Bridging Flood Risk Analytics and Finance in Indonesia: A Risk-to-Finance Framework

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Executive Summary

Indonesia's growing exposure to floods is creating increasing fiscal risks, yet disaster risk information is not systematically translated into financing decisions. Although flood hazard, exposure, and loss analytics are increasingly available, their integration into fiscal planning and Disaster Risk Financing and Insurance (DRFI) remains limited. This contributes to continued reliance on post-disaster public financing and leaves gaps in financial protection when disaster losses exceed routine fiscal capacity. Recent disaster experience, including the estimated Rp 205.26 trillion in rehabilitation and reconstruction needs following the 2025 Sumatra floods compared with approximately Rp 5 trillion in annual disaster reserve allocations, highlights the scale of this fiscal challenge (Bappenas, 2026).

This policy brief introduces a Risk-to-Finance Framework to connect flood-risk analytics with potential fiscal exposure, risk layering, and appropriate financing instruments. The framework follows five steps: assess risk, quantify potential losses and fiscal exposure, segment risk into layers, select financing instruments, and calibrate the financing strategy. Applied to Pontianak, it demonstrates how differences in flood severity and exposure concentration can inform differentiated financing approaches—from regular budgets and reserves to contingent financing, insurance, and other risk-transfer mechanisms. The brief recommends integrating quantified risk analytics into fiscal planning, operationalising risk layering and pre-arranged financing, applying the framework at the subnational level, and strengthening the actuarial, institutional, and equity foundations needed for wider scale-up.

Keywords: disaster risk financing; flood risk; fiscal exposure; risk layering; financial preparedness

Introduction

Indonesia faces increasing exposure to hydrometeorological hazards, particularly floods, driven by climate change, rapid urbanisation and development in high-risk areas. Recent floods in northern Sumatra illustrate the scale of potential impacts, with widespread damage to infrastructure, housing and economic assets. Beyond humanitarian losses, disasters can create significant fiscal pressure: the 2025 Sumatra floods generated an estimated Rp 205.26 trillion in rehabilitation and reconstruction needs, compared with approximately Rp 5 trillion in annual disaster reserve allocations (Bappenas, 2026). This highlights the growing importance of flood risk as a source of fiscal vulnerability.

Indonesia has established a Disaster Risk Financing and Insurance (DRFI) strategy that includes a risk-layering approach to align financing instruments with the frequency and severity of disasters. However, the link between risk analytics, potential fiscal exposure and financing decisions remains limited. Disaster financing therefore continues to rely substantially on post-disaster fiscal resources, while risk information is not yet systematically used to determine financing needs and appropriate financial instruments.

The FINCAPES initiative provides an opportunity to strengthen this link by connecting high-resolution, climate-informed flood-risk analytics with fiscal and financing decisions. This policy brief presents a Risk-to-Finance Framework for translating flood-risk information into potential fiscal exposure, risk layers and appropriate DRFI instruments, supporting a shift towards more proactive, predictable and risk-informed disaster financing.

The Risk–Finance Disconnect: From Flood Risk to Financial Exposure

Flood risk becomes financial exposure when physical hazard translates into losses for people, assets, businesses, and public infrastructure. This process depends on three elements: the probability and intensity of flooding, the concentration of exposed people and assets, and their vulnerability to damage. When these dimensions are combined, flood risk can be expressed in financial terms through metrics such as Expected Annual Loss (EAL), Loss Exceedance Curves (LEC), and scenario losses. These metrics show not only how much damage may occur, but also how frequently different levels of loss could be expected. For governments, this provides the basis for identifying which losses may become contingent fiscal liabilities and therefore require budgetary resources or other financing arrangements.

