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Too big to fail: critical natural systems as macro-critical infrastructure

The economic, finance and governance implications of 'systemically important' natural systems

Policy insight

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Summary

National and global economic stability, human security and resilience rest on a foundation that financial and economic decision-making largely ignores: the health of the Earth's natural systems. Forests regulate rainfall across countries and continents, coral reefs protect coastlines and sustain fisheries for hundreds of millions of people, and river basins underpin water resources, food and supply chains on which whole communities, societies, economies and international trade depend.

While all ecosystems are important, scientific evidence indicates that a subset are so foundational to wellbeing, economic growth and resilience that their degradation would not simply represent an environmental loss: it could materially impact food, water and energy prices, national fiscal balances, supply chains and financial markets. We refer to these systems as 'critical natural systems'. HRH King Charles III told the Joint Meeting of Congress in Washington DC this April: "our generation must decide how to address the collapse of critical natural systems...We ignore at our peril the fact that these natural systems... provide the foundation for our prosperity and our national security".

This paper offers two new contributions:

- **First, we explore the economic, finance and governance implications of critical natural systems including forests, rivers, biodiversity hotspots and productive land and how they are analogous to national critical infrastructure.** The evidence makes clear that critical natural systems are just as vital to national resilience and prosperity as roads, railways and electricity grids. They provide the essential ecosystem services that underpin all economic activity, and act as a buffer against shocks, reducing extreme weather and climate risks.
- **Second, we surface a new concept of Global Systemically Important Natural Systems (G-SINS), analogous to the Global Systemically Important Banks (G-SIBs).** Like G-SIBs, G-SINS are, in effect, "too big (or too important) to fail" – science tells us that their degradation could pose systemic risks to the whole global economy due to their size, interconnectedness, non-substitutability and the criticality of dependencies upon them. At a global scale, tropical forests, for example, store vast quantities of carbon and drive regional water cycles. Recent global price shocks demonstrate how disruptions to critical systems cascade rapidly. The purpose of the SINS framework is not to replicate the G-SIB framework, but to borrow its central insight: that some assets are sufficiently important to system stability that their degradation warrants enhanced monitoring, governance and risk management. We explore how this concept could apply at a global scale or be implemented nationally, for example in the form of domestic (D)-SINS, and discuss how such SINS could be identified, building upon several sources of foundational literature.

A growing body of evidence suggesting that some natural systems are 'macro-critical' – that is, they have the potential to affect domestic or external stability – which we synthesise in this paper. Research from central banks, international organisations and academic institutions increasingly finds that ecosystem degradation can affect economic growth, inflation, sovereign risk, financial stability and trade. These shocks can propagate through food systems, water resources, energy production, supply chains and financial markets, generating impacts that extend well beyond the locations in which environmental degradation occurs. New evidence illustrates the scale of these dependencies, including the role of forests in sustaining rainfall and economic activity. Our findings suggest that over US\$1 trillion of annual GDP in China, Europe and the USA depends on forest-linked rainfall, so called 'green water'. Across more than 130 countries, we estimate direct economic dependencies on 'green water' alone exceeding US\$5 trillion and upstream supply-chain dependencies of almost US\$3 trillion. We present preliminary results on the impacts of deforestation on cocoa prices, demonstrating the additional inflation and monetary policy implications of the erosion of critical natural systems.

Despite many successes and significant progress in global and national policy, many critical natural systems continue to deteriorate. We identify persistent public goods problems, unpriced

externalities, information failures, short-term incentives, and coordination failures that collectively result in the undervaluing of ecosystems in economic and financial decision making, under-pricing of risks, and chronic underinvestment. Today, according to UNEP, US\$7.3 trillion per year flows into environmentally harmful activities globally, while only US\$220 billion is invested in nature – a ratio of more than 30:1. Fewer than 1% of publicly reporting companies mention biodiversity impacts in their reports

We argue that the challenge is not necessarily a lack of environmental commitments, but – in part – the absence of mechanisms that formally recognise, value and embed the systemic importance of critical natural systems, and the risks of their degradation, within economic and financial decisions at all scales. The G-SINS concept provides one possible framework through which governments, regulators, corporates and financial institutions can begin to address this gap. The concept is not intended to replace or diminish the importance of existing frameworks or conservation efforts, but we suggest it could provide a focus for better integration of critical natural systems within mainstream financial and economic frameworks.

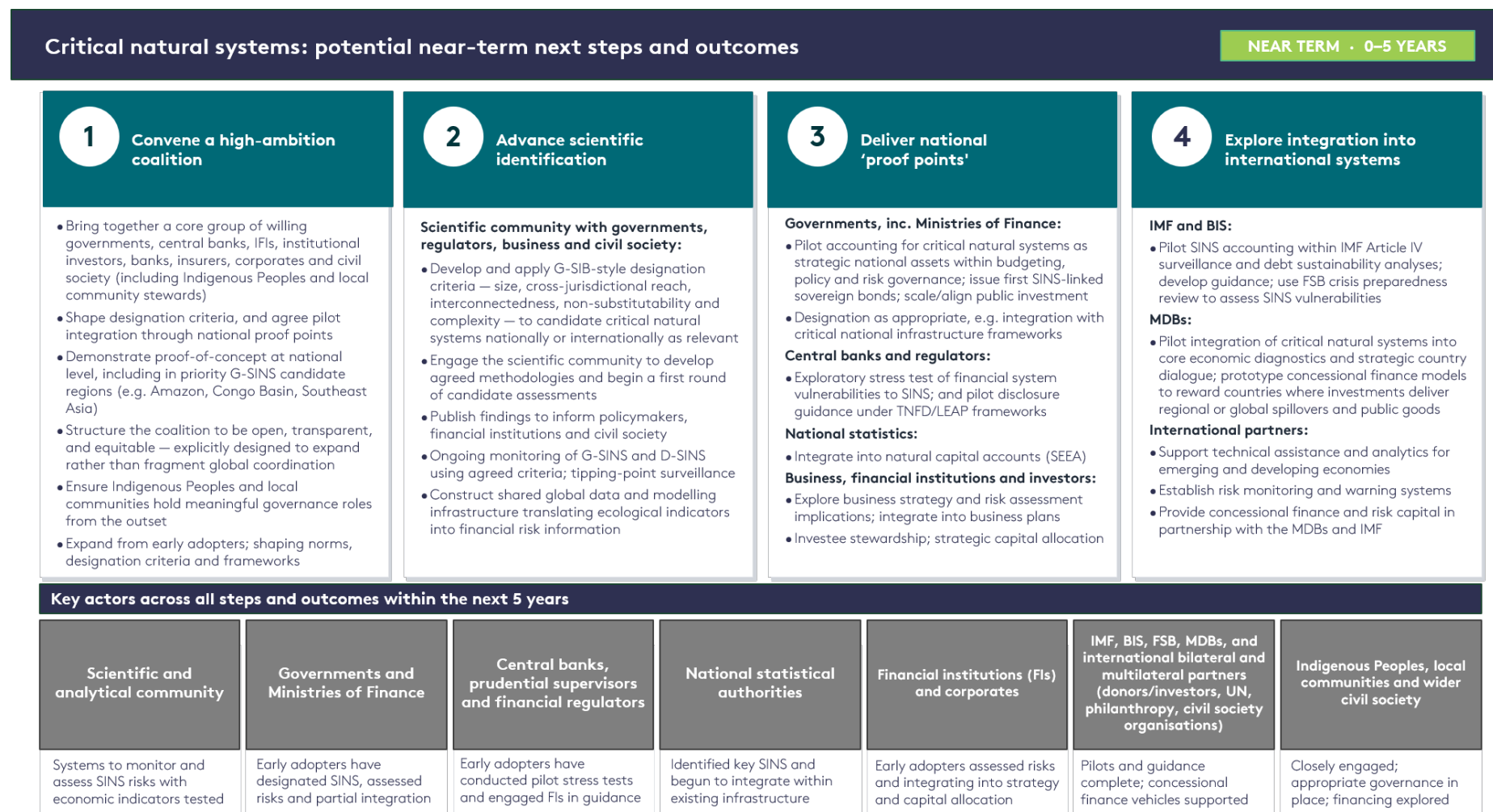
The central policy question we explore is therefore whether and how recognition of critical natural systems could help close existing governance gaps. What ‘recognition’ means in practice will vary by country or institution: it could be recognition in law, in supervisory guidance, or could mirror other forms of critical national infrastructure. Such recognition, in various ways, could support more systematic integration of nature-related risks into fiscal planning, infrastructure and industrial policy, financial supervision, macroeconomic surveillance, disclosures and concessional finance architectures. It could also provide a common framework through which governments, financial institutions and businesses identify and manage risks arising from the degradation of ecosystems that are fundamental to stability and prosperity.

This paper aims to explore options and prompt discussion. It does not propose new institutions or legal mandates; rather, it explores pathways through which existing institutions could embed the macroeconomic and financial significance of critical natural systems. It emphasises that frameworks must be consistent with Indigenous rights, local stewardship, equitable benefit-sharing and internationally recognised principles of governance.

To further explore the potential integration of critical natural systems, the following next steps could be considered (see also Figure S1 below):

- 1. Advance the scientific identification of critical natural systems and candidates for G-SINS.** Scientists could be engaged to develop and apply G-SIB-style designation criteria – size, cross-jurisdictional reach, interconnectedness, non-substitutability and complexity – nationally or internationally, to identify which natural systems meet the G-SINS or D-SINS threshold, within frameworks set by business and civil society. This could be supported by the development of shared data infrastructure capable of monitoring these systems – including tipping-point proximity – and translation of ecological indicators into decision-relevant financial information.
- 2. Convene a high ambition coalition to prototype the concept at key ‘proof points’.** A core group of willing governments, central banks, international financial institutions, institutional investors, banks, insurers, corporates and civil society (including Indigenous Peoples and local stewards) could champion the concept, shape designation criteria and pilot integration with relevant policies, standards and investments to demonstrate proof-of-concept.
- 3. Apply existing levers at the national and global scale.** Bodies responsible for existing governance frameworks could embed critical natural systems within their existing processes and mandates. In the near term, countries could pilot accounting for critical natural systems as strategic national assets within fiscal policy, risk assessments and investments, including core economic diagnostics and national statistics. Internationally, it could be piloted within International Monetary Fund Article IV surveillance and processes such as the Financial Stability Board’s ongoing crisis preparedness review. Disclosure guidance could be piloted for SINS dependencies, and new investment structures that target SINS explored. All of these actions could proceed within existing mandates.

Figure S1. How the concept of critical natural systems could be explored and implemented over the coming years



1. Introduction

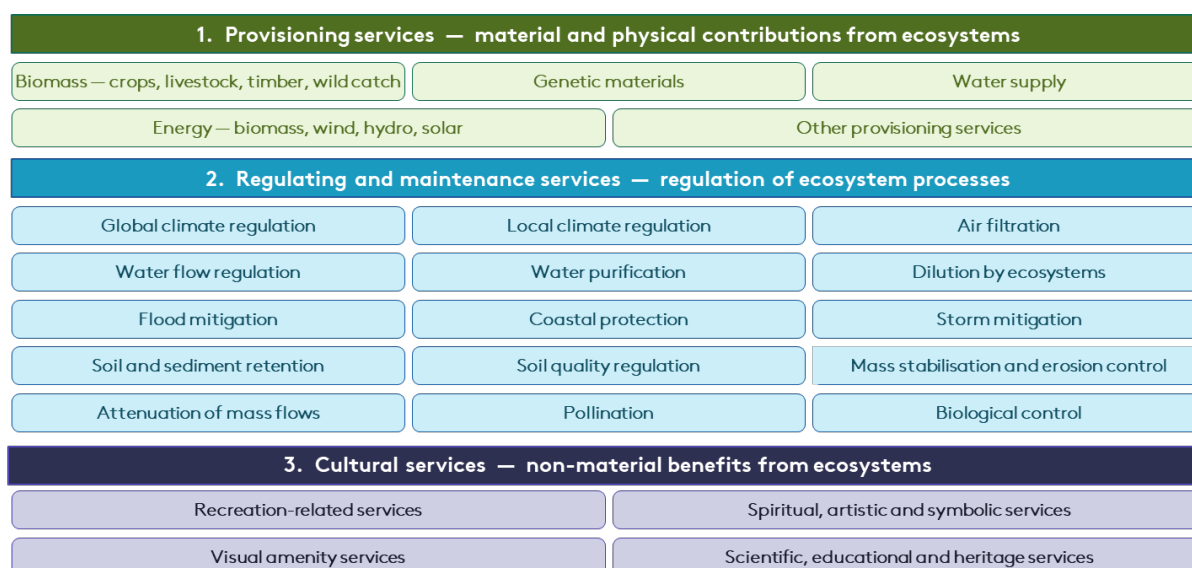
National and global prosperity, resilience and security rest on a foundation that remains largely invisible in economic and financial decision-making: the stability of the Earth’s natural systems. While all ecosystems are important, scientific evidence indicates that a subset are so foundational to wellbeing, economic growth and resilience that their degradation would not simply represent an environmental loss: it could materially impact food, water and energy prices, national fiscal balances, supply chains and financial markets. We refer to these systems as ‘critical natural systems’. This paper firstly explores how such systems are analogous to national critical infrastructure and secondly surfaces a new concept: Global Systemically Important Natural Systems (G-SINS).

The role of critical natural systems

Forests regulate rainfall across continents and store billions of tonnes of carbon, coral reefs support fisheries and coastal protection for hundreds of millions of people, and productive land and river basins sustain the food systems and vital water resources that underpin global trade and growth (see Figure 1.1; IPBES, 2026). Natural systems face unprecedented and growing threats. Fourteen of 18 critical ecosystem services have declined since the 1970s (IPBES, 2019). Scientists in 2025 concluded that seven of the nine planetary boundaries which define a safe operating space for humanity have now been breached (Planetary Boundaries Science, 2025).

Scientists also warn of tipping points with critical thresholds beyond which a small disruption can trigger large, abrupt and potentially irreversible shifts in system state (Lenton et al., 2008). The *Global Tipping Points Report 2025* found that dieback in warm-water coral reefs, on which the livelihoods of nearly a billion people depend, is now passing their thermal tipping point (Global Tipping Points, 2025). The landmark *Business and Biodiversity Assessment* by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2026) makes the economic dependencies clear, highlighting that the global economy “depends heavily” on biodiversity and nature’s contributions, including food, fuel, climate regulation, water purification, flood regulation and air filtration. It cites US\$44–58 trillion, over half of global GDP, as moderately or highly dependent on ecosystem services.

Figure 1.1. Types of ecosystem services provided by critical natural systems



Note: Classification follows CICES v5.1 and the ENCORE nature dependencies framework.

