tended to compare these risk measures to either corporate financial performance (e.g., return on assets) or market returns on equity and bond investments (therefore linked to cost of finance and capital).
 28. Academic studies typically show an inverse correlation between environmental performance and entity financial performance or market returns in over 50% of studies with neutral or mixed correlations in more than one-third of the studies. Relationships between environmental and financial performance or returns, however, may vary based on market, type of financial asset, sector, study methodology or other factors.

¹⁸ Johnson, Justin Andrew; Ruta, Giovanni; Baldos, Uris; Cervigni, Raffaello; Chonabayashi, Shun; Corong, Erwin; Gavryliuk, Olga; Gerber, James; Hertel, Thomas; Nootenboom, Christopher; Polasky, Stephen; Gerber, James; Ruta, Giovanni; Polasky, Stephen. (2021). [The Economic Case for Nature: A Global Earth-Economy Model to Assess Development Policy Pathways](#). World Bank; Zero Carbon Analytics (2024). [Finding economic value in nature beyond carbon](#). Briefing note; and Ranger, N., Alvarez J., Freeman, A., Harwood, T., Obersteiner, M., Paulus, E. and Sabuco, J. (2023). [The Green Scorpion: The Macro-Criticality of Nature for Finance – Foundations for scenario-based analysis of complex and cascading physical nature-related risks](#). Oxford: Environmental Change Institute, University of Oxford

¹⁹ Evison, W., Low, L.P., and O'Brien, D. (2023). Managing nature risks: From understanding to action. Strategy+business. PwC. Retrieved from www.strategy-business.com and [Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy](#) (2020). World Economic Forum.

²⁰ This literature was an even mixture of peer-reviewed journal articles and working papers/pre-print publications. While peer-reviewed studies were preferred as sources of evidence, the nascent nature of research on BEES-related risks and opportunities means that peer-reviewed studies are somewhat limited.

Effects on corporate financial performance

29. Almost all the academic literature reviewed by the staff finds an inverse correlation between an entity's environmental performance and risk management and its corporate financial outcomes such as return on equity (ROE) and return on assets (ROA). Responses to Carbon Disclosure Project (CDP) questionnaires from entities themselves also identify financial effects arising from disruption in production capacity, supply chain disruptions and workforce management and planning disruptions due to biodiversity-related issues.²¹
30. **Positive relationships between better environmental risk management performance and financial performance.** One peer-reviewed meta study of more than 2,000 empirical studies shows a high proportion of studies (~59%) found inverse correlations between environmental risks and financial performance.²² Another peer reviewed meta-analysis of 142 empirical primary studies found corporate investments in environmental sustainability had a positive correlation to financial performance over the long term

²¹ Cherief, A., Sekine, T., & Stagnol, L. (2022). The Market Effect of Acute Biodiversity Risk: The Case of Corporate Bonds. Amundi Institute Working Paper 136-2022. Retrieved from <https://www.amundi.com> This report also analysed CDP (Carbon Disclosure Project) forest data. The researchers used the CDP Forest Response dataset published in October 2021, which was filled out by nearly 450 companies for the year 2021. The analysis focused on the current state of companies' dependence on forest products and summarized the different types of detrimental impacts suffered by companies according to their dependence on different commodities, including reputational and market impacts, physical impacts, regulatory impacts, and technological impacts. It provided a breakdown of these impacts by commodity, such as timber, soy, cattle, palm oil, coffee, cocoa, and rubber. It highlighted specific examples of supply chain disruption, increased operating costs, reduction or disruption in production capacity, brand damage, and disruption to workforce management and planning.

²² The paper includes a detailed analysis of studies that focus specifically on environmental performance (E) and its relation to corporate financial performance. It specifically looks at the environmental criteria of companies' environmental management practices and strategies, green real estate investments and performance related to environmentally sustainable buildings and properties and corporate environmental performance, including efforts to reduce environmental impact and improve sustainability. Friede, Gunnar, Timo Busch & Alexander Bassen (2015) *ESG and financial performance: aggregated evidence from more than 2000 empirical studies*, Journal of Sustainable Finance & Investment, 5:4, 210-233, DOI: 10.1080/20430795.2015.1118917

(defined as greater than one year).²³ The study found that financial benefits from improved environmental risk management increased after two years, becoming both statistically and economically significant in terms of corporate financial performance. A peer-reviewed study of 2,256 A-share listed companies in China from 2015 to 2021 found that ESG performance positively and significantly affected corporate financial performance (return on assets), especially for polluting entities, which experience a stronger positive impact of ESG performance on financial performance compared to non-polluting firms.²⁴

31. **Mixed or no relationship between environmental risk management performance and financial performance.** In contrast, a peer-reviewed paper investigating the impact of environmental scores on firm value (ratio of market value to replacement cost of assets) and profitability (return on assets) **found mixed results.**²⁵ It found that higher environment score for companies did not significantly affect firm value, but had a

²³ The study measured environmental performance using process-based measures, outcome-based measures, proactive measures and reactive measures. Financial performance was measured using market-based measures (e.g., Tobin's Q, stock return or market value of the entity) and accounting-based measures (e.g., ROA, ROE or return on sales). Hang, Markus and Geyer-Klingeborg, Jerome and Rathgeber, Andreas, *It is Merely a Matter of Time: A Meta-Analysis of the Causality between Environmental Performance and Financial Performance* (2018). *Business Strategy and the Environment*, Vol. 28, Issue 2, pp. 257-273, DOI: 10.1002/bse.2215.

