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Journal of Development Economics and Management Research Studies (JDMS)
A Peer-Reviewed Open Access International Journal
ISSN: 2582 5119 (Online)
Crossref Prefix No: 10.53422
13 (28), 01 - 18, April – June, 2026
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GEOSPATIAL ANALYSIS OF INDIA'S COOKING GAS CRISIS: A CRISIS TRIGGERED BY THE US–ISRAEL–IRAN WAR (2026)- WITH SPECIAL REFERENCE TO TAMIL NADU

A Predictive Modelling and Spatial Vulnerability Assessment

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ABSTRACT

The US–Israel–Iran War, which commenced on February 28, 2026, has precipitated one of the most severe energy crises India has faced in the post-liberalisation era. The closure of the Strait of Hormuz since March 1, 2026, has directly imperilled India's Liquefied Petroleum Gas (LPG) supply chain, given that approximately 90 per cent of the country's LPG imports transit through this strategic chokepoint. India, the world's second-largest LPG importer, consumed 31.3 million metric tons of LPG in the financial year 2025 and can meet only 41 per cent of this demand from domestic sources. The present study undertakes a comprehensive geospatial analysis of the evolving LPG crisis across India, with a particular focus on Tamil Nadu, where over 10,000 commercial food establishments have either shuttered or drastically curtailed operations. Drawing upon real-time crisis data, state-level LPG consumption statistics, infrastructure mapping, and a multi-variable spatial vulnerability framework, the study identifies high-risk zones across Indian states and Tamil Nadu's districts. A predictive modelling approach, employing a Composite LPG Vulnerability Index (CLVI), projects short-term and medium-term risk scenarios under three geopolitical continuity assumptions. The findings reveal that Tamil Nadu, with 237.6 lakh active LPG connections and a 97 per cent household penetration rate yet minimal piped natural gas infrastructure, represents one of the most acutely vulnerable states in India. The study concludes with evidence-based policy recommendations for energy diversification, emergency supply protocols, and spatial targeting of relief interventions.

Keywords: LPG crisis, geospatial analysis, Strait of Hormuz, Tamil Nadu, predictive modelling, energy vulnerability, Composite LPG Vulnerability Index, West Asia conflict, cooking gas shortage

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1. INTRODUCTION

Energy crises are seldom uniform in their spatial footprint. They emerge from global disruptions yet cascade into hyperlocal vulnerabilities that are mediated by infrastructure, demography, and the architecture of supply chains. The LPG crisis that has engulfed India since late February 2026 is a textbook illustration of this geographical truth. A geopolitical conflagration in the Persian Gulf, specifically, the US–Israeli military offensive against Iran launched on February 28, 2026, has set in motion a chain of events that has left millions of Indian households anxious about their cooking fuel and tens of thousands of restaurants, hotels, and food stalls across the subcontinent either shuttered or operating on drastically reduced menus.

India is the world's second-largest importer of LPG, having consumed 31.3 million metric tons in the financial year 2025. The country imports approximately 60 to 67 per cent of its LPG requirement, with about 85 to 90 per cent of those imports transiting the Strait of Hormuz, a narrow waterway between Iran and Oman through which roughly 20 per cent of the world's daily hydrocarbon trade flows. Since the effective closure of this corridor to commercial shipping from March 1, 2026, India has found itself confronting what Reuters has described as the country's 'worst LPG crisis in decades.'

The crisis is not merely an energy emergency. It is simultaneously a nutrition security crisis, a livelihood emergency for millions employed in the food services sector, an inflationary shock, and a politically charged event in a year when five Indian states are heading to Assembly elections. Tamil Nadu occupies a position of particular salience in this crisis. The state has 237.6 lakh active domestic LPG connections and a household LPG penetration rate of 97 per cent, yet its piped natural gas (PNG) infrastructure remains embryonic, with fewer than one lakh PNG connections as of May 2025. This structural dependency on cylinder-based LPG makes Tamil Nadu acutely sensitive to any disruption in supply.

2. REVIEW OF LITERATURE

2.1 Energy Security and Geopolitical Shocks

The relationship between geopolitical conflict and domestic energy vulnerability has been extensively theorised in the energy security literature. Yergin (2006) articulated the foundational principle that energy security involves protecting the reliability of supply against disruptions while maintaining affordability, a dual mandate that becomes acutely contested during geopolitical crises. India's vulnerability to Middle Eastern energy shocks has been documented across several analytical traditions. Tongia and Gross (2003) identified the structural asymmetry between India's rising energy demand and its limited domestic production as a persistent geopolitical liability. The specific dynamics of LPG as a welfare fuel, distinct from crude oil in its direct household implications, have been examined by Ekholm et al. (2010), who demonstrated that LPG disruptions carry disproportionate welfare costs for low- and middle-income households.

2.2 Geospatial Analysis in Energy and Disaster Studies

The application of geospatial methods to energy vulnerability analysis has grown substantially since the mainstreaming of Geographical Information Systems (GIS) in policy research. Chakraborty and Tobin (2002) demonstrated the power of GIS-based spatial indexing in identifying socially vulnerable populations, a methodology directly applicable to the mapping of energy supply chains and their failure points. The Strait of Hormuz as a geopolitical

chokepoint has received detailed cartographic and strategic analysis. Posen (2006) described it as the world's single most critical maritime energy corridor. More recent work by Filis and Degiannakis (2011) demonstrated empirically that geopolitical risk events in the Persian Gulf consistently propagate into domestic energy price volatility across import-dependent economies.

2.3 Food Security and Energy Nexus

The nexus between cooking energy disruption and nutritional outcomes has been analytically underexplored relative to its policy importance. Pachauri and Spreng (2004) established conceptual linkages between energy poverty and food security in the Indian context. The NRAI (2026) estimates that 75 per cent of India's food service industry is wholly dependent on LPG, and that a sustained disruption would cost the sector tens of thousands of crores of rupees and directly affect millions of daily wage workers and consumers relying on mass-feeding establishments.