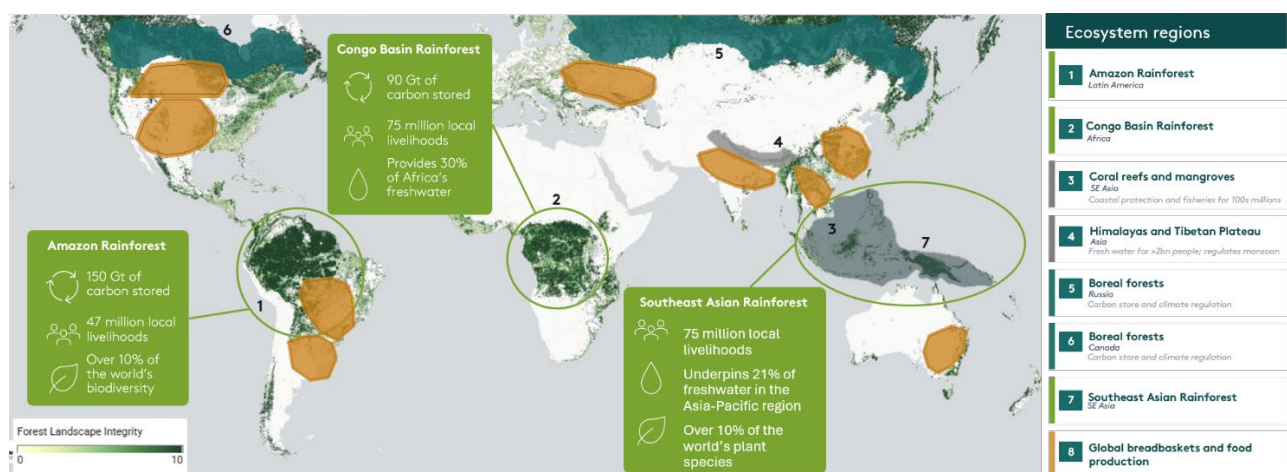
Sources: Haines-Young and Potschin (2018); ENCORE (2024); IPBES (2019)

While all ecosystems play important and interconnected roles, scientific research increasingly highlights a subset of ecosystems whose degradation could trigger impacts of systemic national or global significance – systems upon which the health and functionality of other natural and human systems depend. We refer to these as ‘critical natural systems’. HRH King Charles III used this term in his April 2026 address to the Joint Meeting of Congress in Washington, saying: “our generation must decide how to address the collapse of critical natural systems.... We ignore at our peril the fact that these natural systems – in other words, Nature’s own economy – provide the foundation for our prosperity and our national security”. Previous authors have discussed concepts such as ‘critical natural assets’ (Chaplin-Kramer et al., 2023) and ‘critical natural capital’ (Ekins et al., 2003a, b). We use the phrase critical natural system to reflect the system-functioning of nature and the interdependencies across ecological, social, economic and financial systems.

At the national level, critical ecosystems – including rivers, forests, biodiversity hotspots and productive land – act as infrastructure. We argue they are at least as vital to national resilience and prosperity as roads, railways and energy networks – with potential for irreversible loss due to human pressures and underinvestment. The concept of ‘nature as infrastructure’ has been highlighted by authors including the Asian Infrastructure Investment Bank (AIIB, 2023), the European Bank for Reconstruction and Development and the Paulson Institute (2025). In many countries, this critical national infrastructure is being eroded. In the UK, for example, the Office for Environmental Protection’s latest assessment highlights a growing mismatch between the UK’s dependence on natural systems and their current condition. The OEP finds that many environmental targets remain off track, biodiversity recovery is insufficient, and freshwater ecosystems continue to face significant pressures (Office for Environmental Protection, 2026).

At the global scale, scientific research points to some critical natural systems that are globally systemically important. These include tropical forests in Southeast Asia, and the Amazon and Congo Basins, boreal forests in the high northern latitudes, coral reefs in the Coral Triangle and Great Barrier Reef, the major food ‘breadbasket’ regions (Gaupp et al., 2020), and major river deltas including the Ganges-Brahmaputra, the Yangtze and the Mekong, all of which are under increasing stress (Figure 1.2 shows the distribution of these potential critical natural systems).

Figure 1.2. Potential candidates for global critical natural systems, highlighting the three major tropical rainforest zones and their significance



Source: Authors, adapted from GRI Risk Viewer, Forest Integrity Index, and Defra (2026)

Despite the action taken to date to protect these systems and several promising successes, action has, in general, fallen far short of what is required. Protection and restoration of critical natural systems remain chronically underfunded, while economic incentives continue to favour activities that degrade them. Global supply chains, agricultural expansion, land conversion and pollution, as well as increasing impacts from climate change, continue to place mounting pressure on ecosystems that

regulate climate, water cycles and food systems (IPBES, 2026). As a result, many of the world's most important natural systems are being degraded at unprecedented rates.

A growing focus on nature–economy–financial system linkages

The focus on the linkages between nature, the economy and the financial system has accelerated in recent years. This linkage was made explicit in the goals of the Kunming-Montréal Global Biodiversity Framework (GBF), in which 196 parties agreed to halt and reverse biodiversity loss to put nature on a path to recovery. For example, six of the GBF's 23 targets explicitly reference the economy and finance, with targets covering issues such as sustainable business and sectoral transitions, disclosures, sustainable consumption, economic decision-making, natural capital accounting and finance mobilisation. The IPBES (2026) *Business and Biodiversity Assessment* is an important landmark report for the way it draws together the scientific evidence on the relationship between nature, the economy and finance.

Given the evidence of the economic dependence on systems that are being eroded, there is growing consensus that protecting and restoring critical natural systems is not merely a conservation imperative, but is a central macroeconomic concern, as well as an investment in long-term economic stability and resilience (NGFS, 2024; IPBES, 2026). Within the financial sector, while climate-related financial risks have dominated the risk discourse since the mid-2010s, over the last five years or so, climate risk has become increasingly understood to be a subset of nature risk. Indeed, climate change is one of several interconnected drivers of environmental degradation, alongside land-use change, pollution, invasive species and resource extraction (IPBES, 2026).

Central banks and financial regulators have begun to explicitly recognise that nature-related financial risks are macro-critical and systemic, for example in the conceptual framework put forward by the Network for Greening the Financial System (NGFS, 2024).¹ There is also increased recognition that the risks to the economy and finance are endogenous as well as exogenous, meaning the financial sector itself, through what it finances, contributes to the build-up of the very risks it is exposed to (IPBES, 2026; O'Donnell et al., 2025; Marsden et al., 2024, 2025). This creates feedback loops between the financial system and nature.

Beyond the economic and financial consequences, a new focus has emerged on the security implications of nature degradation that complements this analysis on the economic risks. In 2026, a UK Government national security assessment on global biodiversity loss concluded that critical global ecosystems may be at risk of collapse, some as early as the 2030s. The assessment identified the potential catastrophic effects, including loss of major food sources, geopolitical instability, economic insecurity, conflict, migration and increased inter-state competition for resources (Department for Environment, Food & Rural Affairs [Defra], 2026).

Recent global price shocks, from food to energy, have demonstrated how disruptions to critical systems and value chains can cascade rapidly across economies with non-linear implications. Global fertiliser prices surged by at least 21% in early 2026, driven by the Middle East war, Strait of Hormuz supply disruptions, and export restrictions from China (Arita et al., 2026). Compounding these pressures, the fifth La Niña event in six years has intensified drought conditions and reduced production, as part of a broader pattern of more frequent La Niñas than El Niños over the past quarter century. In recent La Niña years, global economic losses have ranged from US\$258 billion to US\$329 billion (Sullivan et al., 2025). Evidence warns that increasing volatility driven by climate change is creating structurally higher and less predictable food commodity prices and headline inflation, which will affect affordability in both higher- and lower-income markets (Kotz et al., 2024). Yet current financial and economic frameworks largely fail to recognise these systemic dependencies, which will become increasingly important as global competition accelerates in a race for resources.

¹ In this paper, we adopt the Financial Stability Board's definition of systemic risk: "a risk of disruption to financial services that is (i) caused by an impairment of all or parts of the financial system and (ii) has the potential to have serious negative consequences for the real economy" (Financial Stability Board, International Monetary Fund and Bank for International Settlements, 2009). We are therefore using "systemic risk" to refer to the risk to the functioning of the financial system, as opposed to a system-wide or systematic risk (the risk inherent to the entire market that cannot be mitigated solely through diversification or asset allocation).

The scale and significance of critical natural systems means that protecting them is a collective challenge, beyond the action of any single government or institution.

What this paper does

This paper should be read as a conceptual exploration to spur debate, discussion and further research. The paper offers two new intellectual contributions. Firstly, it explores the economic, finance and risk governance implications of **critical natural systems as analogous to national critical infrastructure**. Secondly, it surfaces a new concept of Domestic or **Global Systemically Important Natural Systems (D-SINS or G-SINS)** to support dialogue on the role of critical natural systems within global risk governance and the financial system. The paper also offers new preliminary quantitative analyses of the global economic dependencies on forests and the implications of deforestation-linked risks to one supply chain (cocoa) for inflation and monetary policy. These two new evidence pieces further illustrate the economic importance of nature; adding to an already strong literature base, as evidenced by the IPBES (2026) *Business and Biodiversity Assessment*.

Throughout the paper, we explore the materiality of critical natural systems for both host countries and those economically dependent on them, and discuss issues at national and global scales. For example, we identify that in-country nature degradation can undermine economic security and fiscal stability, whereas nature preservation reinforces the productive assets that drive, protect and enable growth and economic stability. For non-host countries, materiality is expressed through trade and supply chain exposure, as well as financial exposures and macroeconomic effects (e.g. interest rates, sovereign bond yields and currency shifts).

Introducing the concept of ‘Systemically Important Natural Systems’ (SINS)

The SINS framing proposed here intentionally draws a parallel with the Global Systemically Important Banks (G-SIBs) – those deemed ‘too big to fail’ after the 2008 global financial crisis.² The purpose of the SINS framework is not to replicate the G-SIB framework, but to borrow its central insight: that some assets are sufficiently important to system stability that their degradation warrants enhanced monitoring, governance and risk management.

As part of the post-2008 reform agenda, the G20, Financial Stability Board (FSB) and Basel Committee introduced a formal framework that identifies banks whose size, cross-jurisdiction activity, non-substitutability, interconnectedness and complexity make their failure systemically important. Building upon the concept of G-SIBs, we explore G-SINS as a potential designation of ecosystems that are ‘too big (or too important) to fail’ – that is, systems whose degradation could pose systemic risks to the economy due to their complexity, interconnectedness, size, non-substitutability, and cross-jurisdictional dependencies on them. We also explore how SINS might be designated at the national scale as D-SINS.³

SINS would need to be identified through an inclusive, robust, transparent and evidence-based process. While the SINS framework is envisaged here as a purely economic and financial framework, in practice it is impossible to fully remove values and subjectivity from such a designation and therefore an inclusive process for defining selection criteria is central.

That said, a substantial literature exists upon which one a framework could be founded for identifying SINS, for example the work of Ekins, De Groot and co-authors (Ekins et al., 2003a, b; De Groot et al., 2023), Chaplin-Kramer et al. (2023), the planetary boundaries and tipping points frameworks (Rockström et al., 2009; Steffen et al., 2015; Lenton et al., 2008) and recent work taking a security

² The WWF and PwC coined the idea of ecosystems being ‘too big to fail’ in 2020 (WWF and PwC, 2020).

³ Analogously to how the G-SIB framework allows individual jurisdictions to designate domestic systemically important banks (D-SIBs) the SINS framing could also apply to Domestic Systemically Important Natural Systems (D-SINS) tailored to their own ecological and economic circumstances. This would allow the same governance logic to operate at multiple scales simultaneously: national governments embedding the macro-criticality of their own critical natural assets into domestic fiscal frameworks, planning systems and regulatory structures, while global institutions monitor and coordinate action on systems whose degradation creates cross-border systemic risks.

perspective (Defra, 2026). In a related paper under preparation, we suggest that G-SINS could be identified using similar criteria to those of the G-SIBs: size, cross-jurisdictional activity, interconnectedness, substitutability and complexity (Ranger et al., in preparation).

Based on these existing frameworks, we postulate that some of the G-SINS will overlap with those identified in Defra (2026) and Lenton et al. (2008). Yet, SINS will also likely include systems like major river basins and major food producing landscapes that are important from a socioeconomic perspective and do not necessitate large-scale physical ‘tipping points’ in the Earth system. Localised ecological or socioeconomic thresholds can have material economic impacts and may happen earlier than implied in the tipping points literature – see, for example, lessons from historical ecological crises (e.g. Biggs et al., 2018; Ranger et al., 2023). The series by Ekins and co-authors identifies freshwater systems, coastal wetlands and temperate forests as high-priority candidates for ‘critical natural capital’ status given their functional importance and the degree to which they are threatened or degraded. Benoist et al. (2026), for the Banque de France, additionally identify food producing landscapes as material. Chaplin-Kramer et al. (2023) proposes a quantitative approach – defining critical natural assets as the natural and semi-natural ecosystems that provide 90% of the total current magnitude of 14 types of ‘nature’s contributions to people’ (NCPs). They find that ‘critical natural assets’, as defined in the study, cover only 30–44% of global land area but underpin wellbeing for 87% of the global population. Bradley et al. (2026) refine this framework by proposing a hierarchy of NCPs, in which some are deemed more critical than others.

These types of analyses could ground identification of SINS. To build a SINS framework on this foundation, we suggest that at least four further analytical layers would be needed that Chaplin-Kramer et al. (2023) do not provide:

- **Substitutability analysis.** The paper’s 90% threshold is a service-provision threshold, not a substitutability threshold. It tells you where nature currently delivers, not whether those services could be replaced if the ecosystem were lost. This distinction matters enormously for systemic risk. The critical natural capital literature, particularly Ekins et al. (2003), who define critical natural capital as performing irreplaceable environmental functions that cannot be substituted by other types of capital, provides the conceptual grounding, but operationalising this spatially is an open problem. Cohen et al. (2019) conclude that substitutability of natural capital is “low to moderate”, with a minimal consensus that some critical natural capital cannot and should not be substituted, but translating that into spatially explicit, ecosystem-specific substitutability coefficients does not yet exist in the literature. An economically-based G-SINS framework would need to distinguish between ecosystems where human-made capital can substitute (e.g. some water purification functions can be replicated by infrastructure) and those where it cannot (e.g. moisture recycling by the Amazon Rainforest, or ocean carbon sequestration).
- **Threshold and tipping point analysis.** Chaplin-Kramer’s 90% threshold is a statistical design choice, not a biophysical tipping point. To identify systems that are systemically important in the financial-stability sense – analogous to the ‘too big to fail’ logic of G-SIBs – it would be important to overlay biophysical evidence about where ecosystems may be under a level of stress that could undermine their functioning. Marsden et al. (2024) make precisely this point, arguing that modelling frameworks used to quantify physical risks significantly underestimate impacts because they assume near-perfect substitutability and fail to incorporate the non-linear dynamics of tipping points, hence arguing that current models are not yet decision-useful for policymakers. The planetary boundaries framework introduced by Rockström et al. (2009) and updated by Steffen et al. (2015) identifies nine Earth system processes with quantified thresholds, where transgression risks triggering non-linear, potentially catastrophic changes at the continental to planetary scale. This framework provides the threshold logic that Chaplin-Kramer lacks, but it operates at the global process level rather than the ecosystem or regional level needed for financial risk assessment.

- **Systemic interdependence and contagion analysis.** Neither Chaplin-Kramer et al. nor the planetary boundaries literature adequately captures the interdependence between natural systems – the fact that degradation in one may trigger or accelerate collapse in another, analogous to contagion in financial networks – or how shocks and stresses can transmit, cascade and amplify through the economy, supply chains and trade networks. The Amazon-Cerrado moisture recycling system is the clearest example of a biophysical feedback: deforestation in the Cerrado region reduces rainfall that sustains the Amazon Rainforest, which further reduces moisture recycling, and can accelerate the Cerrado’s degradation. In terms of interconnections to economic systems, Ranger et al. (2024) find that around half of the nature-related risks that the UK is exposed to come from overseas via supply chains. A G-SINS framework therefore requires a network or ‘telecoupling’ analysis of these dependencies (e.g. see Ranger et al., 2023, 2024) but this type of analysis has not been integrated with the spatial optimisation approach of Chaplin-Kramer et al.
- **Financial materiality, transmission and contagion.** Past frameworks have been orientated towards environmental policy and do not take account of macroeconomic and financial transmission channels or contagion efforts, as outlined, for example, in NGFS (2024).

Despite these identification challenges, we conduct a preliminary screening of potential candidate G-SINS through combining these multiple sources of literature and incorporating the additional macroeconomic and financial layer based on Ranger et al. (2023, 2024) and NGFS (2024, 2026): see Figure 1.2 above for illustration. Note that this is not exhaustive and considers G-SINS, not D-SINS.

A further aspect not considered in the existing frameworks discussed above is the governance dimension and how the concept of critical natural systems, and relatedly SINS, could be operationalised within existing economic and financial architectures; this is explored in this paper.