The preliminary Pontianak analysis already illustrates why this translation matters. The deepest flood conditions are concentrated in Pontianak Timur, while larger populations and building stocks are concentrated in Pontianak Barat, Pontianak Utara, and Pontianak Kota. This indicates that areas with the highest hazard intensity are not necessarily those with the greatest concentration of exposed assets. At this stage, however, the analysis primarily establishes hazard and exposure patterns rather than monetary losses. Incorporating vulnerability functions or depth-damage/loss curves would allow these patterns to be translated into expected damages at different flood depths. Combined with actuarial loss analysis, this would enable a more complete financing assessment by estimating loss distributions, potential fiscal exposure, and the scale of financing needed across different flood scenarios. The next challenge is ensuring that these quantified risk and loss estimates are systematically translated into fiscal planning and financing decisions. The key policy challenge is therefore to translate these quantified risk and loss estimates into fiscal planning and financing decisions.

Indonesia's disaster risk financing system is constrained by a disconnect between risk analytics and fiscal decision-making. Although flood hazard maps, probabilistic loss estimates, and loss exceedance curves are increasingly available, they are not systematically integrated into budgeting or financing instruments, limiting their role in financial preparedness. This gap is also evident in the Disaster Risk Financing and Insurance (DRFI) strategy: while its risk-layering approach seeks to align financing instruments with disaster frequency and severity, its application remains largely conceptual (Marlina et al., 2024). Financing decisions are therefore not consistently grounded in quantified risk metrics, such as expected losses and probability distributions.

Institutional fragmentation further reinforces this disconnect. The Ministry of Finance, BNPB, and subnational governments operate across fiscal, disaster-management, and planning functions with limited coordination. These weaknesses contribute to a reactive and inefficient financing system, with post-disaster government budgets remaining heavily relied upon and exposed to fiscal pressure when losses exceed available reserves (Badan Kebijakan Fiskal, 2018). Financing gaps also persist for frequent medium-scale events, while weak risk-informed planning can lead to mismatches between risk profiles and financing instruments, contributing to fiscal volatility and delays in recovery (Handoyo et al., 2024). Together, these challenges highlight the need for a more systematic approach that connects risk assessment and loss estimation to risk layering, financing instruments, and fiscal decision-making.

Risk-to-Finance Framework: From Analytics to Financing Decisions

The Risk-to-Finance Framework provides a step-by-step approach for translating flood-risk information into financial preparedness. It connects risk analytics, potential fiscal exposure, risk layering, and the selection of appropriate Disaster Risk Financing and Insurance (DRFI) instruments. This approach builds on established principles for linking disaster risk assessment with financial management and matching financing instruments to the frequency and severity of losses (Organisation for Economic Co-operation and Development [OECD], 2012; World Bank, 2018).



First, assess the risk. In this case, flood risk is used as an example to assess potential impacts by combining hazard, exposure, and vulnerability. This identifies where flooding is likely to occur, which assets and populations are exposed, and how susceptible they are to damage. For Pontianak, this provides the basis for understanding the spatial distribution and potential concentration of flood risk.



Second, quantify potential losses and fiscal exposure. Translate physical flood risk into financial terms using Expected Annual Loss (EAL), Loss Exceedance Curves (LEC), Probable Maximum Loss (PML), and scenario-loss estimates. These metrics help identify the frequency and magnitude of potential losses. Importantly, total modelled losses should be distinguished from the government's potential fiscal exposure, since not all economic losses will require public financing.

Third, segment risk into layers. Group potential losses by frequency and financial severity. Frequent, lower-severity losses can generally be retained through budgets and reserves; moderate losses may require pre-arranged contingent financing; and rare, high-severity losses may warrant insurance or other risk-transfer mechanisms (World Bank, 2018; Marlina et al., 2024). The boundaries between layers should be informed by loss distributions, fiscal capacity, risk tolerance, and the characteristics of available financing instruments, rather than set arbitrarily.

