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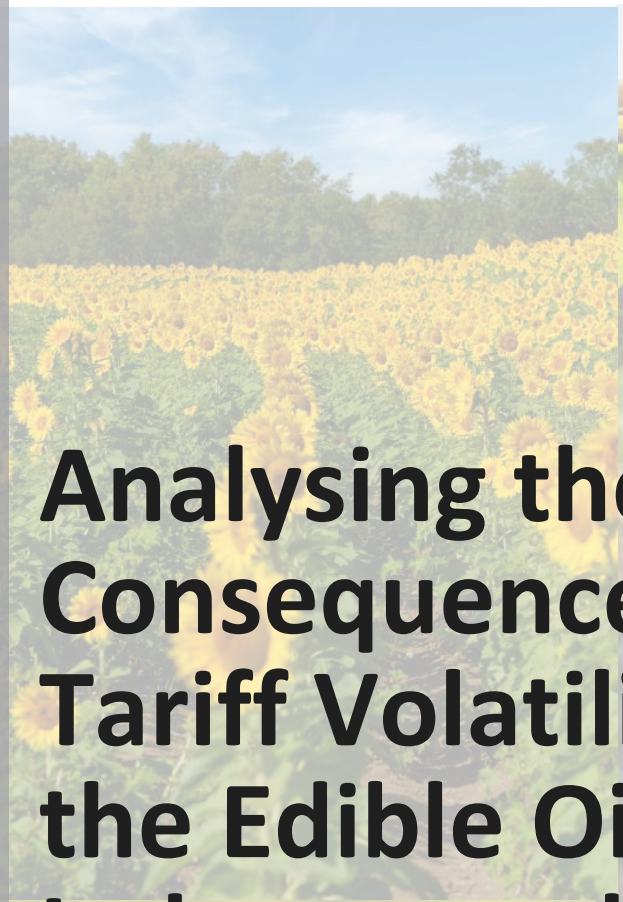
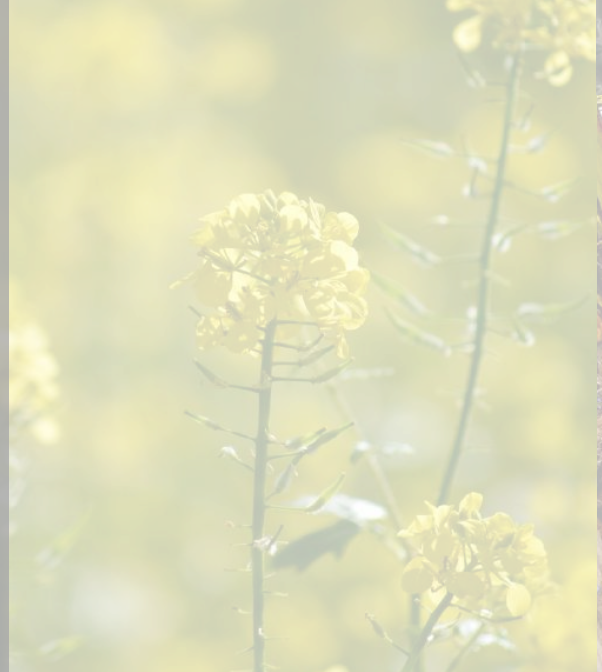


# Analysing the Consequences of Tariff Volatility on the Edible Oil Industry and Its Stakeholders in India

2025



# Analysing the Consequences of Tariff Volatility on the Edible Oil Industry and Its Stakeholders in India

## Disclaimer

*This research project titled "Tariff Volatility and Stakeholder Dynamics in India's Edible Oil Sector" is a joint academic endeavour undertaken by the Centre for Economic Studies and Planning (CESP), School of Social Sciences, Jawaharlal Nehru University (JNU), VeK Policy Advisory and Research, and the Associated Chambers of Commerce and Industry of India (ASSOCHAM). The study represents a collaborative effort combining academic analysis, data interpretation, and policy evaluation to understand tariff volatility and stakeholder responses in India's edible oil sector.*

*The views, findings, and interpretations expressed in this document are those of the research team and do not necessarily represent the official policies of JNU, VeK, or ASSOCHAM. While every effort has been made to ensure the accuracy and integrity of data and analysis, the institutions bear no responsibility for any errors, omissions, or interpretations arising from the study.*

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## Foreword

**Prof. Rajendra P. Kundu**
Chairperson, CESP,
Jawahar Lal Nehru University

I congratulate **Professor Pardeep S. Chauhan** and his team of dedicated researchers (**Chetna Rana, Shubhra Suman, Lakshika Bhardwaj and Vikas Kumar Shah)** on the successful completion of this study on India's edible oil sector. Given the pivotal role of this sector in achieving food security and enhancing trade performance, a comprehensive and rigorous analysis of the implications of tariff volatility on market stability and welfare outcomes in this sector was much needed and is welcome. The study examines how fluctuations in import duties are transmitted asymmetrically through various stakeholder groups—consumers, refiners, farmers, and firms—affecting price dynamics, profit margins, and trade behaviour. By focusing particularly on palm oil, which constitutes nearly 60 per cent of India's edible oil imports, the analysis captures the systemic importance of this commodity in shaping domestic prices, refining activities, and overall trade performance. Methodologically, the study employs a robust analytical framework that combines advanced econometric and forecasting tools, including GARCH, Nonlinear ARDL (NARDL), and panel regression models, to quantify both the short-run and long-run effects of tariff movements. This research bridges a critical gap between macro-level trade policy analysis and the micro-level impacts on stakeholders. It also underscores the importance of consistency and predictability in tariff administration for ensuring equitable and sustainable growth in India's edible oil economy. The findings presented in this report offer valuable insights for designing a more stable, transparent, and stakeholder-sensitive tariff policy.

I hope that this report will serve as an essential reference for researchers, policymakers, and industry stakeholders involved in shaping India's trade and agricultural policies.

## Foreword

**Mr. Manish Sharma**
Chief Executive Officer
VeK
Policy Advisory & Research

At VeK, we work at the intersection of policy and how it affects industries across various sectors in India's dynamic policy ecosystem. Therefore, we believe that this study on *"Analysing the Consequences of Tariff Volatility on the Edible Oil Industry and Its Stakeholders in India"* is significant and timely, given that edible oils are a striking example of a commodity whose market behaviour reaches far beyond simple market signals. Global price swings, supply disruptions, and structural limits to domestic production, all converge to create an environment of sustained uncertainty. For firms that process, refine, and use edible oils at scale, that uncertainty translates into real operational costs, disrupted investment plans, and a constant need to rewire commercial strategies. For policymakers, the same volatility shapes choices that must weigh consumer affordability, farmer incomes, processors' margins, and national objectives of reducing import dependency and with it, the burden that edible oil imports place on our forex reserves. That combination of scale, complexity and social consequence made this topic a priority for us.

Our interest in this collaboration is practical and strategic. We approach this as a comprehensive, real-world initiative grounded in practical impact and broad relevance. We see edible oils as a lens through which to view how trade policy, domestic capacity and market structure interact in ways that matter to millions of consumers and to large segments of industry. Tariff changes are one visible lever in that system, but their effects cascade along value chains and across time. Understanding those effects in granular, business relevant terms is essential if private investment and public policy are to move in complementary directions rather than at cross purposes.

