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From Compliance to Competitive Advantage: The Institutional Benefits of Climate Risk Assessment

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Abstract **Original Research Article**

Climate risk assessment (CRA) has become a key institutional requirement, and is rapidly gaining traction in the public and private sectors. The article explores the various advantages of CRA for institutions and posits that this goes beyond compliance to provide strategic value to institutions. The analysis is based on recent developments such as the IPSASB's first-ever public sector climate disclosure standard (January 2026 ⛓), the ISO framework for adaptation planning (14092:2026 ⛓) and emerging national regulations aligned with the ISSB. The article illustrates the ways leading organizations are using leading practices in climate risk assessment to turn a disclosure headache into a positioning strategy for competitive advantage through a number of case studies, from utilities to academic institutions to governments. Institutions are also getting access to new analytical instruments, such as machine learning methods for forecasting systemic risk (Srour et al., 2025 ⛓) and incorporation of energy reliability into vulnerability indices (De-Jesús-Grullón et al., 2026 ⛓). Persistent challenges within implementation of these initiatives – such as data availability, cost restrictions and capacity gaps – are discussed along with practical recommendations for institutions of different levels of maturity for climate risks. The article ends by saying that in an age of increasingly fast physical and transition risks, climate risk assessment should be a core component of institutional resilience as well as long-term value creation.

Keywords: Climate risk assessment, physical risk, transition risk, TCFD, ISSB, IPSASB, institutional resilience, adaptation planning, green banking, systemic risk

1. INTRODUCTION

The stability and performance of institutions are threatened by the effects of climate change. Businesses in all industries are becoming increasingly vulnerable to climate risks, from weather conditions and climate change affecting operations to policy changes impacting the market. These risks are becoming increasingly challenging for financial stability, and research based on 92 countries between 2013 and 2020 found that more robust climate law implementation has led to greater financial stability by lowering systemic risks, credit default, and market distortions (Alkatheeri et al., 2026 ⛓). Businesses are seeing insurance premiums go up, supply chains are breaking up, and businesses in vulnerable locations are being threatened in their operations that cannot be fully insured away. Political risk has been found to be the most

significant factor affecting banking stability in the MENA region, which indicates that financial institutions in the region are structurally weak to political, economic, and financial crises (Abbas & Shahwan, 2025 🔗).

Physical risks are those that occur as a direct consequence of climate change. These include acute risks associated with extreme weather events (floods, storms, heatwaves and wildfire events), and chronic risks associated with longer-term changes (sea-level rise, temperature changes, and precipitation changes). Physical risks have repercussions for institutions of damage to assets, disruption to the supply chain, safety concerns for employees and/or service failures. Machine learning analysis (1994–2024) indicates that the landscape is undergoing changes due to climate factors, suggesting an evolving ecological imbalance and direct risks to current infrastructure and livelihoods as glaciers are rapidly retreating and extreme events (such as landslides and flash floods) are becoming more frequent, especially in the Western Himalayas (Kashyap & Kumar, 2026 🔗). Studies conducted in the Dominican Republic also highlight the fact that energy reliability is an under-researched aspect of climate vulnerability and that failures in the energy supply worsen the effects of climate extremes on vulnerable populations (De-Jesús-Grullón et al, 2026 🔗).

CRA is becoming an increasingly critical issue for institutions in recent years. Climate change was the province of environmental specialists who are now expected to join the board of directors, due to three intersecting factors: first, the physical reality of climate impacts is becoming more severe; second, the regulatory landscape is changing rapidly; and third, the expectations of investors, insurers and other stakeholders are also evolving at a fast pace. Research analysing agricultural systems in Southern Africa shows that governance inefficiencies and institutional weakness can have large negative long-run effects on productivity with institutional capacity serving as a link between climate vulnerability (Semosa, 2025 🔗). Earlier, the effectiveness of a nylon barrier to prevent the entry of tigers was studied in India's Sundarban region, and the results indicate the wide range of interactions between structural measures and community resilience; in communities where participation was high, human-wildlife conflict was significantly reduced (Biswas et al., 2026 🔗). Structural marginalisation is linked to climate vulnerability of the tribal dominated areas, which calls for inclusive adaptation planning (Arya et al., 2025 [Link unavailable]).

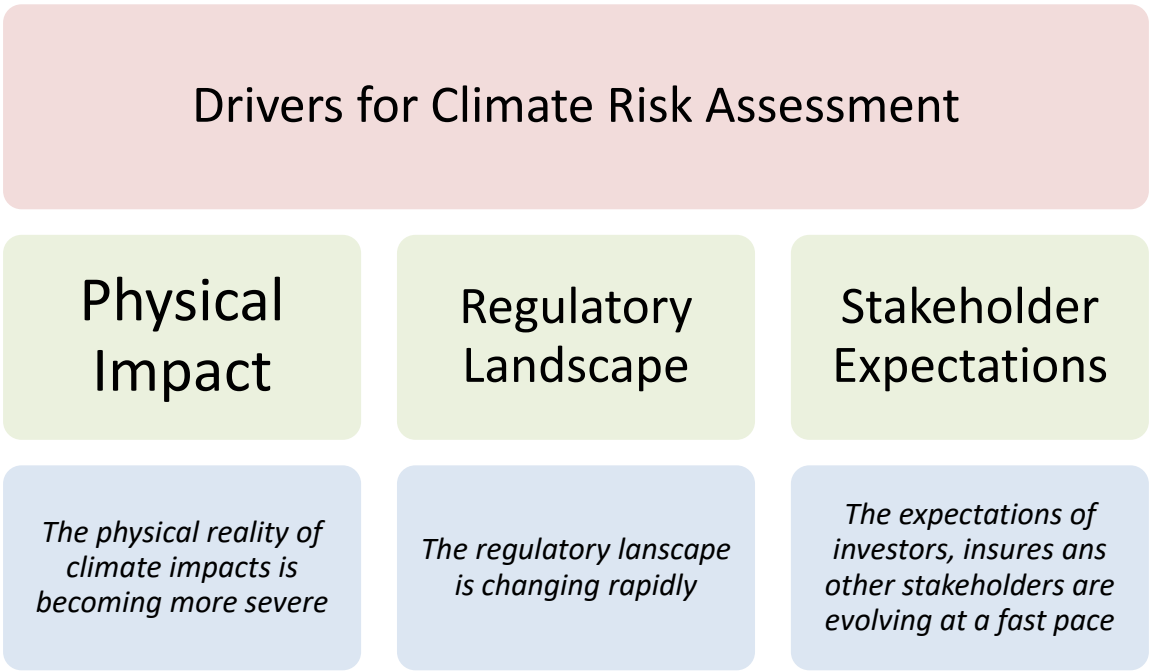
2.1 Theoretical background: The evolving character of the assessment of climate risk.

