



## Building a Parametric Insurance Ecosystem in Indonesia: A Narrative Literature Review of Global Practices and Strategic Recommendations

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### ABSTRACT

Parametric insurance is an innovation in disaster risk management that provides fast, transparent, and data-driven solutions, with claims payments triggered by measurable parameters, such as extreme rainfall or earthquake magnitude. These schemes serve as an essential alternative to risk financing, especially in developing countries such as Indonesia, which face significant challenges in accelerating post-disaster recovery. This article aims to review global practices in parametric insurance and to formulate a context-specific implementation strategy for Indonesia, based on a review of the narrative literature. The study identifies four key pillars for developing a strong parametric insurance ecosystem: strengthening data and technology infrastructure, creating an adaptive regulatory framework, increasing the capacity of the insurance industry, and fostering multi-stakeholder collaboration through pilot projects. The findings suggest that the use of satellite data, IoT-based monitoring systems, and the integration of national hazard data sources can reduce baseline risks. In addition, a transparent and collaborative regulatory framework is essential to ensure transparency and consumer protection. The involvement of local insurtechs also catalyzes the digitization of inclusive parametric products, particularly for MSMEs and the agricultural sector. Through a phased approach based on sectoral pilot projects and government fiscal support, Indonesia has significant potential to become a pioneer in the application of parametric insurance in Southeast Asia. This study contributes both conceptually and practically to strengthening a resilient and sustainable national disaster risk financing system.

## INTRODUCTION

Parametric insurance has emerged as an innovative solution with the potential to address gaps in insurance protection against a wide range of risks, from individuals to government entities (Lin & Kwon, 2019, 2020). These insurance products are designed to cover previously uninsured or underinsured risks through simplifying product design and reducing transaction costs (Lin & Kwon, 2020). In contrast to conventional claims-based insurance, parametric insurance pays compensation based on predetermined triggers, such as specific weather conditions or measurable hydro-meteorological parameters, rather than traditional time-consuming damage assessments (Goffard & Loisel, 2025; Steinmann et al., 2023). Its advantages lie in low transaction costs, rapid claims settlement, and the ability to leverage remote sensing data, thereby enabling insurance coverage in remote and hard-to-reach areas (Steinmann et al., 2023). The model also reduces operational costs and improves accessibility and fairness in climate risk management, particularly by integrating artificial intelligence to enhance risk assessment and price accuracy (Pandiri & Chitta, 2023). In the context of increasing losses attributed to climate change, these models are increasingly relevant for estimating risks across a range of hazards and simulating risk-related parameters for insurance schemes, such as premiums and reductions (Ingels et al., 2024). Parametric insurance covers various risk categories and serves clients ranging from individuals and businesses to governments by designing innovative and principled products (Lin & Kwon, 2020). This approach is particularly relevant in the context of rising economic losses from natural disasters, especially in developing countries, where parametric microinsurance can enhance the financial resilience of low-income households (Kousky et al., 2021). Community-based disaster insurance also provides an effective mechanism for risk mitigation, particularly for economic losses from climate-triggered natural disasters (Purwandari et al., 2024; Sheehan et al., 2023).

Despite its great potential, the market share of parametric insurance remains limited due to the presence of base risk, i.e., a mismatch between actual losses and claims payments (Gao et al., 2025). However, innovations such as data-driven parametric insurance powered by Bayesian Neural Networks can address the inaccuracies of traditional risk models, which are increasingly obsolete due to climate change uncertainty (Pang & Choi, 2022). The application of parametric insurance offers significant potential as an instrument of innovation in the insurance industry, particularly in response to the growing challenges posed by the vulnerability of human communities and their assets to natural disasters (Radu & Alexandru, 2022). The use of big data and artificial intelligence can significantly improve the accuracy of insurance risk metrics and coverage, enabling automated verification and algorithmic claims approval to mitigate these challenges (Hao et al., 2023; Sheehan et al., 2023). These innovative products provide practical solutions to address challenges in ensuring high-risk assets, owing to their high volatility and the lack of data to develop efficient and profitable protection models (Lopez & Nkamani, 2025).

Indonesia is among the countries with the highest disaster risk globally, including earthquakes, floods, volcanic eruptions, and droughts. Economic losses from disasters continue to rise, threatening fiscal resilience and people's well-being. In this context, parametric insurance is an innovative approach to disaster risk financing that relies on measurable parameters rather than actual losses. In contrast to conventional insurance, parametric insurance enables rapid disbursement of funds upon the occurrence of specified thresholds (e.g., extreme rainfall or earthquake magnitude). Some countries, such as Jamaica, the Philippines, and Vanuatu, have successfully developed these schemes through regional models, including CCRIF, ARC, and PCRIC.