This report is therefore an effort to unpack those linkages. It examines how import dependence and global shocks shape domestic prices and business decisions, and how a diverse set of actors: farmers, refiners, traders, manufacturers, and consumers, experience the same policy moves differently. Our aim in partnering on this work is to bring to the fore insight that is useful to business leaders who must plan months and years ahead, and to policymakers who must design measures that are effective at scale. We have aimed to arrive at an analysis that clarifies trade-offs, highlights where uncertainty is most costly, and points to areas where collaborative, evidence-based discussion can improve outcomes.

We are grateful to the research team at the *Centre for Economic Studies and Planning (CESP), Jawaharlal Nehru University (JNU)* for their rigorous analysis, and to the *Associated Chambers of Commerce & Industry of India (ASSOCHAM)* for their invaluable inputs and contribution. This collaboration between academia, industry and policy research reflects the kind of cross sector dialogue that VeK believes is necessary to build resilient and competitive supply chains while advancing the national goals of self-reliance and inclusive growth.

## Foreword

**Mr. Manish Singhal**
Secretary General,
ASSOCHAM

India stands at a defining juncture in its journey toward self-reliance and sustainable growth. The edible oil sector which is central to our food security, consumer welfare and trade stability has immense potential to drive this transformation. The report *"Analyzing the Consequences of Tariff Volatility on the Edible Oil Industry and Its Stakeholders in India,"* prepared by the Centre for Economic Studies and Planning, Jawaharlal Nehru University (JNU), in collaboration with ASSOCHAM and VeK, is a valuable contribution to understanding this vital domain.

The study examines tariff volatility and its impact across the edible oil value chain. Using advanced econometric models, it provides evidence-based insights on how duty changes affect consumers, farmers, refiners, and industry participants, supporting the Government's vision of *Atmanirbhar Bharat* through stability and predictability in policymaking.

The findings highlight that initiatives such as the National Mission on Edible Oils–Oil Palm (NMEO–OP) can make the sector a model of resilient and inclusive growth. By advocating a medium-term tariff framework and greater domestic value addition, the report outlines strategies to stabilise prices, enhance farmer incomes and strengthen refining capacity.

For ASSOCHAM, this collaboration reaffirms our commitment to linking industry, academia and government to foster informed, data-driven policymaking that advances economic efficiency and social equity.

## Acknowledgements

This research project, *"Tariff Volatility and Stakeholder Dynamics in India's Edible Oil Sector,"* has been a collective effort made possible through the guidance, support, and cooperation of many individuals and institutions.

I express my deepest gratitude to all those who provided valuable insights and encouragement throughout this study. In particular, I acknowledge the Centre for Economic Studies and Planning (CESP), School of Social Sciences (SSS), Jawaharlal Nehru University (JNU), for providing an enabling academic environment, infrastructure, and administrative support. I also thank the Dean, School of Social Sciences, the Centre for Economic Studies and Planning office personnel, the Dean's Office staff, the Research and Development Cell, and the Project Cell of JNU for their continuous assistance. I am also thankful to the chairperson and all my colleagues at CESP for their encouraging and fruitful academic deliberations.

I am grateful to the VeK Policy Advisory and Research and the Associated Chambers of Commerce and Industry of India (ASSOCHAM), especially. Mr. T S Vishwanath, Mr. Manish Sharma, Mr. Adhiraj Gupta, Ms. Abhilasha Nayal, for facilitating access to industry-level data, trade policy archives, and field insights, which greatly enriched the empirical and policy relevance of this study.

I sincerely appreciate the dedication and hard work of my research team Ms. Chetna Rana, Ms. Shubhra Suman, and Ms. Lakshika Bhardwaj, whose efforts in data compilation, econometric estimation, and policy synthesis were indispensable to the successful completion of this project.

Finally, I thank all others, within and outside the institution, who provided support, cooperation, and encouragement at various stages of this work. This report reflects a shared intellectual endeavour and institutional collaboration aimed at contributing meaningfully to the discourse on India's edible oil trade policy.

**Professor Pardeep S. Chauhan**
Centre for Economic Studies and Planning,
School of Social Sciences,
Jawaharlal Nehru University (JNU), New Delhi
October 2025

# Executive Summary

# Executive Summary

India's edible oil sector is a critical pillar of food security, price stability, and trade policy. The country meets nearly 60-65% of its edible oil requirement through imports, with palm oil alone contributing around 60% of total imports. Given its centrality, any change in palm oil tariffs reverberate across the entire edible oil value chain, influencing consumer prices, refining margins, domestic oilseed incentives, and fiscal revenues.

Over the past decade, tariff policy on edible oils has been marked by frequent and unpredictable revisions, with more than 25 changes occurring between 2015 and 2025. These short-term adjustments, though aimed at curbing inflation or protecting consumers, have created policy volatility, reduced market predictability, and weakened stakeholder confidence.

This study was commissioned to evaluate the impact of tariff volatility in India's edible oil sector with a special focus on palm oil due to its market dominance and import dependence. The research examines how frequent tariff fluctuations affect different stakeholders consumers, refiners, FMCG industries, and international suppliers and proposes a roadmap for predictable, transparent, and evidence-based tariff policy aligned with India's self-reliance vision under the National Mission on Edible Oils–Oil Palm (NMEO–OP).

**Findings**

*Tariff Volatility and Market Instability*

- India's edible oil tariffs have been altered over 25 times in the last decade mostly on an ad hoc and reactive basis.
- Frequent revisions distort market expectations, complicate import planning, and raise transaction costs for refiners and traders.
- Duty hikes lead to immediate retail price escalation, while duty cuts often produce incomplete or delayed relief for consumers.
- The absence of a medium-term tariff framework reduces investment confidence and hinders policy credibility.

*Asymmetric Transmission and Stakeholder Impact*

- Consumers: Face price instability and inflationary pressures due to delayed pass-through tariff reductions.
- Refiners: Experience margin uncertainty due to inconsistent crude–refined duty differentials, affecting capacity utilisation.
- FMCG Companies: Struggle with input cost volatility, undermining long-term pricing strategies.
- International Suppliers: Confront of unpredictable import demand, disrupting supply commitments.

*Structural Dependence on Palm Oil*

- Palm oil's 60% import share makes it the price anchor for all edible oils in India.
- High dependence on Indonesia and Malaysia exposes India to external policy risks (export bans, biofuel diversion, geopolitical disruptions).

- Without diversification, India remains vulnerable to global shocks, currency fluctuations, and supply chain disruptions.

*Analytical Insights*

- Econometric analysis confirms that tariff changes trigger short-run volatility in wholesale and retail prices.
- Machine learning models show that tariff predictability reduces volatility and improves price transmission efficiency.
- The study demonstrates a clear link between tariff uncertainty and market inefficiency, emphasising the need for stable, data-driven policymaking.

**Key Policy Recommendations**

*Establish a Medium-Term Tariff Framework*

- Introduce a 3–5-year Tariff Policy Plan with annual reviews.
- Define clear revision triggers (e.g., international price thresholds, domestic inflation limits).
- Ensure advance notice (30-60 days) for all duty revisions.
- Create a Tariff Review Committee for cross-ministerial coordination (Finance, Consumer Affairs, Commerce, Agriculture).

*Maintain a Rational Duty Differential*

- Retain a 7.5–10% duty gap between crude and refined oils to protect domestic refining.
- Avoid sudden reversals that distort import composition and discourage processing.
- Implement counter-cyclical tariffs that adjust gradually with global prices.