2.2 Measures to tackle global climate risks and institutional vulnerability in the Philippines

Elevated risks to the need to accelerate the pace of climate change are indisputable. There is an increased frequency and severity of extreme weather events across all regions. Vulnerability assessments, which are also increasingly applied to understanding what human–nature systems are vulnerable and for informing policy, planning and resource allocation, require multidisciplinary knowledge to understand the drivers of human–nature systems (O'Donnell et al., 2025 🔗). These assessments are a combination of climate hazard exposure, system sensitivity, and adaptive capacity and are used to guide targeted adaptation strategies.

Figure 1. Key Drivers Accelerating Institutional Climate Risk Assessment

This figure illustrates the primary factors driving the adoption of climate risk assessment, including increasing physical climate impacts, evolving regulatory requirements, and growing stakeholder expectations.



The study has been conducted in Western Himalayas that shows how machine learning analysis of landscape transitions (1994-2024) can help detect emerging ecological instability as a result of climate change, which can be used to inform infrastructure planning and community resilience (Kashyap & Kumar, 2026 🔗). The use of these micro assessments indicates that vulnerability is different in a small area, which further requires that the approaches be institution specific and not generalised. Similarly, in Jharkhand, India, Arya et al., 2025 [Link unavailable] have estimated climate vulnerability and adaptive capacity by analysing the Earth observation data as well as the NFHS-5 microdata and found that the districts which were dominated by tribal groups were the most vulnerable and also found that the effect of structural marginalisation on adaptive capacity.

De-Jesús-Grullón et al. (2026 🔗) have built up this approach and implemented it as an extra factor in the Climate Shock Vulnerability Index, constructing a comprehensive case study of the Dominican Republic. They demonstrate how the power outage data can offer new insights and approaches to understanding climate vulnerability that were not previously considered, particularly in Latin America and the Caribbean, where social vulnerability indicators were used. The methodological development has a direct connection to the implications of institutions that are critically dependent on a stable electricity supply.

The reliability of projections of climate risks has in turn been questioned. Recently, Pollack et al., 2026 🔗, provided a study of the transparency and reproducibility of the top 100 peer-reviewed climate risk studies, and found that only 4% of the studies made available their data and code, which is considered a basic requirement for T&R. This is different from current projections with a significant impact on the validation and verification of projections that can be used to inform critical decisions on future household locations, credit risk evaluation by lenders, and where communities will be funded for climate resilience.

Technology, Standards and Beyond: From TCFD to ISSB and Beyond.

A fast-changing reporting framework and standard has influenced the institutional response to climate

risk. Climate risk disclosure was born in 2015 with the formation of the Task Force on Climate-related Financial Disclosures (TCFD). It had a structure which broke up into four areas: governance, strategy, risk management/metrics and targets, and this structure was quite prevalent in both jurisdictions and sectors.

In 2023, the TCFD officially ended, with its efforts incorporated and strengthened into the International Sustainability Standards Board (ISSB), which was set up in 2021 to bring together the various climate and broader sustainability reporting standards. The first two ISSB standards – the General Requirements (ISSB S1) and the Climate-related Disclosures (ISSB S2) – were released in June 2023 and introduced a global standard for sustainability reporting (Bezverkhyi & Poddubna, 2023 🔗).

In December 2025, the ISSB published targeted amendments to IFRS Standard 2 (ISSB, 2025 [Link unavailable]), which clarify Scope 3 Category 15 GHG disclosures and allow for different methodologies to disaggregate financed emissions. This gives financial institutions much-needed flexibility in dealing with the complexity of value chain emissions accounting.

The IFRS S1 sets out the fundamental concept that enterprises are required to disclose sustainability-related risks and opportunities reasonably likely to impact the prospects of the enterprise, and which the IFRS are material, which is consistent with the definition of material used in financial reporting. (Bezverkhyi and Poddubna 2023 🔗) IFRS S2 specifically applies this to Climate, with scenario analysis and transition planning, as well as disclosure of scope 1, 2 and 3 GHGs under the GHG Protocol.

2.3 The Public Sector Breakthrough: IPSASB SRS 1 (2026)

In January 2026, IPSASB published its first public sector climate reporting standard, SRS 1: Disclosures about Climate Change (International Public Sector Accounting Standards Board [IPSASB], 2026 🔗). This standard fills a crucial gap: although private sector climate disclosure has made substantial progress, there is a lack of clarity on how governments and public sector actors can disclose climate-related risks and opportunities.

The IPSASB standard has great importance for these reasons. First, it acknowledges that the role of government is a key factor in climate action because government decisions can influence outcomes throughout the economy (IPSASB, 2026 🔗). Second, it is in line with IFRS S2, which would improve consistency and comparability between the public and private sectors, which are important to lenders and other resource providers. Third, it is applicable to general purpose financial reports for the annual reporting periods beginning on or after January 1, 2028, and for earlier adoption.

2.4 Climate Laws and Financial Stability

Recent studies have resulted in empirical evidence connecting climate regulation and financial stability. Using panel data from 92 countries from 2013 to 2020 and fixed-effects regression, instrumental variable and propensity score matching, Alkatheeri et al. (2026 🔗) concluded that the more a climate law is implemented, the more it strengthens financial stability by lowering systemic risks, credit defaults, and market distortions. But their study also finds that the impact of climate regulations is dependent on the type of regulation, institutional quality, the depth of the financial markets and regulatory enforcement.

This does have direct implications for institutions, as climate risk assessment is not a compliance exercise, but rather a macroprudential tool that can help towards systemic stability. The study highlights the importance of effective and thorough enforcement measures to optimise the income stability benefits of climate policies (Alkatheeri et al., 2026 🔗).

2.5 Climate Services and Operational Risk Management

Climate services for institutional risk management has been a topic of growing interest. The application of climate services to enhance climate risk management for critical infrastructure (CI) in

Tanzania is illustrated by the case of the Kidatu Hydroelectric Power Plant (HHP) (Msoka & Pauline, 2025 ⛓). Due to the link between precipitation, water inflow and electricity production, the study identified the following climate risks that affect hydropower facilities: loss of production and damage to infrastructure from increased rainfall, long dry spells and extreme droughts as a result of climate change and variability.

