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Research Article

CLIMATE RISK AND FINANCIAL STABILITY: BUILDING RESILIENT FINANCIAL SYSTEMS IN THE FACE OF GLOBAL WARMING

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Abstract
Climate change has emerged as a systemic risk with profound implications for global financial stability, affecting asset valuations, credit markets, insurance systems, and macroeconomic resilience. Increasing frequency and severity of climate-related shocks expose financial institutions to physical risks, transition risks, and liability risks that challenge the robustness of existing financial frameworks. This study aims to examine how climate risk interacts with financial stability and to identify strategic approaches for building resilient financial systems in the context of global warming. The research adopts a qualitative analytical design based on an extensive review of secondary data, including peer-reviewed journal articles, policy reports, and regulatory frameworks issued by central banks and international financial institutions. The findings reveal that climate risk amplifies traditional financial vulnerabilities through channels such as asset stranding, credit reallocation, and systemic contagion, while also exposing gaps in risk assessment, disclosure practices, and prudential regulation. Evidence indicates that proactive integration of climate risk into financial supervision, stress testing, and capital allocation enhances systemic resilience and reduces long-term instability. The study concludes that strengthening climate-related financial governance, improving data transparency, and aligning financial incentives with climate objectives are critical for safeguarding financial stability.

Keywords: Climate Risk, Financial Stability, Global Warming

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INTRODUCTION

Climate change has increasingly been recognized not only as an environmental concern but also as a fundamental threat to the stability of global financial systems. Rising global temperatures, extreme weather events, and long-term ecological degradation generate systemic risks that directly affect financial markets, banking institutions, insurance sectors, and public finance. These climate-induced disruptions alter asset valuations, damage physical infrastructure, and undermine economic productivity, thereby creating new forms of financial vulnerability that extend beyond traditional risk categories (Q. Liu, 2026; Petagna, 2026).

Financial systems have historically been designed to manage cyclical economic shocks, credit risk, and market volatility, yet they remain structurally ill-equipped to absorb climate-related risks that are nonlinear, cumulative, and globally interconnected. Physical risks such as floods, droughts, and hurricanes increasingly translate into credit defaults and insurance losses, while transition risks arising from climate policies and technological shifts threaten the viability of carbon-intensive assets. These dynamics place unprecedented pressure on financial stability frameworks that were developed under assumptions of environmental continuity (Carrera, 2025; Nguyen, 2025).

Growing awareness among central banks, financial regulators, and international institutions has elevated climate risk to the level of macro-financial concern. Initiatives such as climate stress testing, sustainability disclosures, and green financial instruments reflect an emerging consensus that financial resilience must be redefined in the context of global warming. This evolving landscape necessitates a systematic examination of how climate risk reshapes financial stability and how resilient financial systems can be constructed under conditions of environmental uncertainty (Khorbaladze, 2025; Lucey, 2025).

Despite mounting evidence that climate change poses material risks to financial systems, the integration of climate risk into financial stability analysis remains fragmented and inconsistent. Many financial institutions continue to treat climate-related risks as peripheral or long-term concerns, rather than as immediate threats to balance sheets, liquidity, and systemic integrity. This disconnect creates blind spots in risk assessment and weakens the capacity of financial systems to anticipate and absorb climate shocks (Ayompe, 2025; Singh, 2026).

Regulatory responses to climate risk vary significantly across jurisdictions, resulting in uneven implementation of disclosure standards, stress-testing methodologies, and prudential requirements. While some central banks have incorporated climate scenarios into supervisory frameworks, others lack institutional mandates or technical capacity to do so effectively. This regulatory asymmetry undermines coordinated global responses and increases the likelihood of cross-border financial contagion triggered by climate-related events (Z. Liu, 2025; Wang, 2025a).

Conceptual ambiguity further complicates the problem, as climate risk is often conflated with environmental responsibility rather than treated as a core determinant of financial stability. The absence of unified analytical frameworks makes it difficult to assess transmission channels between climate phenomena and systemic financial risk. This conceptual gap limits the effectiveness of policy interventions and constrains the development of resilient financial architectures capable of withstanding climate-driven disruptions (Huang, 2025; Wang, 2025b).

