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UK Nature-Related Risk Analysis Update

This brief is provided as an update on the methodological building blocks of the analysis ahead of the final results and detailed publication of this research in April 2024.

Summary

Ecosystem services, such as clean water and healthy soils, are vital for the normal functioning of all sectors, and therefore the entire economy. However, the depletion of nature across the UK and internationally, means these vital ecosystem services are at risk of disruption unless steps are taken to protect and restore the natural ecosystems that provide them. This poses a risk to those financial assets exposed to nature-related risk, and also to the resilience and financial stability of the UK economy. These risks at present remain unquantified.

In early 2023, the Green Finance Institute (GFI), in collaboration with the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), the University of Oxford, the University of Reading and the National Institute of Economic and Social Research (NIESR), set out to develop the first analysis of the financial risks posed by nature degradation and the erosion of ecosystem services, both domestically and globally, to the real economy and financial sector in the UK.

The development of the methodology and analysis described in this brief has been informed by contributions from several sources, including public data and governance around the use of this data from the Bank of England. In addition, input has been provided by the Department for Environment, Food and Rural Affairs (DEFRA), the Financial Conduct Authority (FCA), HM Treasury and the Taskforce on Nature-related Financial Disclosures (TNFD), as well as targeted input from scientific experts and the financial sector. The team has coordinated with the Network of Central Banks and Supervisors for Greening the Financial System's (NGFS) Taskforce on Biodiversity Loss and Nature-related Risks and the TNFD to build upon and ensure consistency with their guidance and frameworks on risk assessment and scenario analyses. The analysis and insights expressed in this update, however, are those of the project team and do not necessarily reflect the views or positions of the associated institutions informing the research.

The work of the project team aims to advance understanding of the materiality of nature-related risks in the UK - moving us beyond assessing nature-related dependencies on ecosystem services, to gauging whether, and to what extent, those dependencies are resulting in a material financial risk to the UK macroeconomy and financial stability.

It advances upon the methodologies developed in the 2023 NGFS Occasional Paper "The Green Scorpion: The Macro-Criticality of Nature for Finance" and extends its modelling to around twenty ecosystem services.

The project includes several innovative new approaches. For example, it:

- provides a first-of-its-kind **UK Nature-Related Risk Inventory,**
- estimates the **dependency of UK banks and insurers on ecosystem services,**
- estimates the **upstream (indirect) and spatial exposure** of those dependencies,
- provides **a methodology to translate dependencies into financial risk to the real economy,**
- provides **three scenarios** that integrate plausible yet extreme futures of **nature and climate risks** and their **transmission channels into the UK economy,**
- tests the scenarios and their channels over a time horizon to result in an estimated **percentage impact on UK GDP,** and
- calculates **value at risk for typical UK lending and investment portfolios.**

The outputs of the project could be used by a wide range of stakeholders to inform their own nature-related risk management approaches, in particular:

- private financial institutions to inform internal nature-related risk assessment and management frameworks including prioritising risk drivers and sectors for UK portfolios, comparing the materiality of nature with that of broader macroeconomic risk drivers, and getting started while counterparty-level data improves;
- central banks and financial supervisors to inform approaches to macroprudential assessments of nature-related risks, as well as how nature may enter microprudential supervisory frameworks;
- businesses in the UK real economy to both inform business and resilience planning, and support communication on nature-related risks with financiers and shareholders; and
- environmental NGOs to inform strategic priorities for UK programmes aiming to support, convene and build capacity in the private sector to manage nature-related impacts and risks.

While the focus of the analytical results is on the UK economy, the methods and approaches are applicable internationally.

Ahead of April, GFI and the University of Oxford and the University of Reading will be hosting a small number of UK workshops to finalise feedback on the inventory and scenarios, and engage with the stakeholders listed above.

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Section 1:
Importance of Nature-related Risk

The need for action globally to protect and restore biodiversity and natural capital is clear and well accepted. We are all dependent on nature and can't survive without it, and, as such, our entire economy requires a healthy, thriving natural environment.

However, natural capital across the globe has now been significantly altered by multiple human drivers, including land-use change, pollution, overextraction, invasive species and climate change. The 2019 Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) concluded that fourteen of the eighteen nature's contributions to people that were assessed had declined since the 1970s.

In the UK, the 2023 State of Nature report pointed to further negative impacts within our natural environment with average species abundance declines of 19% since 1970 **(Natural England, 2023).** In England, only 14% of rivers can currently claim to have good ecological status **(Environment Agency, 2023),** and across England and Wales, almost four million hectares of soil are at risk of compaction and over two million hectares of soil are at risk of erosion **(UK Parliament, 2023).** This environmental degradation both exacerbates – and is exacerbated by – the impacts of climate change.