One key finding was that co-production of climate services and continuous dialogue between stakeholders and experts is needed for effective climate risk management. Strong user interface platforms between weather services providers and infrastructure operators enable the efficient use of weather services and support the successful implementation of integrated water resources management (IWRM) (Msoka & Pauline, 2025 ⛓).

2.6 Banking Sector Climate Disclosure and Green Banking

The banking sector has come out as a leader in climate risk assessment, due to the regulatory requirements and the awareness of climate risk as a systemic risk. Zhu and Yu (2025 ⛓) examine the disclosure of climate risk stress tests in the Chinese banking sector and find that 66.67% of 42 Chinese A-share listed banks explicitly report on content related to climate risk stress testing in their environmental, social, and governance (ESG) reports. This practice has strengthened banks' ability to detect, understand and engage with climate risks, as well as increased the quality and depth of disclosure.

There are three important trends revealed in the research: First, convergence of the standards systems towards a "governance-strategy-risk management-metrics and targets" core framework.The research reveals three important trends: convergence of standards systems towards a "governance-strategy-risk management-metrics and targets" core framework.

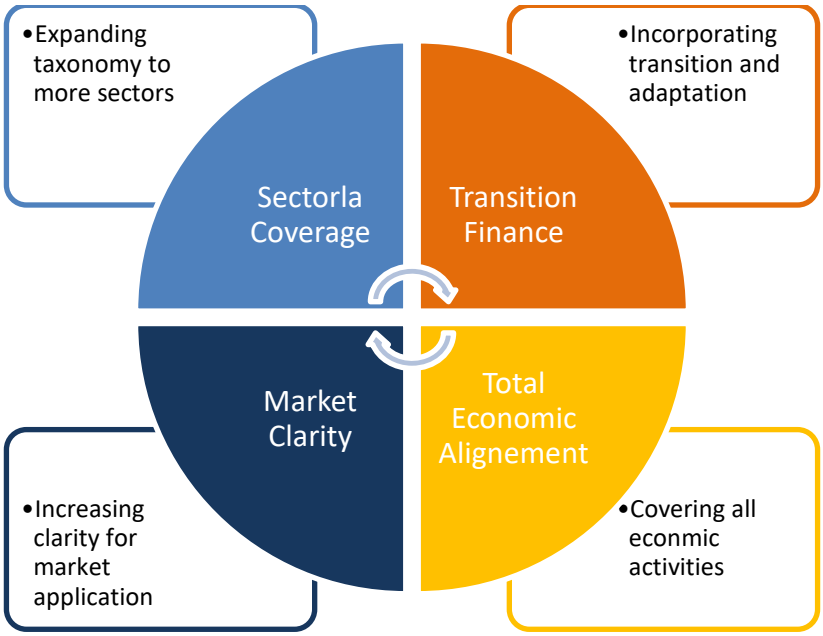
On 8th January 2026, the European Supervisory Authorities (2026 ⛓) published joint guidelines on ESG stress testing, providing a harmonised approach to incorporating ESG risks into stress-testing frameworks across the EU. The guidelines establish common expectations regarding the integration of environmental, social and governance (ESG) factors in the design, governance and methodologies of stress tests, effective from January 1, 2027. This regulatory development will bring consistency and harmonization across the EU thereby minimizing fragmentation and allowing for more comparable cross-border comparisons.

2.7 Sustainable Finance Taxonomies and Disclosure Guidelines

The way to climate aligned finance is to continue evolving. In January 22, 2026, the Hong Kong Monetary Authority (2026 ⛓) published Phase 2A of its Taxonomy for Sustainable Finance that incorporates more sectoral coverage and additional transition and climate adaptation elements. This helps to increase clarity for market application and to prepare for the increasing interest in transition and adaptation finance, which goes beyond "green" activities and covers the total range of economic activity that needs to be aligned to climate.

Figure 2. Core Components of Climate-Aligned Finance and Sustainable Taxonomy Development

The figure summarizes the major elements supporting climate-aligned finance, including sectoral coverage, transition finance, market transparency, and economy-wide alignment.



On the same day, the Shanghai, Shenzhen and Beijing Stock Exchanges released revised rules pertaining to sustainability reporting (Chinese Stock Exchanges, 2026). The updates feature the unification of calculation methods for environmental metrics and specification of expectations for environmental risk identification, which aims to make environmental metrics calculation methods more standardized, and to meet international standards while considering local requirements.

In addressing the complexity in Scope 3 Category 15 (financed emissions) disclosures, the ISSB has targeted amendments to IFRS S2, which offer financial institutions additional flexibility. The amendments allow for a variety of ways to disaggregate financed emissions, acknowledging the variety of business models and data availability in the financial sector, while still achieving the primary goal of transparency.

The CBAM came into effect on 1 January 2026, and will force customs offices to check CBAM authorisations, as well as having a direct influence on importers' supply chain decisions (European Commission, 2026). This new rule has introduced new compliance requirements for institutions involved in international trade.

2.8 The Adaptation Planning Framework: ISO 14092:2026

A key milestone in February 2026 was the publication of ISO 14092:2026, a comprehensive guide for local climate adaptation planning (International Organization for Standardization [ISO], 2026). The standard tackles what has been called the "adaptation gap," namely the ongoing mismatch between ambition and action for adaptation.

ISO 14092 offers a framework for a number of important aspects:

The governance system should define who decides on the management of the land and what happens if a decision is made that is detrimental to the soil.Governance should clearly define institutional responsibilities and decision-making processes, and what should be done if a decision is arrived at that damages the soil.

- Creating dedicated teams to facilitate adaptation processes (facilitation teams)
- Vulnerability and risk assessment: A process to systematically analyze local exposure to climate hazards

- The prioritization involves prioritizing risks and adaptation options according to urgency and cost-effectiveness.
- The implementation guidance helps to translate plans into concrete projects and investments.
- Monitoring and evaluation: Keep track of progress and make adjustments to plans as needs change.

Importantly, ISO 14092 is in the context of two other standards: ISO 14091 (Guidelines for Climate Risk and Vulnerability Assessments) and ISO 14093 (Mechanisms for channeling climate finance to subnational authorities through performance-based grants). These three standards, combined, provide what experts call a "governance-to-finance pipeline"—the process of conducting robust risk assessments, followed by responsible implementation, and then precise financing.