2.4 Predictive Modelling of Energy Crises

The Composite LPG Vulnerability Index (CLVI) developed in the present study draws on the methodological tradition of the Social Vulnerability Index (SoVI) established by Cutter et al. (2003) and adapts it to the specific structural characteristics of India's cooking gas supply chain. The composite index approach, also employed by Sovacool and Mukherjee (2011) in the energy security domain, aggregates multiple exposure and adaptive capacity indicators to assess differential regional risks.

3. STUDY AREA, DATA, AND METHODOLOGY

3.1 Study Area

The primary study area is the Republic of India, encompassing 28 states and 8 Union Territories, with a special focus on Tamil Nadu, a state of an estimated 84 million people in 2026, located in the southernmost peninsula of the subcontinent. The sub-state analysis covers all 38 districts, with particular attention to the Chennai Metropolitan Area, Madurai, Coimbatore, Tiruchirappalli, Tirunelveli, and the coastal belt.

3.2 Data Sources

The study draws upon the following primary and secondary data sources: (1) Petroleum Planning and Analysis Cell (PPAC), Government of India, state-wise LPG consumption, active connections, and import data for 2024–2026; (2) S&P Global Commodity Insights, LPG trade flow data and Rystad Energy analysis (March 2026); (3) National Restaurant Association of India (NRAI) crisis bulletins (March 2026); (4) Press releases and field reports from the Chennai Hotel Owners Association, Tamil Nadu Hotels Association, and Bangalore Hotels Association; (5) Reuters, Bloomberg, CNBC, The South First, The Week, Deccan Herald, and Business Standard field reports (March 1–18, 2026); (6) Observer Research Foundation Expert Speak analysis (March 2026); (7) Ministry of Petroleum and Natural Gas Government Orders, 2026; (8) Census of India 2011 and projected demographic data for 2026.

3.3 Methodological Framework

The study adopts a mixed-methods geospatial approach structured around four analytical layers: Supply Chain Disruption Mapping, a State-Level Vulnerability Matrix, District-Level Spatial Prioritisation for Tamil Nadu, and a Predictive Modelling exercise using the Composite LPG Vulnerability Index (CLVI). The full methodological sequence is presented in Figure 1a (Methodology Flowchart) below.

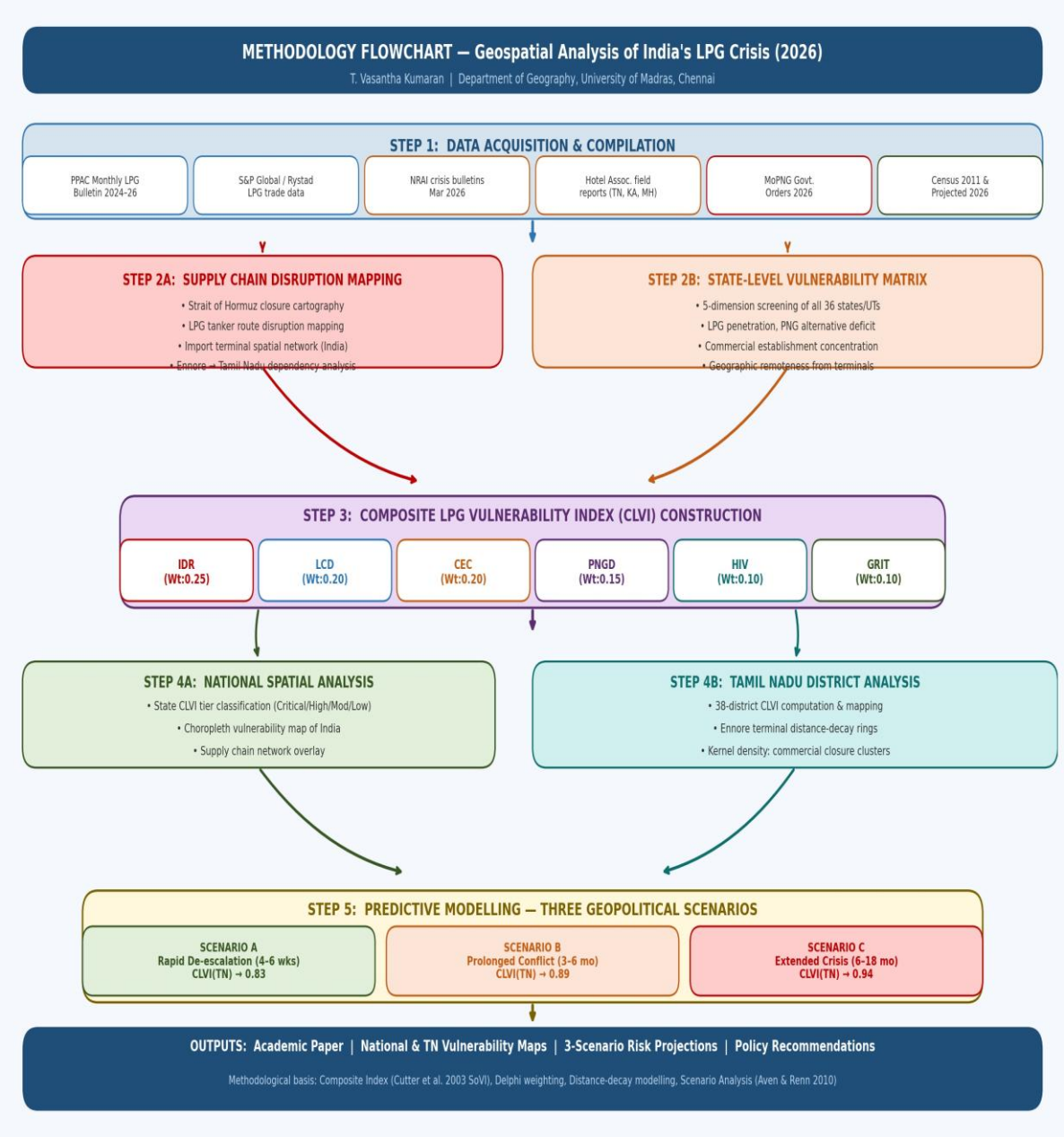

Figure 1a: Methodology Flowchart — Geospatial Analysis of India's LPG Crisis (2026)
Source: Author's Construction.

