Catastrophe Bonds for Thailand

Parametric Trigger, Pricing, and a Capital-Market Implementation Roadmap

EXECUTIVE SUMMARY

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Disaster risk as a fiscal financing problem

The central question of this research is whether Thailand can secure reliable financing before a catastrophic flood, rather than mobilise it only after economic losses and emergency expenditure have materialised. The 2011 Great Thailand Flood exposed the scale of this problem. The disaster affected 66 provinces and more than 13 million people, caused approximately THB 1.43 trillion in damage and economic losses, and created reconstruction needs estimated at THB 1.5 trillion (World Bank and GFDRR, 2012). Its consequences extended beyond damaged property to industrial output, supply chains, public services and fiscal capacity.

Thailand has experienced further significant floods since 2011, while the region's natural-catastrophe insurance protection gap leaves a large share of losses with households, businesses and ultimately the public sector. Government reserves, emergency appropriations, conventional insurance and post-disaster borrowing each respond to different financing needs, but none by itself guarantees prompt liquidity for an extreme event. This study examines sovereign catastrophe bonds as a complementary, pre-arranged layer of risk financing: investors assume a specified portion of disaster risk in return for compensation paid before the event. The Thai General Insurance Association's proposed THB 50 billion Natural Catastrophe Fund demonstrates contemporary interest in capital-market solutions (Artemis, 2026), although it is separate from the sovereign structure analysed here.

Research contribution and analytical boundaries

The paper brings together three elements usually considered separately: hydrological trigger design for the Chao Phraya basin; preliminary pricing informed by sovereign catastrophe bond transactions; and a ten-step legal, institutional and capital-market implementation pathway for Thailand. It evaluates indemnity, modelled-loss, industry-loss and parametric triggers before selecting the latter for its potential to make an objective determination rapidly, without awaiting the adjustment of actual economic losses. The comparative analysis draws on transactions undertaken for the Philippines, Jamaica, Mexico and Chile through the World Bank's Capital-at-Risk (CAR) notes programme.

The methodological framework combines peaks-over-threshold extreme-value analysis, the Generalised Pareto Distribution, a seasonally varying flood-arrival process and a proposed simulation approach to risk pricing. It is important to distinguish the specified methods from their execution. The study uses published flood and market evidence to propose parameters and investigate historical behaviour; it does not report a fully fitted, independently validated hydrological catastrophe model or completed transaction-grade Monte Carlo pricing. Access to continuous station-level datasets, loss observations and independent model validation would be prerequisites for determining attachment probabilities, expected loss and binding transaction terms.

Proposed instrument and parametric trigger

The reference structure is a three-year flood catastrophe bond providing up to THB 15 billion in protection (approximately USD 420 million using the paper's illustrative exchange-rate assumption). Thailand, through the Ministry of Finance and the Public Debt Management Office (PDMO), would be the beneficiary and risk-transfer sponsor. The International Bank for Reconstruction and Development (IBRD) would issue Capital-at-Risk notes to investors, avoiding the need to establish a new sovereign-owned special-purpose issuer. The principal structure is envisaged in US dollars, with a potential Thai-baht tranche subject to execution feasibility. Investors could lose a defined proportion of principal following a qualifying flood; that amount would fund the sovereign payout.

The proposed trigger combines accumulated rainfall with river discharge, reflecting both the meteorological origin of flooding and its movement through the economically exposed river corridor. Seven-day upper-basin rainfall must reach at least the historical 90th percentile for initial attachment, notionally around 180 millimetres in the paper. Five river measurement points are selected: Nakhon Sawan C.2; Chao Phraya Dam in Chai Nat; Bang Chom Sri Gate in Sing Buri; Ang Thong; and Ayutthaya/Bang Sai. Bangkok Noi is proposed as a supplementary extreme-event station. The design requires discharge exceedance over three consecutive days and uses multiple stations to distinguish extensive basin flooding from isolated heavy rainfall.

Payouts are proposed at 30%, 60% or 100% of principal. The first tier requires rainfall at or above the 90th percentile together with exceedance at two of the five principal stations; progressively broader or more severe conditions lead to higher tiers. The catastrophic tier uses a 99th-percentile rainfall threshold, notionally 250 millimetres in seven days, together with extensive exhaustion-level discharge readings, while the paper also specifies a Bangkok Noi alternative. The exact interaction between that alternative, the rainfall precondition and the duration rule must be resolved in final legal documentation. Satellite-observed inundation is proposed as fallback evidence if fewer than three principal stations report usable data. The expanded term sheet contemplates a trigger-determination period of no more than five business days, which remains a design target rather than a demonstrated payout time.

Historical assessment and basis risk

The paper tests the logic of the proposed mechanism against a small set of documented floods between 1942 and 2021. On the study's reconstructed assumptions, the 1942 and 2011 catastrophes would have produced full payouts, the 1995 flood a 60% payout, and the more localised 2021 Tropical Storm Dianmu event no payout. It also assesses the 1983 and 2006 events, identifying the greatest uncertainty in intermediate-severity floods. The reported Spearman rank correlation of approximately 0.95 between assigned severity and indicative payout tier is best understood as an exploratory consistency check, not a statistically validated forecast of actual trigger performance. Several historical outcomes are inferred from event descriptions rather than calculated from complete synchronised gauge and rainfall records.

