Article

Not peer-reviewed version

# High-Dependency Border Fractures and National ‘Cascading Vulnerability’: A Framework for Identifying Critical Vulnerabilities, Intelligence-Driven Simulation, and Early Warning in Cambodia Based on Structured Knowledge Graphs, with a Discussion on Thailand's Compliance Economic Action Portfolio Amidst Border Conflict Spillover

Wei Meng * and Xinyuan Li

Posted Date: 16 December 2025

doi: 10.20944/preprints202512.1399.v1

Keywords: Cambodia; cascading risk; dependency networks; knowledge graphs

 doi:10.20944/preprints202512.1399.v1



*Article*

# High-Dependency Border Fractures and National 'Cascading Vulnerability': A Framework for Identifying Critical Vulnerabilities, Intelligence-Driven Simulation, and Early Warning in Cambodia Based on Structured Knowledge Graphs, with a Discussion on Thailand's Compliance Economic Action Portfolio Amidst Border Conflict Spillover

**Wei Meng * and Xinyuan Li**

Dhurakij Pundit University, Thailand

* Correspondence: wei.men@dpu.ac.th

**Abstract**

Against a backdrop of increasingly frequent external shocks and deepening cross-sectoral coupling, traditional national risk assessments centred on 'industry/sector' units often struggle to explain why seemingly localised disturbances rapidly evolve into systemic instability. This paper proposes an integrated 'Dependency Network–Knowledge Graph (DN-KG)' framework tailored for intelligence research and academic discourse. This framework abstracts Cambodia's macroeconomic, financial, real estate, fuel and power supply, border security, climate agriculture, tourism services, and governance regulatory systems into node sets. It integrates cross-system constraints and operationalises the DN-KG framework to: DN-KG)' framework for intelligence research and academic discourse. This framework abstracts Cambodia's macroeconomic, financial, real estate, fuel and power supply, border security, climate-agriculture, tourism services, and governance-regulation sectors into node sets, while cross-system constraints and transmission relationships are abstracted into edge sets. 'High-betweenness dependency edges" serve as the core indicator for identifying systemic vulnerabilities. Building upon verifiable OSINT data, this paper constructs a reproducible node-edge inventory and cascade mechanism model. This enables evidence-anchored causal chain interpretation and scenario simulation for short-term trigger points (fuel channels and supply chains), medium-term structural vulnerabilities (US export concentration—employment—household debt—financial asset quality), and risk amplifiers (property correction—collateral — non-performing exposures—credit supply contraction). Research indicates that Cambodia's most critical vulnerability lies not in the weakness of any single sector, but in the cascading structure formed by the combined effects of 'disruptability × cross-sector spillover × recovery difficulty' along a few high-degree dependency edges. Therefore, resilience-building priorities should shift from 'sectoral blood transfusions' to 'alternative pathways for critical dependency edges, inventory buffers, and institutional stabilisers'. Furthermore, strictly refraining from providing operational coordination or violence optimisation recommendations, this paper proposes a 'compliant, auditable, reversible, humanitarian exception' economic action portfolio for Thailand to adopt in the context of conflict spillover. This aims to reduce regional systemic risk and create conditions for de-escalation negotiations.

**Keywords:** Cambodia; cascading risk; dependency networks; knowledge graphs

 doi:10.20944/preprints202512.1399.v1



## 1. Introduction

The vulnerability of small open economies often extends beyond the question of 'which sector is relatively weak' to encompass 'which dependency chain, if disrupted, could simultaneously drag multiple sectors into a pressure zone'. Fuel supply exemplifies this: it is not merely an energy issue, but a common upstream input for transport logistics, pricing, tourism, and industrial fulfilment. When critical fuel channels face sudden constraints, the shock propagates cross-sectorally through the cost-expectations-cash flow-credit chain, manifesting as deteriorating financial asset quality and macroeconomic growth deceleration. This 'cascade' describes how a localised shock first disrupts a key link, then propagates and amplifies along dependency chains, ultimately triggering sequential failures across multiple systems or sectors.

For Cambodia, international institutions have repeatedly cautioned in recent years: the property and construction sectors are undergoing correction, financial system vulnerabilities are rising, and external trade policy uncertainties may intertwine with domestic balance sheet pressures to form downside risks (IMF, 2024; IMF, 2025; World Bank, 2025). Concurrently, public reports from 14–15 December 2025 concerning escalating border tensions between Thailand and Cambodia alongside tightening fuel supply channels provide a real-world window into such 'trigger points': Thailand discussed or implemented fuel restrictions and halted fuel shipments via Laotian border crossings to prevent diversion to Cambodia (Reuters, 14 December 2025; Reuters, 15 December 2025).

**Research Questions:**

**RQ1.** From a 'dependency network' perspective, what constitutes Cambodia's most vulnerable sector/link?

**RQ2.** Is its systemic vulnerability concentrated in a few 'high-degree dependency edges'?

**RQ3.** How would the rupture of these links trigger cross-sectoral cascades? How might an observable early warning indicator system be constructed?

**RQ4.** Against the backdrop of conflict spillover, what combinations of economic actions—non-civilian-targeted, compliant, and reversible—could Thailand employ to mitigate regional systemic risks?

## 2. Theoretical Framework: From 'Sectoral Risk' to 'Dependency Edge Risk'

### *2.1. Dependency Networks and Cascading Instability*

This paper abstracts the national economic-social-infrastructure system as a graph G=(V,E): nodes V represent critical subsystems/sectors (exports, employment, finance, property, fuel, electricity, climate, tourism, governance, etc.), while edges E denote cross-system dependencies (input constraints, funding chain constraints, price/expectation transmission, regulatory adjustments, etc.). The 'weakest link' is defined herein as: a dependency edge exhibiting high interruptibility, broad spillover effects, and significant recovery difficulty. Empirically, such edges often possess a 'high betweenness' characteristic, meaning they lie on multiple critical paths; once disrupted, cascading effects are substantially amplified.