*Diversify Import Sources and Promote Domestic Production*

- Reduce supplier concentration by pursuing bilateral trade agreements with emerging exporters (Latin America, Africa).
- Align NMEO–OP with targeted oilseed cluster development and price support mechanisms.
- Incentivise R&D and high-yield varieties to boost local palm and alternative oilseed production.

*Strengthen Market Intelligence and Data Systems*

- Develop an Integrated Edible Oil Data Portal tracking global prices, import volumes, and retail trends.
- Use AI-based forecasting tools for policy simulation and early warning systems.
- Issue monthly policy briefs to improve transparency and stakeholder communication.

*Institutionalise Stakeholder Consultation*

- Formalise consultation with industry bodies, farmer groups, and FMCG associations before tariff revisions.
- Promote risk management capacity-building (hedging, futures, and options).
- Provide technical assistance to small refiners for policy adaptation.

**Major Risks and Mitigation Strategies**

| Risk | Impact | Mitigation Strategy |
|---|---|---|
| Policy Volatility | Uncertainty in trade & investment | Introduce a multi-year tariff roadmap |
| External Supply Shocks | Import disruptions, price spikes | Diversify sources; establish strategic reserves |
| Asymmetric Price Pass-through | Consumer inflation persistence | Enforce price reporting and transparency norms |
| Over-Reliance on Palm Oil | Vulnerability to global policy shifts | Promote alternative oilseeds, invest in domestic production |
| Revenue vs Inflation Trade-off | Conflicting fiscal and welfare goals | Apply the counter-cyclical tariff formula |
| Data Gaps | Weak evidence-based decisions | Develop a real-time integrated data dashboard |
| Sustainability Concerns | Non-compliance with ESG standards | Import certified sustainable palm oil, promote eco-friendly domestic plantations |

**Strategic Policy Outcomes Expected**

If adopted, these measures will:

- Ensure price stability and inflation control.
- Strengthen consumer welfare through timely pass-through.
- Enhance refining capacity utilisation and investment confidence.
- Encourage domestic oilseed diversification and farmer income growth.
- Build trade resilience against external shocks.
- Improve policy credibility through transparency and predictability.

Tariff policy in India's edible oil sector must evolve from a reactive instrument to a strategic policy tool. A predictable, transparent, and data-driven framework, anchored in stakeholder consultation and medium-term planning, is essential to achieve price stability, self-reliance, and balanced welfare outcomes.

Focusing on palm oil tariff stability offers the most effective lever to ensure market equilibrium, reduce import dependency, and align India's edible oil policy with its broader economic and food security objectives.

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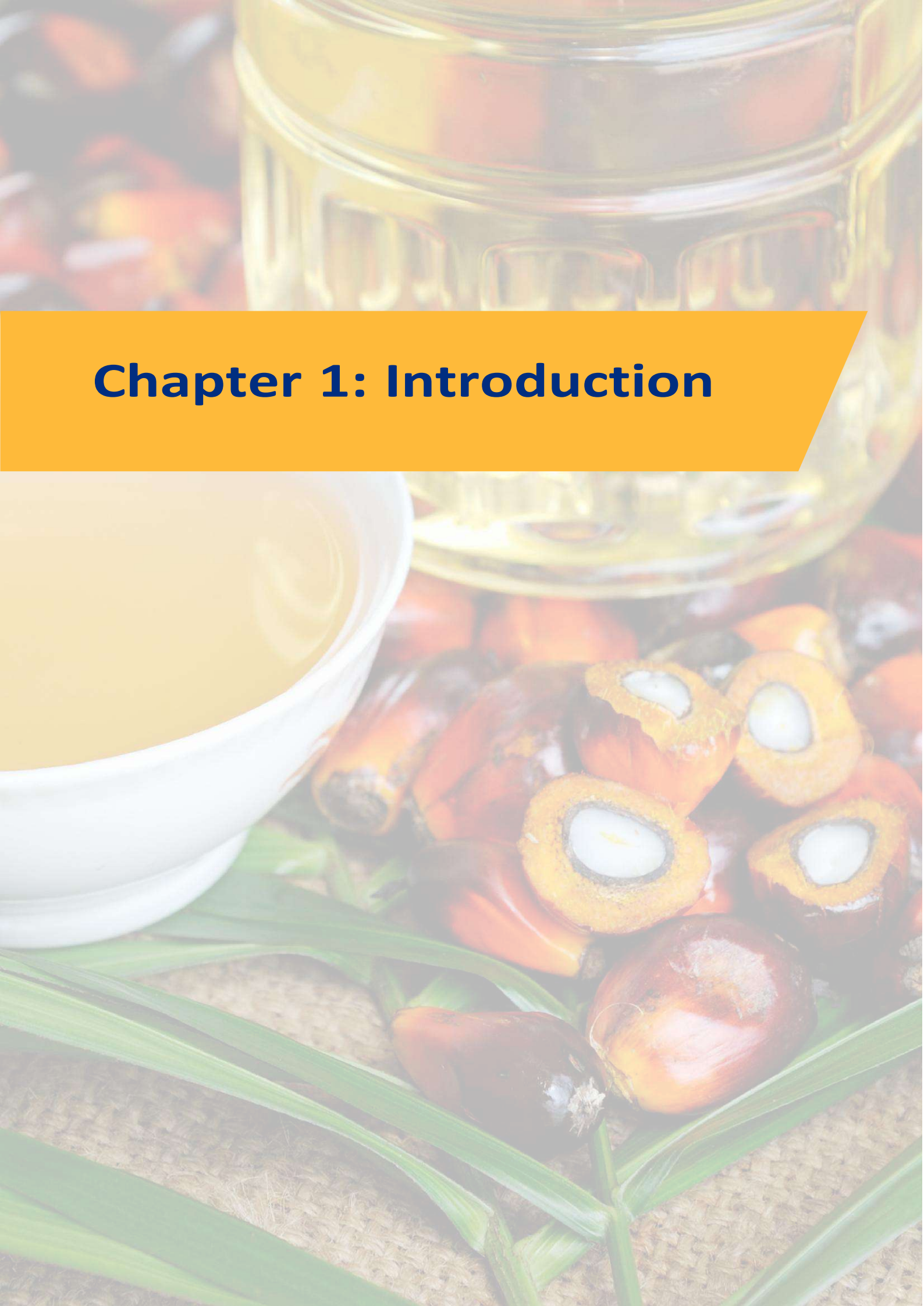
## List of Abbreviations

| Abbreviation | Description |
|---|---|
| ADF / PP | Augmented Dickey–Fuller / Phillips–Perron unit root tests |
| AIC / BIC | Akaike / Bayesian Information Criterion (lag selection) |
| ARIMA | Autoregressive integrated moving average |
| CPI | Consumer Price Index, Oils & Fats (All India, Combined, 2012=100) |
| DCC-GARCH | Dynamic Conditional Correlation |
| DW | Durbin–Watson statistic (residual autocorrelation) |
| ECM | Error-Correction Model |
| ECT | Error-Correction Term (lagged disequilibrium) |
| FMCG | Fast-moving consumer goods |
| FX | USD/INR exchange rate (monthly average) |
| GARCH | Generalised Autoregressive Conditional Heteroskedasticity |
| HAC | Heteroskedasticity & Autocorrelation Consistent (Newey–West) |
| ICMR | Indian Council of Medical Research |
| ICRA | Investment Information and Credit Rating Agency |
| LB(12) | Ljung–Box Q-test at 12 lags |
| NARDL | Nonlinear Autoregressive Distributed Lag |
| Palm (USD/MT) | International palm-oil price, USD per metric ton |
| $R^2$/ _$R^2$ | Coefficient of determination / Adjusted $R^2$ |
| SAFTA | South Asian Free Trade Area |
| Tariff | Effective import duty rate on edible oils |
| VECM | Vector Error Correction Model |
| τ+t, τ−t*τt+, τt−* | Tariff positive/negative partial sums (hikes/cuts) |