²⁴ The study states that because polluting enterprises face greater public pressure and regulatory scrutiny, it incentivizes them to improve their ESG performance to mitigate external criticism and avoid potential fines. Consequently, these efforts in environmental governance can lead to better financial performance for such companies. The study also found that the positive impact of ESG on financial performance extends beyond the current year, showing lasting effects over subsequent years. Fu T and Li J (2023), An empirical analysis of the impact of ESG on financial performance: the moderating role of digital transformation. *Front. Environ. Sci.* 11:1256052. doi: 10.3389/fenvs.2023.1256052

²⁵ The paper selected from the largest 5,000 publicly listed companies from Bloomberg (market cap of US\$2.85 billion and above) from 2013 to 2021 and filtered for companies with ESG scores resulting in 1,720 publicly listed companies in the study. It defined 'environmental performance' as part of the Environment (ENV) score, which is one of the three pillars of ESG (Environment, Social, Governance) performance. The Environment score assesses a firm's performance across three themes: emissions, innovation, and resource usage. The score reflects how well a company manages its environmental impact and sustainability practices. Aydoğmuş, M., Gulay, G., & Ergun, K. (2022). *Impact of ESG performance on firm value and profitability*. *Borsa Istanbul Review*, 22(S2), S119-S127. <https://doi.org/10.1016/j.bir.2022.11.006>

positive and significant correlation with profitability. The study concludes that this difference between firm value and profitability highlights that environmental initiatives may contribute more directly to a firm's operational efficiency and profitability than its market valuation. The authors state that the lack of a significant relationship between the environmental score and firm value may be due to the longer time required for environmental actions to produce results and the high investment costs associated with them.

32. An academic working paper that studied about 2,262 entities drawn from the Russell 3000 index over the period 2013 to 2020 found **no significant relationship** between the three types of biodiversity scores used in the study and a company's return on assets, earnings, profit margins, firm valuation, systematic or idiosyncratic risk.²⁶ The study concludes that current biodiversity metrics in the E component of ESG ratings do not provide enough useful information for financial decision-makers and do not effectively shift capital away from biodiversity-harmful activities or improve the management of nature-based risks. However, the study noted that its results may vary from other studies due to different focus areas, sample and methodology differences, market perception and investor behaviour, regulatory and market context, quality of ESG metrics, and temporal effects.

²⁶ To test the relationship of the biodiversity score, the study constructed three sets portfolios - portfolios where stocks were sorted into quintiles based on their composite biodiversity score from low to high; portfolios where stocks were sorted into quintiles based on their biodiversity exposure score (low to high); and portfolios where stocks were sorted into quintiles based on their biodiversity management score (low to high). The biodiversity exposure score measures the extent to which a company's business is vulnerable to biodiversity and land use risks, the biodiversity management score measures how well the company manages these risks, and the composite biodiversity score is a composite score derived from these two other scores. Xin, W., Grant, L., Groom, B., & Zhang, C. (2023). *Biodiversity Confusion: The impact of ESG biodiversity ratings on asset prices*. University of Exeter Business School

Effects on market returns (cost of capital)

33. In this section, the staff summarises the literature on effects of BEES-related risks and opportunities on market returns related to equity or bond instruments. Many of the academic studies that the staff reviewed indicated an **inverse correlation between biodiversity risk and market returns** on equities and bonds. More information about these studies is provided in Appendix D.
34. In respect to the **equity markets**, studies have found that **nature risks can adversely affect** the price of an entity's stock. Conversely, entities with strong biodiversity risk management could obtain lower costs of capital and were at a lower risk of significant stock price declines (volatility).
35. Similarly, in relation to the **bond markets**, studies found significant **inverse correlation** between environmental performance and bond prices, with entities that have strong risk management receiving better pricing on their long-term debt. Another finding is that entities in sectors with significant biodiversity impacts, such as paper and forest products, metals and mining and chemicals, experience widening corporate bond spreads following news of acute biodiversity events, indicating increased perceived risk and higher borrowing costs.
36. Finally, some studies show nature risks (most prominently flooding and pollution risks) to have a **negative impact on property values**, either manifesting as a drop in property prices and/or difficulty in selling the properties, hence posing market and liquidity risks. The effect also was shown to extend to insurance premiums on property.
37. However, a few studies question the **degree to which biodiversity risks are currently priced in the market**. For example, a survey conducted among 668 finance academics, professionals and public sector regulators showed that about half of respondents believe that biodiversity risks are not sufficiently priced across various asset markets, including

stock, commodity, sovereign debt, and real estate markets.²⁷ Respondents attributed this to complexity and measurement challenges that makes it difficult for market participants to fully understand and incorporate these risks into asset prices; lack of standardised disclosure making it hard for investors to assess and compare the biodiversity risk exposures of different firms and industries; slow-moving nature of risks making it difficult to quantify the immediate impacts and incorporate them into current asset prices; and future regulatory and consumer response uncertainty, which adds to the difficulty in pricing these risks accurately.