SINS ‘designation’, as we discuss here, is conceived primarily as an analytical and governance framing – it can be thought of as a formal recognition that certain natural systems are systemically important and macro-critical – rather than as a direct regulatory or fiscal instrument in itself. It is comparable to existing frameworks that identify assets or places of exceptional national or international importance, including the designation of critical national infrastructure; marine protected areas and national parks; Ramsar wetlands and Key Biodiversity Areas; and priority catchments for drinking water protection or natural flood management. Across these examples, designation principally serves to recognise strategic importance and guide planning, policy coordination, investment and, where appropriate, subsequent legal, regulatory or financing measures. The SINS concept differs from existing biodiversity and conservation designations in that it introduces systemic economic importance as an explicit criterion for designation. Rather than asking primarily which ecosystems are of greatest ecological significance or conservation value, it asks which natural systems are so important for macroeconomic stability, food and water security, energy systems, supply chains and financial resilience that their degradation could generate systemic economic and financial risks. In doing so, SINS complements existing conservation frameworks by integrating ecological and economic perspectives, providing a basis for prioritising not only conservation but also resilience planning, infrastructure investment, financial regulation and long-term public and private finance.

The institutional form of SINS designation would depend on national circumstances. It could be established through legislation, regulation, government policy or guidance, voluntary frameworks, or through administrative processes analogous to those used to designate critical national infrastructure. Once established, designation would provide a common reference point that existing institutions could incorporate within their respective mandates. Governments could integrate SINS into fiscal policy, infrastructure planning, spatial planning and national resilience strategies; central banks and financial supervisors could, where relevant to their existing mandates, incorporate associated risks into macroprudential surveillance, supervision and stress testing; and international financial institutions, development finance institutions and donors could use the framework to prioritise technical assistance, coordinate concessional finance and support investments that reduce

system-level risks. In this way, SINS designation is intended not to create new institutional mandates, but to improve coordination across existing policy, regulatory and financial frameworks.

The paper considers both domestic and global governance and implementation implications. We suggest that this dual focus is essential due to the cross-border implications of nature. For example, while national fiscal, monetary and supervisory frameworks focus on domestic risks and firm-level disclosure frameworks can illuminate micro-level impacts and dependencies, the monitoring, assessment and management of the potential systemic impacts of critical natural systems requires coordinated action, including the use of system-level ecological, economic and financial monitoring and vulnerability assessment capable of detecting the build-up of systemic risks across economic networks and threshold effects. The collapse of a critical natural system and its consequences would likely be irreversible; pre-emptive action and proactive stewardship are therefore justified to mitigate the potential for severe economic and financial effects.

The paper focuses on the economic and financial dimensions of critical natural systems, which should not underplay their wider importance to human security and wellbeing, including health and food security, and the implicit value of nature itself, which are addressed elsewhere. While recognising there is a vast system of environmental policies which create a web of environmental governance around biodiversity and the environment, here we focus only on the economic and financial levers.

Structure of the paper

Section 2 brings together the evidence on the macro-criticality of critical natural systems. **Section 3** then discusses how current efforts to protect them are falling short, and the market failures inherent in the current situation. **Section 4** examines the potential implications for economic and financial policy across several dimensions: fiscal policy and public finance; financial institutions; corporates and value chains; international risk governance; and concessional finance. **Section 5** considers the distributional and equity considerations before **Section 6** concludes.

The style of the paper is to set out the evidence and ask questions. We hope that this will spur further debate and research.

2. Critical natural systems as macro-critical infrastructure

Conceptual foundations

The argument that certain natural systems are non-substitutable and that their degradation generates irreversible macroeconomic costs has deep roots in the academic literature. Foundational contributions trace from Daly (1973), Dasgupta and Heal (1979) in the 1970s, through Dasgupta's (1982) early work in the 1980s to Pearce, Barbier, Ekins and colleagues' work in the 1990s and early 2000s on "critical natural capital" (as discussed above) which cannot be replaced by produced capital (Pearce and Turner, 1990; Turner, 1993; Barbier et al., 1994; Ekins et al., 2003) and the work of Costanza and colleagues in the 1990s–2010s on the value of natural capital (Costanza et al., 2003, 1997).

The landmark *Dasgupta Review on the Economics of Biodiversity*, commissioned by HM Treasury in the UK, provides an authoritative and comprehensive exploration of the economic importance of nature, arguing that because the human economy is embedded within, rather than external to, the biosphere, continued biodiversity loss represents not merely an environmental externality but a fundamental failure of portfolio management at the level of the global economy (Dasgupta, 2021). The evidence base for these conclusions was further strengthened by the IPBES *Business and Biodiversity Assessment* (IPBES, 2026) and previous IPBES *Global Assessments* (IPBES, 2019). Recent empirical studies also explore the non-substitutability of natural systems in the context of the scale of degradation observed, making the case for the value of ecosystem services to be more appropriately integrated into policymaking processes and natural capital accounting (Drupp et al., 2025).

Our reference to critical natural systems builds on this tradition,⁴ translating longstanding insights into the contemporary architecture of risk and financial governance through recognition of the macro-criticality of certain systems.

What makes the degradation of critical natural systems a distinct and urgent economic challenge is not simply its scale but its macro-critical character. In macroeconomic policy, the International Monetary Fund (IMF) defines an issue as macro-critical if it affects, or has the potential to affect, domestic or external stability (IMF, 2015). The concept has been synthesised as meaning "sufficiently critical from a macroeconomic and financial stability perspective to warrant the [IMF]'s focus on that issue in a systematic manner in its engagement with member countries" (Georgieva and Weeks-Brown, 2023). Increasing evidence suggests that the loss of some natural systems meets this threshold. The degradation of ecosystems such as tropical forests, coral reefs and major river basins can transmit shocks through food systems, energy markets, water security, supply chains and trade.

Crucially, the interconnections between natural systems and global economic and financial systems are complex, with potential transmission of risks through non-linear pathways. As a result, their deterioration can generate impacts across economies and financial systems locally and globally, as identified by the IMF itself (Gardes-Landolfini et al., 2024), the Network for Greening the Financial System (e.g. see the conceptual framework [NGFS, 2024] and the NGFS 'Nature Package' of reports from 2026); IPBES (2026; 2019); the World Bank (e.g. see Damania et al., 2025); the Taskforce on Nature-Related Financial Disclosures (TNFD, 2023a); central banks (discussed below) and many researchers including Ranger et al. (2023, 2024, 2025), Kedward et al. (2020) and Almeida et al. (2024).

Linking critical natural systems to financial and economic risk

The causal chain of risk flowing from the degradation of critical natural systems outlined in the literature is as follows. Local, firm- and sector-level risks arise mainly from operational and supply chain dependencies on the ecosystem services provided by critical natural systems. Global value chains and an interconnected global economic and financial system mean that shocks and stresses resulting from the cumulative decline of critical natural systems cascades across economies, with

⁴ See Bradley et al. (2026) for a review of the literature on 'critical natural capital'.

potential amplification by financial networks. As outlined in NGFS (2024), the risks can be chronic or acute. Chronic risks may be associated with, for example, the impacts of gradual degradation of ecosystem services on productive sectors, such as the impacts of soil erosion, chemical pollution and reduced rainfall on agriculture. Acute shocks might include growing risks of drought or flooding associated with changes in land-use and deforestation, impacting real-estate, mining and manufacturing. In parallel, firms are exposed to transition risks such as changing demand, shifting environmental policies and regulations that may increase costs as well as litigation and reputational risks (TNFD, 2026).

Exploratory modelling suggests that nature degradation could generate material macroeconomic impacts, potentially of a magnitude comparable to major economic shocks. For example, for the UK economy, Ranger et al. (2024) uses scenario analysis coupled with a macroeconomic model to suggest that environmental degradation could cost the UK economy 6–12% of GDP, with half of this risk coming from nature loss overseas via supply chains. The Deutsche Bundesbank has published analysis finding that over half of the €1.7 trillion corporate lending portfolio of German banks is highly dependent on ecosystem services, with water-based services identified as the most central (Bundesbank, 2026). Similarly, research from the European Central Bank has found that 75% of all European Union bank lending is to companies with high dependence on at least one ecosystem service and that nature degradation may significantly affect loan portfolios, making it a financial stability issue (Boldrini et al., 2023). Recent research by the Banque de France (Benoist et al., 2026) demonstrates that degradation of ecosystem services can generate material macroeconomic consequences, including lower output, higher inflation, tighter financial conditions and international spillovers. Their results reinforce that certain natural systems, particularly freshwater and food-producing systems, function as forms of critical economic infrastructure.

These studies reinforce conclusions drawn by other central banks around the world, including in the Netherlands (DNB, 2020), France (Svartzman, 2021), Hungary (Boffo, 2024), Brazil (Calice et al., 2021) and Malaysia (World Bank and Bank Negara Malaysia, 2022). Importantly, none of these studies captures the potential impacts of a large-scale collapse of critical natural systems; therefore they could be considered conservative (Marsden et al., 2024).

The partial collapse of three specific ecosystem services identified as being close to tipping points have been modelled by Johnson et al. (2021): wild pollination, provision of food from marine fisheries, and timber from native forests. Under this partial collapse scenario, global real GDP falls by US\$2.7 trillion annually by 2030 – equivalent to 2.3% of global GDP – relative to the baseline. The relatively moderate size of the impact is explained by several factors, including the fact that more macro-relevant ecosystem services such as water and soil erosion are not included in the study. Despite this, the study provides important insights. Critically, the impacts are highly unequal: in low-income and lower-middle-income countries, GDP losses reach 10% by 2030, with Sub-Saharan Africa facing a 9.7% annual contraction and South Asia 6.5%. Some 51 countries would experience GDP falls of between 10% and 20%.

In terms of governments, sovereign costs of capital and fiscal risks, recent empirical analysis by Wollenweber et al. (2026) found that nature degradation has led to statistically and economically significant impacts on sovereign borrowing costs, from around 25 to 70 basis points for five- and two-year tenors on average, while also controlling for other domestic and global factors that affect bond yields. The impacts here are also particularly significant for lower-income economies. The analysis suggests that nature losses exacerbate financial fragility of low-income countries, which have a higher dependency on ecosystem services than higher-income countries, in turn affecting debt sustainability, fiscal space and sovereign credit ratings. The study also found implications for high-income countries, given the global nature of supply chains and the systemic importance of sovereign debt for global financial stability. The findings identify sovereign debt markets as a key channel through which nature loss propagates into financial fragility. This is significant for critical natural systems because it demonstrates that degradation moves through sovereign balance sheets into global bond markets, potentially affecting institutional investors, pension funds, multilateral lenders and development finance institutions worldwide through economic and financial channels.

While evidence for the economic materiality of critical natural systems is growing, there are still uncertainties over the potential timing and scale of the risks, and none yet fully consider the macroeconomic consequences of a full ecosystem collapse, as noted by Marsden et al. (2024). But there is growing consensus that there is near-term materiality, particularly in highly nature-dependent critical sectors such as agriculture, fisheries, forestry and mining – and risks related to water resources across sectors and economies (Alvarez et al., 2025; IPBES, 2026).

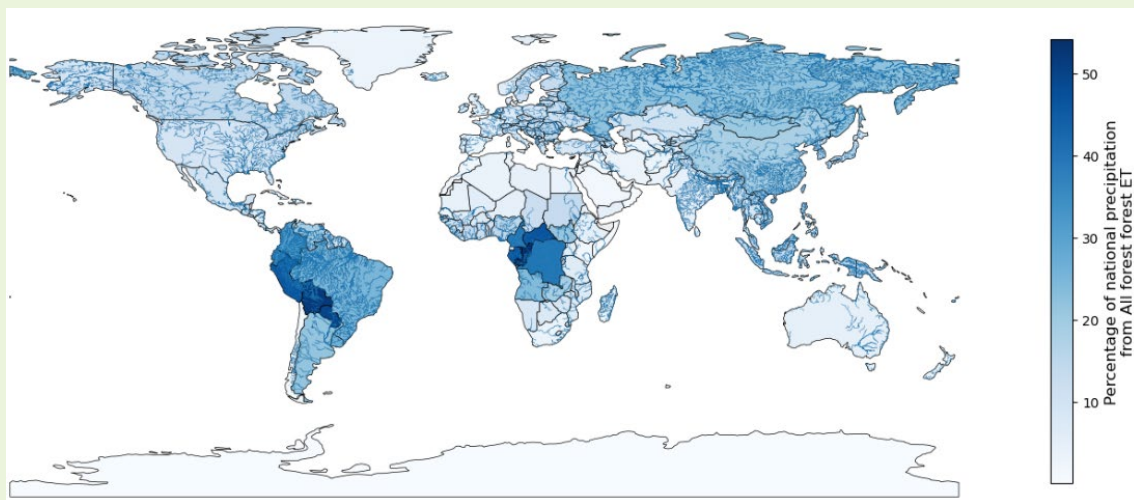
Tropical forests as critical natural systems

Case Study 1. Economic dependencies on moisture recycling from forests

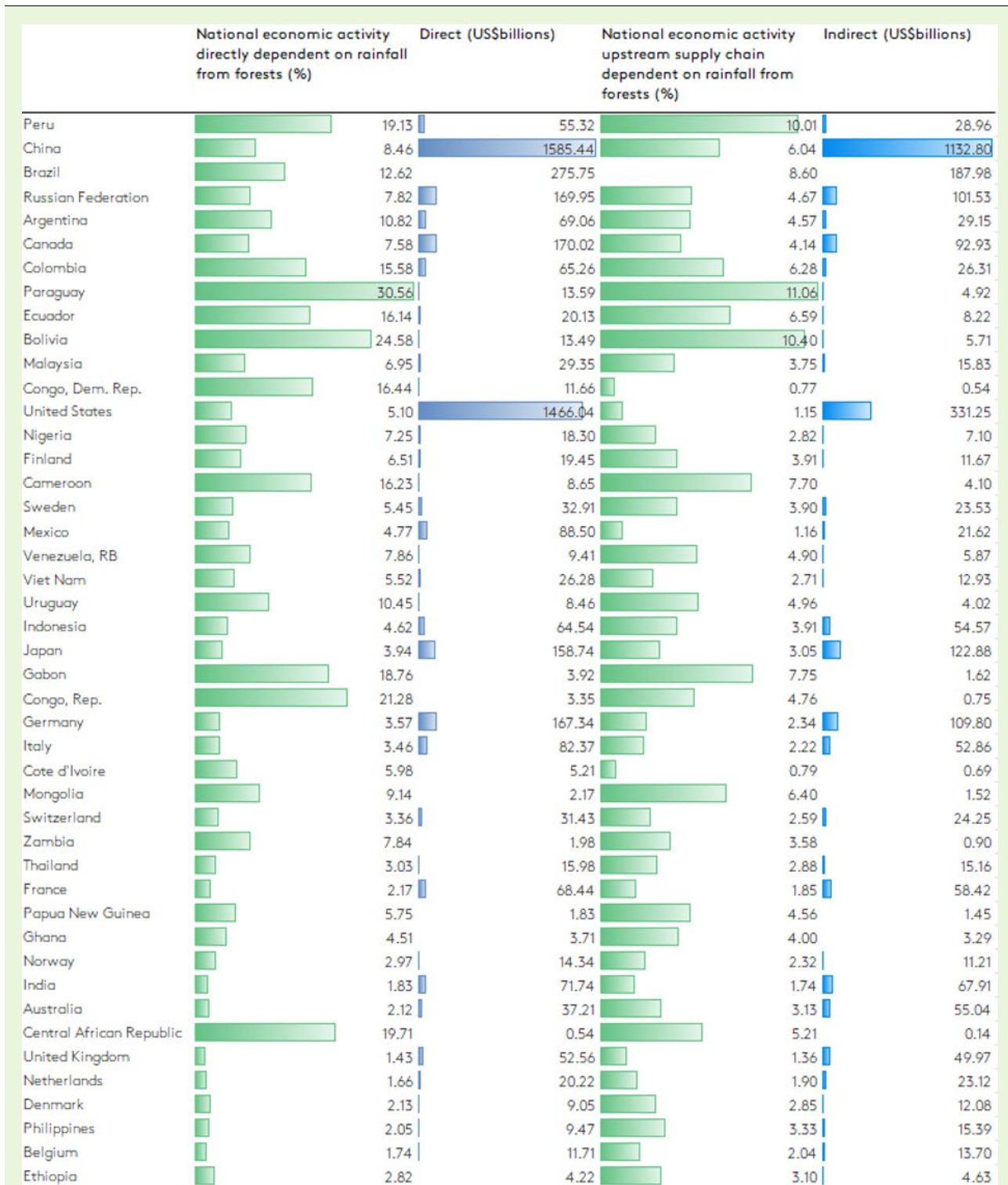
Forests play a critical role in generating precipitation across the globe through evapotranspiration, the process by which water is released from trees into the atmosphere. The value of this ecosystem service both to the host country and globally has not been captured in detail in previous assessments.