# Chapter 1: Introduction

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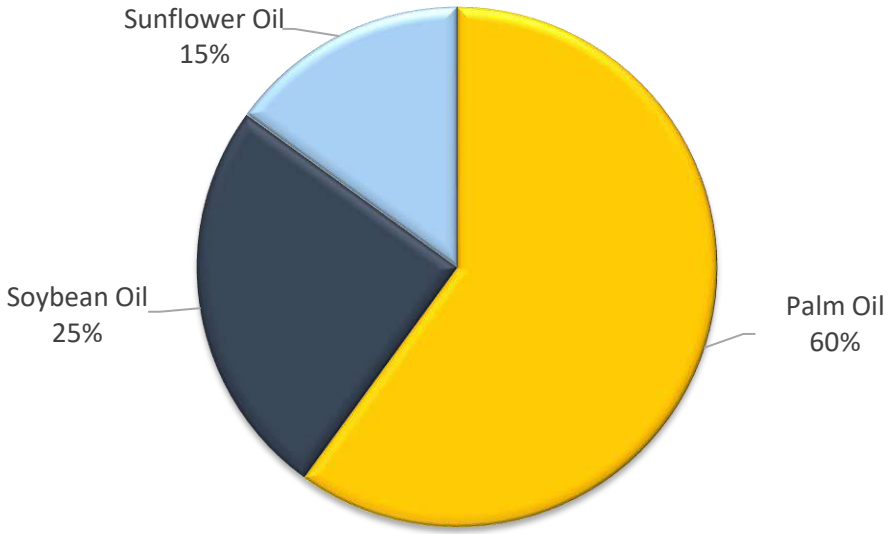
## 1.1 Overview

In recent years, India's edible oil sector has emerged as a crucial arena of policy intervention shaped by rising consumption, deep import dependence, and the government's efforts to achieve *Atmanirbhar Bharat* (self-reliance) alongside food price stability. Frequent adjustments in import duties once used sparingly to correct market imbalances have now become a structural feature of India's trade management strategy. These high-frequency revisions reflect the country's attempt to navigate complex trade-offs between consumer affordability, farmer protection, and industrial competitiveness. Yet, the economic and distributive implications of such tariff changes remain underexplored, particularly in a sector that touches millions of livelihoods and influences food inflation across households.

India's edible oil sector is a cornerstone of the nation's oil economy, driving both domestic agricultural policy and external trade engagements. It plays a pivotal role not only in ensuring affordable access to cooking oils but also in determining the income stability of oilseed farmers, refining margins of processors, and cost structures of FMCG manufacturers. The broader aim of this study is to view the sector through a multi-stakeholder lens examining how tariff volatility redistributes benefits and burdens across consumers, producers, processors, traders, FMCG firms, and international suppliers. Food security thus serves as a sub-premise, nested within a larger framework that explores how fluctuating tariffs influence incentives, welfare, and market dynamics across the entire value chain.

The scale of India's edible oil economy underscores why a narrow food security lens is insufficient. In 2024–25, per capita consumption of edible oils reached 23.5 kilograms per year, almost triple the level recorded in 2001 (8 kg per capita) and significantly above the ICMR-recommended intake of 19 kilograms. National demand now exceeds 26 million metric tonnes (MMT) annually, while domestic production can supply only 35–40% of this requirement. Consequently, India imports roughly 16–17 MMT of edible oils each year, making it the largest importer globally. Palm oil constitutes around 55–60% of these imports, followed by soybean oil (25%) and sunflower oil (15%). The import bill crossed USD 20 billion in FY 2024, accounting for nearly 3.5% of total merchandise imports, a figure second only to crude petroleum among agriculture-linked commodities. Over 85% of palm oil imports originate from Indonesia and Malaysia, reflecting India's exposure to global policy shifts such as export bans and biofuel mandates. This structural dependency elevates tariff policy to a critical policy lever for managing supply, stabilising prices, and shaping long-term self-reliance goals.

**Figure 1.1: Composition of India's Edible Oil Imports (2024-25)**




*Source: Author's compilation based on trade statistics (FY 2024)*

As depicted in Figure 1.1, India's edible oil import structure is heavily dominated by palm oil, which accounts for nearly three-fifths of total imports. While this ensures low-cost supply for domestic consumers and industries, it also heightens vulnerability to policy shifts in major exporting nations like Indonesia and Malaysia. The dependence on a single commodity thus amplifies the effects of tariff volatility, making palm oil tariffs a central determinant of overall price stability in the edible oil market.

Given this heavy reliance on imports, import duties serve as India's primary instrument to balance three competing objectives:

1. Affordability for consumers,
2. Protection for farmers, and
3. Viability for refiners and processors.

Any adjustment in tariff rates immediately influences landed import costs, retail price transmission, refining margins, and farm-gate earnings. Over the past decade, tariffs on edible oils have been revised more than 25 times, oscillating between steep hikes aimed at shielding domestic producers and sharp cuts designed to contain inflation. These frequent and often unpredictable changes, collectively termed tariff volatility, create planning challenges for importers, income uncertainty for farmers, and cost instability for consumers and industries alike. Understanding these dynamics is vital to designing a predictable and welfare-sensitive tariff regime that aligns short-term stabilisation with long-term developmental objectives.

Existing research has largely focused on aggregate price trends or import volumes, leaving tariff volatility itself understudied as an independent policy variable. Few studies have quantified its magnitude, examined its asymmetric effects (hikes vs. cuts), or traced its stakeholder-wise distributional impacts. This study fills that gap by integrating historical policy

analysis, econometric modeling, and stakeholder mapping to assess how tariff volatility shapes economic outcomes in India's edible oil ecosystem.

India's edible oil policy has evolved through distinct phases, reflecting the country's shifting development priorities and trade strategies. In the early decades after independence, the government pursued self-sufficiency through protectionism, using high tariffs and quantitative restrictions to shield domestic producers. The Technology Mission on Oilseeds (1986) marked a turning point by promoting productivity gains through improved seeds, credit, and extension services. Although this mission narrowed the demand-supply gap, it could not offset the pressures of rapid population growth and changing consumption patterns.

The liberalisation era of the 1990s introduced a new policy paradigm. To enhance affordability and integrate with global markets, India dismantled import quotas and lowered tariffs, especially on palm oil. This move brought short-term consumer benefits but intensified import dependence and undermined the competitiveness of traditional oils like groundnut and mustard. The Lahiri Committee (2006) later recommended tariff rationalisation to reduce distortions between crude and refined oils.

In the post-2010 period, policy attention shifted toward reducing import dependence. The National Mission on Edible Oils–Oil Palm (NMEO-OP, 2021) sought to expand palm cultivation, especially in Andhra Pradesh and the North East. However, constraints such as low yields, environmental concerns, and processing bottlenecks have limited its impact. Consequently, tariff management remains India's most frequently used policy lever, employed both as a developmental tool and a crisis response mechanism.