Case examples of effects on entity prospects

38. In addition to the academic literature and non-academic reports, the staff also identified and selected 29 illustrative case examples of BEES-related risks and opportunities affecting particular entities' prospects. Nineteen of the cases are water-related involving drought, floods, pollution, availability or recycling issues; five were land use-related; one was pollution/waste-related; and four were climate-related (climate being one of five drivers of nature loss).²⁸ These are summarised in Appendix E.
39. Eleven of the cases were related to increased costs, four to asset write downs, four to lost revenue, nine to opportunities and one to access to capital. The monetary effects ranged from US\$4 million to US\$20 billion. Most fell into the US\$100 million to US\$500 million range. The cases were almost equally divided between examples of physical risks (9 cases) and transition risks (11 cases), with acute physical risks more numerous than chronic physical risks. Transition risks were largely related to compliance, regulatory, legal liability and reputational risks.

²⁷ Giglio, Stefano; Theresa Kuchler, Johannes Stroebel, Xuran Zeng (April 2023) Biodiversity Risk, NBER

²⁸ These cases were not randomly selected so conclusions about the frequency of certain BEES-related topics and related effects should not be seen as generally representative of effects on entity prospects.

Appendix A – Illustrative sector nature dependencies and impacts²⁹

Sector	Industry	Dependency ³⁰	Impact ³¹
Food & Beverage		High	High
Extractives & Mineral Processing	Oil & Gas Exploration & Production	Moderate/Low	High
	Metals & Mining	Moderate/Low	High
Resource Transformation			
	Chemicals	Moderate/Low	High
Consumer Goods		Moderate	High
Health Care		Low	Moderate
	Biotechnology & Pharma		High
Infrastructure			
	Electric Utilities & Power Generators	Moderate	High
	Construction	High	High
	Real Estate	Moderate	Low
Transportation		Moderate	Moderate
Technology & Communications		Moderate/Low	Moderate
Renewable Resources	Forest, Paper and Pulp	High	Moderate

²⁹ **Table reflects direct operations only.** Also note that this table illustrates results from only two different sources for estimating dependencies and impacts.

³⁰ Evison, W., Low, L. P., & O'Brien, D. (2023, April 19). *Managing nature risks: From understanding to action*. Strategy+business. PwC. Retrieved from <https://www.strategy-business.com/>. Dependence on nature estimated using the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) database, which calculates an overall dependency rating based on the multiple ecosystem services. This rating was combined with the gross value added (GVA) of each industry to calculate the percent of GVA dependent on nature: High = 60 - 100%, Moderate 35 - 59% and Low below 35%.

³¹ Finance for Biodiversity Foundation. (October 2024). *Assessment of the biodiversity impacts and dependencies of globally listed companies: A collaborative multi-tool footprinting approach*. Retrieved from www.financeforbiodiversity.org. Relative impact categories determined by application of multiple biodiversity footprinting tools to 2,369 companies from the MSCI ACWI, excluding financial services. High=top third of industries ranked by impact scores; moderate=middle third; and low= bottom third.

Appendix B – Water-related risks, opportunities and entity prospects

B1. In this appendix, the staff provides a more in-depth analysis of how a specific BEES topic – water-related risks and opportunities – affects entity prospects. Water was chosen as a focus topic due to its important role both in nature and in the economy, its interest to most investors as a dependency of and risk to many businesses, and its relative maturity as a BEES-related topic in terms of measurement and disclosure practice.

The role of water

B2. Water and ecosystems are deeply interdependent. The availability and quality of water significantly impacts the health and function of ecosystems, while ecosystems in turn play a crucial role in regulating water cycles and distribution.

B3. Water is a crucial input for real-economy activities, affecting both macroeconomic activity (e.g., economic growth) and microeconomic activities. For instance, water is used in nearly every stage of production in many industries, from manufacturing to power generation, acting as a vital input for cooling, cleaning and raw material processing.³² The agricultural sector is particularly reliant on water for irrigation, with a significant portion of global water usage dedicated to crop production. In turn, economic activities leading to groundwater depletion and water diversion and transfer as well as pollution such as eutrophication, metals contamination and plastics pollution can impact water resources by affecting water quantity and quality. These water-related dependencies and impacts (see Appendix C) give rise to water-related risks (and opportunities) for businesses.

³² Of 4,815 companies reporting on CDP's water questionnaire in 2023, 65% rated the importance of water quality and quantity to the success of their business as either vital or important. See web-based report at [Biodiversity targets - CDP](#)

Water-related risks and opportunities

- B4. Water risks, as with BEES-related risks in general, can be categorised as physical or transition risks. In a 2023 CDP report, about 44% of over 3,900 respondents reported **substantial exposure to water-related risks** with 79% of these citing exposure to physical risks and 21% to transition risks.³³ A 2024 CDP analysis showed that the **potential financial impact from water-related risks** was 70% from acute physical risk and 21% from chronic physical risk, with 9% from transition risks.³⁴
- B5. Examples of water-related **physical risks** are abundant in the literature and press.³⁵ While many water-related risks are local in nature, physical risks at times may have the potential to cause widespread disruptions from broader scale effects of water scarcity, floods and pollution.³⁶ These broader scale effects can simultaneously impact multiple sectors like

³³ CDP Worldwide. (2023). Riding the Wave: How the private sector is seizing opportunities to accelerate progress on water security. Retrieved from <https://www.cdp.net/en/responses>.