Using global evaporation and precipitation datasets alongside a moisture tracking dataset, we estimated how this forest-driven rainfall moves across borders and sustains economic activity (Tuinenburg et al., 2020; Hersbach et al., 2023; Pranindita et al., 2025). Our analysis shows that national economies depend on forests both directly, through their role in regulating rainfall and water availability that support agriculture, hydropower and other economic activities, and indirectly through global supply chains whose production systems rely on forest-generated moisture. These functions complement other well-established ecosystem services provided by forests, including timber, heat regulation, water purification, air-quality enhancement and flood mitigation. Strikingly, some countries are heavily dependent on rainfall from forests beyond their own borders: in Paraguay, for example, 30% of its national economy is dependent upon rainfall from the Amazon.

Figure 2.1. Percentage of each country's precipitation from evapotranspiration from forests and associated economic dependency of each country for domestic economic activity and global upstream supply chains



Cont. next page



Source: Authors

Physical transmission channels are also important: economies depend on critical natural systems at the local, regional and global levels. For example, the forests of the Congo Basin, Amazon Basin and Southeast Asia store vast quantities of the world's remaining 140 ± 440 gigatonnes of irrecoverable carbon (Noon et al., 2022), which underpin global climate security. Forests also drive water availability and weather patterns locally and regionally. For example, the Congo Basin Rainforest

plays a major role in regional moisture recycling and rainfall generation across east and central Africa (Worden and Fu, 2025), underpinning economic development, food production, and energy generation. Similarly, estimates suggest that deforestation accounts for around 50–75% of the precipitation decline across parts of the Amazon basin since the 1980s, which some studies suggest has been as much as 8–11% (Franco *et al.*, 2025; Cui *et al.*, 2026). This rainfall underpins both regional production of food and critical materials, as well as global supply chains. For example, the Democratic Republic of the Congo (DRC) holds 50–70% of the world’s cobalt reserves (US Department of Commerce, 2026), while Southeast Asian tropical forest countries produce 97% of the world’s rubber (WWF, n.d.) and 83% of palm oil (Ostfeld and Reiner, 2024). An estimated 20% of freshwater required for Brazil’s soy and beef exports to China, and 54% for EU imports, comes from river basins with high or critical water scarcity (Lathuilière *et al.*, 2025). Deforestation makes these supply chains more vulnerable to shocks and disruption, for example from droughts, fires, and extreme weather, while also exposing economies to system wide risks across energy, food, trade, and financial systems.

These wider economic benefits of forests are often underappreciated in economic and financial decision-making. Case Study 1 above presents new analysis of national and global economic dependencies on evapotranspiration, or so-called ‘green water’, from forests. Evapotranspiration is the process by which water stored in soils and vegetation is transferred to the atmosphere through evaporation and plant transpiration, releasing atmospheric moisture that contributes to rainfall both locally and across distant regions. The Global Commission on the Economics of Water argues that this green-water cycle is a fundamental component of the global hydrological cycle, underpinning agricultural production, water security, ecosystem functioning and economic activity across regions and continents (Global Commission on the Economics of Water, 2024).

Our analysis shows that, for many countries, a substantial share of national rainfall originates from such forest-driven moisture recycling, particularly across Central Africa and parts of South America where forest-derived moisture can contribute more than 40% of total rainfall, in line with previous studies such as Damania *et al.* (2025). Given the importance of this rainfall for productive sectors such as agriculture, hydropower and industry, we estimate that economic activity equivalent to more than 15% of GDP is dependent on forest-supported rainfall in several countries, including Paraguay, Bolivia, Peru, Brazil, Colombia, Ecuador, the Democratic Republic of the Congo, Cameroon, Gabon, the Republic of the Congo and the Central African Republic. In larger economies such as China and the United States, the share of GDP dependent on forest-supported rainfall is smaller, at around 5–10%, but still corresponds to well over US\$1 trillion of annual economic activity. Europe (the EU27 + the UK) similarly has just under US\$1 trillion in direct economic dependencies on forest green water.

These estimates are conservative because they do not include additional water resources from rivers supplied by this rainfall, and the substantial economic systems dependent on those. For example, across several countries, such as Brazil, hydropower provides more than 80% of the electricity – this vast economic benefit of green water is not fully incorporated. Yet, these dependencies are transmitted globally through trade and supply chains, with many countries exhibiting substantial upstream dependencies on forest-regulated rainfall beyond their borders. Across more than 130 countries, we conservatively estimate direct economic dependencies exceeding US\$5 trillion and upstream supply-chain dependencies of almost US\$3 trillion.

These functions are in addition to the many other ecosystem services provided by forests, including timber production, climate regulation, water purification, air-quality enhancement and flood mitigation. Together, these findings illustrate how forest systems – tropical and boreal – perform a macroeconomically critical infrastructure function by sustaining rainfall patterns that support economic activity across countries, sectors and supply chains.

Despite decades of effort and important successes, these forest systems are under unprecedented and accelerating pressure. A 2024 analysis recorded a 152% surge in Amazon degradation to a two-decade peak, driven mainly by a 400% increase in fire-linked damage (Bourgoin *et al.*, 2025). The Congo Basin lost a record 780,000 hectares of primary forest in 2024, a 14% increase on 2023 rates,

threatening a carbon sink that currently sequesters 160 million tonnes of CO₂-equivalent annually (Nkuintchua et al., 2026).

While in this paper we focus significantly on forests – the systemic importance of which tends to be better studied in the literature – this should not underplay the importance of other critical natural systems, such as peatlands, wetlands, coral reefs, mangroves and major river basins. For example, the Coral Triangle supports a region of over 370 million people – spanning Indonesia, Malaysia, the Philippines, Papua New Guinea, Solomon Islands and Timor-Leste – and provides marine ecosystem goods and services to approximately 120 million people (Foale et al., 2013). Its degradation would not only devastate local food security and livelihoods but would remove a critical buffer against coastal flooding and storm surge for some of the world’s most densely populated and climate-vulnerable coastlines. Scientists concluded in 2025 that globally, coral reefs, vital to the wellbeing of up to 1 billion people and almost a million species, are already passing their thermal tipping point (Global Tipping Points, 2025).

Major river deltas such as the Nile, Mekong, Yangtze and Ganges-Brahmaputra are globally significant socio-ecological systems that support many hundreds of millions of people while sustaining agricultural production, trade, urban centres and economic activity across entire regions.

Recent global price shocks from food to energy demonstrate how disruptions to critical systems cascade rapidly across economies. Nature-related shocks, particularly those associated with critical natural systems, are likely to become increasingly significant drivers of volatility. There is also evidence that these risks are (at best) only partially reflected in current economic and financial frameworks (IPBES, 2026). The following section discusses the status of current efforts to protect and restore critical natural systems and where the gaps are.

3. Shortfalls in current protection and restoration efforts and barriers to mobilising private investment

A gap between commitments and action

Critical natural systems are protected and governed under a complex web of local, national and international laws and policies, as confirmed by the 2025 International Court of Justice in its Advisory Opinion on the Obligations of States in respect of Climate Change (the 'ICJ Advisory Opinion'). This includes a dense web of binding international obligations arising cumulatively from environmental treaties, as well as general environmental law and human rights law that require states to take steps to protect the environment (ICJ, 2025). For example, there are those arising under the UN Convention on Biological Diversity (including the Kunming-Montréal Global Biodiversity Framework [GBF]), the UN Framework Convention on Climate Change (UNFCCC) (including the Paris Agreement), the UN Convention to Combat Desertification (CCD), and the Agreement on Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ).

While primarily concerning climate change, the ICJ Advisory Opinion confirms that states' obligations under international agreements are legally enforceable, requiring stringent due diligence and domestic implementation of international commitments through regulation of core economic sectors. Crucially, the ICJ Advisory Opinion suggests that we do not need new international law but rather must implement existing obligations, including through the regulation of the private sector.

Yet a substantial gap remains between the ambition of these existing commitments and the trajectory of action. Evidence suggests the world is on course to exceed the Paris Agreement's 1.5°C target within the next decade (United Nations Environment Program, 2025). Progress on biodiversity protection is similarly off-track, with global coverage of protected areas standing at just 17% on land and 8% in the marine realm, far short of the 30% by 2030 commitment under the Kunming-Montréal GBF (UNEP-WCMC, 2024b). While the first official stocktake of progress against the GBF is not due until later in 2026, the evidence is that progress remains insufficient and financing remains well below levels required to achieve the GBF targets (for example, European Parliament 2024).

A central reason is argued to lie in structural market failures that distort incentives across economic actors (IPBES, 2026), which are not yet being fully addressed by governments, particularly where this concerns long-term and complex risks. The assessment of the Office for Environmental Protection on progress in the UK, for example, identified particular gaps where risks are long-term, diffuse and complex (OEP, 2026).

Many ecosystem services, such as climate regulation, water cycling and pollination, function as global public goods. Their benefits are widely distributed across economies, while the costs of conservation are often borne locally. This is a well understood problem in environmental economics, discussed recently by Mazzucato (2023). In the context of this paper, we highlight that this classic market failure is heightened in this case by the lack of any system for identifying the critical natural systems whose stability provides the greatest mitigation against systemic risk, or any monitoring system that is tasked specifically to track the status of these systems and their services. There are no early warning systems that identify when SINS are compromised.

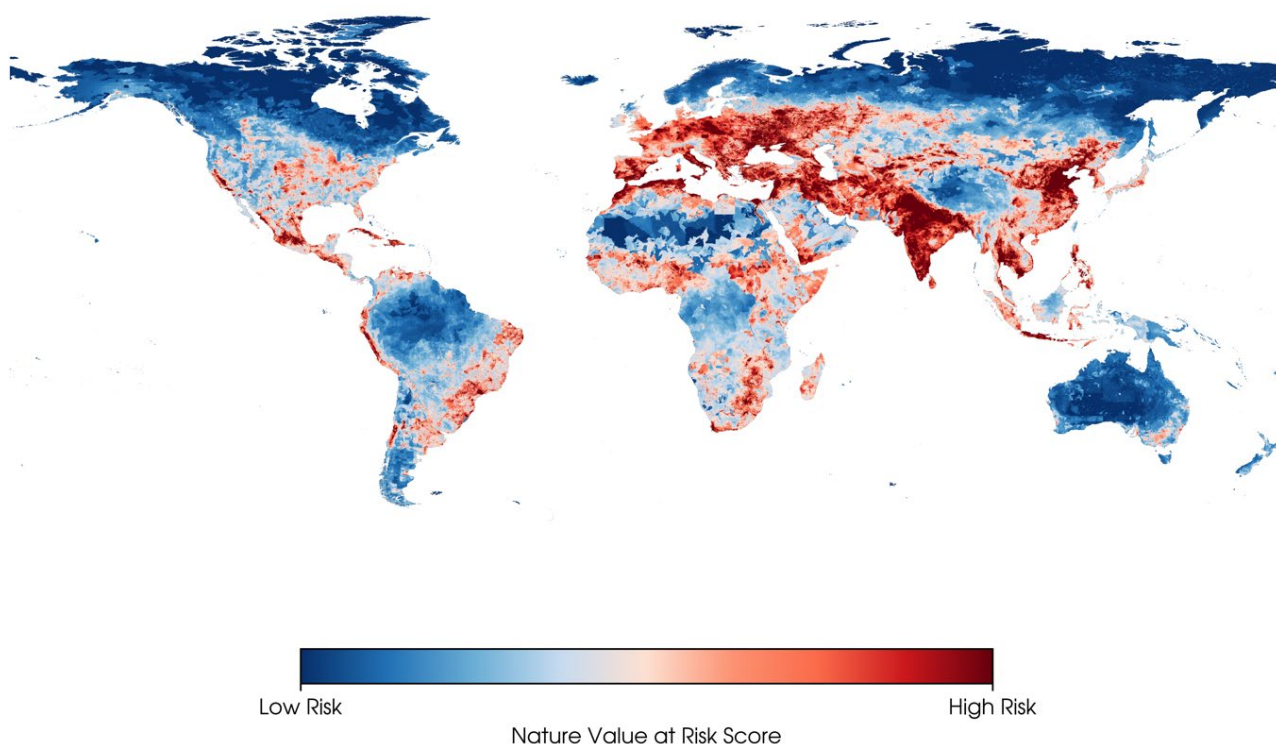
Negative externalities associated with climate change, deforestation and pollution generate economic costs through declining ecosystem productivity, altered rainfall patterns and increasing disaster risks, yet 'biodiversity loss' is not comprehensively priced across economies and evidence suggests it is only partially reflected in market prices (Garel et al., 2024; Guidolin and Pedio, 2025). The costs of these externalities are instead borne by society rather than by the actors responsible for environmental degradation. The UK case again provides an example of this, where the OEP (2026) finds that while there is good progress in addressing negative externalities where these can be clearly attributed, regulatory frameworks have greater difficulty when attribution is more diffuse and uncertain. The unpriced externality challenge leads to a systematic misallocation of capital towards activities that erode natural capital with distortions reflected in global investment patterns. In

addition, discussed below, efforts to mobilise private investment in ecosystem protection and restoration face substantial additional barriers.

Market failures in corporate and financial decision-making

For businesses and financial institutions, market failures related to information, incentives and coordination can curtail action to address environmental degradation, even where arguably it is in a firm's self-interest to do so (van Raalte and Ranger, 2023). Emerging analytical frameworks, such as ENCORE (NCFA, 2021), TNFD LEAP (TNFD 2023b), the WWF Biodiversity Risk Filter (WWF, 2023) and Nature Value at Risk (Ranger et al., 2023; Ceglar, Jwaideh et al., 2025), are beginning to provide tools and metrics that firms can use to assess their risks, dependencies and impacts (see Figure 3.1). There are now also numerous studies on the risks to corporates and financial institutions – for example, recently, Ceglar, Marques et al. (2025) suggested that 40% of euro area bank loan portfolios are linked to companies highly exposed to drought arising from climate change and ecosystem degradation. Business is clearly engaged: to date, more than 700 organisations across nearly 60 countries have committed to TNFD-aligned reporting, including well over 150 financial institutions representing approximately US\$22.4 trillion in assets under management (AUM) (TNFD 2025).

Figure 3.1. Risk map for surface water supply stress for a 1-in-100-year risk. Blue on the map represents areas of lower risk and red presents areas of higher risk



Source: Jwaideh and Ranger (in preparation)

Yet, there are substantial challenges and gaps in operationalising commitments. Information failures remain significant. The absence of standardised, decision-relevant data on critical natural system extent and condition, economic dependency, degradation risks and potential tipping points can make it difficult for corporates, financial institutions and investors to assess risks and returns with the confidence needed to make substantial changes to business strategy or commit capital at scale. Even where information exists, it is generally not systematically incorporated into corporate strategy, credit risk assessments or asset pricing models. Evidence from the TNFD, for example, shows that while the financial materiality of these risks is increasingly clear, their identification, assessment and

management by businesses and financial market participants is, at best, nascent (TNFD, 2025). Recent estimates suggest that less than 1% of companies disclose their biodiversity impacts (IPBES, 2026). Evidence from the first wave of Corporate Sustainability Reporting Directive (CSRD) reporting showed that fewer than 40% of companies identified nature-related issues as material (EFRAG, 2025).