Table 1. Major Climate Risk Assessment Standards and Institutional Applications

Framework/Standard	Primary Focus	Main Users	Institutional Benefit
TCFD	Climate-related financial disclosure	Public and private organizations	Improved governance and transparency
IFRS S1	Sustainability-related disclosure	Private sector	Integration of sustainability into financial reporting
IFRS S2	Climate-related disclosure	Companies and financial institutions	Standardized climate reporting
IPSASB SRS 1	Public sector climate disclosure	Government institutions	Accountability and public transparency
ISO 14091	Climate risk and vulnerability assessment	Public and private organizations	Systematic climate risk identification
ISO 14092	Climate adaptation planning	Local governments and institutions	Adaptation planning and resilience
ISO 14093	Climate adaptation financing	Governments and funding agencies	Climate finance implementation

2.9 Climate Resilience and Sustainable Development Goals:

The topic of climate resilience is now being discussed in the context of the Sustainable Development Goals (SDGs), specifically SDG 13 (Climate Action). Studies conducted in the western Himalayas on climate-induced landscape change highlight the steps taken to build awareness and create early warning systems, but there are significant gaps in financial mechanisms, institutional capacity and community resilience (Kashyap & Kumar, 2026 🔗).

The study points to the fact that the current measures are still weak and insufficiently coordinated, with weak implementation due to limited resources. To improve resilience, it is crucial to create region-based plans that integrate indigenous knowledge with scientific approaches, bolster institutional support

and involve community members in the process (Kashyap & Kumar, 2026).

3. The advantages of Climate Risk Assessment

The objectives of the Climate Risk Assessment (CRA) have various benefits ranging from the strategic to the operational. This section discusses seven benefit categories, as identified by the preceding analysis.

The overarching objective of CRA is to identify and prepare for the risks. The simplest CRA benefit is the awareness of risk as the basis for preparation and CRA has already delivered such benefits as revealed in the hydropower example. Systematic assessment enabled the hydropower managers to learn about the statistical relationships between the precipitation, inflows and electricity production (Msoka & Pauline, 2025). The relationships are key to prioritizing investments and adaptation actions.

The ISO 14092 framework institutionalizes this benefit by obliging organizations to conduct a systematic assessment of vulnerabilities and risks (ISO, 2026). This helps to shift the organisations' preparedness paradigm from crisis management to risk reduction, as they assess the impacts of climate hazards (floods, heat waves, drought, coastal surges) on their personnel, assets, and systems in their operational environment and identify the most vulnerable ones.

Crucially, such risk identification processes raise awareness of what is known and what is not known about the threats facing the organization. The Climate Change Vulnerability Index methodology, which was used in Connecticut to systematically evaluate social, built and natural environments in the context of flooding and extreme heat, serves as an example of a systematic process that enables the organization to prioritize investments and interventions (O'Donnell et al., 2025). An organization can extend the scope of its vulnerability assessment beyond the built environment to include energy security using the Dominican Republic as an example (De-Jesús-Grullón et al., 2026).

3.1. Operational Resilience

Having identified the risks, the organization can build operational resilience by embedding adaptation into its operations and planning. The Kidatu hydropower case in Tanzania illustrates the benefits that electricity producers can accrue by systematically understanding the relationships between climate variables and electricity production and using such insights to design effective personnel interfaces with the meteorological services (Msoka & Pauline, 2025).

Systematic community-based interventions have also been demonstrated to bolster community resilience in an organised manner ($p<0.01$) by engaging the community in human-wildlife conflict resolution while simultaneously facilitating increased agricultural productivity with 70-80% of the households reporting higher agricultural productivity (Biswas et al., 2026) in the Sundarban delta in India after the intervention with nylon barriers. Cha et al. (2025) argue that such understanding of system interactions is critical for future preparedness and adaptation planning, especially for integrated infrastructure systems where energy and telecoms networks are dependent on electricity.

3.2. Financial Stability and Insurance

Markets and regulators are now recognizing the financial benefits of climate risk disclosure and adaptation. The IPSASB standard, for instance, reveals that climate change information is key to unlocking the capital markets to finance the additional costs that climate adaptation imposes (IPSASB, 2026). In other words, climate risk disclosure benefits organizations by enabling them to signal their creditworthiness and sound financial management to lenders and investors.

That is to say that organizations with good governance, mature financial markets, and stringent law enforcement are in a better position to benefit

from the financial stability advantages of climate risk disclosure.

Importantly, organizations that conduct a proper climate risk assessment can benefit from more attractive insurance terms since they can demonstrate to the underwriters that they are not as exposed as it may seem. For instance, the adoption of climate risk stress testing by China's formal banking system has already seen 66.67% of listed A-share banks report climate risk stress testing in their ESG reports (Zhu & Yu, 2025 🔗). Machine learning can help enhance the accuracy of systemic risk forecasts, giving financial institutions cutting-edge climate risk analysis tools. This benefit could be extended to all organizations as machine learning techniques can further improve the accuracy of systemic risk forecasts (Srour et al., 2025 🔗).

3.3. Regulatory Compliance

Climate risk assessment and disclosure regulations are proliferating, and organizations must comply to avoid penalties and negative publicity. The FCA's January 2026 consultation proposes that financial years beginning on or after 1 January 2027 will be subject to reporting against the UK SRS S2 (climate disclosures) for UK listed companies (FCA, 2026 🔗). Notably, Scope 3 emissions are "comply or explain" and will be effective from 2028 but climate risk disclosure is inevitable soon.

IPSASB SRS1 applies to public sector entities for reporting periods beginning on or after 1 January 2028 (IPSASB, 2026 🔗). This gives organizations time to invest in the data analytics, governance structures, and organisational capabilities needed to meet the requirements of the standard. The compliance costs may outweigh the benefits of avoiding penalties if the organization does not meet the requirements.

The new carbon border adjustment mechanism (CBAM) regulation in the European Commission directly affects importers and their supply chains (European Commission, 2026 🔗).

Table 2. Institutional Benefits of Climate Risk Assessment

Benefit Category	Institutional Outcome	Long-Term Value
Risk Identification	Early detection of vulnerabilities	Reduced climate losses
Operational Resilience	Improved infrastructure planning	Business continuity
Financial Stability	Better investment and insurance decisions	Reduced financial risks
Regulatory Compliance	Compliance with global standards	Lower legal exposure
Strategic Decision-Making	Better resource allocation	Sustainable growth
Stakeholder Trust	Improved transparency	Strong institutional reputation
Innovation	Adoption of new technologies	Competitive advantage

The European Supervisory Authorities joint guidelines on ESG stress testing (2026) set minimum requirements for ESG risks, particularly climate change, in the EU Stress Test Framework. This means that all banks in Europe will have to adapt to the requirements since they are binding, and effective from 1 st January 2027. They will have to use consistent methodologies when developing,

supervising, and embedding climate-related risks in stress tests.