Although parametric insurance has proven effective as a disaster risk financing instrument in countries such as Jamaica, the Philippines, and Fiji through schemes such as CCRIF and PCRIC (World Bank, 2021; GFDRR, 2019), its implementation in Indonesia remains underdeveloped. This is due to several main challenges, including the limitations of accurate and standardized hazard data, the lack of a technical regulatory framework that supports parametric product innovation, and the low technical capacity of the insurance industry in the use of spatial data and index-based risk modeling (FloodFlash, 2022; Ministry of Finance, 2021). Based on these conditions, this study aims to identify global best practices for the development of parametric insurance and to develop contextual strategic recommendations for Indonesia through a narrative literature review. The benefits of this research are to make a theoretical and practical contribution in building a strategic framework for the development of a credible, effective, and sustainable national parametric insurance ecosystem, as well as a reference for policymakers, industry players, and academics in supporting the strengthening of the disaster risk financing system in Indonesia.

## LITERATURE REVIEW

### Definition and Basic Concept of Parametric Insurance

Parametric insurance is an innovative risk management instrument that provides compensation based on predetermined parameters or indices. Unlike conventional insurance, which disburses claims based on verified actual losses, parametric insurance actually relies on objective triggers such as rainfall, earthquake magnitude, wind speed, or drought index as the basis for disbursing funds. When the set parameter value is reached or exceeded, payment is made automatically, without the need for a field-based physical damage assessment (Clarke et al., 2012). This approach is particularly suitable for disaster-prone and logistically difficult-to-reach areas because it offers a faster and more efficient claims process.

Parametric insurance is a significant innovation in the insurance sector, designed to address the challenges inherent in conventional insurance products, particularly in claims assessment and risk mitigation that traditional insurance does not address (Goffard & Loisel, 2025; Lin & Kwon, 2020). This insurance product offers an efficient solution by triggering claims payments based on measurable or modeled parameters, rather than on the actual

assessment of losses (Steinmann et al., 2023). This approach facilitates product design simplification, reduces transaction costs, and provides trackable indicators for risk management (Lin & Kwon, 2020; Lopez & Thomas, 2023). This system is fundamentally different from conventional compensation-based insurance in that its payout is triggered by a predetermined threshold for a parameter, such as temperature or precipitation, rather than by the assessment of actual damage (Steinmann et al., 2023). This index-based mechanism ensures that payments are triggered automatically when a predetermined parametric threshold is met, thereby increasing transparency and expediting the claims settlement process (Гумен, 2025).

### **Working Mechanism and Characteristics of Parametric Insurance**

The mechanism of parametric insurance follows the "if-then" principle: if the agreed parameters are met, the claim is paid automatically to the insured. The parameters must be quantitative, verifiable, and free from manipulation. For example, if rainfall in an area exceeds 200 mm in 24 hours, as recorded by BMKG or by satellites such as GPM or ERA5, the insurance policy will automatically pay a specified amount in accordance with the provisions. However, this scheme entails a risk known as base risk, which is the risk of a mismatch between the amount of the claim paid and the actual loss incurred. The basis risk can be positive (losses occur but do not meet parameters) or negative (parameters are met but no real losses) (Collier et al., 2009). Therefore, the accuracy and relevance of parameters are key factors in parametric insurance design.

Parametric insurance is a significant innovation in risk mitigation, particularly for events for which conventional loss assessment is difficult, such as natural disasters and extreme weather events (Lin & Kwon, 2019). This type of insurance operates based on predetermined triggers, such as specific weather conditions or flight delays, which trigger the payment of compensation without the need for time-consuming claims assessment (Goffard & Loisel, 2025). The disbursement of these insurance funds does not depend on the assessment of post-incident physical damage, but is triggered automatically when the agreed threshold is reached (Ng et al., 2021). In contrast to traditional insurance, which is based on actual losses, parametric insurance pays based on measurable or programmatic parameters, reducing transaction costs and significantly accelerating claims settlement (Damacena, 2019; Steinmann et al., 2023). This approach enhances process transparency and ensures prompt compensation for losses (Гумен, 2025). In addition, parametric insurance has the potential to integrate remote sensing data, thus enabling insurance coverage in remote and hard-to-reach areas (Steinmann et al., 2023).