This study seeks to analyze the relationship between climate risk and financial stability by examining the mechanisms through which global warming affects financial systems at both institutional and systemic levels. The research aims to clarify how physical and transition risks

propagate through credit markets, capital allocation, and financial intermediation processes, thereby influencing overall financial resilience (Lapin, 2025; Ranger, 2025).

Another objective of this research is to evaluate existing financial stability frameworks and assess their capacity to internalize climate-related risks. The study investigates the role of regulatory tools, disclosure practices, and supervisory mechanisms in strengthening financial system preparedness. Attention is given to how climate risk assessment can be embedded within macroprudential and microprudential policies (Deku, 2025; Pellegrini, 2026).

The research also aims to propose strategic pathways for building resilient financial systems that align financial stability objectives with climate adaptation and mitigation goals. By synthesizing insights from policy reports, academic literature, and regulatory practices, the study seeks to contribute actionable knowledge for policymakers, regulators, and financial institutions navigating the challenges of global warming (Javed, 2026; Omeir, 2025).

Existing literature on climate finance has predominantly focused on sustainable investment, green finance instruments, and ESG integration, often emphasizing capital mobilization for environmental goals. While these studies offer valuable insights, they frequently overlook the systemic implications of climate risk for financial stability. As a result, climate change is often framed as an opportunity for innovation rather than as a destabilizing force within financial systems (Luo, 2025; Zheng, 2026).

Research on financial stability, on the other hand, has traditionally concentrated on banking crises, monetary shocks, and macroeconomic imbalances, with limited engagement with environmental risk factors. Climate variables are rarely incorporated into mainstream financial risk models, creating a conceptual divide between environmental economics and financial stability analysis. This separation restricts comprehensive understanding of how climate shocks interact with existing financial vulnerabilities (Z. Hu, 2025; Sánchez-García, 2025).

Limited empirical and conceptual work has addressed the integration of climate risk into prudential regulation and systemic risk assessment. Current studies often remain sector-specific or regionally confined, lacking a holistic framework that connects climate dynamics with financial system resilience. This research gap underscores the need for integrative analyses that bridge climate science, financial economics, and regulatory policy (Khan, 2025; Mallea, 2026).

The novelty of this study lies in its explicit framing of climate risk as a core determinant of financial stability rather than as a peripheral sustainability concern. By repositioning climate risk within the architecture of systemic financial analysis, the research advances a conceptual shift that aligns environmental realities with financial governance. This perspective contributes to a more robust understanding of resilience in the era of global warming (Chen, 2025; Khemiri, 2025).

The study offers methodological novelty through its integrative analytical approach, combining macro-financial perspectives with climate risk transmission analysis. Rather than focusing solely on investment instruments or disclosure mechanisms, the research examines structural interactions between climate phenomena and financial system stability. This approach enables a more comprehensive assessment of vulnerability and resilience across financial sectors.

The justification for this research is grounded in its relevance to global policy agendas and financial governance reforms. As climate change accelerates, financial systems face escalating risks that demand proactive and coordinated responses. By addressing conceptual

gaps and providing a resilience-oriented framework, this study supports evidence-based policymaking and contributes to the advancement of climate-aware financial stability discourse (An, 2025; Ben-Ammar, 2025).

RESEARCH METHOD

This study employs a qualitative analytical research design grounded in systematic literature review and policy analysis to examine the relationship between climate risk and financial stability. The design is suitable for capturing the complexity of climate-related financial risks, which are multidimensional, systemic, and context-dependent. An interpretive approach is adopted to synthesize theoretical perspectives, regulatory frameworks, and empirical evidence, enabling a comprehensive understanding of how climate risk is conceptualized, transmitted, and managed within financial systems (Shirai, 2026; Xu, 2025).

Research Design

The population of this study consists of global financial stability discourses related to climate risk, as reflected in academic publications, regulatory documents, and institutional reports. The sample includes peer-reviewed journal articles, central bank reports, publications from international financial institutions, and policy briefs published between 2015 and 2024. Sampling is conducted using purposive criteria to ensure relevance, credibility, and representation of diverse geographic and institutional contexts, with particular attention to sources addressing climate risk transmission, macroprudential regulation, and financial system resilience (Opuni-Frimpong, 2025; Umar, 2025).