3.4. Strategic Decision-Making

Besides compliance, climate risk assessment supports strategic decision-making processes. ISO 14092 recognizes the importance of prioritization in CRA: prioritizing adaptation options while considering climate risks in terms of urgency, cost-benefit, co-benefits, and other factors (ISO, 2026 ⛓). This way, organizations can use CRA to inform strategic planning.

Researchers in the Western Himalayas acknowledge the importance of understanding the region's climate-sensitive characteristics, including the likelihood of transitions, rapid glacial melt, and extreme weather events (Kashyap & Kumar, 2026 ⛓). These factors influence strategies related to large-scale infrastructure, early warning systems, and adaptation options at the community level.

When it comes to strategic-level advantages, studies on agricultural production in Southern Africa underscore the importance of understanding both immediate and long-term implications of climate change, as well as institutional capacity to address climate challenges (Semosa, 2025 ⛓). Researchers note that this knowledge helps create evidence-based strategies for national adaptation planning.

CEPR's framework for valuing nature conservation and climate policies in the face of climate change uncertainty enables organizations to operationalize strategic decision-making (CEPR, 2026 ⛓). Explicitly considering the hedging component of various policy options while assessing their ability to withstand fat-tailed risks allows organizations to rely on scientific evidence when making strategic projections. In particular, CEPR notes that policies that implicitly account for potential tipping points will be critical in strategic decision-making.

3.5. Stakeholder Trust and Reputation

Stakeholders are increasingly demanding that organizations demonstrate their awareness of potential climate risks. As such, companies that perform climate risk assessment can build credibility with stakeholders by showcasing their due diligence. For instance, FCA's proposals require disclosing whether an organization has received third-party assurance over sustainability-related information (FCA, 2026 ⛓). This way, companies can demonstrate credibility with investors who increasingly demand comprehensive risk assessments before considering sustainability-linked bonds. At the same time, UK SRS's draft requirements concern the need to disclose whether transition plans have been published and, if not, the reasons why.

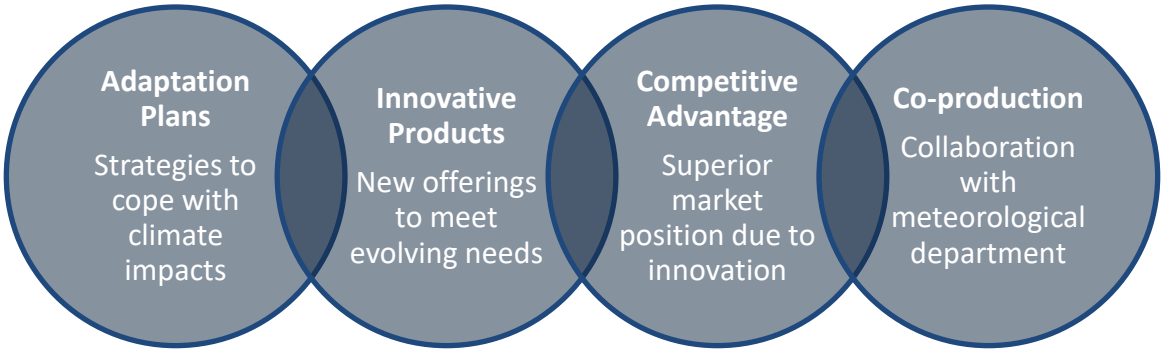
Recent studies highlight the importance of climate risk assessments done in alignment with local community values. For instance, HKMA's sustainable finance taxonomy promotes consistency among market participants and facilitates the transition to sustainable finance (HKMA, 2026 ⛓). In particular, it enables clarity on what sustainable finance transition, adaptation, and mitigation strategies and technologies qualify for enhanced supervision or support. As such, organizations using this taxonomy can demonstrate increased accountability to stakeholders while building awareness of their sustainable finance-related activities.

3.6. Innovation and Competitive Edge

The most advanced organizations understand that climate risk assessment can be the driving force behind innovation and competitive advantage. In particular, climate risk assessment enables the creation of adaptation plans that, in turn, facilitate the introduction of innovative products and services.

Figure 3. Innovation Pathways Enabled by Climate Risk Assessment

The figure illustrates how climate risk assessment promotes institutional innovation through adaptation planning, development of innovative products and services, competitive advantage, and collaborative knowledge co-production.



Studies on climate services note that engaging in co-production of climate services with meteorological departments can enable organizations to introduce innovative services, particularly in the field of climate risk management (Msoka & Pauline, 2025 🔗). The benefits of such services go beyond climate risk management, as they also provide general insurance and increase organizational resilience. IMDA Singapore's Digital Technologies for Sustainability Playbook (2026) offers practical guidance on how digital sustainability can aid in various operations, from procurement to operations. As such, organizations can benefit from adopting digital tools early and often to gain a competitive advantage over less technology-savvy counterparts.

As stakeholders begin to demand more from organizations, those that have performed climate risk assessment will be in a better position to comply with ESG-related regulations while also leveraging various opportunities available to sustainable businesses. In particular, organizations utilizing advanced methods, such as machine learning to inform climate risk assessment and systemic risk forecasting (Srour et al., 2025 🔗), or those that employ enhanced decision-making frameworks, such as CEPR's report on unified cost-benefit analysis of climate policies (CEPR, 2026 🔗), will be best prepared to meet the demands of stakeholders, investors, and regulators.

4. CASE STUDIES

4.1 Utilities: Kidatu Hydropower Plant (Tanzania)

Researchers conducted a qualitative study to assess climate risk at Kidatu Hydroelectric Power Plant, which feeds roughly 50% of Tanzania's hydropower electricity (Msoka & Pauline, 2025 🔗). In particular, they interviewed 17 semi-structured and open-ended questions with expert staff from the hydropower plant and the Tanzania Meteorological Authority (TMA). The study also involved document analysis.