### **Global Practice and Case Studies of the Implementation of Parametric Insurance**

Several countries and regions have successfully implemented parametric insurance schemes to manage natural-disaster risk. In the Caribbean region, CCRIF (Caribbean Catastrophe Risk Insurance Facility) provides index-based disaster protection to member countries, with claims disbursed within less than two weeks of a disaster. A similar scheme is also adopted by the African Risk Capacity (ARC) for drought risk in African countries and by the Pacific

Catastrophe Risk Insurance Company (PCRIC) for Pacific countries. In the private sector, companies such as FloodFlash in the UK are developing Internet of Things (IoT)-based flood insurance products that automatically trigger payments when a sensor detects a specified water level (FloodFlash, 2022). The success of these models shows that parametric insurance can be developed by combining quality data, risk modeling, and digital technologies to accelerate disaster impact management.

Parametric insurance has seen significant improvement in recent years, covering a wide range of risks and serving a wide range of clients, including individuals, businesses, and governments (Lin & Kwon, 2020). This innovative insurance product addresses previously uninsured or underinsured risks by simplifying product design and reducing transaction costs (Lin & Kwon, 2020). This approach differs from conventional claims-based insurance in that payouts are triggered by measurable or modelled parameters, rather than actual damage assessments (Steinmann et al., 2023). This enhances speed and efficiency in the claim's payment process, which is crucial for financing post-disaster reconstruction following natural hazards (Steinmann et al., 2023). This approach is particularly relevant for natural disasters, adverse weather conditions, pandemics, and cyberattacks, which can affect various economic sectors, including agriculture, renewable energy, and construction (Radu & Alexandru, 2022). Artificial intelligence-driven parametric insurance models, leveraging advanced algorithms and real-time data analytics, offer automated payment mechanisms based on predetermined triggers, such as temperature thresholds or rainfall levels (Pandiri & Chitta, 2023). This mechanism enables a rapid response to adverse events, thereby minimizing the risk of significant financial losses for policyholders (Goffard & Loisel, 2025). Parametric insurance verification can be automated, with insurance payments approved algorithmically without manual intervention, thereby saving processing time and reducing operational costs (Hao et al., 2023).

### **Relevance of Parametric Insurance in the Indonesian Context**

Indonesia, a country with a high frequency of natural disasters, requires a rapid, measurable, and integrated risk-funding scheme. Parametric insurance can be an important component of ex ante national disaster risk financing strategies, reducing reliance on post-disaster mechanisms that are slow and uncertain. The Ministry of Finance of the Republic of Indonesia (2021) emphasized the importance of diversifying fiscal instruments, including disaster insurance and disaster bonds, to enhance the country's financial resilience. By using national data sources such as BMKG and BIG, and global satellite datasets (MODIS, CHIRPS, and ERA5), Indonesia has sufficient start-up capital to develop credible risk parameters. In addition, integrating parametric insurance with social protection strategies, particularly for vulnerable sectors such as agriculture, MSMEs, and coastal communities, can expand the long-term benefits of sustainable development (UNDRR, 2020). Therefore, parametric insurance is not only a risk-mitigation tool but also a strategic public policy instrument.

Parametric insurance, which provides compensation based on predetermined triggers rather than traditional claims assessment, is beginning to attract attention as an innovative solution to the insurance coverage gap in Indonesia (Goffard & Loisel, 2025).

This approach has the potential to significantly improve financial security, particularly in areas vulnerable to natural disasters and other risks that are underserved by conventional indemnity-based insurance (Lin & Kwon, 2020; Steinmann et al., 2023). This insurance model is considered an innovative response to the evolving challenges posed by the vulnerability of communities and assets to natural disasters (Radu & Alexandru, 2022). This approach leverages real-time data and advanced algorithms to automate the payment process based on predefined parameters, such as rainfall rate or earthquake magnitude, thereby reducing operational costs and expediting the claims process (Pandiri & Chitta, 2023; Steinmann et al., 2023). Innovations in parametric insurance have led to a range of solutions that cover a broad spectrum of risks, serving individuals, businesses, and governments (Lin & Kwon, 2019). These products are designed to address previously uninsured or underinsured risks by simplifying product design and reducing transaction costs (Lin & Kwon, 2020). One of the main advantages of parametric insurance is its ability to provide automatic payments based on predetermined parameters, such as rainfall, temperature, or yield, thereby increasing transparency and expediting reimbursement (Гумен, 2025).