³⁴ CDP Worldwide. (2024). Stewardship at the Source: Driving Water Action Across Supply Chains. Retrieved from <https://www.cdp.net/en/responses>.

³⁵ Some examples include: extreme flooding in central China shut down coal deliveries, which led to widespread power shortages; flooding and landslides in western Europe disrupted rail traffic for steelmakers and other producers that were unable to get raw materials; the worst drought in half a century in Taiwan in the summer of 2021 deepened the shortage in semiconductors, where large amounts of water are used in the production process; and in the last quarter of 2021, a once-in-a-century flood in British Columbia disrupted supply chains both in Canada and the U.S. for several months. See Ceres. (2022). *Global Assessment of Private Sector Impacts on Water*. Retrieved from <http://ceres.org>.

³⁶ For example, major river basins, such as the Colorado River Basin in the U.S., are facing increasing water stress due to climatic, economic and population pressures, impacting both local and multinational companies in the region. In 2018, the Rhine River was adversely affected by low water levels, which led to bottlenecks in the supply of raw materials to German companies and ultimately to production cutbacks at some plants. Similarly, the Panama Canal is experiencing issues with low water levels due to a prolonged drought, leading to restrictions on the number of ships allowed to transit through the canal. This causes disruptions and delays to global shipping, disrupting global supply chains and increasing the costs for cargo transportation with significant economic consequences ([U.S. Trade and the Impact of Low Water Levels in Gatun Lake and the Panama Canal | Bureau of Transportation Statistics](#)). In 2019 at the peak of Australia's last drought, the state of New South Wales, for the second year in a row, had allocated zero irrigation water to most farmers in the Murray-Darling watershed. To buy water on Australia's spot market was not an option as the drought had sent the average price of Murray-Darling water up 139% in the previous year to US\$360 a megalitre (Waldman, P., Rangarajan, S., Whitley, A., Gross, S., Mejía, E., & Wahid, R. (2023, December 27). The Water Trade Is Booming—and Sucking Australia Dry. Bloomberg).

agriculture and various industries and potentially lead to cascading effects that may trigger a chain reaction of economic, social or environmental impacts. While not directly manageable by individual entities, some entities have taken potential water-related systemic risks into considerations in their risk management and business contingency processes.

- B6. Water-related **transition risks**, such as policy or regulatory compliance risks, legal liability risks and technological and reputational risks, are also a factor affecting entities' prospects.³⁷ For example, in this area, entities may encounter stricter regulations and policies aimed at reducing water pollution, necessitating changes to their operations or business models. The European Union, for example, has implemented measures to reduce nitrate pollution and nutrient losses into water bodies. The cost of adopting new farm practices to reduce such nutrient water pollution in the U.K. was estimated to be as much as US\$4.75 million annually.³⁸
- B7. Water risks affect sectors and industries in different ways depending on the degree of dependency and/or impact particular sectors or industries have on water resources.³⁹ Sectors such as fashion and apparel, technology, agribusiness and metals and mining are particularly vulnerable due to their high dependency on water and their impacts due to water withdrawals and pollution. For example, both the apparel industry and packaged meat industry withdraw significant amounts of water and are responsible for substantial freshwater pollution; these dependencies and impacts, and their attendant risks, have several potential effects on entities' prospects.⁴⁰

³⁷ Water-related risks in equities: Pricing in risk. Donald Graham, CFA, ESG Specialist, Templeton Global Equity Group in Water disruption: Investment risk from multiple angles (2020), Franklin Templeton Institute.

³⁸ Ceres. (2022). Global Assessment of Private Sector Impacts on Water. Retrieved from <http://ceres.org>.

³⁹ See Appendix C.

⁴⁰ Ceres. (December 2021). *Financial Implications of Addressing Water-Related Externalities in the Apparel Sector* and Ceres. (2021). *Financial Implications of Addressing Water-Related Externalities in the Packaged Meat Industry*. Retrieved from <https://www.ceres.org/homepage>.

B8. Despite the consensus in the literature that water-related risks are significant from the perspective of effects on entity prospects, one working paper has pointed out that water-related risks are not fully captured by existing risk assessment approaches. According to the paper, the banking sector does not yet fully grasp its exposure to these risks and the insurance sector, while being aware of water-related risks, needs better risk assessment tools and data to improve underwriting and pricing practices. The paper highlights the need for better data, standardisation and new tools to help investors.⁴¹

Evidence of water-related effects on entity prospects

- B9. The evidence of water-related effects on an entity's prospects appears mostly in the form of case examples, market studies and scenario analyses. Academic studies of the empirical effects of water risk on either corporate financial performance or cost of capital are limited and tend to focus on specific sectors; the staff found no meta studies on water risk and effects on entity prospects.
- B10. When water is scarce either because of quantity or quality issues, it can lead to reduced productivity, higher costs and competition for scarce water resources.⁴² CDP has reported that the costs of water risk have been rising and that companies faced US\$392 billion in financial impact in 2023 due to water risks such as shortages and pollution.⁴³

⁴¹ Davies, L., & Martini, M. (2023). Watered down? Investigating the financial materiality of water-related risks in the financial system. OECD Environment Working Papers No. 224. Organisation for Economic Co-operation and Development. <https://dx.doi.org/10.1787/c0f4d47d-en>

⁴² Of over 1,000 global companies reporting to the CDP in 2021, respondents noted the potential impacts of water risks on their businesses as reduction or disruption in production capacity (44%); increased operating costs (24%); reduced revenues from lower sales/output (11%); supply chain disruption (9%); closure of operations (8%); and constraints to growth (5%). CDP Worldwide. (2022). High and Dry: How Water Issues Are Stranding Assets. A report commissioned by the Swiss Federal Office for the Environment (FOEN). Retrieved from www.cdp.net. In addition, in a separate report, over 50% of 3,910 respondents indicated that water was vital or very important to their direct and indirect operations. CDP Worldwide. (2023). Riding the Wave: How the private sector is seizing opportunities to accelerate progress on water security. Retrieved from <https://www.cdp.net/en/responses>.