The erosion of the UK's natural capital generates significant and long-term risks to society, our economy and, therefore, financial institutions and our financial stability. These risks are multiple: be that an increased likelihood and impact of pandemics, floods and droughts; the undermining of water quality and supplies; damage to agricultural production and diminishing food security; or increasing price volatility.

Nor is it solely the erosion of the UK's natural capital that is presenting systemic risk. The degradation of the natural environment in the countries from which we import goods and services is conceivably a larger risk than those born of domestic erosion.

Today, however, t**hese risks are not captured in the UK within fiscal risk management frameworks or within prudential policies.** Nor do financial institutions account for nature-related risks in their decision-making, or routinely quantify them for the purpose of risk management. **The UK's financial sector is therefore potentially exposed to unmitigated systemic financial risks while finance continues to flow to activities that damage nature and further the risk.**

Central Banks and Nature-Related Risk

The strong dependence of our economies on nature and natural capital has risen up the agenda of central banks and supervisors in recent years and is now included within the wider discourse on potential exogenous threats to financial stability.

NGFS has stated that "Nature-related risks, including those associated with biodiversity loss, could have significant macroeconomic implications, and that failure to account for, mitigate, and adapt to these implications is a source of risks for individual financial institutions as well as for financial stability."

A first step by central banks has been to highlight the high degree of dependence on ecosystem services within their economies, and therefore estimate the exposure of financial portfolios to potential nature-related risks.

Many central banks have now gone further in their journey to assess nature-related financial risk analysis. For example:

- In 2020, the De Nederlandsche Bank (DNB) assessed nature-related risks to the Dutch financial sector. The study focuses on direct physical risk, using the ENCORE tool, but also transition and reputational risks. In 2023, the follow-up report explores the economic and financial stability materiality of nature-related risk by analysing four transition risk scenarios and one physical risk scenario focussed on pollination.
- In 2021, a Banque de France (BdF) analysis built on DNB's 2020 work by estimating upstream dependencies using the EXIOBASE3 input-output table.
- In 2022, the Bank Negara Malaysia analysis followed a similar approach to DNB (2020) but also included exploratory nature-related physical and transition risk scenarios for Malaysia.
- In 2023 the European Central Bank (ECB) took a similar approach on dependencies which also included a sensitivity analysis using different scenarios of biodiversity depletion. In addition, a second report focussed on impact by estimating biodiversity footprints as well as including a preliminary analysis on assessing integrated nature-climate risk on two studies around drought and flood risk.

Central banks have also worked collectively on the subject under the NGFS offering several papers including a conceptual framework to guide action and the technical paper on scenarios mentioned above. In 2023, the OECD published a supervisory framework for central banks to assess nature-related financial risks and is working with the Central Bank of Hungary (MNB) and others to pilot this framework.

Moving from Dependencies to Risk

Dependency exposure analysis cannot indicate the extent to which there is a material nature-related financial risk to the economy or to financial stability, on a par with other non-environmental risks on the radar of central banks and regulators. Nor can a dependencies assessment provide the timescales over which these risks could emerge.

It is, therefore, vital that we move to an assessment of the material risk caused by the degradation of our environment and the ecosystem services upon which we depend – including risks beyond physical risks and interactions between risks.

For example, in the 2023 NGFS report, nature-related risks were defined as the risks of negative effects on economies, individual financial institutions and financial systems that result from:

(i) Physical risks: the degradation of nature, including its biodiversity, and the loss of ecosystem services that flow from it, or
(ii) Transition risks: the misalignment of economic actors with actions aimed at protecting, restoring, and/or reducing negative impacts on nature.

Litigation risks can also arise as a result of physical risks; for example, legal action brought against a company alleged to be responsible for causing harm to ecosystems, or as part of transition risks, such as when businesses fail to adapt to new regulations and face legal consequences.

We therefore need to develop new approaches that shift from dependency analysis to risk analysis and that incorporate the range of nature-related risks if we want to ensure our economic and financial systems are resilient.

Integration of Nature and Climate

It is also worth noting that, at present, climate and nature-related risk assessments have been kept mostly separate in previous analyses. Yet, nature and climate change are intimately linked and failure to represent their interconnection can lead to underestimation of the risks.

Central banks have begun to deploy their toolkits of interventions to start to assess, disclose and if necessary, manage climate risk. The erosion of natural capital, however, further amplifies these risks, while climate change simultaneously accelerates the erosion of natural capital.