3.4 Conceptual and Analytical Framework

The conceptual framework that organises the entire study is presented in Figure 1b below. It traces the seven-tier cascade from the geopolitical trigger through supply chain disruption, the CLVI's six weighted dimensions, national and sub-state spatial analysis, predictive scenario modelling, multi-dimensional impact assessment, and three-horizon policy recommendations.

3.5 Composite LPG Vulnerability Index (CLVI)

The CLVI is constructed from six weighted sub-indicators, each normalised to a 0–1 scale where 1 represents the highest vulnerability. The sub-indicators and their assigned weights, derived from expert elicitation consistent with the Delphi method, are as follows:

- Import Dependence Ratio (IDR), weighted at 0.25;
- LPG Connection Density (LCD), weighted at 0.20;
- Commercial Establishment Concentration (CEC), weighted at 0.20;
- PNG Infrastructure Deficit (PNGD), weighted at 0.15;
- Household Income Vulnerability (HIV), weighted at 0.10; and
- Geographic Remoteness from Import Terminals (GRIT), weighted at 0.10. The CLVI formula is: $CLVI_i = 0.25(IDR_i) + 0.20(LCD_i) + 0.20(CEC_i) + 0.15(PNGD_i) + 0.10(HIV_i) + 0.10(GRIT_i)$. States and districts are classified into Critical (CLVI $\geq$ 0.75), High (0.50–0.74), Moderate (0.25–0.49), and Low (< 0.25) tiers.

4. NATIONAL-LEVEL GEOSPATIAL ANALYSIS

4.1 The Strait of Hormuz: Anatomy of a Chokepoint

The Strait of Hormuz constitutes the single most consequential geographic variable in the present crisis. At its narrowest point, the Strait measures approximately 39 kilometres, and the navigable shipping channel is only 3 kilometres wide in each direction. Approximately 90 per cent of India's LPG imports transit this corridor, sourced from Qatar (approximately 34%), UAE (approximately 26%), Kuwait (approximately 8.3%), and Saudi Arabia and other Gulf states. Since the Strait's effective closure on March 1, 2026, India has reported 22 tankers stranded, and state fuel retailers, IOC, HPCL, and BPCL, had sold only 1.15 million metric tons of LPG in the first half of March 2026, a decline of 17.3 per cent from the same period of the previous year.