Unclear commitments and expectations from governments also make it more difficult for firms to act and increase transition risks – a point recently reiterated by Dr Sabine Mauderer, in her role as Chair of the NGFS and First Deputy Governor of the Deutsche Bundesbank for the case of climate action. She states: “Governments can accelerate the shift by fostering a market environment in which demand and supply adjust to market price signals, correcting market failures and improving financing conditions” (Mauderer, 2026).

Time horizon mismatches also weaken market signals and incentives to act. The financial benefits of activities that degrade ecosystems are often realised in the short term, while the economic costs of environmental degradation, such as declining agricultural productivity or increased disaster risk, may materialise over longer time horizons (van Raalte and Ranger, 2023). Critically, these risks do not accumulate in a linear fashion. Climate and nature risks and their underlying systems are deeply interconnected, and their degradation can trigger reinforcing feedback loops that accelerate losses non-linearly and push interconnected systems past tipping points, making the long-term costs far greater, and less predictable than conventional risk models typically assume (Global Tipping Points, 2025). Corporate governance structures and financial reporting frameworks, such as quarterly performance reporting, often prioritise shorter-term returns, limiting incentives to account for long-term or systemic risks.

Finally, the system-wide scale of the risk poses challenges for individual firms and investors, leading to coordination failures. Individual companies may have limited incentives to reduce environmental pressures if competitors continue to exploit ecosystems. Similarly, corporates and financial institutions may perceive environmental shocks affecting individual sectors or regions as diversifiable risks and ecosystems as substitutable. But this ignores the global interconnectivity of natural, economic and financial systems, and the risk of tipping points with cascading impacts across multiple markets. Self-interested action at the firm level alone is therefore unlikely to solve the problem because the risks are systemic and cannot be effectively mitigated through diversification or divestment (Quigley, 2019, 2020; Climate Financial Risk Forum, 2025). The frameworks that exist today are designed to operate at firm- or jurisdiction-level and do not capture and manage risks that are inherently cross-border and systemic. Compounding this challenge, conventional financial risk assessment and decision-making have historically relied on past data and stable baselines, which is an approach rendered increasingly inadequate in a world of evolving risks.

Despite this growing evidence base on the macro-criticality of critical natural systems – and the clear need for guidance and a clear framework from regulators and supervisors – the systemic importance of critical natural systems is not yet formally recognised within current economic or financial risk governance frameworks. Recent assessments by the WWF, the Financial Stability Board (FSB) and the NGFS suggest that awareness of nature-related financial risks among central banks and supervisors has increased substantially in recent years, with a growing number of authorities beginning to develop analytical frameworks, conducting exposure assessments and incorporating nature-related considerations into supervisory expectations. However, progress remains uneven and nature-related risks remain significantly less integrated into prudential, macroprudential and monetary policy frameworks than climate-related risks (WWF, 2025; FSB, 2024; NGFS, 2026). There is no explicit recognition of critical natural systems.

At the individual bank level, Goumet et al. (2026) reviewed the progress of 15 EU banks on nature risks based on disclosures made over 2020–2024. They determined that while EU banks’ approaches to nature-related risks have evolved since 2020, progress remains uneven, assessments remain largely qualitative and risks have only been partially integrated into prudential risk frameworks. For water-related risks – one of the most material nature risks and an important component of the risks related

to critical natural systems – Spacey-Martin et al. (2026) found that across 18 G-SIBs, banks remain at an early stage of integration of water risks into governance, risk management and strategic planning processes. While most banks have incorporated climate-related governance structures, few demonstrate dedicated water-related expertise, quantitative targets, portfolio monitoring or client-engagement strategies specifically related to water risks. This suggests risks in the system that are currently not being addressed and also that capital may be mispriced. Looking across financial markets, there is empirical evidence that nature risks are beginning to be incorporated into asset prices, although the evidence also suggests that markets may still under-price some longer-term and systemic nature-related risks (Giglio et al. 2023; Guidolin and Pedio, 2026; Cherief et al., 2025; Ma, 2024; Cosma et al., 2025).

But it is how this plays out in the real economy that matters and the evidence here points to significant imbalances and a misalignment of incentives within the economy (IPBES, 2026; Dasgupta, 2021). The latest *State of Nature Finance* report by UNEP found that approximately US\$7.3 trillion per year continue to flow into environmentally harmful activities through subsidies, investment and market incentives (UNEP, 2026). In contrast, financing for ecosystem protection and restoration remains comparatively limited. Estimates suggest just US\$220 billion is invested in nature-based solutions annually – mainly from the public sector – a ratio of 30:1 (UNEP, 2026).

In the following section, we ask whether a SINS designation could help to address these market failures – not by creating new regulatory powers or institutions but by providing the shared classification and common reference point needed to embed critical natural systems into existing economic and financial risk governance processes, such as macroeconomic surveillance, stress testing, disclosures and fiscal risk assessment, which could in turn inform governments in how they reshape the incentives for financial institutions and real economy firms.

4. Closing the gaps in national and global risk governance through designation of systemically important natural systems

The global financial crisis demonstrated the dangers of ignoring system-wide vulnerabilities. In response, multiple mechanisms, including the designation of Global Systemically Important Banks (G-SIBs), were introduced. Why might this approach be relevant to critical natural systems?

The G-SIB framework was put in place at a time of intense global financial stress as the world navigated a recovery from the global financial crisis (GFC). The goal was to implement a systemic response that could pre-emptively identify, assess and manage systemic risks in the system and avoid another crisis.

As part of the response to the GFC, the Financial Stability Board was tasked with identifying vulnerabilities affecting the global financial system and coordinating regulatory, supervisory and policy responses. It has a particularly important role regarding G-SIBs. It is tasked with identifying the G-SIBs, coordinating supervisory expectations through the Basel Framework and national supervisors, and coordinating responses to systemic threats. The G-SIBs framework imposes a graduated system of obligations calibrated to each institution's systemic footprint, including enhanced regulatory capital requirements, heightened liquidity requirements, and stricter standards for recovery and resolution planning – all of which is designed to reduce the probability of failure and, should failure occur, to make it manageable without recourse to public funds and to limit contagion and second-order impacts that could become systemic. The underlying logic is preventive. Because the systemic consequences of a G-SIB collapse are difficult to contain after the fact, the framework seeks to ensure that the conditions for such a collapse do not arise in the first place.

In line with past authors, we propose that the risks of ecosystem degradation require a similarly systemic response, entailing pre-emptive action to ensure that risks do not crystallise into a crisis or system collapse (see Case Study 2). The loss of critical natural systems would likely be irreversible and the economic and financial consequences severe. As noted above, our purpose in this policy paper in exploring the proposed SINS framework is not to suggest a replication of the G-SIB framework but to borrow its central insight: that some assets are sufficiently important to system stability that their degradation warrants enhanced monitoring, governance and risk management.

Case Study 2. Critical natural systems at the national level: Armenia's Lake Sevan

A SINS designation could start at the country level and be implemented by countries themselves. This protects sovereignty and could allow rapid action. Just as certain natural systems are macro-critical to the stability of the global economy (a potential G-SINS), others are macro-critical to the stability of domestic economies (a potential D-SINS) in ways that, if degraded, would generate flow-on fiscal, social and economic shocks within and potentially beyond national borders.

To illustrate, Lake Sevan in Armenia is the largest freshwater lake in the Caucasus region, covering 1,242 km². Over-abstraction, over-fishing, pollution and climate change threaten the lake's freshwater quality and quantity, creating substantial economic costs for Armenia (Asian Development Bank, 2026). Lake Sevan supplies 40% of Armenia's surface freshwater and generates almost US\$400 million in direct economic value per year, equivalent to 1.5% of Armenia's GDP – a figure encompassing only direct use values (fisheries, agriculture, energy, recreation and cultural heritage), but not indirect, non-market ecosystem services such as flood regulation and water quality that are largely invisible within standard fiscal accounts. The potential economic risks associated with the ongoing degradation of Lake Sevan despite Armenia's dependence on it illustrates the mispricing dynamic the SINS framework seeks to address.

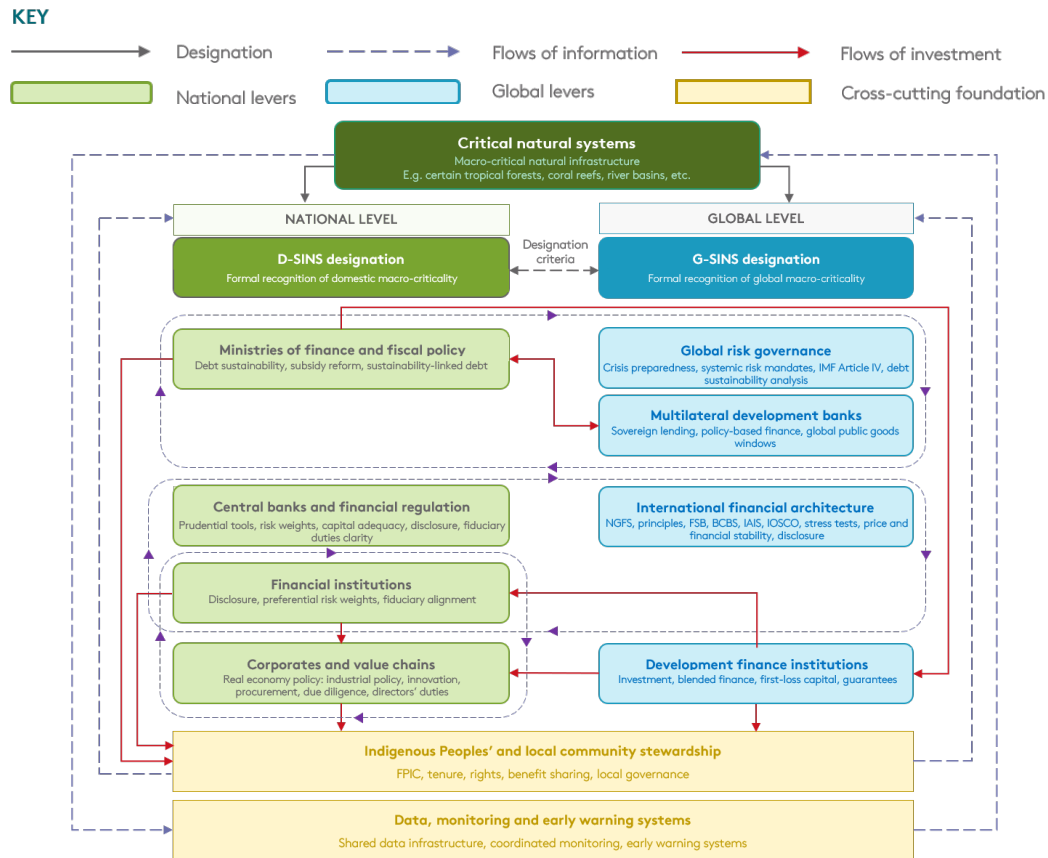
In this section, we explore the potential implications of SINS designation. Key questions arise regarding whether and how formal recognition and integration of SINS could help to build incentives that reduce pressure on these systems and enhance their resilience. It is important to be clear that SINS designation is not explored as a substitute for broader biodiversity goals and targets under the

Kunming-Montréal GBF, but rather as a complementary implementation mechanism that is designed to be compatible with existing macroeconomic and financial risk governance frameworks. The hypothesis to be tested is whether designation of SINS could help to deliver on intersecting international commitments, including the Kunming-Montréal GBF goals (including the 30x30 restoration target), the Paris Agreement (such as Article 5 on natural carbon sinks), and the First Global Stocktake, while also helping to enhance near-term national and global macroeconomic stability and financial resilience, and support the systems-level sustainable economic transitions needed for long-term global stability (Stern, 2025).

Potential implications for different actors and levers

The remainder of this section explores potential implications of SINS designation for different actors and levers, as well as exploring how existing mandates or obligations could be used to embed SINS into risk management and wider macroeconomic and financial frameworks at different levels – see Figure 4.1 for an illustration of application. This conceptual analysis is intended to spur ideas and debate, rather than prescribe solutions. Given the political difficulty of securing universal agreement, a potential ‘high ambition coalition’ of the willing would likely be a more practical pathway to early action from supportive institutions. A core group of willing governments, central banks, international financial institutions (IFIs), institutional investors, corporates and civil society (including Indigenous Peoples and local community stewards) could shape the designation, disclosure and investment norms described below, which others could then adopt over time. Early adopters could prototype the operationalisation of SINS. Efforts would need to be open, transparent, equitable and explicitly structured to expand rather than fragment global coordination, anchored by shared scientific criteria for identifying SINS and a common data infrastructure.

Figure 4.1. Illustrative application of a SINS designation to inform economic and financial governance for protecting and restoring critical natural systems at national and global levels



Source: Authors

Below, we examine potential implications for different actors and levers.

A. Ministries of Finance and Fiscal Policy

Despite significant advances in natural capital accounting and wealth measurement over the past two decades, nature remains only partially integrated into fiscal, macroeconomic and public investment decision-making. While initiatives such as the System of Environmental-Economic Accounting (SEEA) and the World Bank's Changing Wealth of Nations series have improved the measurement of natural capital, economic policy frameworks continue to rely predominantly on GDP and fiscal indicators that do not systematically capture changes in ecosystem assets or the risks associated with their degradation (Dasgupta, 2021; OECD, 2021; World Bank, 2024).

There are positive examples to learn from. For example, in China, 'gross ecosystem product' (GEP) has been used, which seeks to quantify the total economic value of goods and services provided by nature, functioning alongside GDP. GEP aggregates the monetary value of provisioning services (e.g. food, timber), regulating services (e.g. carbon sequestration, flood mitigation), and cultural services (e.g. ecotourism). China has implemented nearly 200 GEP projects at provincial, municipal and national levels (Zheng et al., 2023).

When nature-related risks are excluded from fiscal risk, debt sustainability, economic forecasts and budgetary assessments, liabilities are consistently underestimated, fiscal space misjudged, and investment decisions distorted – potentially leading to capital continuing to flow to damaging activities, reinforcing the negative feedback loop (see Case Study 3) (Ranger et al., 2025). The macro-criticality is already beginning to be recognised by some Ministries of Finance. The Coalition of Finance Ministers for Climate Action's 2022 working group report, for example, determined that: "there is a risk of a far-reaching ecosystem collapse if certain tipping points are crossed, and compounding losses of ecosystem services across multiple regions—a phenomenon already occurring—could result in the loss of ecosystem resilience and systemic reductions in economic and financial resilience. This means that economic actors cannot diversify away from nature-related risks, which has significant implications for Ministries of Finance" (Power et al. 2022). Research by the IMF has similarly stated: "Interacting with climate change, nature loss and transformation generates significant threats to the global economy and financial system" (Gardes-Landolfini et al., 2024).

SINS designation could potentially support better integration of nature within fiscal frameworks by creating a shared basis – using the language and metrics of finance – against which Finance Ministries and other key bodies can assess and recognise the ways in which policies and investments that impact critical natural systems influence growth trajectories.

As the primary mechanism through which sovereign economic vulnerabilities are formally assessed and communicated internationally, the IMF's Article IV reports and consultations carry the institutional authority to reframe environmental degradation as a macro-critical risk. Just as climate-related risks have been progressively integrated into Article IV surveillance on the basis of macro-criticality (IMF, 2021), SINS could follow the same path, with degradation framed as a source of sovereign revenue risk, productivity loss, increased vulnerability to shocks and fiscal instability where this is deemed material. In the near term, steps to bring critical natural systems into fiscal and debt sustainability analyses could include government stress-testing for nature-related shocks, incorporating nature dependencies into baseline growth scenarios, reclassifying nature-based investments as growth-enhancing expenditure, and strengthening institutional capacity to assess and manage these risks (Ranger et al., 2025).