### *2.2. Academicisation of Intelligence Analysis Methods: Reproducibility, Verifiability, and Early Warning*

Intelligence research emphasises structured reasoning and continuous validation under conditions of incomplete information. This paper formalises this approach into three academic outputs: (1) Graphical representation: node-edge inventories (definitions, directions, evidence anchors); (2) Deductive modelling: cascade pathways following critical edge disruptions (causal chains and feedback loops); (3) Metricisation: signposts (observable leading indicators and threshold logic).

## 3. Data Sources and Methods

 doi:10.20944/preprints202512.1399.v1



### *3.1. OSINT Sources and Credibility Stratification*

This paper exclusively utilises verifiable open sources: IMF Article IV-related publications and country reports on Cambodia (anchoring property corrections, financial vulnerabilities and risk structures); World Bank's Cambodia Economic Update: Navigating Uncertainty (anchoring macroeconomic trajectories and uncertain environments); ADB/WBG Climate Risk Country Profile: Cambodia (anchoring climate and flood exposure), Reuters reports on events such as fuel restrictions, border access tightening, and foreign trade tariff pressures (anchoring trigger windows and actual occurrence conditions), and border situation briefings and security advisories issued by Thailand's Public Relations Department and Ministry of Foreign Affairs (anchoring policy narrative boundaries and the 'compliant/humanitarian/reversible' design space).

### *3.2. Anchored Qualitative Quantification: Vulnerability Function*

In the absence of comprehensive microdata, this paper employs 'anchored qualitative quantification' to establish relative rankings for critical edges:

$$Vuln_{edge} = Disruptability \times Spillover \times Recovery\ Difficulty$$

***Disruptability*** denotes the susceptibility to disruption (whether single-point channels exist, and whether conflicts/policies can rapidly impact this edge). Spillover indicates the extent of spillover effects (constraints across multiple sectors and the scope of chain reactions). Recovery Difficulty signifies the difficulty of recovery (costs and time lags associated with alternative pathways, inventory buffers, and institutional repairs).

## 4. DN-KG Structured Knowledge Graph Construction: Nodes, Edges and Evidence Anchors

### *4.1. Node Set (Nodes)*

To ensure reproducibility, this paper fixes ten core nodes (scalable but not arbitrarily renamed):
N1 Exit Engine;
N2 Employment and Household Debt Repayment Capacity;
N3 Financial System Asset Quality;
N4 Real Estate and Construction Chain;
N5 Fuel Supply Chain;
N6 Power System;
N7 Border Security and Geopolitical Conflict;
N8 Climate–Agriculture–Food Prices; N9 Tourism and Service Sector Confidence; N10 Governance and Regulatory Capacity.

### *4.2. Key Dependency Edges and Directional Definitions*

This paper defines nine core dependency edges (directions indicate primary transmission pathways; bidirectional feedback may exist in practice):

E1: N1 → N2 (Exports–Employment Edge): Changes in external demand/tariffs affect orders and working hours, subsequently impacting employment and income. (Reuters, 2025-05-15; Reuters, 2025-08-01)

E2: N2 → N3 (Debt Service – Asset Quality Edge): Declining income and mounting debt pressures heighten overdue and non-performing loan risks. (IMF, 2025-01; IMF, 2025-12)

E3: N4 → N3 (Property – Financial Edge): Property market correction and declining collateral values amplify financial risk exposure. (IMF, 2024; IMF, 2025-12)

E4: N3 → N1/N2 (Credit Supply – Real Economy Employment Edge): Deteriorating asset quality triggers credit contraction, conversely suppressing corporate liquidity and employment. (IMF, 2025-01)

 doi:10.20944/preprints202512.1399.v1



E5: N7 → N5 (Conflict – Fuel Channel Edge): Border conflicts/restrictions disrupt cross-border fuel transportation and supply routes. (Reuters, 2025-12-14; Reuters, 2025-12-15)

E6: N5 → N9/N1 (Fuel – Tourism/Contract Fulfilment Edge): Fuel cost volatility and supply instability raise logistics expenses, undermining tourism and export contract fulfilment. (Reuters, 2025-12-15)

E7: N6 → N1 (Electricity – Industrial Continuity Edge): Power supply stability and cross-border electricity import capacity affect continuous industrial production. (Reuters, 21 October 2024)

E8: N8 → N2/N9 (Climate – Livelihoods/Services Edge): Climate shocks like floods impact agriculture and prices, spilling over into livelihoods and service sector expectations. (ADB & WBG, 2021)

E9: N10 → N3 (Regulatory – Risk Identification/Mitigation Edge): Regulatory transparency and macroprudential measures influence the pace of risk exposure and intensity of financial contraction. (IMF, 2025-12)

## 5. Key Judgement (KJ) Confidence Level

KJ1 (High Confidence): Cambodia's most vulnerable short-term exposure to 'trigger-type cascading' risks lies within its fuel supply chain and critical transit routes (E5, E6). This assessment is based on publicly reported fuel restrictions and transit route tightening measures observed on 14-15 December 2025, coupled with the inherent cross-sectoral spillover characteristics of this border area. (Reuters, 14/12/2025; Reuters, 15/12/2025)

KJ2 (High Confidence): The primary structural vulnerability in the medium term stems from concentrated external exports (particularly to the US) → employment and debt servicing capacity → financial asset quality (E1, E2, E4). This is underpinned by Cambodia's high export dependency on the US, coupled with significant employment absorption in apparel and footwear sectors. Tariff uncertainties have been publicly reported as a major external shock source. (Reuters, 2025-05-15; Reuters, 2025-08-01)

KJ3 (High Confidence): Property market correction (N4) serves as a key amplifier of financial vulnerability (E3), potentially accelerating credit contraction feedback through collateral value and risk recognition. This is supported by the IMF repeatedly linking property and construction market corrections to financial risk exposure in its 2024/2025 materials. (IMF, 2024; IMF, 2025-12)

KJ4 (Medium Confidence): Cross-border electricity dependency and climate slow variables (E7, E8) typically manifest as 'background pressures' but may transform into non-linear amplifiers when compounded by conflict/trade/financial stresses. (Reuters, 2024-10-21; ADB & WBG, 2021)

Note: Confidence levels are determined by the consistency of public evidence, the authority of sources, and the verifiability of logical chains.