Tariff volatility refers to frequent, unpredictable adjustments in import duties that alter market expectations and planning horizons. Between 2000 and 2020, import duties on palm oil alone were modified over 30 times, often within short intervals. Tariff hikes aim to protect oilseed farmers and processors by curbing cheap imports, while tariff cuts intend to mitigate food inflation and stabilise consumer prices.

However, such oscillations introduce uncertainty. When duties rise, imports become costlier, retail prices climb, and inflation accelerates. When duties fall, farmers and refiners lose competitiveness. Thus, volatility acts as a double-edged sword—a tool of stabilisation in the short term but a source of instability in the long term. The result is a stop-go policy cycle, alternating between protectionism and liberalisation without achieving a durable equilibrium.

India's edible oil prices are closely synchronised with global benchmarks, given the country's status as the world's largest importer. External shocks such as the COVID-19 pandemic, Russia–Ukraine conflict, and Indonesia's export restrictions have repeatedly disrupted supply chains, triggering inflationary surges in domestic markets.

Empirical studies using GARCH and DCC-GARCH models reveal that edible oil prices exhibit volatility clustering, meaning shocks persist over time. Moreover, global policy measures such as biodiesel mandates or sustainability certifications affect export availability and prices. For

India, these factors magnify vulnerability, making tariff policy a reactive instrument rather than a proactive strategy.

The relationship between tariff changes and price outcomes is nonlinear and asymmetric. Tariff hikes tend to raise domestic prices quickly and sharply, while tariff cuts produce smaller and slower declines. This asymmetry arises from market rigidities, inventory lags, and logistical bottlenecks.

For refiners, higher tariffs may improve margins by encouraging domestic processing. For consumers, they mean immediate cost escalation. For farmers, benefits are muted if global trends remain unfavorable. Conversely, tariff reductions often erode farm-gate prices faster than they lower retail prices. Capturing this complexity requires advanced econometric tools like NARDL models, which decompose tariff movements into positive and negative shocks, allowing policymakers to evaluate differential transmission effects.

Over the past decade, import duties on edible oils have displayed exceptional volatility. Between 2011 and 2021, tariffs on crude palm oil, refined palmolein, soybean oil, and sunflower oil were revised more than 25 times, ranging from near-zero during inflationary phases to over 50–70% in protectionist periods.

Major global events such as the 2013 inflation surge, 2017 duty hikes, 2020 pandemic, and 2022 Ukraine conflict—triggered swift policy responses. While these adjustments helped address immediate challenges, they also reinforced a reactive, short-term orientation in tariff policymaking. The cumulative effect has been planning uncertainty, discouraging investment in both farming and refining.

India’s tariff stance reverberates beyond its borders. As a price leader in import demand, India’s duty changes influence global benchmarks tariff cuts dampen world prices, while hikes exert upward pressure.

Domestically, the pass-through of tariff changes is uneven. Coastal cities reflect revisions almost immediately, whereas inland markets adjust more gradually. Tariff hikes tend to amplify inflation swiftly, while tariff cuts provide transient relief. Hence, volatility functions both as a shock absorber during crises and a source of sustained instability when applied excessively. This dual role complicates policy calibration, requiring greater predictability and coordination with macroeconomic management.

Duty hikes and cuts produce distinct and unequal outcomes across the edible oil value chain. Hikes typically enhance refiner margins and signal protection for domestic producers but simultaneously burden consumers with higher prices. Conversely, cuts help curb inflation but erode processor profitability and depress oilseed prices, discouraging cultivation.

Empirical studies reveal that import volumes respond more strongly to cuts than to hikes, underscoring structural import dependence. Thus, the elasticity of response is asymmetric, and the intended beneficiaries—farmers or consumers—often receive only partial gains. Addressing this imbalance requires evidence-based tariff design grounded in long-term objectives rather than short-term reactions.

The implications of tariff volatility extend across all stakeholders:

- Consumers: Experience immediate price surges after hikes and only temporary relief after cuts, affecting food budgets and inflation expectations.
- Oilseed Farmers: Gain modestly from protectionist phases but suffer income shocks when duties are slashed; frequent reversals deter sustained investment.
- Refiners and Processors: Depend on stable duty differentials; volatility disrupts capacity utilisation and margin planning.
- FMCG Manufacturers: Confront unpredictable input costs, complicating pricing strategies and inventory management.
- International Suppliers: Must recalibrate export volumes and pricing strategies to align with India's fluctuating demand.

These outcomes underscore the political economy of tariff policymaking, where each adjustment creates winners and losers. A transparent, predictable, and stakeholder-sensitive tariff framework is therefore essential for reconciling the goals of food affordability, farmer protection, industrial competitiveness, and trade stability.

### 1.2 Need for the Study

India's edible oil sector occupies a critical position in the country's food security and trade policy framework. With more than 60% of domestic demand met through imports, the sector is structurally vulnerable to global price shocks, geopolitical disruptions, and climate variability. To manage these pressures, the government frequently adjusts import duties on crude and refined edible oils. While such measures are intended to balance inflation control, farmer income, and industrial competitiveness, their ad hoc and unpredictable nature has led to significant tariff volatility. This volatility not only destabilises markets but also creates uncertainty across stakeholders—consumers face erratic price surges, farmers experience depressed farm-gate prices, refiners struggle with fluctuating margins, FMCG firms face cost unpredictability, and international suppliers confront unstable trade flows.

Despite its importance, most existing studies have focused on aggregate price effects or trade volumes, with limited attention to the stakeholder-wise consequences of tariff volatility. Moreover, few studies integrate advanced forecasting tools with policy evaluation, leaving a gap in evidence-based trade strategy. The present study is needed to bridge these gaps by analysing tariff volatility comprehensively, quantifying its asymmetric effects, and providing insights for a more stable, predictable, and stakeholder-sensitive tariff policy in India's edible oil economy.

### 1.3 Significance of the Study

This study carries strategic importance for both academic research and public policy, particularly in the context of India's dependence on palm oil within its edible oil economy. Palm oil accounts for nearly 60% of total imports, making it the most influential commodity in determining domestic prices, refining margins, and trade balances. Owing to this dominant share, any change in palm oil tariffs produces system-wide effects—transmitting rapidly through consumer markets, processing industries, and upstream supply chains. Focusing on

palm oil, therefore, provides a clear and representative case for assessing how tariff volatility shapes outcomes across stakeholders, rather than diluting insights through a generalised analysis of all edible oils.

From an academic standpoint, the study extends existing literature by moving beyond aggregate trade analyses to evaluate tariff volatility as a distinct policy variable. It adopts a stakeholder-oriented framework, examining how shifts in duties redistribute welfare among consumers, refiners, farmers, FMCG firms, and international suppliers. Methodologically, it integrates advanced econometric and machine learning techniques to capture asymmetric policy effects and strengthen evidence-based interpretation. This approach contributes to applied economics by demonstrating how modern analytical tools can decode complex interactions between trade policy and market behavior.

From a policy perspective, the focus on palm oil aligns with India's goal of achieving self-reliance under the National Mission on Edible Oils (Oil Palm). Insights from this research can support the design of a stable and transparent tariff regime that harmonises key objectives: consumer affordability, producer viability, industrial competitiveness, and trade predictability. The findings will aid policymakers in risk assessment, price stabilisation, and long-term planning, particularly in light of global supply disruptions and inflationary pressures.