This UK analysis seeks to integrate nature and climate risk to provide a more accurate view of risk, including showing how multiple risks can compound and cascade; for example, how extreme weather reduces soil quality, affecting crop and tree performance and also increasing wildfire risk.

Section 2:
UK Analysis

The UK analysis conducted by UNEP-WCMC, the University of Oxford, the University of Reading and NIESR, and led by the GFI began in February 2023 and has sought to build on and incorporate the missing elements of nature-related risk assessment to date, while remaining consistent with the frameworks and guidance set out by the NGFS and TNFD.

Summary

The overall analysis has included the following building blocks which will be published in detail in the April 2024 report with final results. Some detail on 1) and 5) of these building blocks is provided within this brief. It should be noted that, given the lack of data available, each of these building blocks is not without limitations. These limitations will be detailed in the final report in April with a research agenda and recommendations for further work to fill critical gaps.

1) **A first-of-its-kind UK Nature-Related Risk Inventory** detailing 20 physical risks, five transition risks and two types of litigation risk that arise from the ongoing damage to natural ecosystems, and the **estimated likelihood and impact of those risks to the UK economy and financial system up to 2050** (see page 10).

2) **Analysis of the estimated dependency of UK banks and insurers on ecosystem services using** the ENCORE tool, carried out by UNEP-WCMC. This data reveals the estimated amount of UK financial stocks from banks and insurers exposed to potentially material dependencies on ecosystem services, through investments and lending to underlying sectors. This can illustrate which sectors have the highest dependencies on ecosystem services and what those ecosystem services are, as well as providing a full view of the overall exposure of the UK's investment portfolio.

   This exposure captured by ENCORE is direct. It does not capture, for example, how lending to the finance sector is ultimately used/invested. It is also non-spatial, meaning that it does not capture where the underlying ecosystem service is produced, and so cannot be associated automatically with the specific nature assets whose state would inform judgements on whether the ecosystem service produced is at risk. (see next 'building block').

3) **Analysis to estimate the upstream (indirect) and spatial exposure** using datasets from:
   - the Foreign Direct Investment dataset from the Office of National Statistics (ONS),
   - EXIOBASE- Multi Regional Input Output (MRIO) table, and
   - the Hotspots of Natural Capital Depletion Layers, developed by UNEP-WCMC.

   This analysis, carried out by UNEP-WCMC with input from SEI York, seeks to illustrate if the exposure of UK banks and insurers and the underlying sectors they lend to and invest in are located in areas at high risk of nature degradation.

4) **A methodology to move from estimates of dependencies into direct (and indirect) risk to the real economy and the implications for risks to lending and investment portfolios.** This methodology was developed by the University of Oxford for eighteen ecosystem services covered in the ENCORE tool and more than 100 sub-sectors and supply chains into the UK from more than 70 countries. It captures both the direct risks to sectors in the UK and the indirect risks resulting from domestic and global supply chains by incorporating data on the state of natural capital and vulnerabilities globally, alongside EXIOBASE multi-regional input-output tables.

The approach has three main components:
- Estimation of probable maximum loss to a sector and country for a specific ecosystem service.
- Country- and ecosystem service-specific risk index.
- Sector and country-specific loss probability distribution.

5) The development of **three scenarios that integrate plausible yet extreme futures of nature and climate risks** and their transmission channels into the UK economy. These include a domestic scenario, an international (supply chain) scenario and an Anti-Microbial Resistance (global) scenario leading to a pandemic (see page 12).

6) **Testing of the scenarios and their transmission risks** over time to result in an estimated **percentage impact on UK GDP** developed in partnership with the National Institute of Economic and Social Research (NIESR) using the NiGEM model.

7) **Estimation of the value at risk for typical UK lending and investment portfolios** by weighting impacts on sectoral GVA by UK financial institution exposure to those sectors.

The above building blocks and their interaction together, including sequencing will be explained in further detail in the final report.

Each of these building blocks in addition to the final results will be valuable to multiple stakeholders – from policymakers and regulators to UK financial institutions and companies through to NGOs.

It will also support the broader field of nature-related risk work as discussed in Section 1, including that being carried out by standard setters, such as the IFRS Foundation.

UK Nature-related Risk Inventory (NRRI)

The UK Nature-related Risk Inventory, that supports this project is the first of its kind. The methodology was developed as part of the INCAF Project of the NERC Integrating Finance and Biodiversity for a Nature Positive Future programme as a collaboration between the Universities of Reading and Oxford and the UK Centre for Ecology and Hydrology (UKCEH). **The inventory demonstrates the integration of climate and nature risks and also the wide range of risks faced by the UK.** Full details of how it was developed will be provided in the final report, but here we offer a summary of the process, and an overview of its content.