⁴³ CDP Worldwide. (2024). Stewardship at the Source: Driving Water Action Across Supply Chains. Retrieved from <https://www.cdp.net/en/responses>.

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- B11. Aggregate effects at a sector level provide another indication that entities in those sectors are likely to experience an effect on their financial performance and prospects. The following are examples of effects on profitability and stock prices in different sectors with high dependency or impacts on water:
- (a) A recent Barclays' research note warned that the consumer staples sector alone, including food and beverage companies, is facing a potential US\$200 billion impact from water scarcity risks.⁴⁴
 - (b) A Ceres analysis indicated that addressing water-related externalities created by the apparel industry could have significant negative effects on entity EBITDA (earnings before interest, taxes, depreciation, and amortisation) ranging from a low of -21% to a high of -47% across eight major apparel companies. Four of these major apparel entities could see their profitability fall below their cost of capital.⁴⁵
 - (c) An academic study of stock prices for 15 industries in China from 2000 to 2014 found that drought generally had a negative impact on stock prices, especially in the following industries: Agriculture, Forestry, Animal Husbandry, and Fishery; Manufacturing; Information Transmission, Software, and Information Technology Services; Finance; Real Estate; Leasing and Business Services; and Water, Environment, and Public Facilities Management.⁴⁶ The authors attributed variations in the strength of the relationship to the level of water dependency, supply chain effects, market expectations and speculation, investor sentiment and government policies.

⁴⁴ S. Meredith, "Water scarcity: Why some of the world's biggest companies are increasingly worried about water scarcity," *CNBC*, New York, 2021.

⁴⁵ Ceres. (December 2021). Financial Implications of Addressing Water-Related Externalities in the Apparel Sector. Retrieved from <https://www.ceres.org/homepage>

⁴⁶ Industries are listed here using nomenclature from the study. Cheng X, Wang Y, and Wu X (2022), The effects of drought on stock prices: An industry-specific perspective. *Front. Environ. Sci.* 10:978404.

- (d) A 2018 non-academic report concluded that if entities had to absorb the full cost of water availability and quality impairment, average profits could be significantly reduced – by 18% for the chemicals industry, 44% for the utilities sector and 116% for the food and beverage sector.⁴⁷ In another example in the same report, a major technology and communications company found that its risk-adjusted water bill for one of its data centres was 11 times greater than the current actual water bill. As a result, the company instituted water recycling and saved more than US\$140,000 per year.
- B13. Of the case examples in Appendix E, 19 provide water-related examples of effects on entity prospects. These effects ranged from US\$4 million to over US\$10 billion. Cases of physical risk (8) were most prevalent in these examples, followed by transition risks (6) (e.g., reputation, regulatory and liability cases). Five cases were investments in the pursuit of opportunities in improved water use efficiency and recycling.
- B14. CDP indicated that companies reported **water-related opportunities** with a combined financial value of US\$436 billion in 2022 of which 68% of the value were due to new products and services valued at US\$297 billion; 21% were market opportunities valued at US\$91 billion; 6% were resiliency improvements valued at US\$25 billion; and 4% were efficiency improvements valued at US\$17 billion, with 1,720 respondents (45%) reporting that they were currently realizing water-related opportunities that could have a substantive financial or strategic impact on their business.⁴⁸

⁴⁷ Tsang, B., & March, R. (2018). [How to Manage Water Risk in Your Growing Business](#). S&P Dow Jones Indices.

⁴⁸ See CDP Worldwide. (2023). Riding the Wave: How the private sector is seizing opportunities to accelerate progress on water security. Retrieved from <https://www.cdp.net/en/responses>.

Appendix C – Water-related impacts by GICS industry

GICS Industry	Supply Chain		Direct Operations		Product Use/End of Life	
	Water Quantity	Water Quality	Water Quantity	Water Quality	Water Quantity	Water Quality
Food Products	Red	Red	Orange	Orange	White	White
Beverage	Red	Red	Orange	Orange	White	Red
Household Products	White	Yellow	White	Yellow	White	Orange
Personal Products	White	White	White	Yellow	White	Orange
Textiles, Apparel, and Luxury Goods	Orange	Orange	Yellow	Red	White	Orange
Automobiles and Components	White	Yellow	White	Yellow	White	Yellow
Hotels, Restaurants, and Leisure	White	White	Yellow	White	White	White
Oil and Gas	Orange	Red	Orange	Red	White	Yellow
Consumable Fuels	Yellow	White	Yellow	White	White	White
Construction and Building	Yellow	Yellow	Yellow	Yellow	White	White
Electroplating	White	White	White	Orange	White	White
Pharmaceuticals	White	White	White	Red	White	Red
Chemicals	Orange	Orange	Yellow	Red	White	White
Construction Materials	White	White	Yellow	White	White	White
Metals and Mining	Orange	Orange	Orange	Red	White	White
Paper and Forest Products	Orange	Orange	Orange	Red	White	White
High-tech and Electronics	Orange	Orange	Orange	Orange	White	White
Semiconductor and Circuit Board	White	White	Yellow	Orange	White	Orange
Battery	Orange	Orange	White	Orange	White	Orange
Renewable Electricity	White	White	Red	Yellow	White	White
Electric Utilities	White	White	White	Yellow	White	White