Table 1. Risk Profile and Disaster Risk Financing Options

Risk profile	Instrument Option	Policy Role
Frequent / lower severity	Budgetary resources, reserves/BTT	Retain and absorb recurrent losses
Moderate frequency / severity	Contingent financing / contingent credit	Provide rapid liquidity beyond routine fiscal resources
Low frequency / high severity	Insurance / risk transfer	Protect fiscal space from severe shocks
Measurable and reliably triggered risk	Parametric / index-based financing	Provide rapid, rules-based payouts

Source: Authors, adapted from World Bank (2018)

Fourth, select the appropriate financing instruments. Match each risk layer with the financing instrument best suited to its frequency, severity, and fiscal implications. No single instrument should finance the full spectrum of disaster risk; rather, instruments should be combined so that lower-cost sources are used for frequent losses while progressively stronger forms of pre-arranged financing and risk transfer are used for more severe events (World Bank, 2018; Calcutt et al., 2021).

Fifth, design and calibrate the financing strategy. Translate the selected risk layers and instruments into a financing structure that specifies how much risk is retained, financed, or transferred and when each instrument is activated. Key parameters include the attachment point, exhaustion point, and coverage limit, which can be informed by loss exceedance curves, return periods, EAL, and fiscal tolerance. Where parametric financing is considered, potential triggers such as rainfall, river level, or flood extent should be calibrated against modelled and observed losses to reduce basis risk. Where loss data remain incomplete, these parameters should be treated as indicative and subject to further calibration.

Pontianak illustrates how the Risk-to-Finance Framework can translate flood-risk information into financing decisions. Flood modelling across multiple return periods and climate-adjusted scenarios provides spatially explicit information on flood extent and depth. By combining hazard, exposure, and vulnerability, the analysis shows that Pontianak Timur experiences deeper flooding, while population and building concentrations are higher in Pontianak Barat and Pontianak Utara. Under the baseline 25-year scenario, mean wet depth reaches 0.63 m in Pontianak Timur, compared with 0.38 m in Pontianak Barat and 0.31 m in Pontianak Utara. This highlights the need to consider both hazard severity and exposure concentration when assessing financial risk.

These risk characteristics can then inform **risk layering and financing choices**. Frequent, lower-severity events could be retained through **regular budgets, municipal reserves, and unexpected expenditure**; medium-impact, lower-frequency events could be supported through **pre-arranged financing and risk-transfer mechanisms, including insurance**; and rare, high-severity events could warrant **catastrophe bonds, regional risk pools, or other forms of risk transfer**. This layered approach matches financing instruments to different levels of risk rather than relying on a single funding source. The proposed structure provides an **illustrative basis for financing decisions**, with layer boundaries, coverage amounts, and parametric triggers to be further calibrated as actuarial loss estimates and other risk data become available.

Recommendations

To strengthen Indonesia's disaster financial preparedness, the following recommendations focus on integrating risk information into fiscal decision-making, operationalising risk layering, and strengthening the institutional and analytical foundations for scale-up.



1. **Integrate risk analytics into fiscal planning.**

   Make quantified flood-risk information—including Expected Annual Loss (EAL), Loss Exceedance Curves (LEC), and relevant scenario losses—a routine input to fiscal-risk assessment, DRFI planning, and financing decisions. This would strengthen the link between risk information and the allocation of public resources, allowing potential fiscal exposure to be considered before disasters occur.



2. **Operationalise risk layering and pre-arranged financing.**

   Translate risk layers into pre-arranged financing strategies that combine reserves and unexpected expenditure, contingent financing, insurance and other risk-transfer mechanisms, and parametric financing where appropriate. Clear financing thresholds, coverage levels, and activation rules should be established so that funding can be mobilised rapidly when predefined risk levels are reached.



3. **Apply the Risk-to-Finance Framework at the subnational level.**

   Use local flood-risk profiles to develop risk layers and indicative financing strategies that reflect subnational exposure, fiscal capacity, and risk characteristics. The Pontianak application can provide a practical model for strengthening financial preparedness and supporting wider application of risk-informed DRFI planning across Indonesian local governments.



4. **Strengthen the evidence and institutional basis for scale-up.**

   Complete the actuarial loss analysis needed to calibrate risk layers, financing parameters, coverage levels, and triggers, while strengthening coordination between national and subnational institutions. DRFI design should also incorporate equity and social vulnerability considerations to ensure that financial protection supports communities and groups most affected by disaster impacts.

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