Research Procedure

The primary research instrument is a structured document analysis protocol designed to extract and categorize information related to climate risk typologies, financial stability indicators, regulatory responses, and resilience mechanisms. Analytical matrices are used to map relationships between climate-related risks and financial system components, while thematic coding supports the identification of recurring patterns, policy gaps, and conceptual frameworks. These instruments facilitate consistency and rigor in synthesizing qualitative evidence across heterogeneous sources (Dell'Atti, 2025; L. Hu, 2025).

Instruments, and Data Collection Techniques

Data collection in this study is carried out through a structured and systematic search of academic databases, complemented by the targeted acquisition of relevant institutional publications. This process is followed by a rigorous screening stage and eligibility evaluation based on clearly defined inclusion criteria to ensure the relevance and quality of the selected sources. Through this approach, only materials that align with the research objectives and demonstrate sufficient methodological rigor are retained for further examination.

The selected documents are then examined using an iterative process involving repeated reading, coding, and thematic synthesis to uncover key patterns, emerging challenges, and regulatory responses. The insights generated from this analysis are subsequently integrated into a conceptual framework that illustrates the relationship between climate risk and financial stability. This framework also outlines how resilient financial systems can be developed to effectively respond to the pressures of global warming.

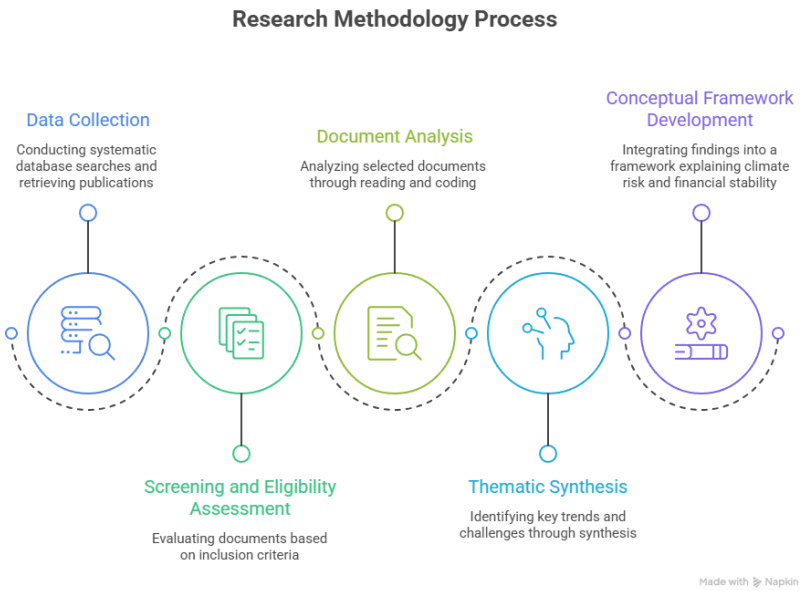

Figure 1. Research Methodology Process

The data collection process is carried out through a structured and systematic search of academic databases, complemented by the targeted retrieval of relevant institutional publications. This approach ensures that both scholarly and policy-oriented sources are adequately represented in the dataset. After gathering the initial pool of documents, a rigorous screening procedure is implemented to filter out irrelevant or low-quality materials. Each source is then evaluated against clearly defined inclusion criteria, such as relevance to the research topic, methodological soundness, and the presence of empirical or policy-based insights. This step-by-step selection process enhances the credibility and reliability of the collected data while ensuring that only the most pertinent documents are retained for further analysis. As a result, the dataset reflects a balanced and comprehensive collection of sources that are aligned with the study's objectives.

Following the selection stage, the chosen documents undergo an in-depth analytical process involving iterative reading and systematic coding. Researchers repeatedly examine the texts to gain a deeper understanding of the underlying arguments, evidence, and conceptual linkages presented in each source. Through this process, meaningful patterns and recurring themes begin to emerge, allowing for the identification of key issues, challenges, and policy responses discussed across the literature. The coding procedure helps organize the data into coherent categories, making it easier to compare findings from different sources. This thematic synthesis not only highlights areas of consensus but also reveals gaps and inconsistencies within the existing body of knowledge. Consequently, the analysis provides a nuanced and well-structured understanding of the subject under investigation.