## **METHODOLOGY**

This study employs the Narrative Literature Review (NLR) approach as the primary method to develop a conceptual and strategic understanding of the evolution of parametric insurance in Indonesia. This approach was chosen because it allows researchers to comprehensively review, analyze, and synthesize a variety of relevant literature sources without being constrained by the strict systematic structure of a systematic review. A review of the narrative literature is beneficial in relatively new, complex, and dynamic fields such as parametric insurance, where not enough empirical studies based on primary data are yet available (Ferrari, 2015). Through this approach, researchers can explore various theoretical views, global practices, public policies, and implementation challenges in depth.

The process of implementing NLR in this study comprises several stages: identification of the study's topic and focus; literature search using scientific databases and policy documents; selection of literature based on relevance and quality; and thematic analysis to compile a narrative synthesis. The literature sources include scientific journal articles, reports from international institutions (the World Bank, GFDRR, UNDRR), Indonesian government policies, and case studies on the implementation of parametric insurance in various countries. The publication period used as a reference is from 2010 to 2023, to ensure the relevance and timeliness of the information studied. Literature is obtained through searches in databases such as Scopus, ScienceDirect, Google Scholar, and the official websites of related institutions.

In the literature selection process, the inclusion criteria used include: (1) literature discussing concepts, practices, or policies related to parametric insurance; (2) having a relevant context for developing countries or disaster-prone regions; and (3) written in Indonesian or English. Literature that is only descriptive in nature, with no clear conceptual or policy contributions, is eliminated from the analysis process. Once the literature was collected, the researchers grouped it by key themes relevant to the development of the parametric ecosystem in Indonesia, including data and technology, regulation, industry capacity, and multi-stakeholder collaboration. Each theme is analyzed narratively to explore the interconnectedness between concepts, global practices, and local challenges.

The use of a narrative literature review in this research has the advantage of explaining complex, multidisciplinary phenomena in a flexible yet evidence-based manner. In addition, this approach enables researchers to develop a contextual, policy-relevant framework of recommendations. Although it is not quantitative or fully systematic, NLR retains scientific validity when conducted transparently and precisely in the selection and analysis of the literature (Baumeister & Leary, 1997). Therefore, this approach is appropriate for addressing research questions on how the global practice of parametric insurance can be adopted and adapted to the needs and conditions of Indonesia.

## **RESULT AND DISCUSSION**

This research aims to identify global practices in the development of parametric insurance and develop contextual strategic recommendations for Indonesia. Based on the results of a literature review through a narrative literature review approach, it was found that the development of an effective parametric insurance ecosystem generally relies on four main pillars, namely: (1) strengthening data and technology infrastructure, (2) developing policies and regulatory frameworks, (3) building the capacity of the insurance industry, and (4) multi-stakeholder collaboration and pilot project implementation.

### **Pillar 1: Data Quality and Technology Infrastructure**

One of the main requirements for implementing parametric insurance is the availability of accurate, real-time, and standardized data to establish trigger parameters. A study by Hersbach et al. (2020) shows that the use of reanalysis data, such as ERA5, and satellite data, such as MODIS, GPM, and Sentinel, can improve the accuracy of weather and climate parameters used to determine insurance payments. In countries such as the Philippines and India, the success of parametric insurance programs is greatly influenced by the quality of observation systems and the integration of data from various sources (World Bank, 2021). In Indonesia, BMKG and BIG have developed a network of meteorological, seismic, and hydrological sensors. However, their use in the insurance sector remains limited and is not fully integrated in an interoperable manner.

Strengthening digital technology also plays an important role in reducing the risk base, which is the mismatch between actual losses and payments

received. Innovations such as IoT sensors for flood detection, the ShakeMap system for earthquakes, and weather radar for extreme weather have been incorporated into parametric products, including FloodFlash in the UK and Jumpstart in the United States (FloodFlash, 2022). This technology not only improves parameter accuracy but also accelerates the automatic, transparent disbursement of claims. Therefore, investment in data infrastructure and technology should be an initial priority in the development of parametric insurance in Indonesia.

The success of parametric insurance relies heavily on accurate and real-time hazard data. Studies by Hersbach et al. (2020) and Funk et al. (2015) show that the use of satellite data, such as GPM, MODIS, and ERA5, can improve the accuracy of index models. Countries such as the Philippines combine local and global data to develop parametric early-warning systems. In Indonesia, BMKG and BIG already have sensor infrastructure, but they still require standardization and interoperability with insurance and fintech systems.