For industry stakeholders, including refiners and FMCG manufacturers, the study offers practical guidance to manage cost volatility and plan procurement more effectively. By clarifying the transmission of palm oil tariff adjustments, it enables strategic hedging, inventory management, and pricing decisions under policy uncertainty.

The study's significance lies in delivering a targeted, evidence-based framework that connects tariff design, market outcomes, and stakeholder welfare, while focusing on the commodity that exerts the greatest systemic influence within India's edible oil sector.

**1.4 Review of Literature**

The literature on tariff volatility in India's edible oil sector has progressed from early theoretical models to sophisticated econometric and spatial analyses. Collectively, these works reveal that while tariff changes are often introduced to protect farmers or stabilise consumer prices, their effects are asymmetric, incomplete, and shaped by both domestic and global factors.

The theoretical foundations were laid by Srinivasan (2004), who used multi-market equilibrium simulations to demonstrate that higher import tariffs tend to amplify rather than reduce domestic price volatility. His findings challenged the conventional view of tariffs as stabilising instruments and instead suggested that variable levies linked to world prices would be more effective. A similar insight was reinforced by Shivakumar (2007), who applied a Computable General Equilibrium (CGE) model to India's edible oil economy. The study showed how even modest tariff changes significantly alter farmer profitability and domestic refiner behaviour, quantifying the trade-offs between consumer welfare and producer protection. Building on these approaches, Balaji, Umanath, and Arun (2021) simulated

inward-looking tariff regimes and found that while tariff hikes produced modest welfare gains for farmers and processors, they failed to generate substantial long-term production responses. Together, these studies established that tariffs are not neutral policy tools but dynamic sources of market volatility.

As the field advanced, attention shifted to spatial and regional heterogeneity. Bandyopadhyay and Ramaswami (2024) employed district-level panel regressions to demonstrate that import competition depressed farm-gate prices and agricultural wages unevenly across states, with oilseed-intensive regions suffering disproportionately. Complementary evidence came from Persaud and Dohlman (2006) and Persaud (2019), who analysed soybean import liberalisation and showed that while processors benefited through capacity expansion and consumers enjoyed lower prices, farmers received little sustained protection. These findings underscored the limitations of uniform national tariff strategies and highlighted the need for spatially differentiated policies.

Another important strand of literature has focused on supply chain dynamics and tariff pass-through. Sanyal and Spearot (2023) combined HS-6 trade data with firm-level and retail price data to reveal that tariff cuts on crude edible oils improved processor margins but did not fully pass through to consumers, particularly in inland markets where distribution costs and logistical bottlenecks absorbed much of the gain. Similarly, Indhushree and Shivakumar (2020) demonstrated that tariff hikes benefited processors more than farmers, while tariff cuts produced short-lived consumer relief. These analyses revealed the asymmetric and incomplete transmission of tariff changes across the supply chain, which varies not only by commodity but also by geography.

Global integration adds another layer of complexity. Rosyadi et al. (2021) and Hidayat et al. (2023) showed how Indonesia’s export bans and biofuel policies altered palm oil flows, directly impacting Indian imports. The ICRA (2022) report titled “Indian Edible Oil Industry” documented that although government duty cuts, such as reducing palm oil tariffs from 30.3% to 5.5%, temporarily lowered prices, global disruptions like the Ukraine war quickly erased these gains. Likewise, IFPRI (2024) "India's edible oil imports from Nepal: Policy implications of current tariffs and free trade agreements" found that regional trade agreements such as SAFTA created arbitrage opportunities, with duty-free imports from Nepal and Bangladesh displacing duty-paid oils in India and undermining domestic processors. Together, these findings demonstrated that India’s tariff interventions are often overwhelmed by global shocks and policy distortions, highlighting the limits of unilateral policy action.

Policy timing and institutional capacity have also been central concerns. Shroff (2024) argued that tariff changes in India are frequently reactive and lag market developments, thereby exacerbating uncertainty rather than stabilising prices. Industry evidence reported by SEA and Reuters (2025) showed that frequent, unpredictable duty revisions disrupted refinery capacity utilisation and undermined investment planning. This strand of research pointed to the crucial role of predictability and institutional credibility in designing effective tariff regimes.

Recent studies have increasingly turned to advanced econometric tools to capture the non-linear and asymmetric effects of tariffs. Mishra et al. (2017) and Supriya and Mamilla (2024)

used GARCH and DCC-GARCH models to demonstrate volatility clustering in edible oil prices, particularly during global shocks such as Covid-19 and the Ukraine war. Pipil (2024) applied a VECM framework and found that import surges depressed domestic incentives for several years, highlighting the asymmetric persistence of shocks. Machine learning approaches by Latha et al. (2024) and IISc (2023) demonstrated that tariff announcements were among the most powerful drivers of volatility spikes, and that nonlinear models such as support vector regression and artificial neural networks outperformed traditional ARIMA or GARCH models in forecasting. NARDL models, applied by Zainuddin (2024) and Indhu shree and Shivakumar (2020), confirmed that tariff hikes and cuts had different magnitudes of impact, with cuts producing sharper import responses than hikes. These methodological advances validate the use of nonlinear econometrics and scenario modelling in analysing tariff volatility.

Synthesising across these strands, the literature converges on several points. First, fixed or static tariffs amplify volatility, while variable levies tied to world prices are more effective stabilisers. Second, regional disparities mean that national-level averages obscure important heterogeneity in how tariffs affect farmers, processors, and consumers. Third, tariff pass-through is partial and asymmetric, with geography and supply chain inefficiencies constraining benefits to consumers. Fourth, external shocks often overwhelm domestic tariff adjustments, exposing the limits of inward-looking protectionist policies. Fifth, unpredictability and frequent revisions generate their own form of volatility, deterring investment and complicating planning. Finally, advanced econometric work demonstrates that the effects of tariffs are inherently nonlinear and must be analysed with tools that account for asymmetry and persistence.

### 1.5 Research Gap

Although the edible oil sector has been widely studied in the context of trade dependence and price dynamics, there remain critical gaps in the literature that justify the present research. First, existing studies on India largely focus on aggregate price movements or import volumes, without adequately addressing the *volatility of tariffs* as a distinct policy variable. The unpredictable adjustments in import duties have been treated as background factors, rather than systematically analysed as sources of uncertainty.

Second, while some international studies have employed econometric or simulation models to examine the welfare impacts of tariff changes, very few have conducted a stakeholder-wise analysis. In the Indian context, the differentiated effects on consumers, farmers, refiners, FMCG firms, and international suppliers remain underexplored. This gap limits the ability of policymakers to design targeted interventions that address the vulnerabilities of each group.

Third, earlier research relies on linear econometric models that may not capture the nonlinear and asymmetric nature of policy transmission. The role of advanced forecasting tools, such as neural networks or NARDL frameworks, has not been adequately integrated into edible oil policy research.

There is a pressing need for a study that systematically analyses tariff volatility, its asymmetric impacts, and its stakeholder-specific consequences, using modern analytical tools and comprehensive data.