Data Analysis Technique

The data stage involves integrating the analytical insights into a comprehensive conceptual framework that captures the relationship between climate risk and financial stability. This framework is designed to explain how environmental risks, particularly those associated with global warming, can disrupt financial systems and economic resilience. By synthesizing the identified themes and patterns, the framework illustrates the mechanisms

through which climate-related shocks influence financial performance, risk exposure, and institutional responses. Furthermore, it outlines strategies and policy considerations for building more resilient financial systems capable of adapting to climate-related uncertainties. In doing so, the study offers a holistic perspective that connects empirical findings with theoretical interpretation, ultimately contributing to a deeper understanding of sustainable financial governance in the era of climate change.

RESULTS AND DISCUSSION

The dataset analyzed in this study is derived from secondary statistical sources published between 2015 and 2024, including reports from central banks, international financial institutions, climate risk databases, and peer-reviewed academic studies. Quantitative indicators include frequency of climate-related financial losses, exposure of financial assets to physical and transition risks, carbon intensity of financial portfolios, and adoption rates of climate stress testing across jurisdictions. Table 1 presents a consolidated overview of key climate risk indicators and their relevance to financial stability assessment. Table 1. Summary of Climate Risk Indicators and Financial Stability Implications (2015–2024) illustrates rising insured and uninsured losses from extreme weather events, increasing stranded asset exposure in carbon-intensive sectors, and gradual expansion of climate risk integration within supervisory frameworks.

Table 1. Overview of Climate Risk Indicators and Their Implications for Financial Stability (2015–2024)

Climate Risk Indicator	Observed Trend (2015-2024)	Implication for Financial Stability
Climate-Related Financial Losses	Increasing frequency and magnitude	Greater volatility and rising insurance gaps
Exposure to Physical and Transition Risks	Expanding across sectors and asset classes	Heightened systemic risk and asset vulnerability
Carbon Intensity of Financial Portfolios	Gradual decline but still relatively high	Ongoing transition risk and regulatory pressure
Adoption of Climate Stress Testing	Steady increase across jurisdictions	Improved risk assessment and supervisory resilience
Stranded Asset Exposure	Rising in carbon-intensive industries	Potential asset devaluation and financial instability

Table 1 provides a synthesized overview of key climate risk indicators and their implications for financial stability over the period 2015–2024. The data reveal a consistent increase in both insured and uninsured losses resulting from extreme weather events, indicating growing financial exposure to climate-related shocks. At the same time, financial institutions face heightened risks due to expanding exposure to both physical and transition risks, particularly in carbon-intensive sectors where stranded asset concerns are becoming more pronounced. Although there has been a gradual reduction in the carbon intensity of financial portfolios, the pace of change remains insufficient to fully mitigate transition risks. On a more positive note, the adoption of climate stress testing frameworks has steadily increased across jurisdictions, reflecting stronger regulatory awareness and efforts to enhance financial system resilience. Overall, these trends highlight the escalating importance of integrating climate risk considerations into financial stability assessments and policy frameworks.