Table 3. Climate Risks, Institutional Impacts, and Response Strategies

Climate Risk	Institutional Impact	Response Strategy
Flooding	Infrastructure damage	Flood-resilient infrastructure
Heatwaves	Reduced workforce productivity	Heat adaptation plans
Drought	Water shortages	Water resource management
Extreme storms	Service disruption	Emergency preparedness
Policy changes	Compliance costs	Climate governance frameworks
Carbon pricing	Increased operational costs	Low-carbon transition planning
Supply chain disruption	Production delays	Supplier diversification

The study revealed that the hydropower plant was vulnerable to reduced hydropower generation and infrastructure damage due to high-intensity rainfall, prolonged droughts, and extreme climate events exacerbated by climate change and variability. The researchers also note that the utility did not engage with or utilize customized climate services provided by the TMA, even though the TMA can provide these services upon request.

The study recommended a number of specific actions, including the following:

- Co-production of climate services: continuous interaction between stakeholders and experts to co-develop customized climate services;
- User interface: collaboration between the TMA and hydropower plants to ensure appropriate end-user interfaces;
- Integrated water resources management: enhanced integration of water resources management, specifically in the Rufiji River Basin;
- Quantitative assessment: quantitative assessment of climate risks and the potential for additional case studies;

While this study focused on one hydropower plant in Tanzania, the findings and recommendations can be generalized to the utilities sector, particularly the need to establish user-interface centers that will enable collaboration with meteorological departments to co-produce climate services that address the needs of individual utilities (Msoka & Pauline, 2025 🔗).

4.2 Regional Government: Connecticut Climate Change Vulnerability Index (United States)

Researchers at the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) have developed a Climate Change Vulnerability Index (CCVI), which aims to combine climate exposure, including flood and extreme heat, with social, infrastructure, and ecological variables to create a unified vulnerability index (O'Donnell et al., 2025 🔗). This index was designed using the IPCC vulnerability framework, which conceptualizes vulnerability as the combination of exposure, sensitivity, and adaptive capacity, and went through a number of iterations. The first version of the CCVI tool was tested in New Haven and Fairfield counties and included social vulnerability indicators, as well as indicators related to infrastructure and the environment for 51 local governmental units. The 2.0 version was applied across Connecticut and included feedback from stakeholders to customize the tool for municipal planners, engineers, decision-makers, and the general public.

The study revealed a number of benefits for the stakeholders who participated in the creation of the tool, including the following:

- Prioritization: identification of areas of priority need based on vulnerability to climate change impacts;
- Resiliency projects: selection of appropriate resiliency projects;
- Open-source portal: an open-source portal that can be used to support various decision-making processes at the municipal level;

The researchers note that vulnerability indices enable stakeholders to understand the implications of climate change, guide adaptation planning, and ensure that the unique environmental and social features of the region are accounted for (O'Donnell et al., 2025 🔗).

4.3 Research Institutions: Sundarban Human-Wildlife Conflict Mitigation (India)

Research examining nylon barrier effectiveness against tiger incursions in the Sundarban Tiger Reserve demonstrate how academic institutions serve as climate risk assessment pioneers while informing community-level understanding of vulnerability (Biswas et al., 2026 🔗)

Using a mixed-method approach, the researchers applied questionnaire surveys (targeting 1040 respondent households from 40 JFMCs involved in conflict, and 32 Forest Department staff), semi-structured interviews with Forest Department and community representatives, and secondary data analysis on human-wildlife conflict cases. Geographical Information Systems analyses and statistical assessments (chi-square tests, Mann-Whitney U tests, correlation analyses) were applied to identify relationships between fence construction, maintenance, community engagement, and human-tiger conflict outcomes.

The study found that

- the number of wildlife intrusions was significantly reduced after the fence construction with almost 98% reduction in tiger incursions in 5-years in several conflict-affected villages,
- community involvement in monitoring reduced human-wildlife conflict ($p<0.01$),
- 70-80% of respondents indicated improvement in agricultural production
- And nylon netting reduced the likelihood of zoonotic disease transmission by minimizing contact between wildlife, livestock, and humans.

The study makes several recommendations, including the need for

- local administrative support and involvement in community-based monitoring and maintenance activities
- national-level inclusion of community participation in conservation financing design
- Community mobilization and engagement.

This case illustrates how research institutes serve as pioneers of climate risk assessment while generating community-level insights into vulnerability (Biswas et al., 2026 🔗).

4.4 Financial Sector: Chinese Banking Climate Disclosure

An assessment of climate information disclosure practices in the Chinese banking sector highlight how financial institutions leverage climate risk assessment to strengthen their operations (Zhu & Yu, 2025 🔗).

The researchers identified domestic and international climate disclosure rules and regulations and evaluated climate risk disclosure practices of China's 4 big state-owned commercial banks and several regional banks using the ISSB's four pillar approach in their ESG reports of 2024. The study found that 66.67% of China's 42 A-share listed banks explicitly disclosed climate risk stress-test content in their ESG reports. Using the IFRS S2 climate disclosure standards as a benchmark, the study identifies "Policy convergence, practice differentiation" climate disclosure patterns, with Chinese banks generally embedding climate into governance,

strategy, and risk management, but substantial variation in disclosure of climate-related metrics (with the notable exception of greenhouse gas emissions).

The study also finds that

While some banks have established climate risk indicators and targets and disclose scope 1, 2, and 3 greenhouse gas emissions, several smaller banks have yet to address any of the climate risk indicator domains, reflecting limitations in data availability and carbon accounting capabilities.

The study recommends

- alignment with international disclosure standards (IFRS S2) and domestic climate risk disclosure rules and regulations to standardize the structure and content of climate-related disclosures
- deepening of technical pathways and methodologies for climate risk stress testing, including the use of international scenarios (NGFS, IPCC, IEA), as well as endogenous scenarios that consider the bank's business model and geographical location
- And building of quantitative capabilities, including extensive use of value chain analysis for scope 3 accounting, third-party data and analytics, industry GHG emission factors, and modelling tools.

This case highlights how the financial sector transforms climate risk assessment into an operational advantage (Zhu & Yu, 2025 🔗).

Setyorini and Hakam (2025 🔗) conduct a similar examination of green banking practices in the Indonesian financial sector, finding that green financing serves as a mediator between green banking practice and environmental performance. Notably, their youth perception study indicates that the younger generation plays a critical role in supporting and executing green initiatives, presenting opportunities for workforce development and capacity building. Abbas and Shahwan (2025 🔗) examine country risk and banking stability in the MENA region, identifying political risk as the most influential factor on banking stability. This has implications for how climate risk assessment incorporates political and geopolitical considerations, particularly in fragile institutional environments.