Why an Inventory?

A Nature-related Risk Inventory (NRRI), similar to the National Risk Register or the UK Climate Change Risk Assessment (CCRA), can play an important social and decision-making role well beyond finance, in identifying risks, enhancing understanding and informing responses, ultimately to prevent unanticipated negative impacts on citizens as well as UK security and prosperity.

There are many nature-related risks that could potentially impact the UK economy and stability, both domestically and internationally. No inventory of risks will ever be fully comprehensive, but we can at least ensure that risks arising from the full range of nature-related dependencies and impacts are encompassed.

In the context of this project, the UK-NRRI may be used in different, complementary ways:

- Prioritising specific risks to particular financial institutions and asset types in order to assess exposure, vulnerability and mitigation options.
- Informing the development of scenarios suitable for financial stress testing and scenario analysis, including combining risks into compounding risk scenarios to understand the potential synergistic impacts.

It will also be informative to UK companies that may not be aware of domestic and international nature-related risks.

Process and Current Findings

The full process of development will be provided in the April final report, but, in summary, the University of Reading and the University of Oxford began with a long list of risks in relation to the IPBES Nature's Contributions to People categories.

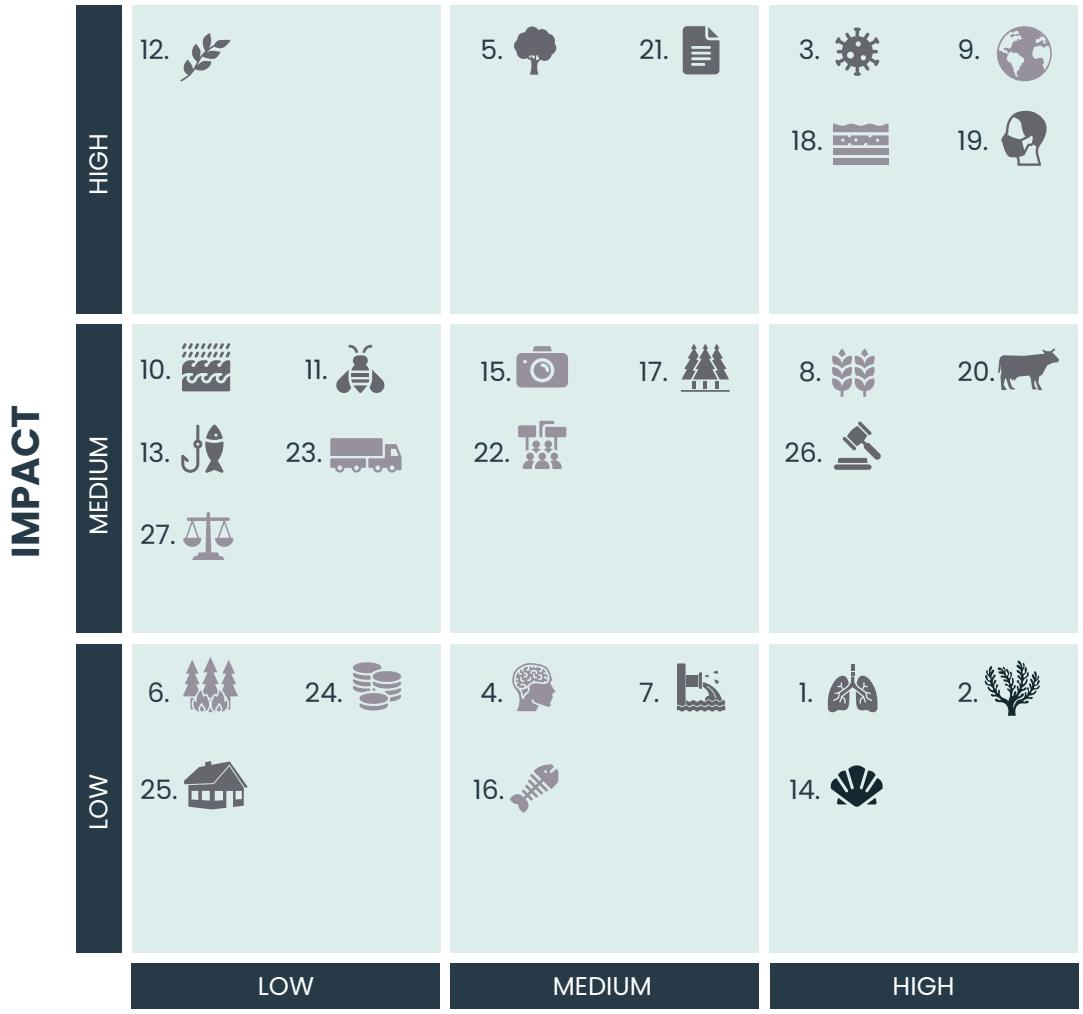
The project team then looked at how each of these risks may impact the UK economy and threaten financial stability based upon pre-existing studies, before consulting with 25 experts from backgrounds in environmental science along with climate-environment risk analysts at various financial institutions to complete an initial risk assessment.