## 6. Findings: Intelligence-Level System Interpretation of Cambodia's Most Vulnerable Sectors/Links

### *6.1. Primary Vulnerability: Fuel Supply Chain and Critical Channels (E5/E6, Triggering Breakpoints)*

Vulnerability Mechanism: (1) Channel Constraints/Fuel Restrictions (Conflict and Regulatory Triggers) → (2) Supply Volatility and Cost Escalation (Widening Wholesale-Retail Price Spread, Declining Days of Inventory) → (3) Rising Logistics and Production Costs (Increased Export Fulfilment Costs; rising service sector costs) → (4) Tourism and service sector confidence erosion (increased cancellation rates, cash flow contraction) → (5) Household expenditure contraction and rising default risks → (6) Financial asset quality pressure and credit tightening (reverse impact on the real economy).

The critical aspect of this chain is that fuel serves not merely as a 'sectoral input' but as a shared upstream constraint across multiple systems; thus, its impact can cascade across sectors. Public reports dated 15 December 2025 indicate Thailand has halted fuel shipments via Laos border

 doi:10.20944/preprints202512.1399.v1



crossings and expressed concern over diversion to Cambodia, while discussing measures such as high-risk maritime restrictions. This signals a marked increase in the tangible vulnerability of this supply route. (Reuters, 15 December 2025)

Early warning indicators: refined oil arrivals and regional inventory days; wholesale-retail price differentials and transport cost indices; rapid shifts in tourism cancellation rates and hotel occupancy; industrial shutdown/shift reduction signals and export fulfilment delays; short-term delinquency rates at financial institutions and changes in restructured loan proportions.

### *6.2. Second Vulnerable Trunk: Export Concentration – Employment – Debt Servicing – Finance (E1/E2/E4, Medium-Term Structural Chain)*

Vulnerability Mechanism: External tariff/market access shocks and order volatility → Declining working hours and wages → Reduced household debt servicing capacity (including micro-loan pressures) → Rising arrears and non-performing loans → Diminished risk appetite among financial institutions → Credit supply contraction → Decline in domestic demand and investment → Further employment pressures (forming a feedback loop).

Public reports indicate that Cambodia's exports to the United States account for a significant proportion of its total exports, with the garment and footwear sectors absorbing a substantial share of employment. Tariff negotiations and changes in tax rates directly impact its growth and employment outlook (Reuters, 15 May 2025; Reuters, 1 August 2025). This chain is 'structural' because it relies not on isolated events but on export composition and market concentration; consequently, its risk manifests as a combination of 'persistent exposure—triggering window—financial feedback'.

Early warning indicators:

- Shipment volumes to the US, order cancellations and delivery delays;
- Manufacturing layoffs/shutdowns, changes in working hours and wage arrears signals;
- Microloan delinquency rates, proportion of restructured loans, regional cash flow pressures; bank credit growth and risk premium shifts.

### *6.3. Third Vulnerability Amplifier: Property Correction – Collateral – Non-Performing Exposure – Credit Crunch (E3/E4)*

IMF documents from 2024 and 2025 highlight that property and construction sectors are undergoing correction, with credit slowdown exposing financial vulnerabilities and downside risks (IMF, 2024; IMF, 2025-01; IMF, 2025-12).

Mechanism: Declining property transactions and prices → Falling collateral values and deteriorating developer cash flows → Accelerated risk recognition and rising non-performing exposures → Financial institutions tightening credit supply → Declining corporate turnover and household consumption → Shift in the macroeconomic growth trajectory.

The danger of this amplifier lies in its 'non-linearity': when risk recognition shifts from "delayed" to 'concentrated exposure', credit contraction may suddenly accelerate.

Early warning indicators: Simultaneous decline in transaction volumes and prices (by region); project suspensions and developer default signals; structural shifts in non-performing loans, restructured loans, and extended loans; credit supply contraction and rising financing costs.

### *6.4. Background Slow Variables: Cross-Border Electricity and Climate Flood Exposure (E7/E8)*

Reuters reports Cambodia plans to enhance its electricity import capacity, reflecting its reliance on cross-border power and interconnection structures (Reuters, 21 October 2024). The ADB/WBG Climate Risk Profile highlights Cambodia's high exposure to climate risks such as flooding, which pose long-term pressures on agriculture, water resources and livelihoods (ADB & WBG, 2021).

 doi:10.20944/preprints202512.1399.v1



Systemic Implications: Within a compound scenario of trade shocks, tightening fuel supply routes, and rising financial vulnerabilities, electricity and climate shocks could become the 'last straw', propelling otherwise manageable pressures beyond cascading thresholds.

*6.5. Cambodia's Electricity Import Sources and Import Share Data (Focusing on 2023)*

This document compiles Cambodia's primary electricity import sources and import shares, presented according to different statistical methodologies. Due to variations in statistical boundaries and methodologies, minor discrepancies in 'shares' may occur. Therefore, comparative explanations are provided for the electricity sector methodology (GWh), trade statistics methodology (HS 271600), and capacity methodology (MW).

6.5.1. By Electricity Sector Metrics (EAC Annual Report Metrics, Compiled via JICA's ASEAN Power Grid) In 2023

As shown in Figure 1: The import source countries are Laos, Vietnam, and Thailand. In 2023, Cambodia's total imported electricity amounted to approximately 3,373.19 GWh, accounting for roughly 20% of the total available electricity supply (Availability) for that year, which stood at approximately 16,987 GWh.

| Country of origin | Imported electricity ( GWh) | Share of imported electricity | Share of national available electricity supply (approx.) |
|---|---|---|---|
| Laos | 2,558.68 | 75.85% | 15.06% |
| Vietnam | 682.29 | 20.23% | 4.02% |
| Thailand | 132.22 | 3.92% | 0.78% |
| **Total** | **3,373.19** | **100.00%** | **≈20%** |

Note: This figure is derived from the electricity sector's statistical tables (imported electricity broken down by country), and more closely reflects the actual cross-border electricity purchases/receipts within the power grid.