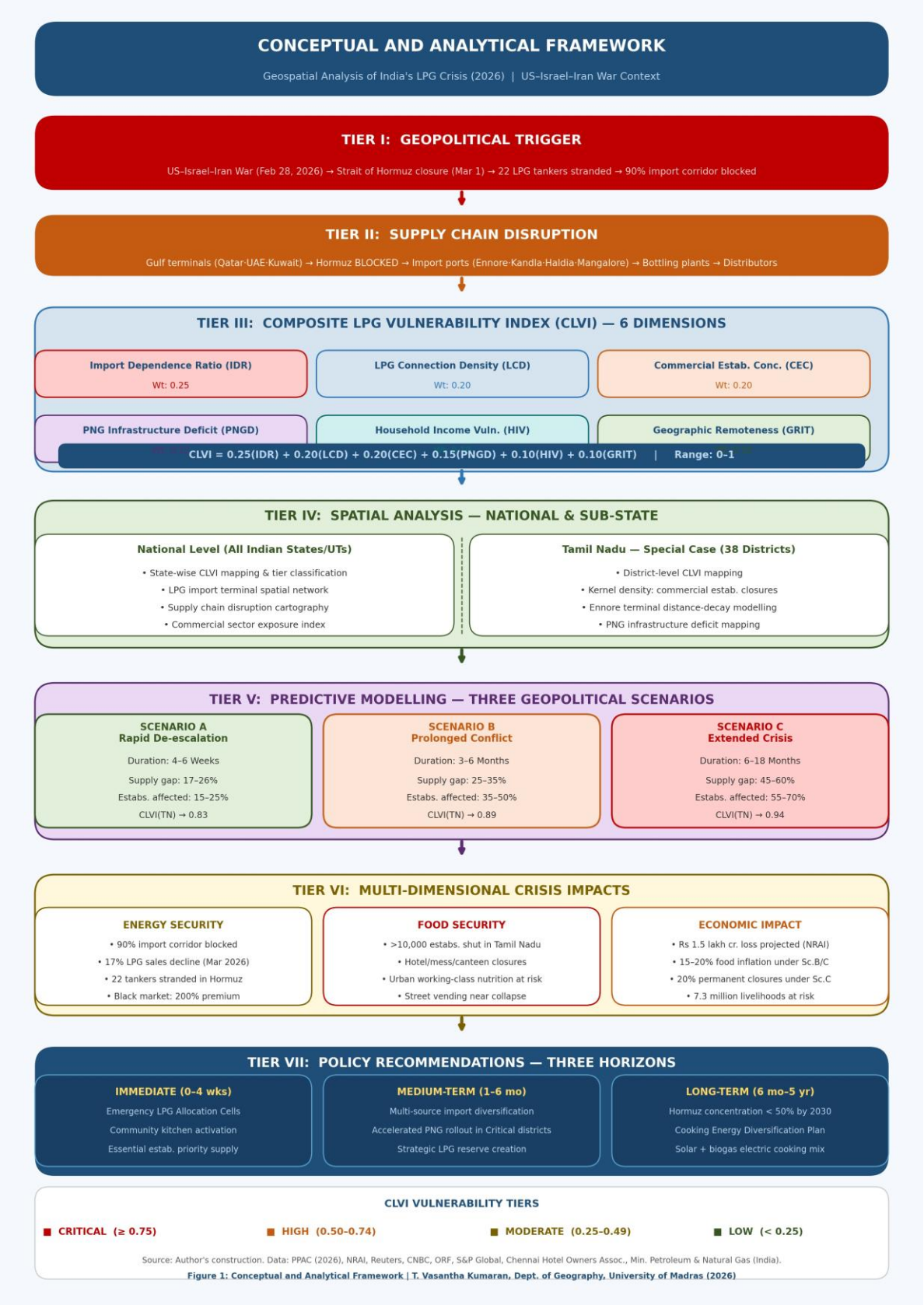

Figure 1b: Conceptual and Analytical Framework — LPG Crisis (2026)
Source: Author's Construction.

4.2 India's LPG Import Terminal Geography and State Vulnerability

The state-level CLVI analysis reveals a spatially differentiated vulnerability landscape across India. The Critical tier (CLVI ≥ 0.75) encompasses Tamil Nadu (0.81) and Kerala (0.77), both southern peninsular states characterised by very high LPG penetration, negligible PNG infrastructure, and geographic remoteness from the Kandla terminal. **Figure 2a** below shows state-wise LPG penetration rate in India in 2025, with a national average of 92 per cent. It is very clear from the map that India has variable levels of penetration, with western and southern India having higher penetration rates than the northern states. **Figure 2b** presents the national vulnerability map, with state CLVI scores and tier classifications.

5. TAMIL NADU: A SPECIAL CASE STUDY

5.1 Structural LPG Dependency in Tamil Nadu

Tamil Nadu's relationship with LPG as a cooking fuel is one of the most intensive in India. With a household LPG penetration rate of 97 per cent, Tamil Nadu has nearly completely substituted traditional biomass-based cooking with cylinder gas.