This distinction is central to basis risk: a flood can cause substantial damage without meeting the contractual index, while a trigger can be satisfied when actual losses are comparatively modest. Reservoir operations, tributary flows, embankments, urban drainage, changing exposure and uneven data availability complicate the mapping from hydrological conditions to fiscal loss. Combining rainfall and discharge offers a plausible mitigation, but the degree of improvement over a simpler trigger has not yet been quantified. Validation should therefore examine both false-negative and false-positive outcomes using continuous observations and independently compiled loss data, including sensitivity to climate and land-use change.

Pricing, protection value and fiscal trade-off

The paper proposes an indicative 7.0–10.5% annual coupon corridor and differentiates three illustrative transaction structures: a supported USD 100 million pilot at 7.0–9.0%; a self-funded USD 250–300 million mid-case at 8.5–10.0%; and a THB 10–15 billion baht-led or dual-currency structure at 10.0–12.0%. Assumed annual expected losses range from roughly 2.5% for the pilot to 3.5–4.0% for the larger transaction. These are preliminary scenario assumptions rather than actuarially derived transaction prices. The component ranges in the paper's coupon build-up require reconciliation, and a future analysis must distinguish the investor's reference-rate return and catastrophe risk margin from the sovereign's net premium, fees, funding and currency costs. The 7.0% risk margin reported for Jamaica's 2024 bond, for example, is not its entire investor coupon (World Bank, 2025a).

Applying the paper's mid-case assumptions to approximately THB 10 billion of protection produces an illustrative annual expenditure of THB 850 million–1.0 billion, before a transaction-specific reconciliation of funding and risk-transfer cash flows. That is a material recurring fiscal commitment, but its purpose is not to finance the entirety of post-disaster reconstruction. A full THB 15 billion payment would have represented only about 1% of the economic losses reported for 2011. The policy value lies instead in having a

contractually specified source of liquidity at the beginning of an extreme event. Whether that value justifies the cost must be evaluated against contingent credit, reserves, conventional reinsurance and other risk-transfer alternatives, rather than inferred from the small ratio of premium to the government's annual budget.

Institutional pathway and market implications

A ten-step roadmap moves from a Cabinet mandate and PDMO-led World Bank engagement to budget provision, data-sharing arrangements, independent modelling, securities disclosures, prudential and tax clarification, investor placement, settlement and post-issuance governance. It assigns responsibilities to the Ministry of Finance, Bureau of the Budget, Royal Irrigation Department, Hydro-Informatics Institute, Thai Meteorological Department, Securities and Exchange Commission, Bank of Thailand, Revenue Department, ThaiBMA and IBRD. ThaiBMA's proposed contribution should be understood in its established capacity for self-regulation, bond information, pricing conventions and market standards; the appropriate exchange listing, offering approvals and settlement route require separate legal determination. Similarly, the bank-capital treatment of catastrophe-linked notes must reflect their potential principal impairment and cannot be assumed solely from the IBRD's standing as issuer.

The original roadmap targets a Cabinet mandate in early 2027, independent modelling through 2027–2028, and possible first issuance in the second half of 2028. This is a conditional implementation scenario, not a regulatory approval or assured timetable. The proposed instrument would principally appeal to specialist international insurance-linked securities investors, with domestic participation depending on tax, mandate, valuation, disclosure and regulatory treatment. Ongoing oversight would require transparent gauge data, independent event determinations, periodic audit and a defined renewal policy; trigger thresholds should not be altered during a live risk period except as contractually permitted.

Limitations and policy conclusion

Five interrelated risks remain material: payout-to-loss mismatch (basis risk); model uncertainty arising from incomplete observations and poorly constrained extreme-event probabilities; foreign-exchange exposure between a USD instrument and Thai-baht fiscal needs; political and budgetary continuity over successive administrations; and climate non-stationarity, which can weaken estimates derived from historical return periods. None is resolved by the availability of the CAR issuance platform. In particular, the assumed cost of protection and the governance of trigger data must be independently tested before the government commits recurring public expenditure.

The principal contribution of the study is therefore an implementable research proposition, not a completed issuance-ready valuation. It demonstrates how Thailand could translate observable flood dynamics into a pre-arranged sovereign risk-transfer contract and identifies the institutions that would have to make such a contract credible. The appropriate next decision is to commission a joint fiscal-hydrological feasibility exercise, with independent catastrophe modelling, a legally unambiguous trigger, explicit treatment of basis risk, verified all-in financing costs and comparison with alternative disaster-financing instruments. If those tests are satisfied, a catastrophe bond could add a targeted layer of rapid fiscal liquidity to Thailand's broader system of flood prevention, adaptation, insurance and recovery finance.

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