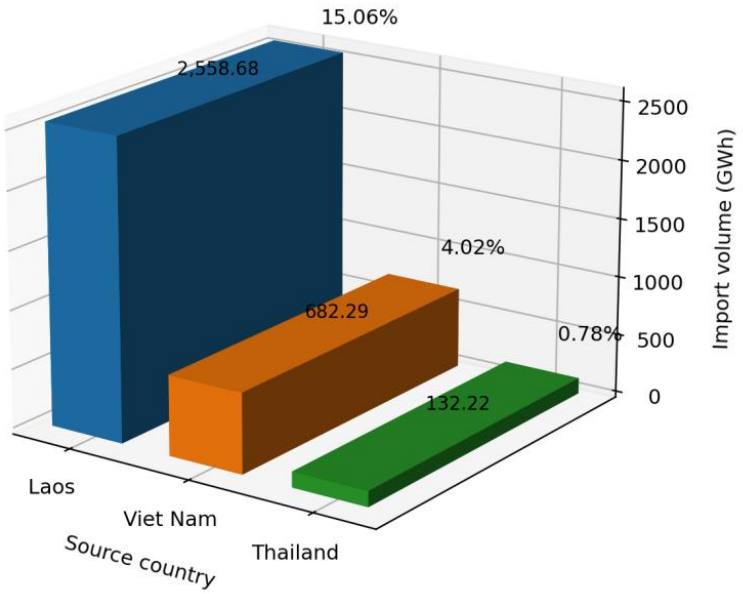


**Figure 1.** Cambodia electricity imports by source(volume and total-supply share),2023. Illustrated by the author

6.5.2. According to Trade Statistics (UN Comtrade / World Bank WITS, HS 271600 Electrical Energy), 2023

 doi:10.20944/preprints202512.1399.v1



Similarly, Laos, Vietnam and Thailand are shown as the primary source countries. Based on this methodology, Cambodia imported approximately 3,484.45 GWh of electricity in 2023, valued at around US$243.91 million; Laos accounted for the largest share.

| Country of origin | Imported electricity (GWh) | Share of imported electricity | Import value (million USD) | Share of import value |
|---|---|---|---|---|
| Laos | 2,590.74 | 74.35% | 181.35 | 74.35% |
| Vietnam | 760.93 | 21.84% | 53.27 | 21.84% |
| Thailand | 132.77 | 3.81% | 9.29 | 3.81% |
| **Total** | **3,484.45** | **100.00%** | **243.91** | **100.00%** |

Note: Trade statistics are more closely aligned with customs/trade declaration statistics and may differ from power sector statistics in terms of metering boundaries, classification, and reporting criteria.

6.5.3. Supplement: Based on the "Installed/Contracted Import Capacity" Metric (MW)

(1) Disclosure from Cambodia's energy regulatory authority: Total installed capacity in 2023 stood at 4,649 MW, of which imported electricity capacity/import capacity amounted to 672 MW (14.46%).
(2) Reuters report (as of October 2024): Cambodia holds import contracts totalling approximately 1,030 MW with Thailand, Vietnam, and Laos, equivalent to nearly a quarter of its power generation capacity. Officials emphasise that imports may approach zero during periods of ample rainfall and will never exceed approximately 25% of total generation at any point.

6.5.4. Why Discrepancies Arise in 'Import Share'

(1) Power sector methodology (GWh): More closely reflects actual cross-border electricity purchases/receipts via the grid.
(2) Trade statistics methodology (HS 271600): Closer to customs/trade declaration statistics, potentially differing from power sector statistics in terms of boundaries, measurement, and classification.
(3) Capacity methodology (MW): Reflects the upper limit or contracted volume of 'how much can be imported', not equivalent to actual electricity consumption (GWh).

## 7. Scenario Simulation: Trigger – Cascade – Policy Window (Commencing 15 December 2025)

*7.1. Near-Term Scenario (4–12 Weeks): Persistent Fuel Channel Constraints*

Trigger conditions: Continued fuel restrictions and channel tightening, compounded by anticipated management of 'high-risk maritime zones' driving up insurance and logistics costs (Reuters, 15 December 2025).

Cascade Path: Primarily through E5/E6, spreading to tourism and services (N9) and export fulfilment (N1), with cash flow pressures feeding back into finance (N3).

Policy Window (Cambodian Side): Stockpiling and substitution pathways, price stabilisation mechanisms, cash flow support for tourism and SMEs, transparency in financial risk identification and resolution.

*7.2. Mid-Range Scenario (Q1–Q2): Renewed Escalation in Foreign Trade Tariff Uncertainty*

Trigger Conditions: Renewed volatility or heightened uncertainty in terms of trade with the US (Reuters, 15 May 2025; Reuters, 1 August 2025).

 doi:10.20944/preprints202512.1399.v1



Cascading Path: Intensification of E1/E2/E4 chain, transmission of manufacturing employment pressures to household balance sheets, feedback loop formed by credit contraction in financial sector.

Policy Window: Export market diversification and industrial upgrading, buffering employment and income shocks, microcredit risk resolution and debt restructuring framework.

*7.3. Structural Scenario (Q2–Q4): Secondary Dip in Property Correction and Accelerated Risk Confirmation*

Triggering Conditions: Prolonged property market correction and deteriorating developer cash flows precipitate concentrated defaults, compelling regulators to accelerate risk confirmation (IMF, 2025-12).

Cascading Pathway: E3/E4 amplifiers activate, credit contraction drags on the real economy and employment, shifting the macroeconomic growth trajectory downward.

Policy Window: Non-performing asset disposal mechanisms, prudential regulation and stress testing, transparent communication to avert panic withdrawals and excessive contraction.