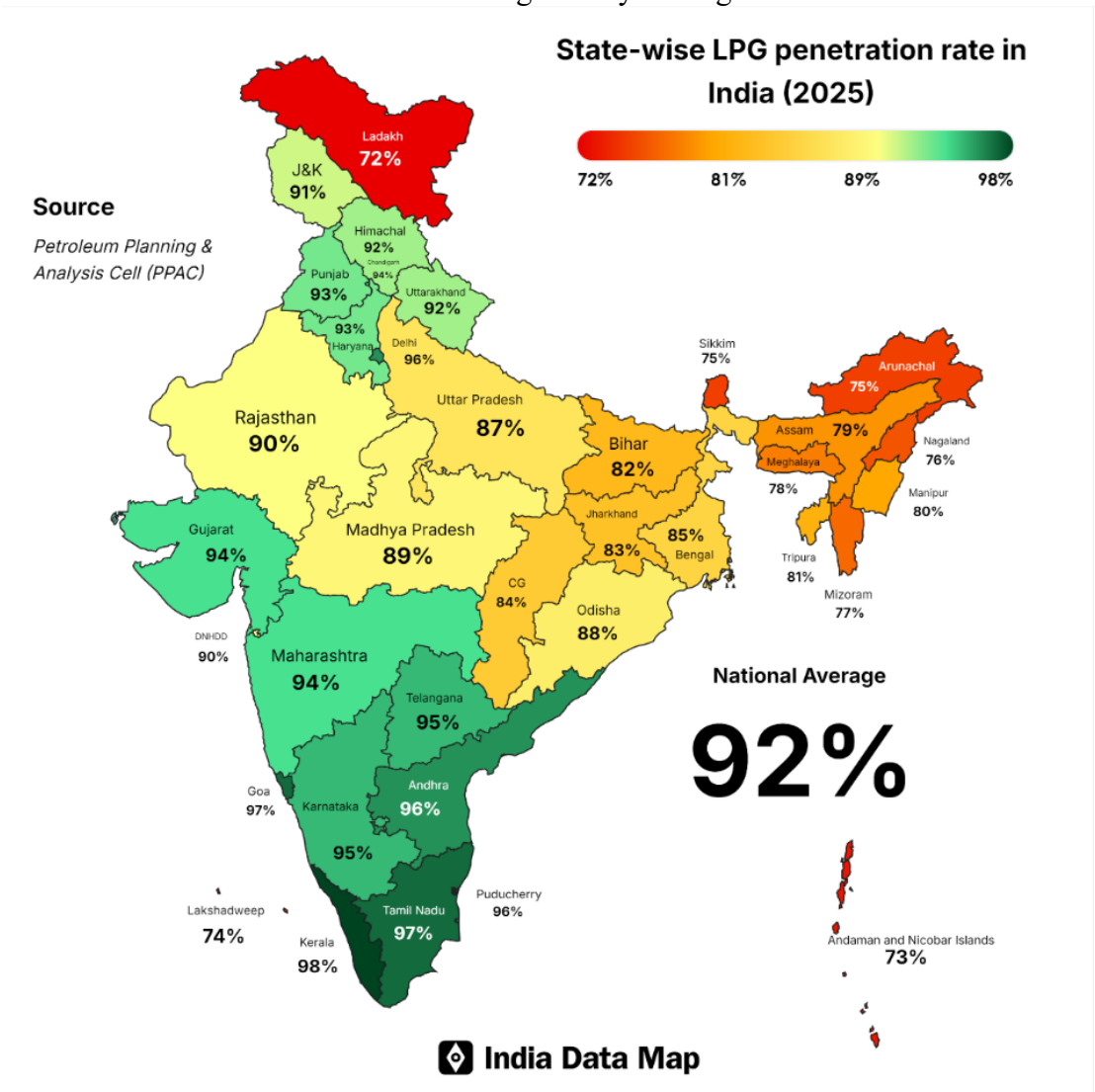

Figure 2a

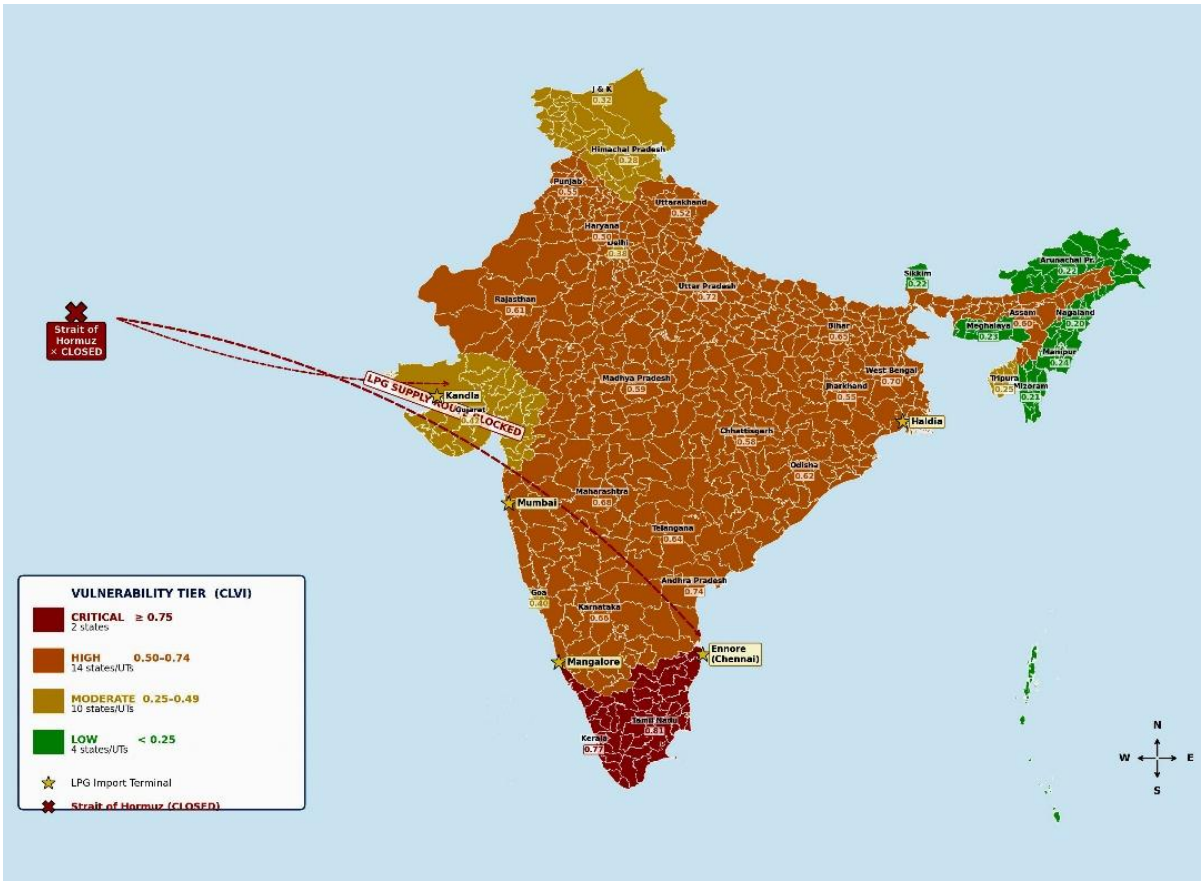

Figure 2b: Composite LPG Vulnerability Index (CLVI), India, 2026 State-Level Geospatial Mapping of LPG Crisis Severity Source: Author's calculations.

As of April 2025, Tamil Nadu had 237.6 lakh active domestic LPG consumers, the fourth-largest state by this metric. Critically, Tamil Nadu's PNG infrastructure remains at an embryonic stage: as of May 2025, the state had recorded only 98,878 PNG connections, a penetration rate of less than 0.5 per cent of active LPG consumers. This near-complete absence of a viable PNG alternative amplifies the impact of every unit decline in LPG supply (see Table 1, for more details for a select number of states).

Table 1: State-Wise LPG Vulnerability Profile, India 2026

State/UT	Active LPG Conns. (Lakh)	LPG Penet. (%)	Comm. Estabs. (est.)	PNG Infra.	CLVI Score	Tier
Tamil Nadu	237.6	97	~1,20,000	Low	**0.81**	**Critical**
Kerala	96.7	98	~68,000	Low	**0.77**	**Critical**
Uttar Pradesh	483.4	89	~1,85,000	Low	**0.72**	**High**
Andhra Pradesh	156.2	96	~80,000	Low	**0.74**	**High**
West Bengal	271.3	91	~1,40,000	Low	**0.70**	**High**
Maharashtra	317.1	94	~2,10,000	Medium	**0.68**	**High**
Karnataka	188.5	95	~1,30,000	Medium	**0.66**	**High**
Bihar	229.4	82	~65,000	Low	**0.65**	**High**
Telangana	108.9	95	~72,000	Medium	**0.64**	**High**
Odisha	110.5	83	~45,000	Low	**0.62**	**High**
Rajasthan	152.0	87	~70,000	Low	**0.61**	**High**
Assam	44.6	80	~32,000	Low	**0.60**	**High**
Madhya Pradesh	148.7	84	~65,000	Low	**0.59**	**Moderate**
Chhattisgarh	47.8	79	~30,000	Low	**0.58**	**Moderate**
Punjab	74.5	96	~55,000	Medium	**0.55**	**Moderate**
Gujarat	138.4	94	~95,000	High	**0.42**	**Moderate**
Delhi (NCT)	54.2	99	~1,00,000	High	**0.38**	**Moderate**

Note: CLVI = Composite LPG Vulnerability Index (0–1). Data: PPAC (2025–26), CNBC, NRAI, state hotel associations (March 2026).