4.5 National Government: UAE Adaptation Financing Capacity Assessment

The UAE Adaptation Financing Capacity Assessment, initiated in January 2026 in partnership with the Global Green Growth Institute, represents national government-level climate risk assessment that informs institutional action (Economy Middle East, 2026 [Link unavailable]).

The assessment works to identify the UAE's readiness to mobilize, allocate, and utilize adaptation finance, targeting six areas, and revealing strengths, weaknesses, and opportunities.

The assessment will inform the UAE's National Adaptation Plan, ensuring the country's climate adaptation goals are "embedded into concrete, financed actions." This case therefore demonstrates how national government takes action based on climate risk assessment findings.

5. DISCUSSION

5.1 Persistent Implementation Gaps

While the cases above demonstrate the value of climate risk assessment, it is evident that institutions face several persistent implementation challenges that hinder effective assessment.

First, data availability and quality present a major limitation, with the Connecticut CCVI development highlighting the need for enhanced knowledge and in-depth analysis to fully understand the exposure, sensitivity, and adaptive capacity to climate change, which can be "time consuming and often overwhelming for many jurisdictions at the regional levels" (O'Donnell et al., 2025 🔗). Relatedly, the banking sector analysis finds that while the IFRS S2 disclosure standard requires banks to disclose scope 3 emissions, this poses technical challenges due to

data availability and the complexity of value chain emissions (Zhu & Yu, 2025 ⛓). Therefore, in addition to climate risk vulnerability assessments, institutions must invest in capacity augmentation to address these data challenges. Pollack et al. (2026 ⛓) note that less than 5% of the most influential climate risk studies make their data and code publicly available, undermining the credibility of the various climate models used in institutional decision-making.

Second, the cost and capacity constraints associated with climate risk assessment present major limitations, particularly for smaller institutions and those in the global south. Kashyap & Kumar (2026 ⛓) examine adaptation financing options in the Western Himalayas and find that "gaps within financial mechanisms, institutional capacity and community resilience present persistent impediments to effective response." With the effective date of the IPSASB standard set for 2028, institutions have a narrow window to build the necessary capacities to meet the disclosure requirements.

Third, the fragmentation of institutional mandates undermines effective climate risk assessment and response. The Sundarban research highlights the need for integrated conservation, community development, and agricultural extension services if forest conservation and community livelihoods are to be achieved (Biswas et al., 2026 ⛓). Similarly, Cha et al. (2025 ⛓) find that cascading impact analyses on Critical National Infrastructure reveal the extent to which disruptions in electricity and telecommunications have cascading effects on other critical infrastructure, necessitating a more coordinated approach to climate risk management. In other words, climate change impacts cut across sectors and require integrated policy responses.

Finally, the uncertainty associated with climate change projections adds another layer of complexity that undermines institutional assessment and response efforts. According to the Kidatu Hydropower Station in Tanzania study, effective climate risk management requires "further research on quantifying climate risks and engaging more case studies before generating conclusive results on the financial risks posed by climate change" (Msoka & Pauline, 2025 ⛓).

5.2 Integration Opportunities

The various implementation challenges described above present opportunities for institutions to integrate climate risk assessment into their operations, including

Table 4. Challenges and Recommended Institutional Responses for Climate Risk Assessment

Challenge	Effect on Institutions	Recommended Response
Limited climate data	Weak risk analysis	Improve data collection systems
High implementation cost	Delayed adoption	Phased implementation strategy
Lack of technical expertise	Poor assessment quality	Staff training and partnerships
Fragmented governance	Inefficient coordination	Establish climate governance committees
Regulatory complexity	Compliance uncertainty	Adopt internationally recognized standards
Climate uncertainty	Difficult long-term planning	Scenario analysis and continuous monitoring

Limited stakeholder engagement	Reduced effectiveness	Inclusive participation and communication

Leveraging the standards ecosystem

ISO 14090,14091-14092-14093 provide a framework and guidance on climate risk assessment, informing financed implementation. The Connecticut CCVI is a good example of how institutions can apply the standards in practice, including engaging stakeholders in the development of the needs assessments to enhance relevance and applicability at the municipal level (O'Donnell et al., 2025 🔗). This case therefore presents opportunities for leveraging the standards ecosystem, including adopting innovative approaches, such as those used by De-Jesús-Grullón et al. (2026 🔗) to integrate energy reliability into the vulnerability assessment framework.

Embedding adaptation into disclosure

Several disclosure frameworks now require organizations to go beyond simply disclosing climate risks and impacts to describing the climate-related adaptations underway or planned. For instance, the FCA's proposed rules on climate-related disclosures require companies to disclose whether they have published transition plans (FCA, 2026 🔗). Similarly, the ISSB's targeted amendments to IFRS S2 on climate-related disclosures provide much-needed guidance on disclosing financed emissions for financial institutions grappling with the implications of transition (ISSB, 2025 [Link unavailable]). Therefore, organizations can capitalize on the emerging regulatory environment by embedding climate risk assessment and adaptation planning into their disclosure practices, deriving benefits from the increased transparency and the business advantages that come with it.

Building partnerships

Partnerships are critical to effective climate risk assessment and response, as demonstrated by the Sundarban tiger conservation case, where community engagement and collaboration between conservation, agriculture, and extension departments are critical to achieving positive outcomes (Biswas et al., 2026 🔗). Similarly, the Kidatu Hydropower Station case highlights the importance of research institutions, meteorological services, and utility companies coming together to assess and respond to climate risks (Msoka & Pauline, 2025 🔗).