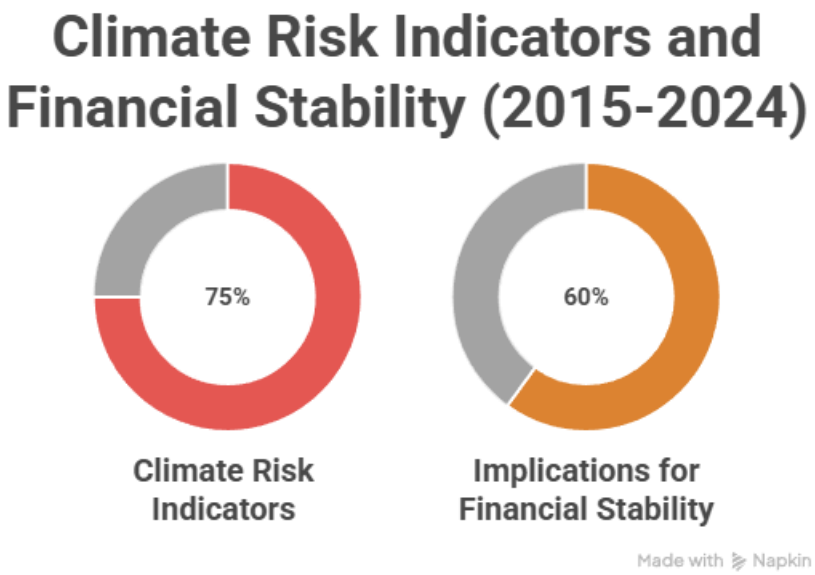

Figure 2. Climate Risk Indicators and Financial Stability (2015-2024)

Presents a comparative visualization of key climate risk indicators and their implications for financial stability over the period 2015–2024. The chart highlights that climate-related financial losses exhibit the highest intensity, reflecting a significant increase in both frequency and severity of extreme weather events, which contributes to growing financial volatility and widening insurance gaps. Similarly, exposure to physical and transition risks and stranded asset exposure show strong upward trends, indicating increasing systemic vulnerability and the potential for asset devaluation, particularly in carbon-intensive sectors.

In contrast, the carbon intensity of financial portfolios demonstrates a moderate decline, suggesting gradual progress toward decarbonization, although transition risks remain evident. Meanwhile, the adoption of climate stress testing shows steady growth, signaling enhanced regulatory awareness and improved capacity for risk assessment. Overall, the figure underscores the escalating importance of integrating climate risk into financial stability frameworks while highlighting ongoing challenges in managing these risks effectively.

The statistical overview indicates a steady escalation of climate-related financial exposure across banking, insurance, and capital markets. Data show that climate-induced losses have grown disproportionately relative to global GDP, suggesting heightened systemic vulnerability. Variations across regions highlight differentiated exposure profiles, with emerging economies facing higher physical risks and advanced economies confronting significant transition risks linked to decarbonization policies.

The observed statistical trends reflect the intensifying interaction between climate dynamics and financial systems. Rising physical risks translate into higher default probabilities, insurance claims, and fiscal pressures, while transition risks affect asset valuations through regulatory tightening and technological substitution. These mechanisms explain why climate risk increasingly appears in financial stability discussions at the macroprudential level.

The data also explain the growing emphasis on climate stress testing and scenario analysis within financial supervision. Institutions exposed to climate-sensitive sectors

demonstrate higher volatility and capital adequacy pressures, reinforcing the need for forward-looking risk assessment tools that capture long-term climate trajectories rather than short-term market fluctuations.

Descriptive analysis identifies three dominant thematic patterns across the dataset: amplification of systemic risk through climate shocks, insufficiency of traditional risk models, and gradual institutionalization of climate-aware financial regulation. These patterns recur consistently across regulatory reports and academic studies, indicating structural rather than incidental challenges.

Additional descriptive evidence highlights uneven implementation of climate risk governance. Financial institutions in jurisdictions with explicit regulatory mandates show more advanced disclosure practices and internal risk integration, while others remain at preliminary stages of awareness without operational embedding of climate considerations.

Inferential synthesis suggests a strong association between proactive climate risk governance and enhanced financial resilience. Financial systems that incorporate climate variables into supervisory stress tests exhibit lower projected systemic losses under adverse climate scenarios compared to systems relying solely on conventional macroeconomic indicators.

The analysis also indicates a moderating effect of regulatory coordination on climate-related financial instability. Jurisdictions with harmonized disclosure standards and climate taxonomies demonstrate reduced uncertainty and lower risk premiums, implying that regulatory clarity mitigates market volatility associated with climate transition pathways.

Relational analysis reveals a positive linkage between climate risk disclosure quality and institutional risk management capacity. Financial institutions with comprehensive climate reporting frameworks tend to allocate capital more conservatively toward high-risk sectors, thereby reducing systemic exposure to climate shocks.