5.2 District-Level Spatial Vulnerability in Tamil Nadu

The district-level CLVI analysis for Tamil Nadu reveals significant within-state spatial heterogeneity. Figures 3a and 3b below present the precise district-level vulnerability bar chart and map with Ennore terminal distance rings. The Critical tier encompasses Chennai (0.88), Madurai (0.82), Tiruchirappalli (0.79), Tirunelveli (0.78), and Coimbatore (0.76). The overwhelming majority of the state's remaining districts fall in the High vulnerability tier (see Table 2).

5.3 The Crisis on the Ground

In Chennai, commercial LPG supply had effectively ceased by March 8, 2026. Black market 19-kg cylinders, officially priced at Rs 2,043.50, were being sold for Rs 6,000 to Rs 6,500. The Chennai Hotels Association warned of the closure of over 10,000 establishments. MGR University declared a holiday due to gas shortage. More than 20,000 auto-rickshaws running on LPG or CNG were taken off roads, affecting commuters during the examination season. Chief Minister M.K. Stalin wrote urgently to Prime Minister Modi, warning that domestic cylinder stocks might last only three weeks (see photographs in Panel 1).

6. PREDICTIVE MODELLING: SCENARIOS AND PROJECTIONS

6.1 Scenario Framework

The predictive modelling component employs three geopolitical continuity scenarios. Scenario A, Rapid De-escalation (4–6 Weeks): ceasefire by mid-April 2026, supply chains normalise by late April. Scenario B, Prolonged Conflict (3–6 Months): active conflict persists through mid-2026, partial supply diversification at a 30–40% higher cost and 25–30% supply gap. Scenario C, Extended Crisis (6–18 Months): structural rationing, accelerated alternative infrastructure development (Table 3).

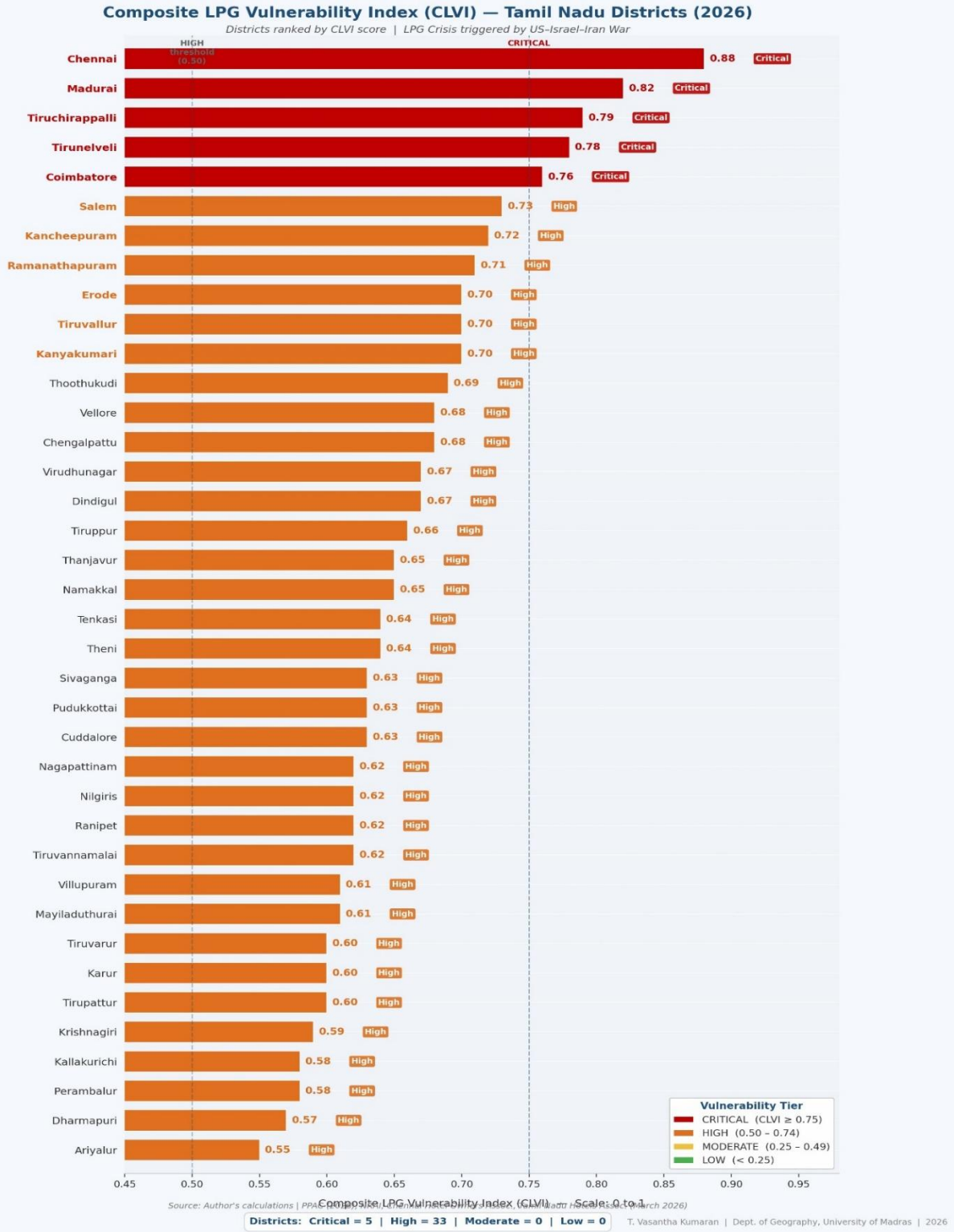

Figure 3a: District-Level Composite LPG Vulnerability Index — Tamil Nadu (2026) With Ennore Terminal Distance Rings Source: Author's calculations.