### **Pillar 2: Regulation and Public Policy**

Precise and adaptive regulation is a significant prerequisite for the growth of parametric insurance innovation. Studies by Collier et al. (2009) and GFDRR (2019) emphasize the importance of regulators in setting standards, parameters, triggers, and risk-based mitigation mechanisms, as well as ensuring consumer protection. In Indonesia, the Financial Services Authority (OJK) currently lacks specific technical guidelines governing parametric insurance products, including product design, risk management, and consumer accountability.

The Ministry of Finance, through the National Disaster Risk Financing Strategy (MoF, 2021), has created space for the integration of parametric products into ex-ante-based disaster risk financing schemes, such as contingency funds, disaster insurance, and catastrophe bonds (cat bonds). However, for the implementation of parametrics to be effective, cross-sector regulations are needed to govern the roles of data providers, insurance companies, local governments, and risk management agencies. These regulations must not only facilitate innovation but also ensure transparency of information and fairness in the distribution of benefits.

Best practices in developing countries demonstrate the importance of adaptive regulation. The OJK is expected to develop technical guidelines on parameters, triggers, risk-based mitigation, and consumer protection. On the other hand, the Ministry of Finance can integrate parametric schemes into national fiscal risk-financing strategies, including through cat bonds and contingency funds.

### **Pillar 3: Insurance Industry Capacity**

The results of the literature review also indicate that the success of parametric insurance depends on the technical capacity of industry players to understand and manage data-driven risks. Swiss Re (2019) and Munich Re state that insurance companies need expertise in hazard modeling, weather index analysis, and geophysical and climate statistics. In many developing countries, this capacity building is done through training programs, technical cooperation with global reinsurers, and partnerships with research institutions. Building the capacity of the insurance industry for parametric insurance is crucial to

overcoming limitations in infrastructure and the availability of claims experts, particularly in developing countries, where such schemes can significantly reduce moral hazard and the difficulty of assessing claims in remote locations (Moro, 2024). The sustainability and scalability of parametric insurance are highly dependent on infrastructure development, human capital, social acceptance, and private-sector capacity, and may be enhanced by government premium subsidies (Taron et al., 2023).

In addition, the involvement of insurtech accelerates the digitization of parametric products. In Indonesia, insurtech can contribute to the development of distribution platforms, parameter monitoring, and claims payment automation. A study by FloodFlash (2022) confirms that integrating digital technology with parametric insurance can reduce transaction costs, expand financial inclusion, and improve claims efficiency, particularly for MSMEs and smallholder segments vulnerable to disaster risk.

The local insurance industry needs capacity building in hazard modeling, the use of spatial data, and index risk management. Studies by Swiss Re and Munich Re emphasize the importance of international training and collaboration to encourage knowledge transfer. The role of local insurtech is also crucial in the digitization of parametric products, especially for MSMEs and the agricultural sector.

#### **Pillar 4: Partnerships and Pilot Projects**

Global experience indicates that the initial implementation of parametric insurance should ideally begin with pilot projects in priority sectors or regions before being widely adopted. An example is the CCRIF in the Caribbean, which initially covered only a few countries and has since become a well-established regional model (World Bank, 2021). In Africa, the ARC scheme employs rainfall-based drought indices to protect smallholder farmers. This approach is considered adequate in testing parameters, improving product design, and building public trust.

In Indonesia, pilot projects can focus on the agriculture and fisheries sectors in drought-prone areas (e.g., East Nusa Tenggara) and on flood-prone urban areas (e.g., Jakarta and Semarang) using IoT sensors. Local governments can also participate early in their own parametric scheme, which the APBD and the APBN jointly finance. Collaboration among BMKG, OJK, the Ministry of Finance, the private sector, and international institutions such as the World Bank and UNDP is essential in the early stages of implementation. Initial implementation is suggested through sector- and region-based pilot projects. For example, the drought index for farmers in Nusa Tenggara or the flood parameter derived from IoT sensors in Jakarta. High-risk local governments can become early participants with the support of BMKG and funding from the center. This approach aligns with the experience of CCRIF and ARC, which began at the regional scale.