These experts were each allocated four risks and reviewed the evidence statements. They then produced a score for each risk's perceived likelihood as 'low', 'medium' or 'high' based on their estimate of the probability that the risk will materialise over the next three decades (Figure 1). They also scored the impact as 'low', 'medium' or 'high' based on an assessment of potential material impact on the UK economy and financial system (i.e. could it cause major economic disruption and financial instability such as pension fund or bank defaults).

The evidence collated on the likelihood and impact of these individual nature-related risks is a first step in understanding potential material impacts. It is important not to only analyse risks individually in a siloed way, therefore the experts were also asked to score the interactions between risks, in terms of whether they have a shared driver, or whether one risk makes another more likely. This data was then used in the next step of the work to generate plausible scenarios of multiple compounding risks.

Figure 1. The estimated likelihood and impact of NRRs to the UK economy and financial system up to 2050.

Confidence in scores indicated by the colour of the risk symbol with darker shading indicating higher confidence.



Mainly Domestic

1. Air pollution from wildfires
2. Algal blooms in water ecosystems
4. Biodiversity access and mental health
6. Direct damage from wildfire
7. Freshwater pollution
10. Flooding due to deforestation and soil damage
15. Risks to tourism from nature damage
25. Housing asset risks due to policy and legal changes

Mainly International

5. Deforestation and ecosystem tipping points
9. Global food security repercussions
12. Multiple breadbasket failure
14. Ocean acidification
22. Global food supply chain interruptions and civil unrest

Domestic and International

3. Anti-microbial resistance
8. Grain crops pest / pathogen outbreak
11. Loss of pollination service
13. North Sea fishery collapse
16. Aquaculture major pest or pathogen outbreak
17. Sitka spruce pest outbreak
18. Soil health decline
19. Zoonotic disease (humans)
20. Livestock disease
21. Acceleration of strict net zero and nature protection policies
23. Business impacts due to UK-only biodiversity policies
24. Reputational risk and depository redistribution
26. Corporate litigation cases
27. Government litigation cases

Scenario Development

An essential part of the UK nature-risk analysis is the development of scenarios for risk assessment, scenario analysis and stress testing. Greater detail will be provided in the final report on how these scenarios were developed and the transmission channels identified, but a summary is provided below, including a list of three scenarios being tested.

Why Scenarios?

Scenario analysis and stress testing are common tools for risk management by financial institutions with requirements and specifications encoded into financial regulation and supervision across most jurisdictions, both at firm level and systems level. It is commonly used as the go-to tool for assessing and managing a wide range of risks, predominantly macroeconomic risks, and more recently more long-term stresses and exogenous shocks like climate change and pandemics.

Scenario analysis for climate change is still relatively new, and it is even more nascent for nature. The rationale for forward-looking scenarios for nature is the same as for climate change; the past is no longer a good guide to the future, and so scenarios are called for to explore potential future outcomes based on a set of assumptions. Scenarios are expected to be a useful and critical tool for nature-related risk assessments. In 2023, the TNFD published specific detailed guidance for how financial institutions can use scenarios providing worked case studies of how scenarios can inform nature-related risk assessments. To ensure the guidance is practical, the case studies use inputs from a publicly available integrated climate and nature scenario, the 'Inevitable Policy Response Forecast Policy Scenario + Nature', published by UN PRI.

Most of the climate scenarios used by central banks to date have been based upon those developed by the NGFS, which is on its fourth iteration of scenarios. While each iteration has come with substantial improvements, several authors, including the NGFS, however, have pointed out challenges with current scenarios, including a poor representation of shocks and tail-risks and an over-reliance on integrated assessment models that are known not to capture many forms of climate risk. These challenges exist and are heightened for nature-related risks.

For this project therefore, particularly given the complex characteristics of nature-related risks, scenario development has addressed the need to represent shocks and tail-risks.