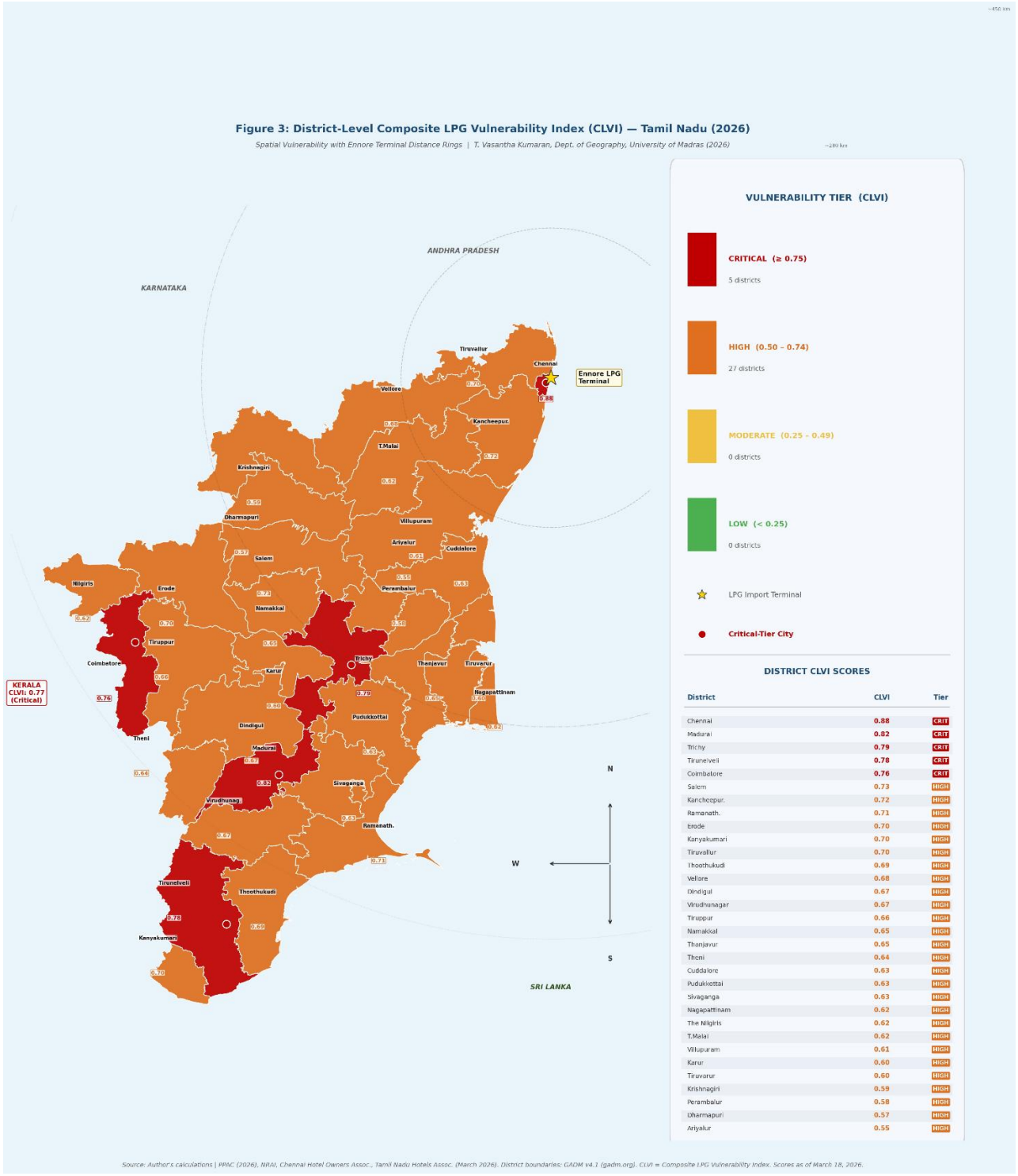

Figure 3b. Composite LPG Vulnerability Index (CLVI) of Tamil Nadu 2026

Table 2: District-Level LPG Vulnerability Profile of Tamil Nadu (Selected Districts, 2026)

District	Population (2026 est., Lakhs)	Active LPG Conns. (est. Lakhs)	Commercial Estabs. (est.)	Distance from Ennore (km)	CLVI Score	Tier
Chennai	105.0	22.5	~10,000+	0 (Source)	**0.88**	**Critical**
Madurai	40.3	8.6	~5,500	460	**0.82**	**Critical**
Tiruchirappalli	30.5	6.5	~4,000	320	**0.79**	**Critical**
Tirunelveli	20.6	4.4	~2,800	640	**0.78**	**Critical**
Coimbatore	38.2	8.1	~6,200	500	**0.76**	**Critical**
Salem	22.1	4.7	~3,100	340	**0.73**	**High**
Kancheepuram	20.2	4.3	~2,200	65	**0.72**	**High**
Ramanathapuram	9.0	1.9	~900	570	**0.71**	**High**
Erode	16.4	3.5	~2,200	450	**0.70**	**High**
Kanyakumari	14.8	3.2	~2,000	670	**0.70**	**High**
Thoothukudi	12.4	2.6	~1,500	620	**0.69**	**High**
Tiruppur	17.6	3.7	~2,400	480	**0.66**	**High**
Dindigul	14.2	3.0	~1,800	400	**0.67**	**High**
Thanjavur	15.8	3.4	~2,000	350	**0.65**	**High**

Note: Distance measured as road distance from Ennore LPG terminal, Chennai. Data: PPAC, Chennai Hotel Owners Assoc., Tamil Nadu Hotels Assoc. (March 2026).