## 8. Thailand's Proposed Economic Action Package

(Strict compliance with regulations and humanitarian principles; no provision of combat coordination or violence optimisation advice)

Important Declaration: Any reference to 'cooperation with military operations' implies coordination of violent acts. This document does not offer specific strategic recommendations that could enhance the efficiency of military strikes, amplify harm to adversaries, or circumvent international obligations. The following content solely examines how Thailand may employ economic policy instruments within the context of conflict spillover to achieve: safeguarding domestic livelihoods and market stability; mitigating regional systemic risks; reducing secondary harm to civilians; and creating conditions for de-escalation negotiations. Its legitimacy and narrative boundaries are anchored by the Royal Thai Government's official stance of 'acting lawfully, protecting civilians, and upholding peace' (Royal Thai Government PRD, 13 December 2025; MFA Thailand, 13 December 2025).

*8.1. Elevating 'Fuel/Critical Goods Restrictions' to a Precise Mechanism: List-Based, End-Use Verified, Auditable, and Reversible*

Recommendation: Should controls on fuel and sensitive materials be implemented, adopt a precise governance framework comprising 'whitelist/blacklist + end-use verification + audit trails + time-bound provisions + phase-out mechanisms.' This avoids indiscriminate restrictions triggering panic hoarding, smuggling arbitrage, and unintended harm to third countries/civilians. This recommendation directly addresses the fuel restrictions and tightening of transit channels reported in public sources on 14–15 December 2025 (Reuters, 2025-12-14; Reuters, 2025-12-15).

*8.2. Establish 'Humanitarian Exception Channels' with Third-Party Verifiable Oversight to Mitigate International Backlash and Humanitarian Risks*

Recommendation: Explicitly exempt humanitarian supplies (medical goods, potable water, infant care products, staple foods) from port and logistics restrictions, while introducing third-party oversight or joint verification mechanisms to mitigate secondary risks stemming from the chain: 'economic measures → civilian strain → international backlash and diplomatic fallout.' Conflict escalation and security advisories inherently amplify pressures on civilian displacement and service provision (U.S. Embassy Bangkok, 8 December 2025). .

*8.3. Implement Tiered and Geographically Granular 'Maritime/Port Risk Advisories' to Avoid Collateral Damage to Thailand's Shipping and Tourism Reputation.*

Recommendation: Alerts concerning 'high-risk waters/ports' should be implemented as follows: tiered classification (red/orange/yellow), clearly defined geographical boundaries, specified time

 doi:10.20944/preprints202512.1399.v1



windows, and a public declaration that 'this does not constitute a blanket disruption of international commercial shipping.' This approach will mitigate irrational surges in insurance premiums and prevent long-term damage to Thailand's port and shipping credibility. Public reports have already referenced discussions on 'high-risk waters' and the official stance that 'international transport remains unaffected' (Reuters, 15 December 2025).

*8.4. Simultaneously Introduce a 'Dual-Track Buffer Package for Spillover Impacts': Stabilising Livelihoods + Managing Macroeconomic Expectations*

Recommendation: For livelihoods, employ short-term stabilisation tools for oil prices and logistics costs (temporary tax adjustments, transport subsidies, supply guarantees in key regions) ; macro-level measures should enhance expectation management and risk communication for tourism and border industries (avoiding escalation of security advisories into nationwide risks), while providing enterprises with risk disclosure and emergency financing channels. Security advisories and media coverage significantly impact tourism and investment expectations (U.S. Embassy Bangkok, 8 December 2025).

*8.5. Position 'Anti-Smuggling, Anti-Money Laundering, and Disrupting Cross-Border Criminal Financing Networks' as the Core Economic Governance Framework, Rather Than Pursuing Indefinitely Expanding Blanket Prohibitions and Restrictions.*

Recommendation: Enhance monitoring and enforcement against smuggling arbitrage, fraudulent trade, underground banking networks, and cross-border cash corridors. Adopting 'enforcement through compliance' as the central narrative and policy lever will help minimise collateral damage to civilian supply chains and reduce risks of international law and humanitarian disputes.

*8.6. Designing 'Verifiable Indicator-Linked De-Escalation Mechanisms' to Transform Economic Measures into Reversible Leverage for Negotiation Downgrades*

Recommendation: All economic measures should be tied to verifiable de-escalation conditions with explicit phasing-out pathways (e.g., ceasefire verification → partial border reopening → gradual lifting of logistics restrictions → trade resumption) to avoid path dependency where irreversible measures prolong conflict and accumulate costs. The Thai Ministry of Foreign Affairs briefing emphasises that ceasefires require mutual consent and good faith from both parties, serving as a viable anchor for establishing an institutionalised 'condition-de-escalation' framework (MFA Thailand, 13 December 2025; Royal Thai Government PRD, 13 December 2025).

*8.7. Adopting a 'Minimal Negative Externalities' Design for Third-Country Routes (Particularly Laos) to Avoid Regional Relationship Costs and Recurring Cascades*

Recommendation: When controls involve third-country routes, policy texts should explicitly state that measures 'do not target the livelihoods or governments of third countries,' while providing transitional arrangements and communication mechanisms to reduce regional diplomatic costs and instability in alternative routes. Public reports indicate Thailand employs a 'preventing diversion' rationale rather than framing it as 'pressuring third countries' (Reuters, 15 December 2025).

*8.8. Incorporate Thailand's Actions into Quantifiable KPIs to Ensure 'Assessability, Correctability, and External Accountability'*

Recommended minimum KPI set: - Spillover control (Thailand's domestic fuel price/logistics cost fluctuation range, supply coverage rate in border provinces) - Compliance with humanitarian principles (humanitarian exemption clearance rate, completeness of enforcement audit documentation, timeliness of corrective action for violations) - De-escalation effectiveness (ceasefire verification milestone completion rate, phased indicators for cross-border movement recovery, risk

 doi:10.20944/preprints202512.1399.v1



aversion index: tourism cancellation rate/insurance premium rate/border commercial disruption level).