Accessing climate finance

Climate finance presents another opportunity for institutions to benefit from effective climate risk assessment and response. For instance, ISO 14093 contains guidance on performance-based climate resilience grants that can be accessed by organizations that demonstrate superior climate risk assessment and adaptation planning. The research on climate laws highlights the financial benefits of effective climate governance, including enhanced financial stability, which could attract financiers to institutions that demonstrate superior compliance with climate regulations (Alkatheeri et al., 2026 🔗). Additionally, the Hong Kong Monetary Authority's sustainable finance taxonomy can be leveraged to access transition and adaptation financing.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Summary of Benefits

Climate risk assessment offers benefits of various kinds and on different levels, extending far beyond the mere fulfillment of regulatory obligations. As discussed in this article, its advantages can be grouped into seven broad categories:

1. Exposure, sensitivity, and adaptive capacity: turning vague worries into specific actions through risk identification and targeted risk reduction measures (O'Donnell et al., 2025 🔗; ISO, 2026 🔗;

De-Jesús-Grullón et al., 2026 🔗)

2. Operational resilience: making adaptation planning and stakeholder engagement central pillars of organizational resilience to climate change (Msoka & Pauline, 2025 🔗; Cha et al., 2025 🔗)

3. Financial: securing access to capital, systemic risk reduction, and fair risk pricing (Alkatheeri et al., 2026 🔗; IPSASB, 2026 🔗; Srour et al., 2025 🔗; Leone et al., 2025 🔗)

4. Regulatory: meeting the expectations of regulators across jurisdictions that are standardizing disclosure requirements (FCA, 2026 🔗; IFRS, 2023 🔗; IPSASB, 2026 🔗; European Supervisory Authorities, 2026 🔗)

5. Strategic: supporting strategic decision-making with prioritized action domains (ISO, 2026 🔗; Kashyap & Kumar, 2026 🔗; CEPR, 2026 🔗)

6. Reputation: satisfying stakeholders' rising appetite for disclosure while enhancing the organization's own reputation as a responsible actor (Biswas et al., 2026 🔗; Zhu & Yu, 2025 🔗; HKMA, 2026 🔗)

7. Innovation: stimulating the development and introduction of new products and services through co-production of climate insights and advanced risk analytics (Msoka & Pauline, 2025 🔗; Zhu & Yu, 2025 🔗; Setyorini & Hakam, 2025 🔗; IMDA, 2026 🔗)

The confluence of disclosure-related standards, represented by IPSASB SRS 1 (IPSASB, 2026 🔗) for the public sector and ISSB S1/S2 (IFRS, 2023 🔗) for the private business, as well as the adaptation-related standard ISO 14092 (ISO, 2026 🔗), creates a unique opportunity for organizations to design comprehensive CRA-related frameworks. These frameworks will capitalize on methodological innovations, including machine learning-enabled risk modeling (Srour et al., 2025 🔗) and the systemic integration of energy reliability into vulnerability assessments (De-Jesús-Grullón et al., 2026 🔗).

6.2 RECOMMENDATIONS

With this conclusion in mind, any organization that wishes to design its own approach to climate risk assessment – at any level of preparedness and sophistication – should consider the following recommendations:

For organizations that are just embarking on their CRA journeys:

1. Start with governance: establish institutional competence in climate risk governance, for instance, by referring to the ISO 14092 guidelines (ISO, 2026 🔗). Studies show that governance quality acts as a critical mediator in climate vulnerability reduction (Semosa, 2025 🔗; Abbas & Shahwan, 2025 🔗).

2. Conduct a vulnerability assessment: use the IPCC framework and similar tools to define the organization's exposure to climate-related hazards and identify knowledge action domains (O'Donnell et al., 2025 🔗). The Connecticut CCVI framework is a useful example of a comprehensive approach that considers social, infrastructural, and natural vulnerabilities. Other researchers suggest integrating factors relating to energy reliability into similar frameworks (De-Jesús-Grullón et al., 2026 🔗).

3. Obtain and analyze climate-related information: consult relevant meteorological departments and climate service providers, engage stakeholders through user interface design, and consider adopting digital solutions to support sustainability reporting and management, as proposed by IMDA Singapore (2026 🔗).

4. Plan your disclosures: make use of the transition relief opportunities, such as the extended transition periods for scope 3 emissions reporting (ISSB Category 15) or the delayed reporting of difficult-to-measure Scope 3 emissions until 2028 (Zhu & Yu, 2025 🔗; ISSB, 2025 [Link unavailable]).

For organizations that have already designed a robust approach to CRA:

1. Connect adaptation planning and disclosure-related activities: recognize that the regulators are moving toward requiring disclosure of adaptation-

related investments and performance, and respond by designing appropriate adaptation planning protocols (FCA, 2026 ⛓; IFRS, 2023 ⛓). Consider applying the taxonomy-savvy disclosure approaches, such as those suggested by HKMA (2026 ⛓).

2. Embed climate risk governance in organizational governance: align your adaptation plans with the relevant ISO standards, specifically 14091-14092-14093, to be able to benefit from the confluence of climate risk-related financial markets (ISO, 2026 ⛓). Design localized climate stress-testing scenarios that take into account your organizational peculiarities and the relevant jurisdiction-specific factors, combining local insights with international scenarios pioneered by the NGFS, IPCC, IEA, and others (Zhu & Yu, 2025 ⛓; European Supervisory Authorities, 2026 ⛓).

3. Collaborate: cooperate with other organizations, government entities, and third parties, and consider multi-jurisdictional collaborations, as exemplified by the research conducted in the Sundarban region (Biswas et al., 2026 ⛓).

4. Analyze new methods: develop your capabilities in innovative fields, such as machine learning-enabled risk modeling (Srour et al., 2025 ⛓) and advanced analytical approaches to "climate policy evaluation" pioneered by CEPR (2026 ⛓). Such disruptive insights can become a significant competitive advantage.

For all organizations, regardless of their readiness and capability levels:

1. Think strategically: conduct CRA-related research as an enabler of institutional strategy rather than a stand-alone exercise. Climate laws are now recognized as macroprudential tools, and their strategic role is increasingly hard to ignore (Alkatheeri et al., 2026 ⛓). Green financing plays a critical mediatory role between green banking and institutional performance (Setyorini & Hakam, 2025 ⛓).

2. Be inclusive: involve stakeholders into the process of climate risk assessment, as their involvement often transforms abstract insights into impactful actions (Biswas et al., 2026 ⛓; O'Donnell et al., 2025 ⛓). Consider designing co-production of climate insights and related services, as suggested by Msoka & Pauline (2025 ⛓).

3. Adapt: keep in mind that climate change and institutional capabilities are both dynamic, and update risk management strategies accordingly (ISO, 2026 ⛓; Kashyap & Kumar, 2026 ⛓). The changing nature of infrastructure-related risks is specifically highlighted by Cha et al. (2025 ⛓).

4. Fill the gaps: acknowledge the importance of addressing the knowledge-related gaps, as they represent significant hindrances to effective risk management (O'Donnell et al., 2025 ⛓; Zhu & Yu, 2025 ⛓). Pollack et al. (2026 ⛓) provide an in-depth discussion of the challenges related to transparency in climate risk research.

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