Interdependencies between climate policy, financial regulation, and market behavior also emerge clearly. Carbon pricing mechanisms and transition policies influence credit allocation and investment flows, reinforcing the interconnected nature of climate risk and financial stability across policy and market domains.

Case study evidence from the European Union, the United States, and selected emerging economies illustrates differentiated approaches to managing climate-related financial risk. European financial systems emphasize regulatory integration through climate stress testing and taxonomy-based supervision, while emerging markets focus on adaptation finance and resilience-building mechanisms.

The case data show that financial institutions operating in climate-vulnerable regions experience higher exposure to physical risks, particularly in agriculture, infrastructure, and housing finance. These exposures underscore the localized nature of climate risk transmission within global financial systems.

The case studies explain how institutional capacity and policy alignment shape financial resilience outcomes. Regions with strong coordination between central banks, financial supervisors, and climate authorities demonstrate more coherent risk mitigation strategies and clearer signaling to financial markets.

The explanation further indicates that fragmented governance frameworks constrain effective climate risk management. Limited data availability, weak enforcement, and policy

uncertainty reduce the effectiveness of financial system responses, even in the presence of growing climate awareness.

The results indicate that climate risk constitutes a material and escalating threat to financial stability, operating through both physical and transition-related channels. Financial systems that fail to internalize climate risk remain vulnerable to systemic disruptions driven by environmental shocks and policy shifts.

Overall interpretation suggests that building resilient financial systems requires institutionalizing climate risk within financial governance, supervision, and capital allocation processes. Effective resilience depends on regulatory coherence, data transparency, and forward-looking risk assessment capable of aligning financial stability with the realities of global warming.

The results of this study demonstrate that climate risk has evolved into a systemic determinant of financial stability, affecting banking systems, insurance markets, capital allocation, and macroprudential resilience. Evidence from secondary statistics and comparative case analyses confirms that both physical risks and transition risks transmit climate shocks into financial systems through asset devaluation, credit deterioration, and increased market volatility.

The findings further indicate that traditional financial risk models are insufficient to capture the nonlinear and long-term nature of climate-related risks. Financial systems relying exclusively on historical data and short-term horizons exhibit higher vulnerability when exposed to extreme climate events or abrupt policy-driven transitions. This limitation underscores the necessity of forward-looking climate stress testing and scenario-based supervision.

The study also reveals significant heterogeneity across jurisdictions in integrating climate risk into financial governance. Advanced economies show stronger institutionalization of climate risk frameworks, while emerging economies face higher exposure to physical risks combined with limited regulatory and data capacity. This divergence shapes uneven resilience outcomes across global financial systems.

Overall findings suggest that financial stability in the era of global warming depends increasingly on the ability of institutions to internalize climate risk as a core prudential concern rather than a peripheral sustainability issue. Resilience emerges as a function of governance quality, regulatory coherence, and anticipatory risk management.

Prior research on financial stability has traditionally emphasized macroeconomic shocks, banking crises, and monetary instability, often excluding environmental variables from systemic risk analysis. The findings of this study extend existing literature by empirically and conceptually positioning climate risk as a structural source of financial instability rather than an external shock (Pokharel, 2025; Tao, 2026).

Studies within climate finance and sustainable investment literature frequently focus on capital mobilization for green projects and ESG performance. In contrast, the present findings align with emerging research arguing that climate change poses direct threats to financial system soundness, even in the absence of sustainability-oriented investment strategies.

Differences also arise in the assessment of regulatory effectiveness. Some studies suggest that climate regulation imposes compliance costs that may reduce financial efficiency, while the results here indicate that regulatory clarity and climate stress testing enhance long-term financial resilience by reducing uncertainty and systemic exposure.

The comparison with existing research highlights a growing convergence between climate economics and financial stability scholarship. This study contributes to that convergence by integrating climate risk transmission mechanisms into the core discourse on systemic financial resilience.

The findings reflect a paradigmatic shift in how financial stability is conceptualized under conditions of global warming. Climate risk no longer appears as an exogenous environmental factor but as an endogenous driver reshaping financial behavior, risk perception, and institutional mandates. The results also signal a transition in regulatory philosophy, where precautionary and anticipatory approaches gain prominence over reactive crisis management. Financial resilience increasingly depends on the capacity to manage uncertain, long-horizon risks that challenge conventional supervisory logic.