This table provides a relative assessment of water impacts created by different industries across areas of their value chains. See Ceres. (2022). Global Assessment of Private Sector Impacts on Water, Table 2 and Appendix D: Methodology: Industrial Impacts on Freshwater- Scoring Criteria Retrieved from <http://ceres.org>.
Red=very high impact; Orange=high impact; Yellow=medium impact; White=not enough information found.

Appendix D – Effects of BEES-related risks and opportunities on market returns (cost of capital)

D1 This appendix provides more details on the literature showing whether and how BEES-related risks and opportunities affect market returns related to equity or bond instruments, the summary of which is provided in paragraphs 25-39 above.

Equity returns

D2 **Extent of exposure to nature-related risks.** A 2023 industry report notes that more than half of the market capitalisation on 19 of the world's largest stock exchanges is exposed to high or moderate dependence on nature, which may be an indicator of potential nature-related risks in equity markets.⁴⁹

D3 **Positive correlation between BEES-related risks and opportunities and equity prices.** A pre-print academic paper, which analysed data from 1,782 U.S. publicly traded entities from 2001 to 2020, found that entities with **higher biodiversity risk face higher costs of equity capital**.⁵⁰ Specifically, for entities with higher biodiversity risks, the paper estimated that investors will demand an additional return of 7.2 basis points to compensate for the perceived increased risk (e.g., risk premium). The paper also identified that entities in areas with higher risk of regulatory enforcement experience a more significant increase in the cost of equity compared to entities in areas with lower risk of regulatory enforcement, which may imply that environmental enforcement is one possible channel through which biodiversity risk affects the cost of equity capital.

D4 A 2019 literature review of 154 peer-reviewed published papers found that **higher nature risks generally leads to adverse effects on the stock market**, and therefore pose

⁴⁹ Evison, W., Low, L.P., and O'Brien, D. (2023). Managing nature risks: From understanding to action. Strategy+business. PwC. Retrieved from www.strategy-business.com

⁵⁰ Lai, S., Liu, S., Pu, X., & Zhang, J. (2023). *Biodiversity Risk and the Cost of Equity Capital*. Pre-print.

financial risks in the form of market volatility and drops in stock prices (market capitalisation).⁵¹ A subsequent 2024 study of over 1,400 entities in 45 countries found that those with **strong biodiversity risk management are at a lower risk of significant stock price declines.**⁵²

D5 An academic working paper that studied about 2,337 entities between 2001 and 2023 concluded that when negative biodiversity news predominates, the equity prices of industries with high biodiversity risk exposure tend to drop more than those with low exposure.⁵³

Bond returns

D6 Almost all the academic studies the staff reviewed found an inverse correlation between BEES-related risks and bond prices and a positive correlation with bond spreads, indicating higher borrowing costs for entities with higher BEES-related risks.

D7 A working paper that investigated the impact of biodiversity, water and pollution prevention on the credit risk term structure of about 60 infrastructure companies found that **managing BEES-related risks effectively provided these entities with up to 93 basis points better (lower) long-term refinancing** costs compared to the worst-

⁵¹ Bassen, A., Busch, T., Lopatta, K., & Opoku, E. E. O. (2019). *Nature Risks Equal Financial Risks: A Systematic Literature Review*. University of Hamburg, Germany

⁵² Bassen, A., Buchholz, D., Lopatta, K., & Rudolf, A. R. (2024). *Biodiversity management and stock price crash risk*. *Business Strategy and the Environment*, 33(5), 4788–4805. <https://doi.org/10.1002/bse.3725>

⁵³ The study used two news-based measures – an index constructed from the New York Times articles related to biodiversity which were assigned a positive, negative, or neutral sentiment score. The index is calculated as the number of negative biodiversity articles minus the number of positive biodiversity articles on a given day. Additionally, a second index, the "Google-Biodiversity Attention Index," is constructed by analysing Google search activity for terms like "biodiversity loss" and "species loss." This index tracks public attention to biodiversity risks and is aggregated into a monthly measure. Both indices are substantially correlated and provide a high-frequency measure of biodiversity risk. Giglio, Stefano; Theresa Kuchler, Johannes Stroebel, Xuran Zeng (April 2023) *Biodiversity Risk*, NBER

performing firms.⁵⁴ Similarly, another working paper that analysed a sample of 1,360 entities in the US corporate bond market from 2002 to 2022 found that **higher biodiversity risk exposure is associated with higher bond spreads** among long-term bonds but not for short-term bonds, which, according to the authors, indicated that biodiversity risk is considered a long-term risk by investors.⁵⁵ A 2015 peer-reviewed meta study found that more than two-thirds of studies on bonds report **significant inverse correlation between environmental performance and bond prices**.⁵⁶

- D8 A research study by an asset manager of USD-denominated bonds for Australian and Brazilian companies between 2019 and 2022 assessed the impact of biodiversity news events on corporate bond spreads.⁵⁷ It found that **biodiversity news events have a significant impact on corporate bond spreads**. Companies in sectors with significant biodiversity impacts, such as paper and forest products, metals and mining, commodities and chemicals, experience widening corporate bond spreads following news of acute biodiversity events, indicating increased perceived risk and higher borrowing costs.