#### **Strategic Recommendations**

Based on the results of the review, the following are strategic recommendations for building a parametric insurance ecosystem in Indonesia:

- a. Strengthening local and global data integration, with interoperability across institutions.
- b. The preparation of technical regulations by the OJK related to parameters, triggers, and information transparency.
- c. Capacity building of industrial human resources through training, certification, and global collaboration.
- d. Implementation of sectoral pilot projects with data-driven evaluation and stakeholder feedback.
- e. Integration of parametric insurance in national fiscal strategies, including fiscal incentives and inter-regional risk pooling.

This study demonstrates that, while parametric insurance is frequently promoted as a rapid and efficient instrument for disaster risk financing, its practical effectiveness is neither universal nor automatic. The literature reveals that the core advantage of parametric insurance—speed of payout—comes at the cost of potential misalignment between measured hazard intensity and actual economic losses. This trade-off, commonly referred to as basis risk, represents a structural limitation rather than a merely technical issue. In high-risk, geographically diverse countries such as Indonesia, spatial heterogeneity of hazards, uneven sensor coverage, and localized vulnerability patterns may significantly weaken the correlation between parameters and observed damages. Consequently, parametric insurance should not be framed as a standalone solution but as a complementary layer within a broader disaster risk financing strategy. Failure to recognize these limitations risks overstating its benefits and may lead to unrealistic policy expectations or erosion of stakeholder trust when payouts do not match perceived losses.

Moreover, this discussion highlights that the successful adoption of parametric insurance is constrained not only by data availability but also by institutional capacity and regulatory clarity. Although Indonesia has improved access to hazard data and articulated disaster-risk-financing objectives at the policy level, the absence of explicit regulatory standards for parametric products creates uncertainty for insurers and reinsurers alike. The literature suggests that weak regulatory frameworks may exacerbate information asymmetries, reduce consumer protection, and limit market scalability. Additionally, reliance on external modeling expertise and global reinsurers raises concerns regarding long-term domestic capability development and regulatory oversight. From a policy perspective, these findings imply that premature large-scale deployment may be counterproductive. Instead, carefully designed pilot schemes, supported by iterative learning and transparent trigger validation, appear more appropriate. This study thus contributes to the literature by reframing parametric insurance not as a technical fix, but as an institutional innovation whose effectiveness depends on governance quality, regulatory maturity, and integration with national disaster risk management systems.

## **CONCLUSIONS AND RECOMMENDATION**

This study concludes that parametric insurance holds significant potential as a complementary disaster risk financing instrument for countries with high and recurrent exposure to natural hazards, such as Indonesia. By enabling rapid and rules-based payouts, parametric mechanisms can effectively address liquidity constraints during the critical early phase of disaster response. However, the findings also confirm that parametric insurance is not a universal solution. Its effectiveness is fundamentally constrained by basis risk, data quality, and the strength of institutional and regulatory frameworks. Without careful parameter calibration, robust hazard data, and transparent governance arrangements, parametric schemes risk generating payout mismatches that may undermine credibility and stakeholder trust. Therefore, parametric insurance should be positioned as part of a layered risk financing strategy rather than as a replacement for indemnity-based insurance or public disaster funding.

From a policy and research perspective, this study emphasizes that the successful implementation of parametric insurance depends as much on institutional maturity as on technical innovation. Strengthening regulatory clarity, enhancing domestic modeling capacity, and improving coordination among government agencies, insurers, and data providers are critical prerequisites for sustainable adoption. The study also highlights the importance of incremental implementation through pilot programs that enable learning, trigger refinement, and evaluate socioeconomic impacts. Future research should move beyond conceptual discussions and focus on empirical assessment of basis risk, welfare outcomes, and cost-effectiveness across different hazard types and sectors. By framing parametric insurance as an institutional and governance challenge rather than a purely technical instrument, this study contributes to a more realistic and policy-relevant understanding of its role in disaster risk management.

## **FURTHER STUDY**

Future research should move beyond conceptual analyses by empirically evaluating the performance of parametric insurance using historical hazard and loss data, with particular emphasis on measuring basis risk, payout adequacy, and welfare impacts across sectors and regions. Comparative studies assessing parametric insurance alongside alternative disaster risk financing instruments – such as contingency funds, risk pooling, and catastrophe bonds – are needed to identify optimal risk-layering strategies. In addition, institutional and regulatory dimensions, including consumer protection, data governance, and public-private coordination, warrant deeper examination. Further research should also explore the role of advanced technologies, such as satellite analytics, machine learning, and IoT-based sensing, in improving trigger accuracy and reducing basis risk in developing-country contexts.

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