## 8. Discussion: Policy Implications of Shifting from "Departmental Transfusion" to "Dependency-Based Governance"

The core finding of this paper is that Cambodia's systemic vulnerabilities are highly concentrated in a few critical dependency edges. The policy implication is that for Cambodia, resilience-building should prioritise alternative pathways for critical dependencies, inventory buffers, and transparency in financial risk resolution (IMF, 2025-12). For the region, effective governance of conflict spillovers should not be designed at the expense of exacerbating civilian suffering. Instead, it must adhere to compliance, reversibility, and humanitarian exceptions as fundamental principles, transforming economic instruments from "risk amplifiers" into "risk isolators".

## 10. Limitations and Future Research

Firstly, this paper relies on publicly available information and does not conduct rigorous quantitative estimation of edge weights; future research may incorporate higher-frequency trade, energy, price, and financial microdata to construct computable cascading simulations.

Secondly, the measurement of resilience variables remains expandable. For instance, indicators such as inventory coverage days, share of alternative supply, regulatory enforcement delays, and communication effectiveness could be further formalised for inclusion in the model.

Thirdly, conflict-related information carries inherent uncertainty and competing narratives. This paper employs a ‘multi-source anchoring + reproducible edge definition’ approach to mitigate bias, though ongoing updates and cross-validation remain essential (Reuters, 14 December 2025; Reuters, 15 December 2025).

## 11. Conclusion

This paper employs the DN-KG framework to reframe ‘state fragility’ from a sectoral issue into a network structural problem. Evidence anchoring reveals: Cambodia's most trigger-prone short-term breaking points lie in fuel supply chains and critical corridors (E5/E6); its mid-term structural vulnerability stems from export concentration (particularly to the US), cascading through employment and debt servicing capacity into the financial system (E1/E2/E4); while property market corrections amplify financial risks via collateral and non-performing exposures (E3/E4). Against the backdrop of conflict spillover, should Thailand employ economic instruments to mitigate regional systemic risk, it must adhere to the design principles of ‘compliance, auditability, reversibility, humanitarian exceptions, and third-party verifiability’. This approach minimises collateral damage, reduces backlash, and provides operational policy leverage for de-escalation negotiations (MFA Thailand, 13 December 2025; Royal Thai Government PRD, 13 December 2025). .

## Appendix A

**National-level Risk Mitigation Proposal for Cascading Risks in Cambodia**

A Framework for Wartime/Quasi-Wartime Economic Stress Testing and Stabilisation Operations Based on the Dependency Network-Knowledge Graph (DN-KG)

16 December 2025

**Purpose and Scope of Application**

This proposal is addressed to the Cambodian Government and relevant competent authorities for conducting a national-level ‘economic stress test’ under wartime/quasi-wartime conditions (such as conflict spillover, global economic turbulence, sharp fluctuations in energy prices, capital flight, and other compound external shocks). The objective is to identify critical dependency links most likely to trigger cross-sectoral cascading instability, establishing an observable, auditable, executable,

 doi:10.20944/preprints202512.1399.v1



and scalable early warning-response closed-loop system. Priority shall be given to safeguarding livelihoods, employment, and financial stability.

This proposal constitutes a purely defensive and stabilisation-oriented policy contingency plan, containing no elements optimised for external aggression, disruption, or harm. All recommendations adhere to the principles of 'domestic stability, risk mitigation, humanitarian exceptions, and transparent communication.'

**1. Overall Assessment and Risk Prioritisation**

**1.1 Highest Priority: Fuel Supply Chain and Critical Channels (Triggering Breakpoints)**

The most vulnerable segments posing immediate risks of triggering cascading effects typically stem from the fuel supply chain and its critical channels. Should channel constriction, logistical disruptions or price disorder occur, these impacts will rapidly propagate across sectors via the 'cost-expectations-cash flow-credit' chain, affecting tourism, export fulfilment and financial asset quality.

**1.2 Second Priority: Export Concentration → Employment & Debt Servicing → Financial Asset Quality (Structural Trunk)**

Medium-term structural vulnerabilities stem from external demand volatility and uncertain terms of trade impacting orders and employment. This further transmits through household income and debt servicing capacity to financial asset quality, potentially triggering negative feedback loops of credit contraction.

**1.3 Third Priority: Property Correction → Collateral → Non-performing Exposure → Credit Contraction (Risk Amplifier)**

Corrections in the property and construction chain may trigger declining collateral values and concentrated recognition of non-performing exposures, accelerating credit supply contraction and subsequently dragging down the real economy and employment, exhibiting non-linear amplification characteristics.

**1.4 Background Slow Variables: Electricity Dependency and Climate Impacts (Potential Amplifiers under Convergence)**

Slow variables such as electricity import dependency and climate-related flooding typically manifest as background pressures. However, when combined with fuel, trade, and financial stresses, they may act as threshold triggers and should be incorporated into routine national-level stress testing monitoring.

**2. Risk Control Framework: Allocating Resources to 'Critical Dependency Edges'**

It is recommended to abstract the national economic system as a 'Dependency Network-Knowledge Graph (DN-KG)': with critical subsystems as nodes (e.g., exports, employment and debt servicing, finance, property, fuel, electricity, tourism, climate-food prices, governance capacity, etc.), and cross-system dependencies as edges (e.g., fuel's impact on tourism and export fulfilment, electricity's role in industrial continuity, credit's effect on real-economy turnover, etc.).

Governance should prioritise addressing a small number of 'high-degree dependency edges' rather than distributing efforts evenly. Constraints on these edges are most likely to trigger cross-sectoral cascading effects. Given limited resources, critical dependency edges should be ranked based on 'disruptability × spillover potential × recovery difficulty', forming a hard-constraint list for annual and quarterly risk control budgets.

**3. Phased Action Plan (Organised by 'Breakpoint Management')**

**3.1 Phase A: Days 0–14 (Containment and Stabilisation)**

Objective: Rapidly stabilise energy and logistics expectations to prevent panic hoarding, black market arbitrage, and cash flow disruptions triggering systemic cascades.