Returns on other assets and financial instruments

- D9 BEES-related risks may also affect real estate values and insurance premiums, two aspects that may in turn affect an entity's prospects (through an entity's property values and its insurance costs). One working paper meta-study of 154 studies found that of 115 studies on real estate, 84% indicate that nature risks (most prominently flooding and

⁵⁴ Hoepner, A. G. F., Klausmann, J., Leippold, M., & Rillaerts, J. (2023). *Beyond Climate: The impact of biodiversity, water, and pollution on the CDS term structure*. University College Dublin, ESSEC Business School, University of Zurich, Swiss Finance Institute Research Paper Series No. 23-10

⁵⁵ Soylemezgil, Sevgi and Uzmanoglu, Cihan (2024) *Biodiversity Risk in the Corporate Bond Market*. Available at SSRN: <https://ssrn.com/abstract=4721219> or <http://dx.doi.org/10.2139/ssrn.4721219>

⁵⁶ Friede, Gunnar; Timo Busch & Alexander Bassen (2015) *ESG and financial performance: aggregated evidence from more than 2000 empirical studies*, *Journal of Sustainable Finance & Investment*, 5:4, 210-233, DOI: 10.1080/20430795.2015.1118917

⁵⁷ Cherief, A., Sekine, T., & Stagnol, L. (2022). *The Market Effect of Acute Biodiversity Risk: The Case of Corporate Bonds*. Amundi Institute Working Paper 136-2022. Retrieved from <https://www.amundi.com>

pollution risks) have negative impact on property values, either manifesting as a drop in property prices and/or difficulty in selling the properties, hence posing market and liquidity risks to the area.⁵⁸ This same study also found that nature risks lead to higher insurance premiums and greater uptake of insurance policies but while nature risks increase the demand for insurance, the net financial impact on the insurance sector remains unclear.⁵⁹

⁵⁸ Bassen, A., Busch, T., Lopatta, K., & Opoku, E. E. O. (2019). *Nature Risks Equal Financial Risks: A Systematic Literature Review*. University of Hamburg, Germany.

⁵⁹ The study indicates that the net financial impact on the insurance sector is unclear because the data used in the studies do not provide a comprehensive picture of the costs and benefits associated with the rise in nature risks. While the studies indicate that increasing nature risks lead to a rise in insurance subscriptions and premiums, they do not detail how much these risks cost the insurance sector or how much insurers benefit from the increased subscriptions. Therefore, it is difficult to assess the net gain or loss for the insurance sector.

Appendix E – Case examples of BEES-related effects on entity’s prospects

Acute Physical Risk		Chronic Physical Risk		Transition Risk	Opportunity
BEES Topic	Sector	Ways in which entity prospects are affected	Description		Financial Impact
Water	Consumer Goods	Revenue loss, disruptions	Water shortages and flooding in supply chain regions caused disruptions in entity’s global distribution networks, leading to losses in revenue. The entity has since invested significantly in water conservation programs across its supply chain, raising operational costs		Not available
Water	Consumer Goods	Opportunity,	Major consumer goods firm implemented water conservation and efficiency program that resulted in significant cost savings since 2008. Cumulative cost avoidance through reducing water use in factories of around €60 million from 2008 – 2017.		€60 million over 10 years
Water	Transportation	Costs, disruptions	Production losses due to extreme flooding and water stress in Southeast Asia supply chain, which affected the availability of key materials, leading to disruptions worth approximately US\$200 million		US\$200 million
Water	Resource Transformation	Costs, disruptions	Over US\$100 million in damages and operational losses after Hurricane Harvey caused severe flooding at several facilities in Texas, leading to increased insurance costs and lost production		US\$100 million
Water	Resource Transformation	Revenue loss, disruptions	Drought in Europe: lower river levels disrupting river transportation which caused suspension of production for 64 days for the company.		€96 million