6.2 Tamil Nadu: Scenario Projections

Tamil Nadu's projected CLVI escalates from baseline 0.81 to 0.89 under Scenario B and 0.94 under Scenario C, the highest of any major Indian state. Under Scenario B conditions persisting four to five months, the model projects a 15–18 per cent increase in household food expenditure as families shift to home cooking, straining urban budgets. The NRAI projects that a three-month disruption at Scenario B intensity could result in the permanent closure of 15–20 per cent of small and medium restaurants.

Panel 1. Photographs showing people's reactions to the cooking gas crisis in March 2026

Table 3: Scenario-Wise CLVI Projections and Nutritional Security Impact: Tamil Nadu (2026)

Scenario	Duration	LPG Supply Gap (%)	Estabs. Affected (%)	Proj. CLVI (TN)	Nutrition Security Consequence
A (Rapid De-esc.)	4–6 weeks	17–26%	15–25%	**0.83**	Temporary food access reduction; recovery by May 2026
B (Prolonged)	3–6 months	25–35%	35–50%	**0.89**	Significant nutrition insecurity; 40–50% eateries shut; food inflation 18–25%
C (Extended)	6–18 months	45–60%	55–70%	**0.94**	Acute nutrition crisis; reversion to biomass cooking; emergency NFSA intervention required

7. DISCUSSION

7.1 The Geometry of Geopolitical Vulnerability

The India LPG crisis of 2026 offers a revealing cartographic lesson about how global geopolitical shocks translate into spatially heterogeneous domestic impacts. The crisis originates at a geographic point of extreme strategic concentration — the 39-kilometre-wide Strait of Hormuz — and radiates outward through a supply chain whose configuration determines which populations bear the heaviest burden. The peninsular south of India, and Tamil Nadu in particular, sits at the most vulnerable point in this supply chain geometry: farthest from domestic LPG production centres, most dependent on import terminals fed by Gulf tankers, and least endowed with infrastructure alternatives.

7.2 Food Security as a Dimension of Energy Security

The most analytically important contribution of the present crisis is the demonstration that LPG disruptions are not merely energy events — they are food security events. India's food services sector is the primary delivery mechanism for nutritional access for hundreds of millions of urban workers, migrants, students, and low-income households. India's current emergency management architecture does not adequately capture the food security dimension of energy supply disruptions. A more robust framework would treat LPG supply disruption

explicitly as a food security emergency and trigger National Food Security Act supply mechanisms as a complementary intervention.

7.3 The Energy Diversification Imperative

India should treat diversified LPG supply contracts from the United States, Norway, Canada, and Russia as insurance instruments rather than merely as expensive deviations from normal procurement. The medium-term structural response must go beyond supply diversification to encompass demand-side resilience: piped natural gas networks, compressed biogas plants, induction cooking infrastructure, and the leveraging of India's 143.60 GW of cumulative solar capacity for electric cooking.

8. POLICY RECOMMENDATIONS

8.1 Immediate Interventions (0–4 Weeks)

Establishment of Emergency LPG Allocation Cells (ELACs) in each district of Tamil Nadu and other Critical-tier states, with real-time allocation authority for commercial LPG supply to verified essential food service establishments. Simultaneous activation of community kitchen provisions under the National Food Security Act in all Critical and High vulnerability districts. Rapid scaling of Amma Canteen satellite locations and pre-positioning of mobile kitchen units.

8.2 Medium-Term Interventions (1–6 Months)

Emergency multi-source LPG procurement from the United States, Norway, Canada, and Australia. Activation of Operation Sankalp-equivalent naval escorts for LPG tankers. For Tamil Nadu specifically, acceleration of PNG infrastructure rollout in the four Critical-tier districts — Chennai Metropolitan Area, Madurai, Coimbatore, and Tiruchirappalli — targeting one lakh additional PNG connection in six months.

8.3 Long-Term Structural Reforms (6 Months – 5 Years)

Systematic reduction of Hormuz concentration from approximately 90 per cent to below 50 per cent of LPG imports by 2030. Development of a national LPG strategic reserve providing 30 to 45 days of buffer supply. A Tamil Nadu Cooking Energy Diversification Plan targeting a diversified cooking fuel mix of 60 per cent LPG, 20 per cent PNG and biogas, and 20 per cent electric cooking (supported by solar energy) by 2030.

9. CONCLUSION

The India LPG crisis of March 2026, triggered by the US–Israel–Iran War and the consequent closure of the Strait of Hormuz, is not merely an energy emergency. It is a profound geographic revelation — a crisis that illuminates the spatial architecture of vulnerability that three decades of rapid LPG expansion have built into India's energy and food security landscape. The geospatial analysis presented in this study demonstrates that this crisis is concentrated with particular severity in peninsular India, and most acutely in Tamil Nadu, whose Composite LPG Vulnerability Index score of 0.81 is the highest among major Indian states.

The predictive modelling component projects that under a prolonged crisis scenario (Scenario B), Tamil Nadu could see 35 to 50 per cent of its commercial food establishments shuttered, food inflation of 18 to 25 per cent, and significant nutritional access disruption for the urban working class. The policy recommendations advanced, spatially targeted emergency LPG allocation cells, community kitchen activation, accelerated PNG expansion in Critical-tier districts, multi-source import diversification, strategic LPG reserves, and a long-term Cooking Energy Diversification Plan, are grounded in the spatial logic of the crisis itself. The Strait of Hormuz is 39 kilometres wide. The crisis it has unleashed crosses a subcontinent. Geography is not merely the stage on which energy crises play out; but it is the very mechanism through which geopolitical shocks are translated into human vulnerability and human resilience.

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