SINS-linked fiscal frameworks – which recognise a nation's critical natural systems as key macro-critical infrastructure that drives, enables and protects growth – may potentially help drive a shift in thinking and analysis such that investments in natural capital are rewarded by improved fiscal space, sovereign credit ratings and costs of capital. When used alongside other policy levers, this could also help directly catalyse private investment in natural capital by improving the risk-return profile of these assets. Taken together, these measures could transform fiscal policy from a passive underwriter

of ecosystem decline into an active instrument for securing the ecological foundations of long-term sovereign prosperity.

Within a SINS-linked fiscal framework, subsidy reform may also begin to look significantly more attractive for governments. Subsidy reform provides a key fiscal lever which could be used to reshape incentives in a way that drives investment towards systemic resilience through critical natural systems. Today, at least around US\$2.4 trillion is spent on nature-harming subsidies annually (UNEP, 2026) – some estimates are far larger. Repurposing subsidies that encourage nature-harming activities (such as overuse of pesticides, fertilisers, fossil fuels and intensive fishing) into support for nature-based resilience investments (such as tax relief for conservation and nature-friendly farming, restoration and management activities, livelihood support for communities living in and adjacent to SINS, and innovation grants for new business models and technologies) could substantially shift the economics of activities impacting SINS. This could correct market distortions that misprice nature-related risk and incentivise dual economic-ecological gains.

For example, Indonesia, home to systemically important tropical rainforests among other critical natural systems, experienced heavy pesticide use in the 1980s which disrupted ecological balances, triggering pest outbreaks that caused an estimated US\$1.5 billion in damage to rice production. In response, the government removed pesticide subsidies, banned broad-spectrum pesticides, and launched a nationwide integrated pest management programme. Pesticide use halved within four years, delivering approximately US\$100 million in fiscal savings, restoring biodiversity and reducing health impacts while increasing yields and farmer incomes (United Nations Development Programme, 2024). South Africa introduced provisions in its Income Tax Act 58 of 1962 (Sections 37C and 37D), which allow income tax deductions for conservation management expenditure under biodiversity stewardship agreements, as well as annual deductions at 4% of the relevant land value upon formal designation of land as a Nature Reserve or National Park, capped in aggregate at total acquisition and improvement expenditure. These provisions demonstrate how fiscal policy can be used to manage trade-offs by treating natural systems as long-term assets worthy of financial incentivisation rather than foregone productive land.

Formal recognition of SINS may also help unlock new financing pathways for governments. Industrial policy could serve to provide a complementary demand-side instrument to fiscal measures, capable of accelerating the structural reallocation of capital towards sectors that improve rather than degrade critical natural systems. This could include sectoral transition planning, nature-positive pathways, green procurement mandates, and state investment in critical natural infrastructure.

Where a government can demonstrate that it is improving and stewarding a designated critical natural system/D-SIN (with verified data, restoration progress and the macroeconomic value of the services provided), it could gain a credible and internationally recognised basis for structuring sustainability-linked debt instruments and green bonds with terms linked to environmental outcomes. This could reduce borrowing costs for host countries, attract a broader pool of impact and institutional investors concerned with systemic risk management, and generate a direct fiscal incentive for governments to maintain and improve ecosystem condition over time. Pioneering examples, such as debt-for-nature swaps, also referred to as nature bonds, and the growing market for sovereign sustainability-linked bonds, demonstrate an evolving investor appetite for these instruments (S&P Global, 2024; Climate Bonds Initiative, 2025). Importantly, the credibility of these structures depends on the robustness of the underlying data infrastructure and the independence of verification mechanisms, both of which a formal SINS designation framework could help to support.

Finally, protecting and restoring ecosystems could also help to close wider financial protection gaps that are heightened by climate change in areas where environmental degradation is undermining resilience (O'Donnell et al., 2026; Geneva Association, 2022). More than half of climate-related losses globally remain uncovered by insurance (AON, 2026), meaning that when disasters strike, the costs often fall on governments and households rather than being absorbed by private risk markets. Investing in protecting natural capital and in nature-based solutions helps reduce risks and maintain the availability of insurance.

Case Study 3. Public finance: integrating nature in debt sustainability frameworks

Macro-critical importance of nature for debt sustainability

Recent analysis from Earth Capital Nexus and University of Oxford researchers (Ranger et al., 2025) examined the rationale and feasibility of integrating nature-related risks into the IMF–World Bank Low-Income Country Debt Sustainability Framework (LIC-DSF), a critical tool shaping debt assessments, fiscal policy guidance and access to concessional finance for low-income countries. The analysis found a strong macroeconomic justification for integration: natural capital and ecosystem services underpin key productive sectors such as agriculture, forestry, mining, fisheries and manufacturing. Degradation of these systems is already driving GDP losses, reducing fiscal space, increasing price volatility and weakening sovereign balance sheets – meeting the IMF’s definition of macro-criticality. Evidence from many low-income countries, including small island developing states and fragile economies, shows that nature-related shocks can have severe and lasting macro-fiscal effects.

Structural and systemic nature-related risks in low-income countries

Nature-related risks in low-income countries are also shown to be structural rather than temporary or episodic. Recurring disasters, long-term land and water degradation, and declining ecosystem resilience are increasingly shaping baseline macroeconomic conditions, interacting with existing vulnerabilities such as poverty, financial fragility and public health burdens. Treating these pressures as idiosyncratic shocks, or excluding them altogether, results in systematic underestimation of debt risks and misidentification of fiscal space. The analysis argues that environmental factors should already feature more prominently in existing LIC-DSF stress tests and that failure to do so creates policy misalignment at a time when environmental shocks are becoming more frequent and severe.

Feasibility and consequences of integrating nature into debt sustainability frameworks

Integrating nature into the LIC-DSF would be feasible and prudent, given available data, modelling tools and operational precedents. Existing IMF and World Bank toolkits – such as the DIGNAD model, scenario-based sensitivity analysis, and extensive geospatial and sectoral datasets – can be used to incorporate ecosystem service shocks, sectoral dependencies and resilience investments. Failing to integrate these risks leads to technical distortions, including unrealistic debt paths, inadequate recognition of the economic value of resilience measures, and mispricing of sovereign risk by external actors such as rating agencies. Ultimately, incorporating nature-related risks into debt sustainability assessments would support more accurate fiscal planning, better investment decisions, and more stable development trajectories for low-income countries.

Source: Ranger, Pasqua and Adam (2025)

B. Financial institutions and investors

Could regulatory frameworks create incentives for investment in ecosystem resilience? Could greater recognition of risks to critical natural systems help spur increased investment from the private sector? Conceptually, investment that redirects capital towards the protection and restoration of designated SINS has the potential to reduce underlying risks to which financial institutions are increasingly exposed (World Resources Institute, 2025a; Zandersen et al., 2025) and therefore should be in the financial institution’s own interest and rewarded under existing risk-based capital frameworks. However, financial institutions may perceive that their investment is unlikely to materially reduce the risks that they themselves face, and that it may not be permanent.

Aggregation can help overcome this by delivering scale, diversification, risk sharing and greater security over outcomes. An ongoing review of nature-focused investment vehicles with private sector investors identified 33 investment vehicles whose use-of-proceeds delivers benefits for nature (Clavey

et al., in preparation).⁵ Of these, 79% explicitly invest in conservation and/or restoration activities. The vast majority of vehicles (97%) were found to address direct drivers of nature loss, with land- and sea-use change emerging as the most frequently targeted driver, addressed by 89% of the vehicles assessed. Several vehicles focus on natural systems that could be considered G-SINS, including the Amazon Biodiversity Fund, which supports ecosystem protection and restoration alongside sustainable agriculture and forestry in the Amazon, and the &Green Fund, which aims to halt tropical deforestation within agricultural commodity supply chains. Indeed, the tropical and subtropical forest biome appears to be the most frequently targeted by funds, covering 60% of investment vehicle proceeds. More broadly, terrestrial ecosystems received substantially greater coverage than marine ecosystems, with 97% of vehicles addressing terrestrial systems compared with only 30% that address marine environments. As degradation of coral reef ecosystems can transmit major shocks through the wider economy, this disparity may represent an emerging investment gap. In terms of financing structures, only 27% of investment vehicles were fully privately funded, while the remainder relied on blended finance, highlighting the current dependence on concessional capital to ensure viability.

Yet, despite evidence that capital is reaching some critical natural ecosystems, the broader financing landscape is still heavily unbalanced and, as discussed and revealed by UNEP's *State of Nature Finance* series, the system itself remains tilted towards degradation (UNEP, 2026). Misaligned incentives and the scale of risk associated with critical natural system decline means it is challenging for individual firms to act, and there is a need to ensure the commercial case is made for investment, including through quantifying the upside associated with risk reduction and resilience pathways.

Given the market failures discussed above that are heightened for the case of SINS – which require long-term collective action to address complex risks – policy and regulatory levers are likely to be required. Formal SINS designation, accompanied by standardised metrics, clear guidance and expectations, and shared data infrastructure, could help support firms to respond. Institutions could begin to integrate SINS exposures – where these pose material financial risks – into risk management frameworks and board-level governance. As noted previously, recent reviews by the NGFS, FSB and WWF have noted progress by several central banks and regulators around the world on building understanding of nature-related (or environmental) risks and beginning to incorporate these within disclosure regulations and supervisory expectations. This includes, for example, France, the Netherlands, Singapore, Brazil and Europe more widely. The NGFS has stated that recent work on the notion of nature-related financial risks confirms that there are grounds for considering the impacts and dependencies on nature, including biodiversity and ecosystems, as a source of material risk from a macroeconomic and financial stability perspective: “The NGFS is therefore of the view that nature-related risks are relevant for central banks and supervisors: given the macroeconomic, macroprudential and microprudential materiality of nature-related financial risks, such risks should be adequately considered for the fulfilment of their mandates” (NGFS, 2022).

Looking further ahead, regulators could explore if capital adequacy requirements might reflect SINS-related exposures more explicitly, to capture the risks and rewards of investments, such as applying preferential risk weights to protection and restoration investments. This requires additional study and consideration of the options and their advantages and disadvantages. The Reserve Bank of India's groundbreaking Basel III proposal provides an instructive example which could be adapted to consider SINS. The proposal explicitly incorporates climate risk into capital adequacy requirements and reduces risk weights for high-quality operational infrastructure, demonstrating that prudential regulation can be tailored to lower the cost of financing for climate-resilient assets (Feyertag et al., 2026), providing a direct regulatory precedent for applying preferential capital treatment to investments in critical natural systems.

There is also a market-wide assumption that the responsibility for addressing these risks lies solely with governments rather than there being any responsibility or self-interest in financial institutions

⁵ Benefitting nature is defined as investing in activities or projects that restore or conserve biodiversity or ecosystems, reduce the direct drivers of nature change, integrate nature-based solutions across economic sectors or enable policy, tools or other instruments.

cooperating with policymakers and supervisors to support the stability and integrity of the markets and systems upon which their business models rely. There is a perception that there will always be a public backstop to intervene and absorb market risks or shocks, even when the fiscal capacity of governments to do so must be questioned. These assumptions contribute to the under-identification, integration and pricing of risks.

The financial materiality of nature and climate-related risks, including those from the degradation of critical natural systems, mean that existing investor duties can already be interpreted to require their consideration and management. But the subjectivity of many of these duties means that the approach taken by financial institutions, and the weight given to these risks as opposed to other, more familiar and traditional risks, varies enormously and the current regulatory interpretation is often permissive rather than prescriptive on their integration and interpretation. For example, Dolman and Wildner (2025) argue that where system-wide risks can materially affect investment objectives, investors are not only permitted but required to consider and respond to risks associated with climate change and nature loss. Further, they posit that if reasonable steps exist to mitigate material portfolio-level risks, fiduciaries ought to take them. This flows from existing and binding duties on financial institutions to act in beneficiaries' best financial interests, to act with undivided loyalty, and to do so with care and prudence – although the interpretation of what the best financial interest of beneficiaries requires, and the time horizon over which to assess financial benefit, is subjective and inconsistent, with many still taking a narrow approach. However, a broad assessment of these obligations is likely to be especially pertinent for financial institutions with significant exposure to countries and firms dependent on critical natural systems, where the accelerating loss of biodiversity and ecosystem services translates most directly into stranded asset risk, impaired cash flows and the kind of portfolio-wide spillover effects that could generate material, system-level financial harm (Svartzman et al., 2021; NGFS, 2024).

Regulatory clarification that material SINS risks fall within the scope of existing fiduciary duties offers a further potential lever to support those who already consider dependence on critical natural systems and act as a nudge for those who do not. Identification of SINS within sustainable finance taxonomies could also help investment to flow. Taken together, these actions could serve to improve the identification and pricing of systemic ecological risks across investment portfolios and lending books.

Fundamentally, where a risk poses material threats to the functioning of financial markets as a whole, it is in the self-interest of market participants, as well as the purview of their duties, to take steps to manage the risk as well as amplify these risks to supervisors and government. Capital allocators have firm-level risk management processes open to them. These include adoption of TNFD-aligned approaches to identify location-specific nature dependencies and impacts across asset classes and value chains, particularly where they intersect with natural systems that could be considered macro-critical. Pilot portfolios and scenario analysis can already be used to assess impacts on risk-adjusted returns. At the governance level, board-level oversight of nature-related risk can be placed alongside climate risk. Capital allocators can also set portfolio-level metrics and targets focused on reducing exposure to high-risk activities while increasing allocation to resilient and sustainable assets and practices. Finally, system-level stewardship tools – including voting, engagement, and particularly policy advocacy – provide additional levers for managing nature-related risk, particularly where systemic solutions are required.

SINS recognition could also spur innovative new insurance products, including natural asset insurance and insurance for nature-based solutions, among others, thereby supporting actors to better manage risk and mobilise private finance (O'Donnell et al., 2026).

C. Corporates and value chains

By identifying which natural systems are macro-critical and providing standardised data on their extent, condition and value chains dependencies, risk professionals and boards would have a clearer, externally validated basis for integrating nature risks into risk management, corporate strategy and

board-level governance. Having greater transparency over the risks – through disclosures – could help close gaps in national preparedness for nature risks.

Today, value chains are a net driver of nature loss, with global trade embedding 20–30% of global CO₂ emissions and 30% of species threat (World Trade Organization, 2021; Lenzen et al., 2012). The consequences are increasingly visible in price volatility. For example, extreme heat events and excess rainfall leading to pest flare-ups in Ghana and Côte d'Ivoire were linked to a 280% increase in global cocoa prices in 2024, highlighting the interconnection between climate- and nature-related risks. Similarly, global coffee prices spiked 55% in August 2024 after drought in Brazil and Vietnam (Kotz et al., 2025). These are not isolated shocks but early signals of systemic exposure to rising climate and environmental risks. In 2024, CDP identified that companies disclosing data to CDP face at least US\$77 billion in potential losses from water-related supply chain disruption, with almost US\$7 billion at immediate risk. Critically, 50% of the water footprint of high-income economies originates in areas of emerging and developing economies already facing extreme water insecurity (CDP, 2024).

A growing body of legal analysis across jurisdictions argues that existing company law directors' duties – including to promote company success and exercise care, skill and diligence⁶ – require boards to identify, assess and manage material nature-related risks, as ecosystem degradation constitutes an increasingly foreseeable financial threat to long-term company value. Failure to do so may expose directors to personal liability, particularly as disclosure frameworks and the foreseeability of nature-related financial risk becomes harder to dispute (Chapman Tripp, 2023; Hartford-Davis and Bush, 2023; Shivji et al., 2024; DeMarco and Vollmer, 2025; Yamada et al., 2025). This is particularly pertinent in the context of growing investor interest in portfolio company exposure to nature-related risks (Johannes-Gold et al., 2026), as well as new methods and tools emerging for assessing company-level resilience (see Case Study 4).

Case Study 4. Corporate resilience: assessing company-level risk and resilience in relation to critical natural systems

Understanding how firms are adapting to and building resilience against environmental change is essential for financial institutions, regulators and governments. This is particularly important where companies and their value chains impact and depend on critical natural systems, thereby creating potential risk transmission channels to other parts of economic and financial systems.