Development of Scenarios for UK Analysis

Based on a literature review on current regulatory and supervisory practices and lessons from the TNFD pilots and NGFS' Taskforce on Biodiversity Loss and Nature-related Risks, the University of Oxford and the University of Reading, with input from UKCEH, developed an analytical framework for scenarios which can capture the 'bigger picture' of risk transmission, going beyond the Integrated Assessment Models used for climate risk, to understand the plausible but severe potential risks that could emerge related to the loss of biodiversity and ecosystem services.

It should be noted that these scenarios were developed to stress-test the UK financial system. As such, they are not directly transferable to the financial sector. However, the aspects of the process can be useful to financial institutions as they work through their own nature and climate scenario analysis.

From the literature review and discussion with project stakeholders, the project team identified several key aspects for scenario development:

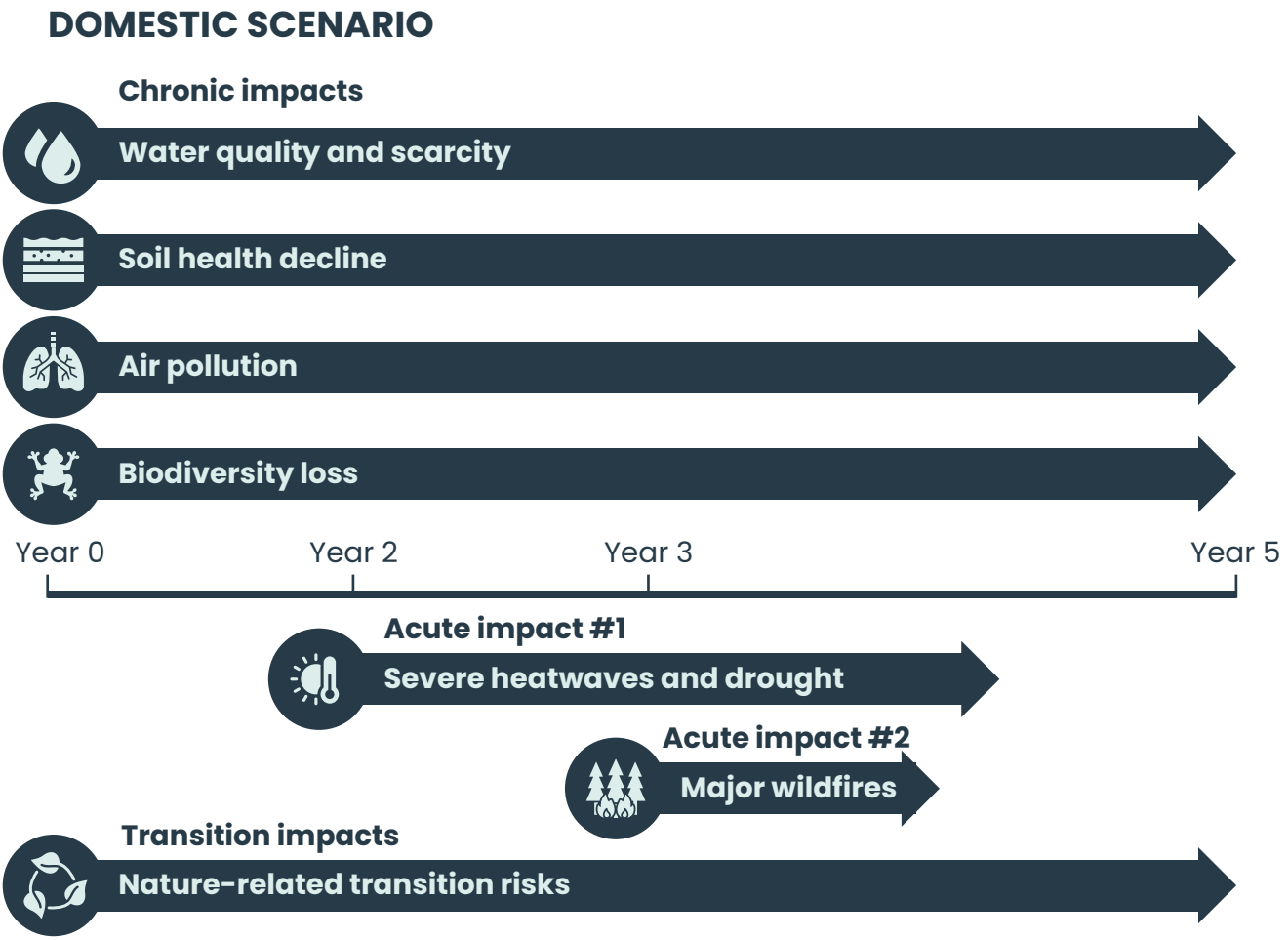
- To reflect 'plausible yet extreme' in terms of potential material financial impact.
- To include elements of both transition and physical risks (albeit to different degrees).
- To include multiple nature-related risks that likely co-occur through a shared driver or feedback processes (i.e. avoiding siloed analysis of single risks).
- Impact on financial systems can be in unexpected ways, i.e. from sources of shock not captured in climate scenario analysis exercises previously conducted by central banks and supervisors.
- To create diversity across the scenarios, so that the financial system can be stress tested in different ways (i.e. diversity in risk transmission channels across scenarios).