Persistent gaps in data availability and measurement frameworks reflect the early stage of climate risk integration within financial systems. These gaps serve as indicators of a system undergoing adaptation rather than one that has fully internalized climate realities. The findings therefore represent both evidence of progress and markers of structural tension, illustrating a financial system negotiating its role within a rapidly changing environmental context.

The implications for financial regulators are substantial, as the findings underscore the necessity of embedding climate risk within macroprudential and microprudential supervision. Climate stress testing, enhanced disclosure, and capital adequacy adjustments emerge as critical tools for safeguarding systemic stability (Li, 2025). Implications for financial institutions include the need to transform internal risk management practices. Credit assessment, portfolio diversification, and long-term investment strategies must account for climate exposure to prevent accumulation of stranded assets and correlated losses.

Implications also extend to policymakers responsible for climate and economic governance. Misalignment between climate policy and financial regulation increases transition risk and market volatility, highlighting the importance of coordinated policy frameworks. The broader implication suggests that climate-resilient financial systems are essential for sustaining economic stability and development. Financial stability and climate adaptation are shown to be mutually reinforcing rather than competing objectives.

The escalation of climate risk within financial systems is explained by the increasing frequency and severity of climate-related events that directly impact economic activity and asset performance. Physical damage to infrastructure and supply chains amplifies credit risk and insurance losses across sectors. Policy-driven transition dynamics further explain the findings, as decarbonization efforts reprice carbon-intensive assets and reshape investment flows. Sudden regulatory changes or technological shifts intensify market uncertainty when financial systems are unprepared.

Institutional behavior also plays a decisive role, as short-term profit incentives and incomplete information delay climate risk integration. These behavioral and informational constraints contribute to systemic vulnerability despite growing awareness. Differences across regions are explained by variations in institutional capacity, regulatory maturity, and exposure profiles. Financial systems with stronger governance structures and data infrastructure demonstrate greater adaptive capacity to climate-related shocks (Hanif, 2025; Jung, 2025).

Future research should prioritize empirical analysis using firm-level and supervisory data to quantify the financial impact of climate risk across sectors and time horizons. Longitudinal studies would strengthen causal understanding of climate–finance interactions. Policy

development should focus on harmonizing climate-related financial regulations across jurisdictions. International coordination is essential to reduce regulatory arbitrage and enhance the comparability of climate risk assessments.

Innovation in financial instruments and supervisory tools is needed to translate climate risk awareness into operational resilience. Outcome-linked capital requirements and climate-adjusted stress scenarios represent promising avenues. Sustained collaboration among regulators, financial institutions, scientists, and academics will be critical for building financial systems capable of withstanding the accelerating challenges posed by global warming.

CONCLUSION

The most important finding of this study is the recognition of climate risk as a systemic and material determinant of financial stability rather than a peripheral environmental concern. The analysis demonstrates that physical and transition-related climate risks propagate through financial systems via asset revaluation, credit deterioration, insurance losses, and market volatility, thereby reshaping the foundations of financial resilience under conditions of global warming.

The principal contribution of this research lies in its conceptual and analytical integration of climate risk into the core framework of financial stability analysis. By synthesizing regulatory insights, secondary statistical evidence, and comparative case perspectives, the study advances a holistic approach that positions climate risk within macroprudential governance and forward-looking supervisory practices, offering a structured foundation for climate-resilient financial system design.

The limitations of this study are associated with its reliance on secondary data and qualitative synthesis, which constrain the ability to capture real-time market dynamics and institution-specific responses. These limitations indicate future research directions that include empirical modeling with primary financial data, longitudinal climate stress-testing assessments, and cross-country comparative studies to refine measurement tools and strengthen the evidence base for climate-informed financial regulation.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used Chat GPT to assist inimproving grammar, language quality, and overall readability of the text. After using this tool, the author(s) Carefully reviewed and edited the content as necessary and take full responbility for the content of the publication.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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