Context

Corporate disclosure on climate and nature-related adaptation and resilience remains limited (Spacey Martin et al., 2025). Because value chains expose companies to specific climate and nature risks – as well as potential opportunities – there is a growing need for better information on how business strategy and corporate finance are utilised by companies to support long-term resilience, including through targeted investment in supply chain interventions. This is particularly so for companies that source from critical natural systems and dependent regions who are therefore more exposed to both geographically-specific and systemic risk that could arise from continued degradation and potential collapse.

Initial findings

Researchers at Earth Capital Nexus have evaluated a global chemicals and manufacturing company sourcing raw materials from regions linked to potential G-SINS candidates (Brazil and the Democratic Republic of the Congo – home to parts of the Amazon and Congo Rainforests).⁷ This work combines asset-level physical risk data, scenario analysis, large language model assessment of corporate disclosures on resilience actions, and data from specialist providers on corporate revenue and investments.

⁶ The precise nature of these duties and mechanisms for their enforcement vary by jurisdiction.

⁷ The company has been anonymised for the purposes of this report. However, publicly available analysis on sector and company-level adaptation and resilience is forthcoming.

While the company was found to be materially exposed to surface water flooding, coastal inundation, riverine flooding and tropical cyclone storm surge flooding, it has not disclosed whether it has set targets to bolster resilience of its operations or to limit their impact on ecosystem services. Similarly, reported engagement with value chain partners on these issues appears to be absent. Most of the company's engagement with government has been via fines and remediation, with no evidence of proactive engagement in its disclosures. The analysis suggests that 0% of the company's total investment flows have been into nature-positive or resilience-focused activities. This is not an isolated example: many companies in the same industry have similar practices in place.

Potential policy implications

There is a lack of publicly available information on company-level adaptation and resilience, as well as a lack of jurisdictional information to guide companies' efforts and with which to assess them against. For example, corporate reporting and due diligence requirements could be strengthened to align with National Adaptation Plans (NAPs) and National Biodiversity Strategies and Action Plans (NBSAPs). Additionally, this could be underpinned by a shared G-SINS data infrastructure that links the global with local and can be used by public and private sector decision-makers alike.

Ongoing research

This illustrative analysis is part of a broader programme of work in which Earth Capital Nexus has partnered with ClimateArc and XDI to develop ResilienceArc, a new platform which combines multiple layers of data to create a more complete picture of how climate risks translate into real-world financial and operational impacts at the sectoral and company-level. Over the coming months, the analysis will be published after engagement with prospective users, as well as technical experts in adaptation, resilience and sustainable finance, before being made publicly available. Future research will focus on expanding the set of metrics to specifically focus on nature-related risk and value chain exposures.

Many voluntary actions can already be taken to identify, communicate and where possible mitigate nature-related risk and impacts. These include assessment and disclosure of exposures, governance frameworks, target setting (TNFD, 2023), and revision of procurement and investment standards in line with the mitigation hierarchy (IPBES, 2026).

In addition, substantial commercial opportunities and innovations are emerging that can already be captured by firms that move early to develop the technologies, business models and supply chain capabilities needed for future-facing, resilient value creation. The World Economic Forum estimates that the nature-positive transition represents US\$10 trillion in annual opportunities by 2030 that offer pathways to competitive advantage and resilient growth. There is a wealth of guidance now available on investible nature opportunities that are commercially viable today (Global Canopy, 2026; World Economic Forum, 2026). Research by the London Stock Exchange Group (LSEG) has also found that the green economy equities market has also outperformed global equities by 59% since 2008 (LSEG, 2025), demonstrating a clear business case for investment.

Those pursuing these opportunities could benefit from SINS designation to signal the strategic importance of the critical natural systems underpinning certain value chains, strengthen the investment case, and provide a globally recognised framework within which corporate action could be coordinated and scaled up. SINS designation could also provide a focal point for directing innovation policy, such as public procurement standards, R&D incentives, bioeconomy incentives and regulatory sandboxes, towards the technologies, business models and supply chain solutions needed to decouple economic activity from the degradation of critical natural systems.

As the risk associated with degrading critical natural systems becomes better understood, corporate advocacy could be leveraged as a powerful force to argue for the subsidy reform, regulatory clarity, and investment incentives needed to reduce it.

Yet, there is growing recognition that value chain resilience cannot be secured only at the firm level. Moving from project-level interventions to landscape-level approaches – where multi-stakeholder governance delivers multi-functional benefits for people, nature and businesses – can enhance the social licence to operate, supply chain resilience and the cost-efficiency of interventions (World Bank, 2025; UNEP-WCMCa, 2024). SINS designation may be able to help by identifying where coordinated action is needed. Public-private partnerships are likely to be key to delivering long-term supply chain resilience and investment at this scale, combining the policy authority, concessional capital and long-term mandate of governments and IFIs with the supply chain reach, technical capability and commercial incentives of the private sector.

More broadly, voluntary corporate action alone, while necessary, will likely be insufficient. Voluntary action is unlikely to overcome coordination failures and time horizon mismatches at the speed or scale required. Could SINS designation provide regulators with a coherent focal point for identification of the most material risks around which regulations can be structured, including, for example, moving from broad, difficult-to-operationalise sustainability obligations towards targeted requirements linked to specific systems? There would be advantages and disadvantages. On the one hand, this may help overcome some of the barriers to implementing sustainability regulations and better balance sustainability ambition with competitiveness concerns, but it could also mean that some material risks may fall through the cracks and lead to misallocations of capital. Providing data and recognising SINS in the reporting standards and guidance documents of the International Sustainability Standards Board and the TNFD framework could aid firms in identifying the most material dependencies and impacts.

A shared data infrastructure, including data on SINS-related risks, impacts and dependencies, could help translate systemic ecological risk into decision-relevant financial information. At the EU level, for example, this would assist the implementation of sustainability regulation, including the EU Deforestation Regulation (EUDR), the Corporate Sustainability Due Diligence Directive (CSDDD), and the Corporate Sustainability Reporting Directive (CSRD). Freely available tools like TRASE⁸ can help track risks related to deforestation and agricultural supply chains.

Regulatory fragmentation across jurisdictions limits the efficacy of regulation, creating uneven competitive conditions and opportunities for regulatory arbitrage. Could a broader high ambition coalition of willing jurisdictions help to address this fragmentation by providing common standards around SINS and a shared evidentiary basis for due diligence requirements? Could this reduce the compliance burden on firms operating across multiple jurisdictions while strengthening the overall regulatory signal?

D. Global risk governance and international financial architecture

Like the G-SIBs, the macro-criticality of certain critical natural systems is inherently transboundary, making their resilience a matter of shared international interest. This raises the question of whether G-SINS could be designated at an international level and a registry maintained based on transparent scientific and economic criteria.⁹ As with the G-SIBs, designation could be supported by a set of mechanisms to monitor vulnerabilities in the system and coordinate efforts across national, regional and global actors to address accumulating risks.

The FSB is currently undertaking a strategic review of its crisis preparedness activities to strengthen the *Key Attributes of Effective Resolution Regimes for Financial Institutions* as the international standard for financial institution risk resolution regimes, and its broader preparedness toolkit (FSB, 2026). As part of this review, the FSB could take steps to consider how its supervisory, recovery and resolution planning captures vulnerabilities and exposures to degradation of critical natural systems, applying its existing mandate in a forward-looking way to address structural environmental risks that could threaten systemic resilience. This could lay the groundwork for new guidance, monitoring and

⁸ <https://trase.earth/>

⁹ Given the political difficulty of establishing new institutions, a near-term priority could be to recognise G-SINS within existing mandates, while leaving open the case for a dedicated body in future.

early warning systems for regulators, supervisors and financial market participants, and provide crucial feedback to Ministries of Finance and wider government. These activities would fall squarely within the FSB's existing mandate, which states its role is to "[a]ssess vulnerabilities affecting the global financial system as well as to identify and review, on a timely and ongoing basis within a macroprudential perspective, the regulatory, supervisory and related actions needed to address these vulnerabilities and their outcomes" (FSB, 2012).

As the financial materiality of risk associated with the degradation of critical natural systems is acknowledged, the existing mandates of international standards for prudential and non-prudential regulation of banks and insurers, as well as regulation applicable to the non-bank lending sector and pension funds, could be applied in their monitoring, supervisory and coordination capacity. For example, the existing mandates of the Basel Committee on Banking Supervision (BCBS) for banks, the International Association of Insurance Supervisors (IAIS) for insurers, and the International Organization of Securities Commissions (IOSCO) for securities to monitor and mitigate systemic risk could be used to recognise the degradation of G-SINS as systemic risk factors without altering their core charters. Given the growing evidence on the macro-criticality of nature, not incorporating monitoring and necessary action within the FSB and broader global regulatory coordination and guidance would arguably be a significant gap.

Loss of critical natural systems could also have implications for price stability and monetary policy. To illustrate, Case Study 5 below sets out exploratory analysis with preliminary results showing that environmental degradation, such as deforestation in key commodity-producing regions, can trigger supply-side shocks, price spikes and inflationary pressures in consumer markets, highlighting the deep interconnectedness of nature-related risks and the local-to-global links. These effects are likely to be exacerbated for value chains dependent on critical natural systems.

The analysis presented in Case Study 5 underscores that deforestation can act as a non-monetary driver of inflation, comparable in mechanism to traditional supply shocks such as energy price surges. Therefore, actions to protect and restore critical natural systems can be viewed not only as environmental objectives but also as critical stabilising instruments capable of supporting price stability and mitigating inflation risks. Integrating trade-adjusted climate and nature-related risks into macroeconomic and inflation frameworks and monitoring systems, including consideration tracking the ecological integrity of SINS and the impacts on global supply chains and prices, could help strengthen price stability.

To secure financial resilience in a world of growing climate and nature risks, dependencies on SINS could be incorporated into central bank stress tests, such as modelling of rainfall shifts, drought-induced commodity shocks, and stranded asset risk in a way that considers the interconnected, global and non-linear nature of these risks (Ranger et al., 2023). Indeed, studies by the Banque de France (Benoist et al., 2026) and Ranger et al. (2024) already provide a prototype in exploring the financial system implications of a multi-breadbasket failure – a scenario entailing drought impacts to key productive landscapes globally, which could be considered G-SINS.

Non-prudential tools, including existing transparency requirements to disclose risks and management strategies, could be interpreted as necessitating reporting on risks arising from SINS degradation. Indeed, in light of the growing evidence explored in this paper, it may be reasonable to assume that a financial institution's reporting is not complete unless it considers exposure to risks related to critical natural systems. Disclosure requirements could potentially serve not only as risk management tools, but as capital allocation signals that allow investors to systematically favour firms reducing their dependence on degraded ecosystems. Supervisory guidance issued by central banks could also be used to provide expectations for how firms can explicitly embed the state of these systems into risk management frameworks.

Case Study 5. Global value chains: Linking nature degradation with price shocks and inflation

Context

Côte d'Ivoire and Ghana together account for around 60–70% of global cocoa output (zu Ermgassen, 2021), a key input into the chocolate industry, which is a US\$130 billion industry (Bhutada, 2020). The cocoa sector is crucially important to Ghana and Côte d'Ivoire's economies, as a major employer and contributor to more than 20% of all exports by value (zu Ermgassen, 2021). Deforestation in West Africa is a major threat to growing conditions. A recent study found that forest clearings in West Africa could cut rainfall as much as 8–11% during the cocoa growing season, putting yields, producer incomes and importer costs at risk (Smith et al., 2023). Separate analysis suggests that conserving approximately 400,000 hectares of Ghana's forest over the next decade could reduce the country's public debt-to-GDP ratio by about three percentage points and support a one-notch improvement in its sovereign credit rating relative to a business-as-usual deforestation scenario (Kulenkampff, 2025).

Initial findings

Using data from Global Forest Watch, UN Comtrade and the IMF, preliminary econometric analysis by Pasqua and Ranger (in preparation) provides early evidence of a short-run link between deforestation and import-price inflation in the cocoa sector. While the findings are exploratory, initial results suggest that a one-percentage-point increase in annual forest loss in Ghana and Côte d'Ivoire (measured as a share of 2000 forest extent) could be associated with around 9% faster quarterly growth in UK cocoa import prices. This relationship appears to hold even after accounting for broader commodity and macroeconomic factors. A one-percentage-point increase in tree cover loss corresponds to roughly 70,000 hectares in Ghana and 150,000 hectares in Côte d'Ivoire (University of Maryland and Global Forest Watch, 2022). In 2022, the UK imported about US\$180 million in cocoa beans (HS 1801: Cocoa beans, whole or broken, raw or roasted), about 97% of which were sourced from Ghana and Côte d'Ivoire (World Bank WITS, 2022). Applying the estimated elasticity, an indicative 2–3% annual deforestation rate (World Bank, 2020; EU REDD Facility, 2019) could translate into up to US\$47 million in additional import costs, equivalent to roughly 26% of the UK's 2022 cocoa-bean import bill. Even under a 2% deforestation rate, the potential increase would remain material, at about US\$31 million (about 17% of its current cocoa-bean import bill).

These findings should not be read as comparing degradation against a costless baseline. Instead, the analysis suggests that continued deforestation generates acute and potentially non-linear and irreversible disruption. By contrast, nature conservation and restoration, while costly, may enable more gradual, manageable adjustment that economies can adapt to. The relevant comparison is between disorderly and potentially irreversible disruption versus a calibrated pre-emptive transition.

These findings suggest that deforestation operates as a structural supply shock, directly affecting agricultural productivity, export capacity and trade-dependent price dynamics. Additionally, the inflationary impact appears immediate and pronounced in the short term but may partially normalise as supply chains adapt, for instance through replanting, substitution or diversification. However, when deforestation persists over multiple years, the analysis indicates a lasting effect, with structurally higher import-price inflation for a consumer economy, such as the UK, reliant on commodities exposed to climate and nature-related risk.

Source: Authors; Carlo Pasqua

E. Concessional finance

Given that the benefits of ecosystem stability often accrue globally while the costs of conservation are borne locally, concessional finance from multilateral development banks (MDBs) and development finance institutions (DFIs) may play a role in addressing these cross-border externalities. While recognising the broader need for concessional finance for countries and communities to meet climate and nature goals, a 'high ambition coalition' could explore if SINS designation could help host countries to unlock additional concessional capital from donors, MDBs and DFIs towards the

protection of critical natural systems in a more coordinated way. For example, would G-SINS designation support allocation of concessional capital to the most material risks and opportunities? Could it help global funds targeting critical natural systems to mobilise more private capital contributions?

MDBs have increasingly recognised nature as a foundational asset underpinning economic development, resilience, jobs and poverty reduction. In their Joint Statement on Nature, People and Planet delivered in 2021, MDBs committed to mainstreaming nature across policies, analysis, investments and operations, recognising that biodiversity loss, climate change and development challenges are fundamentally interconnected (MDBs, 2021). The Subsequent *MDB Common Principles for Tracking Nature Finance* established a shared framework for identifying and scaling up investments that contribute to halting and reversing nature loss (MDBs, 2023). Together, these initiatives imply a shift away from treating biodiversity as a sectoral environmental issue towards viewing ecosystems as critical assets that support food systems, water security, livelihoods, climate resilience and sustainable economic development, consistent with the concept of critical natural infrastructure.

Indeed, the AIIB and EBRD have recognised natural capital is akin to “critical, productive, investable public assets that deliver essential infrastructure-grade services” that can attract investment in the same way as built assets: through national infrastructure plans, blended finance and public-private delivery partnerships (AIIB et al., 2025). The nature as infrastructure framing aligns with a broader discourse that points to the need to move from project-level, nature-based solutions to large-scale, landscape-level management that enables the achievement of multifunctional environmental, social and development objectives, while also being more capable of attracting larger-scale investment for public goods (Estrada-Carmona et al., 2024; Sowińska-Świerkosz et al., 2024).