The Scenarios

Each scenario has both chronic components (i.e. long-term background impacts) overlaid with acute impacts over a shorter time period (months up to five years). The timeframe of the scenarios is from present day up to 2050.

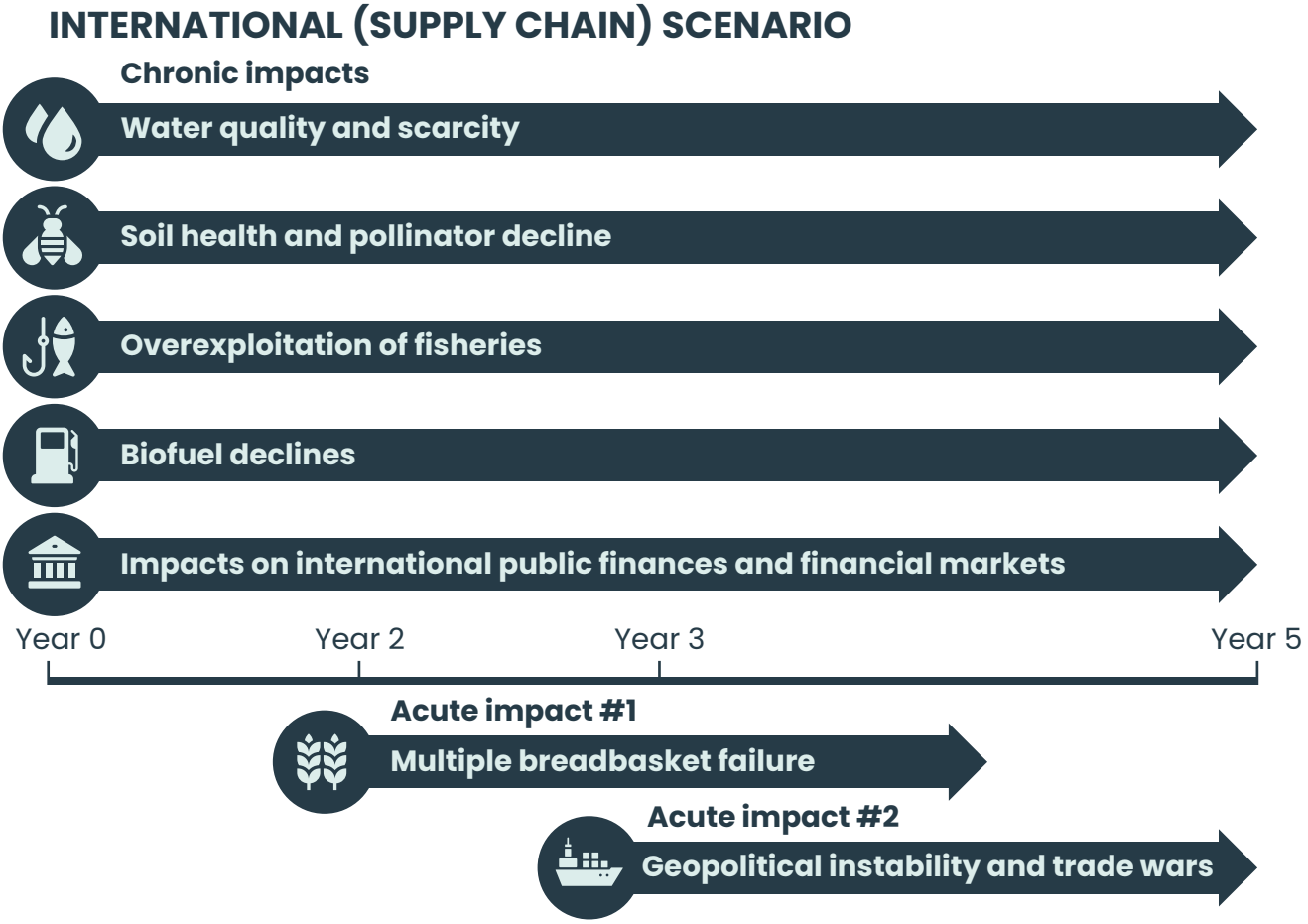
The three scenarios and their transmission channels that have been developed as are follows:

1. **Domestic Scenario**
   This scenario includes chronic impacts of water quality and water scarcity, soil health decline, air pollution and biodiversity loss, with acute shocks of severe heatwaves and droughts and wildfires (driven by an inability for nature to recover). Transition risks were also included in this scenario such as those arising from the direct and indirect (e.g. competitiveness) costs of more stringent environmental regulation.



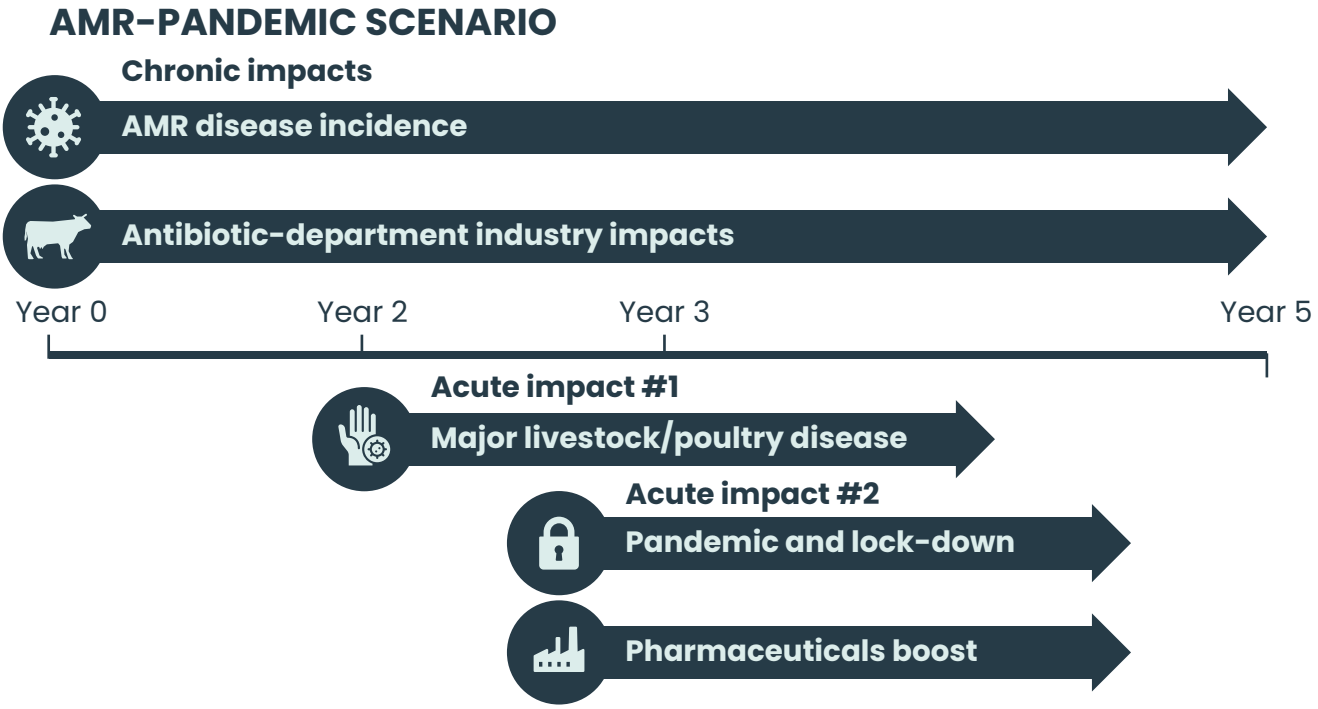
2. International (Supply Chain) Scenario

This scenario captures the chronic risks of water quality and scarcity, soil health, pollinator decline, fishery overexploitation, biofuel-land use tensions and fiscal issues, with acute impacts of multiple breadbasket failure internationally and geopolitical instability and trade wars.



3. AMR-Pandemic Scenario (Global)

This scenario looks at the chronic impact of anti-microbial resistance with antibiotic dependent industry impacts, and the acute shocks of major livestock and poultry disease with a pandemic and lockdown.



Next Steps

As mentioned previously, the full report with GDP impact estimates will be published in April 2024. Until then, the project team led by GFI will be hosting feedback sessions and engagement on the report. For further information, please contact helen.avery@gfi.green.

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