## 1.6 Objectives of the Study

1. To analyse the nature and extent of import tariff volatility in India's edible oil sector over the past decade.
2. To assess the impact of tariff volatility on global and domestic price fluctuations of key edible oils, with particular attention to volatility spillovers and macroeconomic linkages.
3. To identify and analyse the asymmetric effects of import duty hikes and cuts on the edible oil value chain, highlighting differences in transmission to prices and market stability.
4. To examine the stakeholder-wise impact of tariff volatility on consumers, domestic refiners, FMCG manufacturers, and international suppliers, using advanced econometric and machine learning approaches.
5. To draw policy implications for designing a transparent, predictable, and stakeholder-sensitive tariff regime that balances food security, farmer welfare, industrial competitiveness, and trade stability.

## 1.7 Methodology

### *1.7.1 Nature & Extent of Tariff Volatility*

The methodology for analysing the nature and extent of tariff volatility in India's edible oil sector combines historical-institutional review with descriptive statistical analysis of tariff data for the period 2015–2025. The study first compiles effective duty rates on crude and refined edible oils—particularly palm, soybean, and sunflower oil—using government notifications and trade statistics as the primary sources. These data are organised into a continuous time series to allow examination of both long-term patterns and short-term fluctuations. The analysis begins with a historical review of tariff policy, situating recent adjustments within India's broader trade policy trajectory since the liberalisation of the 1990s and subsequent WTO commitments. This contextual narrative is essential to interpret the motives underlying tariff changes, whether oriented toward consumer affordability or producer protection.

Subsequently, the study employs graphical and statistical tools to quantify volatility. Time-series plots are constructed to map the movement of effective duties, highlighting phases of decline, spikes, sharp falls, and rebounds that characterise the cyclical nature of policy. Descriptive statistics including the mean, median, standard deviation, coefficient of variation, and range are then calculated to measure central tendency, dispersion, and relative instability in tariff rates. A high standard deviation and coefficient of variation are treated as indicators of significant year-to-year variability and policy unpredictability. The analysis also compares median and mean values to infer the general orientation of policy, while the range between minimum and maximum duty levels captures the intensity of policy swings. These results are interpreted alongside global price movements and domestic policy motives to provide a holistic assessment of tariff volatility. By combining historical narrative with rigorous statistical evaluation, the methodology ensures that both the structural drivers and the quantitative magnitude of volatility are adequately captured, thereby offering an empirical foundation for subsequent chapters that investigate price effects, asymmetries, and stakeholder impacts.

**Steps**

1. **Timeline & heatmaps:** monthly duty levels by oil & form; annotate policy dates.
2. **Volatility metrics:** rolling (k=3,6,12 months) **Mean, SD, CV**, and % change.
3. **Event flags:** binary dummies for major hikes/cuts; count of changes per year.

**Outputs**

- Tables for average level, CV, change frequency by phase.
- Plots: duty timelines, rolling CV, differential stability.

*1.7.2 Tariff Volatility → Price Volatility (Domestic & Global)*

To evaluate the effect of tariff volatility on global and domestic edible oil prices, this study applies both descriptive and econometric techniques. The analysis begins by comparing global and domestic price series through graphical and statistical approaches, identifying co-movements and divergences over the period 2015–2025. This descriptive step establishes whether tariff interventions have acted as stabilisers or amplifiers of volatility. To formally capture the dynamics, the study employs the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) family of models, which are well-suited for analysing commodity markets where volatility is time-varying and shocks cluster over time. This analysis tells us whether tariff policy contributes to stable edible oil prices or unintentionally increases market volatility, guiding policymakers on how to manage tariffs more effectively.

The standard GARCH (1,1) model is first estimated for both global and domestic price returns. The conditional mean equation includes an autoregressive AR (1) term to capture price persistence, while the conditional variance equation models volatility as a function of past shocks (the ARCH term, α) and past volatility (the GARCH term, β). High α values indicate strong sensitivity to new shocks, while high β values suggest persistence of volatility over time. Tariff volatility, exchange rates, and crude oil prices are introduced as exogenous regressors to test their role in amplifying or mitigating price instability. This framework allows the study to disentangle the short-run reactivity of domestic markets from the longer-term persistence of global volatility.

Extensions of the model incorporate Exogenous GARCH (GARCH-X) specifications, where tariff changes and exchange rate fluctuations directly enter the variance equation, permitting an assessment of how policy-induced shocks shape volatility transmission. Diagnostic checks, including Ljung–Box Q-tests for residual autocorrelation, ARCH-LM tests for remaining heteroskedasticity, and alternative error distributions (Student-t, GED) ensure robustness of results. By comparing parameter estimates across global and domestic models, the study highlights asymmetries in volatility behavior: global markets characterized by persistence, and domestic markets more reactive but short-lived in their volatility.

This modeling strategy not only quantifies the impact of tariff volatility but also integrates external drivers such as crude oil and currency fluctuations. Together, these models provide a comprehensive basis for assessing the inflationary and welfare consequences of tariff interventions, thus fulfilling the chapter's objective of identifying whether tariffs act as stabilizers or destabilisers of edible oil markets.

*1.7.3 Asymmetric Effects of Hikes vs Cuts (NARDL)*

To investigate whether tariff hikes and cuts exert symmetric effects on consumer prices of edible oils, this chapter employs the Nonlinear Autoregressive Distributed Lag (NARDL) framework proposed by Shin, Yu, and Greenwood-Nimmo (2014). The standard ARDL model is widely used for small-sample settings and mixed orders of integration, but its linear form assumes that upward and downward movements in an explanatory variable have equal and opposite effects on the dependent variable. This assumption does not hold in India's edible oil markets, where evidence suggests that tariff hikes drive strong price increases while tariff cuts provide only weak and delayed relief. The NARDL approach extends ARDL by decomposing tariff changes into positive and negative partial sums, thereby allowing estimation of separate coefficients for tariff hikes and tariff cuts.

Estimation employs a parsimonious lag structure selected using AIC and BIC, with two autoregressive lags for CPI, contemporaneous and short lags for palm oil prices, and up to two lags for tariff partial sums to capture inventory effects. To ensure robustness against serial correlation and heteroskedasticity typical of monthly commodity data, inference relies on Newey–West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with a 12-month bandwidth. Diagnostic checks include unit root tests (ADF/PP), residual autocorrelation tests (Durbin–Watson and Ljung–Box Q), and model stability via CUSUM and CUSUMSQ statistics.

By combining NARDL's asymmetric decomposition with HAC inference, the model rigorously identifies whether tariff hikes and cuts transmit differently into consumer prices. Dynamic multipliers are also derived to trace the adjustment path over 24 months, highlighting whether effects are front-loaded or persistent. This methodological framework not only provides quantified evidence of asymmetry in tariff pass-through but also connects directly to the policy dilemma of whether counter-cyclical tariff cuts meaningfully protect consumers in practice.

*1.7.4 Stakeholder-Wise Impact (Panel Models)*

The fourth objective of this study investigates the stakeholder-wise impact of tariff volatility in the palm oil sector, with a particular focus on consumers, FMCG manufacturers, and international suppliers. To capture these effects, the analysis combines panel regression methods with time-series econometric techniques, each tailored to the nature of the outcome variables.