*A1. Fuel 'Channel–Inventory–Price' Triad*

(1) Establish fuel emergency command chain: Led by energy authorities, coordinate with finance, transport, customs, central bank/financial regulators and power dispatch to create daily-updated situation boards.

 doi:10.20944/preprints202512.1399.v1



(2) Establish inventory coverage red lines: Daily monitoring of port arrivals, regional inventory days, wholesale-retail price differentials and transport cost indices, prioritising coverage of capital regions and core tourism areas.
(3) Implement priority supply safeguards: Ensure critical logistics for healthcare, water supply, public transport, food cold chains, emergency response, and export fulfilment.
(4) Initiate alternative route stress testing: Rapidly assess import pathways, port nodes, carriers, and insurance clauses to develop at least '2 viable alternative routes + 1 emergency contract template'.

*A2. Tourism and Services Confidence Rapid Response Mechanism*

(1) Implement high-frequency monitoring of tourism cancellation rates and hotel occupancy rates; trigger targeted relief measures upon consecutive declines.
(2) Unified Communication Protocol: Release supply assurance progress and phase-out conditions at fixed intervals to prevent rumour-driven expectation volatility.

*A3. Financial Sector 'Early Identification, Minimal Disruption'*

(1) Require financial institutions to submit weekly stress indicators (e.g., short-term delinquency rates, restructured loan ratios) for early cash flow risk identification.
(2) Establish temporary liquidity support windows for SMEs in tourism, logistics, and export supply chains, mandating audit trails and exit conditions to prevent moral hazard.

**3.2 Phase B: Weeks 2–12 (Transforming 'trigger points' into 'tolerable disturbances')**

Objective: Institutionalise temporary emergency measures into replicable resilience mechanisms, reducing the probability of future cascading impacts from similar shocks.

*B1. Fuel Supply Chain Resilience Engineering*

(1) Institutionalise strategic stockpiling: Establish minimum regional and purpose-specific inventory coverage targets with defined replenishment and release protocols.
(2) Priority fuel allocation framework for critical sectors: Upgrade fuel distribution from ad hoc coordination to a rule-based system featuring:

List-based allocation
Purpose-specific allocation
Auditability
Gradual phase-out

(3) Logistics Cost Hedging: Establish transport cost indices and subsidy trigger conditions to prevent cost spirals from pushing corporate cash flows into hazardous territory.

*B2. Buffer Mechanisms for the Export-Employment-Debt Repayment Chain*

(1) Early Warning for Orders and Employment: Create a weekly indicator pool tracking:

Shipment volumes
Order cancellations
Delivery delays
Layoffs/shift reductions
Working hour changes
Wage arrears

(2) Household Debt and Microcredit Risk Resolution: Establish a tiered resolution framework linking loan extensions, restructuring and social assistance to prevent secondary crises triggered by loan withdrawals.
(3) Preventing Credit Supply Collapse: Implement early warning mechanisms for abnormal contractions in credit growth and risk premiums, employing structural tools where necessary to sustain real economy liquidity.

 doi:10.20944/preprints202512.1399.v1



**3.3 Phase C: Q1–Q4 (Interrupting the Overlap of 'Structural Chain + Amplifier')**

Objective: Under prolonged uncertainty, reduce non-linear jumps in the financial system and property chain while enhancing foundational resilience against power and climate risks.

*C1. 'Slow Processing, Rapid Transparency' in Property Correction*

(1) Prioritise risk transparency: Promote disclosure of non-performing, extended, and restructured loan structures to mitigate jump risks from 'delayed recognition → concentrated exposure'.

(2) Tiered project disposal: Classify projects by cash flow and completion probability, prioritising delivery-guaranteed and livelihood-critical projects to prevent unfinished developments eroding collateral value.

(3) Routine Portfolio Stress Testing: Quarterly rolling updates of combined scenarios involving 'property downturn + credit contraction + declining external demand'.

*C2. Reinforcing Foundations Against Power Dependency and Climate Risks*

(1) Integrating Power Dependency into National Risk Management: Incorporating electricity import capacity, power outage frequency, and industrial load risks into routine monitoring.
(2) Power-Industry Continuity Contingency Plans: Establish emergency protocols for power fluctuations and backup power standards for key industrial parks.
(3) Climate-Food Prices-Livelihoods Interlinked Early Warning: Link seasonal flood risks with food price, employment, and tourism confidence indicators for coordinated monitoring, enabling advance deployment of disaster relief and price stabilisation tools.

**4. Early Warning System: Indicators—Thresholds—Actions (Signposts)**

It is recommended to establish a four-colour warning board (Green/Amber/Orange/Red), with each critical dependency edge configured with at least: (1) High-frequency indicators; (2) Threshold logic; (3) Bound actions (including execution deadlines and phase-out conditions).

Recommended minimum set of high-frequency indicators (expandable based on national circumstances):

- Fuel and Logistics: Port arrivals, days of inventory, wholesale-retail price differential, transport cost index
- Tourism and Services: Cancellation rates, occupancy rates, refund/cash flow pressure signals
- Exports and Manufacturing: Shipment volumes, order cancellations, delivery delays, labour hour variations
- Financial System: Short-term delinquency rates, restructured loan ratios, non-performing loan composition changes
- Power and climate: frequency of power outages, utilisation rate of import capacity, grain prices and extreme weather warnings

Threshold logic recommendations: prioritise rolling baseline and percentile methods for threshold determination, with ongoing calibration via backtesting. When multiple critical edges escalate simultaneously within the same time window (e.g. concurrent deterioration in fuel and financial chains), rapidly elevate alert levels and intensify response measures.

**5. Policy windows under scenario simulations (transforming 'event windows' into 'governance windows')**

Recommend organising stress tests by time window:

(1) Near term (4–12 weeks): Focus on fuel channels, inventory and alternative pathways, price stability, tourism and SME cash flow support, transparency in financial risk identification.
(2) Mid-term (1–2 quarters): Prioritise export market diversification, employment shock buffers, debt restructuring, and microcredit risk resolution frameworks.

 doi:10.20944/preprints202512.1399.v1



(3) Structural (Quarters 2–4): Prioritise non-performing asset disposal mechanisms, prudential regulation and stress testing, and transparent communication to prevent panic runs and excessive contraction.