Water	Resource Transformation	Costs: fines, legal liabilities, cost of capital	Large speciality chemical company incurred fines with US municipal water authorities for remediation of water pollution from PFAS chemicals . Total liabilities could grow up to US\$30 billion. Company also experienced a 40% sharp decline in stock price from 2019-2023 thought to be stemming from PFAS litigation.	US\$10.3 billion, with potential to grow
Water	Infrastructure	Costs	Operational losses of US\$300 million due to extreme weather events like hurricanes and floods. Increased flooding damaged infrastructure, leading to higher maintenance and insurance costs.	US\$300 million
Water	Infrastructure	Costs: fines,	Incurred over US\$102 million in costs related to the cleanup of coal ash ponds that contaminated local water bodies . These environmental issues led to increased regulatory fines and operational delays.	US\$102 million
Water	Infrastructure	Asset write downs	A nuclear facility discharged thermal water pollution into local waterways resulting in ecological and biodiversity impacts. As a result, tighter regulatory standards for effluent discharge were imposed on the company. The parent group decided to decommission the facility early rather than expend the funds necessary to comply with the regulations. Since this facility was only 1% of the group's total assets and liabilities and only 2% of its production capacity, the company judge the monetary impact was minimal in the overall scheme of things.	US\$900 million
Water	Food & Beverage	Costs: legal liabilities, reputation	Significant reputational and legal risks linked to water pollution caused by runoffs from meat processing facilities, resulting in a settlement of US\$4 million and changes to supply chain	US\$4 million
Water	Food & Beverage	Costs, disruptions	Increased operational costs and supply chain disruptions due to droughts and extreme weather in regions supplying commodity inputs . Entity had to adjust sourcing strategies and invest more in sustainable farming practices, raising its costs by millions of dollars.	Not available
Water	Food & Beverage	Opportunity,	Water scarcity in key production regions led entity to invest heavily in water replenishment programs and local water recycling infrastructure . This increased capital expenditure by approximately US\$2 billion as the entity sought to protect its long-term water supply	US\$ 2 billion
Water	Food & Beverage	Opportunity,	Invested US\$1.4 billion into water-saving technologies and eco-friendly farming practices as part of its strategy. These efforts were prompted by water scarcity risks in its supply chain , especially in regions like India and Mexico, affecting costs	US\$1.4 billion

Water	Food & Beverage	Costs, disruptions	Entity reported failure to procure enough groundwater in Colorado watershed leading to a shut down in one facility.	US\$640 million
Water	Technology & Communications	Revenue loss, disruptions	Supply chain was impacted by a series of floods in its Asian manufacturing hubs, resulting in over US\$1 billion in lost revenue due to delayed production	US\$1 billion
Water	Technology & Communications	Opportunity	Entity's data centres faced increased costs due to rising energy demands and water usage for cooling . Entity invested in water-positive solutions for its cloud infrastructure, raising operational costs but reducing long-term risks of water scarcity	Not available
Water	Technology & Communications	Opportunity	Spent US\$200 million to invest in water reclamation facilities and eco-friendly manufacturing . These investments were driven by increasing water use for its production, resulting in rising operating costs in regions prone to water stress	US\$200 million
Water	Extractives and Mining	Asset write downs	Gold mining company was involved in a water pollution incident followed by regulatory reduction in access to water and difficulty in obtaining operating permits. Asset write downs exceeded operating profit. Shares lost more than half their value.	US\$7.5 billion
Water	Extractives and Mining	Asset write downs	Coal mining company depleted an aquifer . As a result of regulatory action and water-related litigation , the company had to reduce production and write off a total of US\$1.25 billion in assets, reducing total assets by 14% and net worth by nearly half.	US\$1.25 billion
Land Use	Consumer Goods	Costs, reputation	Entity faced supply chain disruptions due to deforestation-related scandals linked to leather sourcing in the Amazon. These reputational risks affected revenue and forced entity to revise its sourcing strategy, commit to more sustainable materials, and increased operating expenses	Not available
Land Use	Resource Transformation	Costs: Fines, legal liabilities	Entity faced fines and rising liabilities tied to land-use controversies. Paid US\$46 million in fines and settlements for environmental damage caused by mining operations linked to deforestation	US\$46 million
Land Use	Food & Beverage	Revenue loss	Entity experienced a US\$100 million revenue hit after cocoa shortages, caused by deforestation and extreme weather , affected production. The entity has since invested in sustainable sourcing programs	US\$100 million

Land Use	Food & Beverage	Access to capital	A large meat producer was exposed for sourcing cattle from suppliers implicated in illegal deforestation in the Amazon. Company's 2023 IPO on NYSE was delayed pending an SEC investigation.	US\$20 billion
Land Use	Extractives & Mineral Processing	Costs, Revenue loss	A US\$10 billion copper mine was closed due to environmental backlash resulting in a 37% decrease in the company's production and a net loss to shareholders. Company is now spending US\$15-US\$20 million per month to preserve the site until a final decision is reached.	> US\$159 million
Pollution & Waste	Consumer Goods	Opportunity	A major consumer goods company avoided costs of around €250million from 2008 to 2017 from its waste programme.	€250 million
Climate	Transportation	Opportunity	Marine transportation companies are investing to transition away from heavy fuel oils. Some companies have older fleets and need to be upgraded at great cost. Others are already modernized and will require less investment to switch fuels.	Not available
Climate	Transportation	Opportunity	Entity's investment in electric vehicle (EV) technology resulted in higher capital expenditures to retool its manufacturing plants and develop eco-friendly vehicles, part of a broader shift toward sustainable transportation solutions . The strategy and investments were aimed at protecting against future market risks from carbon regulations.	Not available
Climate	Healthcare	Opportunity	Spent US\$500 million on energy-efficient facilities to meet eco-friendly regulations and reduce its carbon footprint. This led to a rise in capital expenditures, but the entity expects long-term operational cost savings from reduced energy usage.	US\$500 million
Climate	Extractives & Mineral Processing	Asset write down	Write down of US\$2.5 billion in assets as part of impairments linked to changes in expectations around regulations and transition risks .	US\$2.5 billion