Numerous dedicated concessional financing mechanisms have been established to support the protection of critical natural systems, yet arguably they fall short of what is required. These include the Amazon Fund, Central African Forest Initiative, and many others, which are often characterised by chronic underfunding and persistent gaps between commitments and disbursements (Correa et al., 2019; Nasi and Cerutti, n.d.). Congo Basin countries received just US\$40 million for forest protection between 2017 and 2021, equivalent to US\$0.04 per hectare per year (Zero Carbon Analytics, 2025). The Tropical Forest Forever Facility (TFFF), launched in 2025 at the UN climate conference COP30 in Belém, represents the most ambitious attempt to address this gap, proposing long-term results-based payments of US\$4 per hectare to over 70 eligible tropical forest countries (World Resources Institute, 2025b; Tenkhoff and Voigt, 2026).

Given the evidence on the macro-criticality of tropical forests, investment in such a vehicle could be considered an investment in macroeconomic risk stabilisation for the planet. To date, countries including Brazil, Norway, Indonesia, France, Luxembourg, the Netherlands and Portugal, as well as the Minderoo Foundation, have made substantial commitments to the TFFF – and the Facility has already raised over US\$6.7 billion in sponsor capital and pledges.

Beyond forests, dedicated financing infrastructure is almost entirely absent for other critical systems. The Global Fund for Coral Reefs remains the only mechanism for reef systems, while the Global Biodiversity Framework Fund had received just US\$386 million in pledges as of mid-2025 against a US\$700 billion annual financing gap (Global Environment Facility, 2025).

Critically, none of these mechanisms is formally integrated into the macroeconomic and financial governance frameworks.

Incorporating nature into economic diagnostics is important. The World Bank’s Country Climate and Development Reports (CCDRs), a key diagnostic tool to support the World Bank’s clients, have made progress in integrating nature-climate linkages into economic analyses but remain inconsistent and unsystematic, with coverage strongest for forestry, water and carbon mitigation while largely overlooking biodiversity, pollution, soil health and international nature-related risks. Analysis of 71 CCDRs indicates the need for a strategic framework to ensure comprehensive identification of nature-related risks and opportunities, particularly for critical natural systems, alongside better

quantitative tools to incorporate natural capital into macroeconomic modelling (Ranger et al., 2025). Crucially, the authors find that transboundary risks and interdependencies across countries related to the erosion of regionally and globally important natural systems are not fully captured: beyond a recognition of the carbon sink and sequestration value of nature, G-SINS are entirely absent.

While not detracting from the fact that all financing of nature aligned with the GBF is important (and underfunded), recognition of SINS could enable IFIs such as MDBs and DFIs to better coordinate their financing of nature protection and recovery across transboundary critical natural systems and leverage their ability to make high-impact investments at the scale necessary to protect SINS. IFIs could also serve as enablers of private investment into SINS by providing policy support, pipeline development and risk transfer. Concessional capital could be structured to achieve better alignment with the risk–return requirements of the private sector and seed public–private vehicles targeting SINS, ensuring returns accrue through enhanced fiscal revenues (e.g. stabilised commodity exports), reduced disaster liabilities, and additional revenue streams, potentially operationalising high-impact but illiquid natural assets as investable infrastructure for global stability. This could include utilising guarantees, first-loss or subordinated capital, preferential terms for different classes of investors, technical assessment, capacity building and offtake agreements (van Raalte and Ranger, 2023).

The recent report by the AIIB, EBRD and Paulson Institute (2025) proposes Public Private Partnerships for Nature (PPPNs) to structure investment at scale. The logic is that nature delivers infrastructure-grade services much like toll roads or hospitals, so the same PPP machinery can be ported across. Like traditional infrastructure PPPs, PPPNs would provide long-term contracts, risk sharing and standardised structures, but applied to forests, wetlands, grasslands and coral reefs. The structure mirrors a conventional PPP: the public sector may commit to outcome-based payments linked to nature restoration goals, while private partners would coordinate delivery consortia, manage performance and maintain nature assets.

At the international level, recognising the political economy challenges associated with setting up new funding windows, deployment of concessional capital by IFIs would be most effective if channelled through existing windows. Within the 21st replenishment for the International Development Association (IDA21), the World Bank’s low-income country lending arm, a proposed global public goods window failed to gain traction despite initial support from some members and civil society advocacy (Healy et al., 2024; Zattler, 2024). The failure leaves a potential structural weakness in the international financial architecture, being the absence of a mechanism directly designed to support systems that are located within low-income sovereign territories and generate global public goods, yet their value accrues transnationally. However, the IDA21 package did retain Global Challenge Programs on ‘Forests for Development, Climate, and Biodiversity’ to build sustainable forest economies in critical forest biomes and ‘Fast-track Water Security and Climate Adaptation’ (World Bank, 2025), which could be leveraged to support investment in critical natural systems.

Complementary pathways are available that might be suitable for channelling investment into critical natural systems, such as the new IDA Global and Regional Window, whose design rationale encompasses cross-border externalities (but not necessarily global). The Global Environment Facility and nascent Global Biodiversity Framework Fund could be used as additional grant layers to cover the global public goods premium, supported by thematic purpose-built facilities, such as the Tropical Forest Forever Facility, and scaling instruments such as debt-for-nature swaps, nature bonds and Project Finance for Permanence, conditioned on measurable conservation performance and co-designed milestones. If the role of SINS as a global public good were formally recognised by IFIs, a SINS designation could potentially be used to justify concessional capital treatment within IFI operational frameworks. Beyond unlocking and better coordination of public flows, a formal SINS designation could strengthen the investment case for private co-financing of dedicated funds by providing the standardised data, verified outcomes and institutional credibility that private investors require to commit capital alongside concessional sources at scale.

5. Governance and distributional considerations for SINS

The governance of SINS raises distributional and sovereignty considerations that are as important to the success of the concept as the economic, financial and regulatory mechanisms described in earlier sections. Communities and countries responsible for managing critical natural systems often bear the opportunity costs of conservation while the benefits of ecosystem stability accrue at regional or global scales. This asymmetry is compounded by the fact that many potential G-SINS host countries are low- and middle-income economies whose development pathways have been shaped by external demand for commodity production that drives degradation. However, these communities also stand to benefit from myriad opportunities associated with nature-inclusive, climate-smart production systems, including through the protection, restoration and sustainable management of SINS and the growth of the bioeconomy. An approach that fails to deliver equitable outcomes for host countries and communities will lack political legitimacy and be rendered ineffective.

Sovereignty and stewardship

If a pathway towards SINS designation is taken, such a process must be designed to reinforce rather than constrain national sovereignty. The Tropical Forest Forever Facility (TFFF) offers a promising example of this approach in practice, designed to reward host governments of tropical forests directly for forest stewardship as providers of global public goods, thereby aligning conservation incentives with national economic and development priorities.

Effective governance frameworks will need to be co-created to resonate with domestic economic and development priorities in host countries, rather than relying on a single global narrative, and would need to be designed in a way that recognises the protection of critical natural systems as providing macro-critical ecological infrastructure for both the host countries and the global economy, underpinning growth and productivity. In Brazil, for instance, rainfall and water levels in hydroelectric dams – supplying the majority of the country's electricity – are directly dependent on 'flying rivers' generated by Amazonian forest cover. Spatial analysis can identify precisely which forest areas are hydrologically critical to specific dams (Arias et al., 2020), creating an evidence base for conservation investment for critical natural systems that speaks directly to energy security, industrial policy and economic productivity rather than abstract global benefits. Instead of simply imposing external standards, the designation mechanism would need to create tangible financial, diplomatic and reputational incentives and opportunities for host country governments to invest in the long-term stewardship of their critical natural assets.

Formal recognition of critical natural systems and a G-SINS designation could potentially confer a structural shift in geopolitical bargaining power onto the host country. If the global community accepts that a given ecosystem is macro-critical, the custodian government negotiates from a basis of recognised strategic importance, which may serve to strengthen its leverage in multilateral fora and discussions, particularly in an era where international relations and power dynamics are evolving. This reframing may prove more politically durable than conservation commitments, but will need to be carefully managed within the designation framework to avoid creating perverse incentives.

Indigenous Peoples and local communities as essential stewards

Indigenous Peoples and local communities (IP and LCs) are often the primary stewards of ecosystems and their livelihoods most dependent upon them. Evidence demonstrates that conservation and restoration outcomes are stronger where IP and LCs exercise meaningful governance and control over their territories, as supported by meta-analyses of analytical studies across biomes (Dawson et al., 2021). Spatial analysis confirms that approximately 40% of the world's protected areas and ecologically intact areas overlap with Indigenous lands (Garnett et al., 2018). Emerging work also maps the distributional concentration of ecosystem value on IP and LC-held territories, including within the Congo Basin, a G-SINS candidate, and identifies (although does not causally attribute) higher natural capital values in community forests and customary land tenures, emphasising the importance of rights-based approaches (Filewood et al., 2025).

Implementation of a SINS framework must centre the rights and knowledge of IP and LCs on two distinct but reinforcing grounds: effectiveness and rights. The effectiveness argument is empirical, being that critical natural systems cannot be effectively protected without the active participation of the communities who govern them, whereas the rights-based argument is normative and legal. Target 22 of the Kunming-Montréal GBF explicitly requires full and effective participation of IP and LCs in decision-making related to biodiversity governance. Under international human rights law, including the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and International Labour Organization Convention 169, states and other actors are obliged to obtain the free, prior and informed consent (FPIC) of IP before adopting measures that may affect their lands, territories and resources. The ICJ Advisory Opinion further reinforces states' due diligence obligations in ways that cannot be discharged without meaningful engagement with affected communities. A SINS framework that fails to embed FPIC requirements and IP and LC participation risks material harm to the rights, lands and customs of IP and LCs, as well as practical failure.

Governance mechanisms for equitable benefit sharing

Any future SINS designation and framework will need to be centred on governance mechanisms capable of ensuring that the global financial benefits of ecosystem stewardship flow equitably to those who bear its costs locally. This would need to ensure that local institutions, IP and LCs hold meaningful decision-making power over how SINS-related investment and finance is deployed in their territories.

A foundational precondition is the recognition and regularisation of IP and LC land tenure. Without secure rights over lands and resources, communities lack the authority to make the long-term stewardship investments that the resilience of critical natural systems requires (IPCC, 2019; Camino et al., 2023). Existing efforts can be instructive, including progress made through the National Indigenous People Foundation (FUNAI) and Coordination of Indigenous Organizations of the Brazilian Amazon (COIAB) in advancing tenure recognition across the Amazon Basin, and the Intergovernmental Land Tenure Commitment at COP30 pledged to secure and strengthen land tenure and governance rights and protection for IP and LCs on 160 million hectares of tropical forests by 2030 (Forest & Climate Leaders' Partnership, 2025).

Results-based finance and payment for ecosystem services frameworks, including nature credit markets, offer one pathway for directing financial flows to local stewards of critical natural systems in proportion to verified conservation, restoration and sustainable management outcomes. Critically, these mechanisms must be accessible directly to IP and LC groups rather than through intermediaries. The Tropical Forest Forever Facility has set a notable precedent by ringfencing 20% of its funding for IP and LCs with provision for direct access. The Podáali Fund also provides an example of Indigenous-led dedicated vehicles for rewarding forest stewards, with SINS designation potentially providing an additional rationale for capitalising and expanding existing models.

Finally, SINS designation could play an important role in supporting socio-bioeconomy models that protect critical natural systems while improving livelihoods. Designation could bolster the strategic economic case for land stewardship practices and inform policies to provide market access for IP and LC businesses and products. Governance structures flowing from designation that combine national policy, IP and LC governance systems, and private sector engagement are likely to be more effective and durable than top-down conservation programmes that bypass local institutions and communities (Dawson et al., 2021).

6. Conclusion

Two distinct but related concepts have been explored in this paper: the macro-critical role of critical natural systems and a proposed SINS framework that recognises those systems that are ‘too big to fail’. This framework borrows a central insight from the G-SIB framework: that some assets are sufficiently important to system stability that their degradation warrants enhanced monitoring, governance and risk management. The core objective of the proposed frameworks is to enable policymakers, financial institutions, investors, corporations, Indigenous Peoples and local communities to manage the macroeconomic, financial and systemic risk posed by the decline of critical national systems globally and domestically and put in place policies and investments that protect these systems both as economic stabilisers and for people and nature.

It is also important to reiterate that the discussed SINS designation within national and global risk governance would be just one of the many levers capable of contributing to global goals for climate and nature. It is not intended to replace or diminish the importance of existing frameworks, goals or conservation efforts, but we suggest it could provide a focus and first step for better integration of consideration of critical natural systems within existing macroeconomic and financial frameworks by highlighting the most material risks and impacts and so shaping the most valuable initial interventions. Addressing the governance gap identified in this paper does not necessarily require new institutions or instruments. The paper has purposely focussed on those levers that already exist.

Importantly, this paper has been designed to spur discussion, debate and further research.

To summarise the key levers we have explored:

- **Ministries of Finance and fiscal policy:** IMF Article IV surveillance and existing debt sustainability frameworks already provide the institutional authority through which SINS degradation could be recognised as a macro-critical fiscal risk, following the precedent already set in relation to climate change. Existing subsidy reform agendas and the growing sovereign sustainability-linked finance market offer further levers that could be oriented towards G-SINS stewardship without requiring new instruments.
- **Financial institutions:** Existing fiduciary duties, TNFD-aligned disclosure frameworks and emerging International Sustainability Standards Board (ISSB) reporting standards already create foundations for a legal and regulatory basis for integrating critical natural systems-related risks into portfolio management. Yet questions remain regarding whether existing obligations and voluntary frameworks are being adequately applied. Capital adequacy frameworks and supervisory guidance provide further existing tools through which regulators could signal expectations without requiring new legislation.
- **Corporates and value chains:** Existing due diligence frameworks, including the EUDR, CSDDD and CSRD, alongside TNFD and ISSB reporting standards, provide a foundation on which SINS-specific requirements could be built, reducing fragmentation rather than adding new layers of regulation and standards. Directors’ duties under existing company law already create obligations to consider and manage material nature-related risks, with SINS designation potentially helping to operationalise what those duties require in practice.
- **Global governance and financial integration:** The FSB’s ongoing strategic review of crisis preparedness offers an immediate entry point for considering how to embed critical natural systems within existing mandates, while the supervisory frameworks of the Basel Committee, International Association of Insurance Supervisors (IAIS) and International Organization of Securities Commissions (IOSCO) could be applied to treat critical natural system degradation as a systemic risk factor without requiring new institutions or charter amendments. Central bank stress testing and prudential frameworks already provide the technical architecture within which SINS dependencies and risks could be integrated.
- **Concessional finance:** IDA21 Global Challenge Programs, the Global Environment Facility and nascent mechanisms such as the Tropical Forest Forever Facility represent channels through

which concessional capital could be better coordinated and targeted towards critical natural systems. The World Bank's CCDRs offer an existing diagnostic tool that could be strengthened to capture G-SINS dependencies more systematically, while debt-for-nature swaps and Project Finance for Permanence provide established financing models that could be scaled up.

Next steps could include engaging scientists to progress the identification of critical natural systems and bringing together a high-ambition coalition of actors to prototype the concept in action within two or three early adopter countries and institutions. We suggest that a system of SINS designation would serve to identify those natural systems so foundational to macroeconomic stability, financial resilience and human prosperity that their loss would be too consequential and too irreversible to allow. In turn, designation could provide policymakers, regulators and capital allocators with a shared, evidence-based reference point from which to coordinate and sequence intervention towards the systems where the stakes are most material, using existing levers and institutions while leaving room for future institutional evolution.

Finally, we ask whether, as with the 2008 financial crisis, the current moment – marked by supply chain shocks, mounting fiscal pressures and accelerating erosion of critical natural systems – could be right for an equivalent systemic response: a pre-emptive, coordinated framework that prices in the risks that have previously been invisible before the cost of inaction becomes irreversible.

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