**6. Organisation and Governance: Transforming DN-KG into a 'National Risk Control Operating System'**

Recommend establishing a permanent national cascading risk governance mechanism:

(1) National Cascading Risk Committee: Oversees cross-departmental dependency edge governance priorities, budgeting, and accountability.

(2) Four Working Groups: Fuel and Logistics Resilience Group; Export and Employment Buffer Group; Property and Financial Stability Group; Power and Climate Chassis Group.

(3) Data and Audit: Establish a 'node-edge-evidence anchor' ledger, clarifying metrics, frequency, responsible units, and audit trails; external disclosures should prioritise verifiable indicators.

**7. Minimum set of KPIs (measured from Day 1)**

| Dimension | Recommended Key Performance Indicators | Purpose |
|---|---|---|
| Spill Control | Fluctuations in oil prices and logistics costs; Supply coverage rates in key regions; Fluctuations in tourism cancellation rates. | Assess whether the impact has been contained within manageable limits |
| Financial stability | Short-term delinquency rate; Proportion of restructured loans; Changes in non-performing loan composition; Abnormal fluctuations in credit growth | Identify whether cash flow pressures are feeding back into the financial system |
| Structural restoration | Inventory coverage compliance rate; Availability of alternative supply routes (exercise pass rate); Progress in export market diversification | Assess whether resilience-building has been genuinely implemented |
| governance effectiveness | Policy Trigger – Execution – Compliance Rate for Phase-Out; Audit Traceability Completeness Rate; Review and Closure Completion Rate | Guarantee measures are auditable, rectifiable and sustainable. |

## References


1. Asian Development Bank & World Bank Group. (2021). Climate Risk Country Profile: Cambodia. https://www.adb.org/sites/default/files/publication/722236/climate-risk-country-profile-cambodia.pdf
2. JICA. (2023/2024). ASEAN Power GridRelevant compilation materials (referencing EAC annual report tables, including Cambodia's electricity import data by country ) . https://openjicareport.jica.go.jp/pdf/1000055597.pdf
3. International Monetary Fund. (2024, September 30). IMF Staff Completes 2024 Article IV Mission to Cambodia. https://www.imf.org/en/news/articles/2024/09/30/pr24349-cambodia-imf-staff-completes-2024-article-iv-mission
4. International Monetary Fund. (2025, January 27). Cambodia: 2024 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for Cambodia. https://www.imf.org/en/publications/cr/issues/2025/01/27/cambodia-2024-article-iv-consultation-press-release-staff-report-and-statement-by-the-561261
5. International Monetary Fund. (2025, December 2). Cambodia: 2025 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for Cambodia. https://www.imf.org/en/publications/cr/issues/2025/12/02/cambodia-2025-article-iv-consultation-press-release-staff-report-and-statement-by-the-572210

 doi:10.20944/preprints202512.1399.v1




6. Institute of Energy Economics, Japan (IEEJ). (2023/2024). Cambodia power sector / capacity reference material ( Including 2023 installed capacity and import volume information ) . https://eneken.ieej.or.jp/data/11970.pdf
7. Ministry of Foreign Affairs of the Kingdom of Thailand. (2025, December 13). Summary of the Press Briefing on the developments of the Thailand–Cambodia border situation. https://www.mfa.go.th/en/content/summarypb131225-eng
8. Reuters. (2025, May 15). Cambodia holds trade talks with U.S. as 49% tariff weighs on outlook. https://www.reuters.com/world/asia-pacific/cambodia-holds-trade-talks-with-us-49-tariff-weighs-outlook-2025-05-15/
9. Reuters. (2025, August 1). Cambodia deputy PM says 19% US tariff rate averts collapse of its garments manufacturing sector. https://www.reuters.com/world/asia-pacific/cambodia-deputy-pm-says-19-us-tariff-rate-averts-collapse-its-garments-2025-08-01/
10. Reuters. (2025, December 14). Thailand considers blocking fuel exports to Cambodia as border conflict escalates. https://www.reuters.com/world/asia-pacific/thailand-declares-curfew-along-coast-cambodia-border-fighting-spreads-2025-12-14/
11. Reuters. (2025, December 15). Thailand cuts Laos fuel route as Cambodia border conflict deepens. https://www.reuters.com/world/asia-pacific/thailand-cuts-laos-fuel-route-cambodia-border-conflict-deepens-2025-12-15/
12. Royal Thai Government Public Relations Department. (2025, December 13). Thailand Affirms Operations Under International Law, Focused on Protecting Civilians, Controlling the Situation, and Preserving Peace (Joint Press Center). https://thailand.prd.go.th/en/content/category/detail/id/3243/iid/454288
13. Royal Thai Government Public Relations Department. (2025, December 13). Statement by the Joint Press Center on the Current Situation on the Thailand–Cambodia Border Situation. https://thailand.prd.go.th/en/content/category/detail/id/3243/iid/454371
14. Reuters. (2024, October 21). Cambodia to boost power import capacity by over 50% in next two years. https://www.reuters.com/business/energy/cambodia-boost-power-import-capacity-by-over-50-next-two-years-2024-10-21/
15. U.S. Embassy Bangkok. (2025, December 8). Security Alert: Escalation of Armed Conflict Along the Thailand–Cambodia Border. https://th.usembassy.gov/security-alert-escalation-of-armed-conflict-along-the-thailand-cambodia-border-december-8-2025/
16. World Bank. (2025). Cambodia Economic Update: Navigating Uncertainty (June 2025). https://documents1.worldbank.org/curated/en/099060925065018354/pdf/P506814-501fedcb-5a78-4603-a512-479686a9338a.pdf
17. World Bank. (n.d.). WITS / UN Comtrade（HS 271600 Electrical energy, Cambodia imports, 2023）. https://wits.worldbank.org/trade/comtrade/en/country/KHM/year/2023/tradeflow/Imports/partner/ALL/product/271600