For international suppliers and the demand side linked to FMCG manufacturers, the study uses a panel regression framework. Monthly import data for palm oil are disaggregated by trading partners—Indonesia, Malaysia, and the Rest of World—covering the period from 2015 to 2025. Imports serve as the dependent variable, while tariff rates, the exchange rate, global palm oil prices, and the FMCG sector index are included as explanatory factors. In addition, a country dummy is introduced to account for structural supply disruptions such as Indonesia's temporary export ban in 2022. The fixed-effects approach is adopted after formal testing, as it controls for unobserved heterogeneity across trading partners and ensures consistent estimates. This design makes it possible to assess how tariffs and external shocks reshape

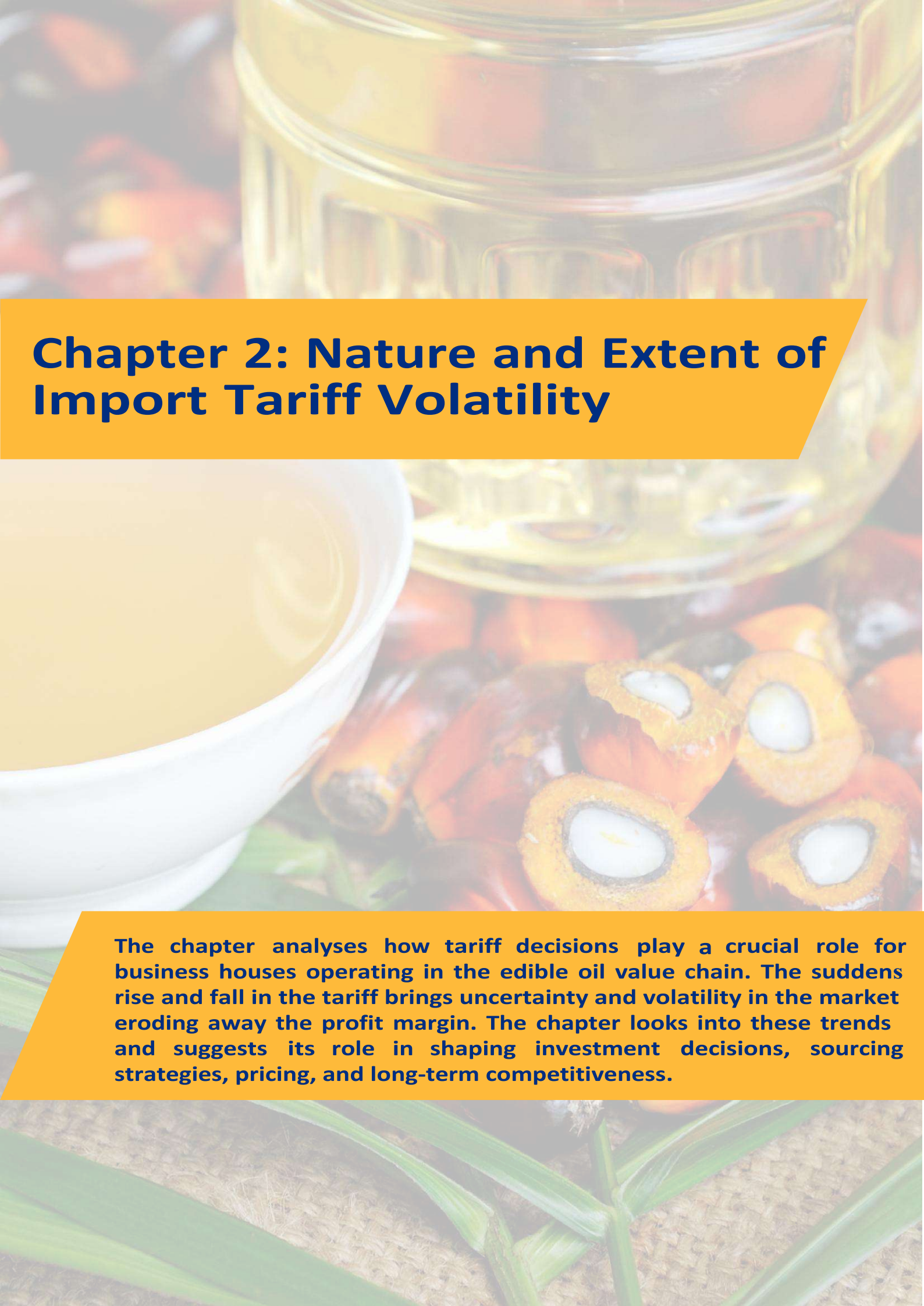
import patterns and, by extension, the dependence of India's FMCG sector on foreign supplies.

For consumers, the relevant outcome is the national retail price of palm oil, which does not vary across trading partners. Hence, a time-series regression model is applied to monthly data from 2015 to 2025. The explanatory variables mirror those used in the panel analysis, allowing for comparability. This model quantifies how tariff adjustments, exchange rate movements, and global price shocks translate into consumer-level price inflation. By isolating the effect of tariffs within this framework, the study tests whether policy changes aimed at consumer protection actually deliver relief in practice.

Across both models, robust standard errors are employed to correct for potential heteroskedasticity and autocorrelation in the residuals. Diagnostic checks, including model fit measures and significance testing, validate the reliability of the results. The panel regression sheds light on the vulnerability of suppliers and industry demand to tariff volatility, while the time-series regression highlights its transmission to consumer prices. Together, these methods provide a comprehensive understanding of how India's tariff regime distributes costs and benefits across stakeholders in the edible oil value chain.

**1.8 Limitations**

- Data Availability and Quality Constraints
- Lack of Ground-Level Behavioural Insight
- Time Constraints and Resource Limitations



# Chapter 2: Nature and Extent of Import Tariff Volatility

The chapter analyses how tariff decisions play a crucial role for business houses operating in the edible oil value chain. The suddens rise and fall in the tariff brings uncertainty and volatility in the market eroding away the profit margin. The chapter looks into these trends and suggests its role in shaping investment decisions, sourcing strategies, pricing, and long-term competitiveness.

# Chapter 2: Nature and Extent of Import Tariff Volatility

## 2.1 Overview

India is among the world's largest consumers and importers of edible oils, making this sector highly sensitive to both international market forces and domestic policy shifts. Unlike staples such as cereals or pulses, where domestic production meets most of the nation's demand, the majority of edible oil requirements are satisfied through imports. Because of this structural dependence on global supply, changes in trade policy especially import tariffs have an immediate and substantial impact on the business environment for refiners, FMCG companies, and other industry players.

For business houses operating in the edible oil value chain, tariff decisions translate directly into changes in landed costs, working capital needs, and supply chain planning. Sudden increases in tariffs can quickly erode margins for refiners and FMCG companies by raising input costs, while duty cuts may enhance profitability but also increase competition and price volatility. The magnitude and frequency of tariff changes thus play a critical role in shaping investment decisions, sourcing strategies, pricing, and long-term competitiveness for these firms.

Such volatility is not limited to business operations; it also affects consumers. Rapid adjustments in import tariffs can lead to spikes or drops in retail edible oil prices, influencing food cost inflation and household budgets. For Indian consumers, especially in low and middle-income segments, where edible oils are a core food item, these fluctuations can significantly influence the cost of living and consumption choices. As a result, tariff policy has become a key tool not only for national food security but also for the financial health of both businesses and households in the country.

The evolution of India's edible oil tariffs includes phases of liberalisation and protectionism. Figure 2.1 shows import duties from 1994 to 2015. Duties fluctuated widely due to economic crises, WTO policy shifts, and political pressures, with rates at times exceeding 80%. This context sets the stage for structural volatility in the present decade.

**Figure 2.1: Import Duty on Crude and Refined Palm Oil (1994–2015) by policy regime.**

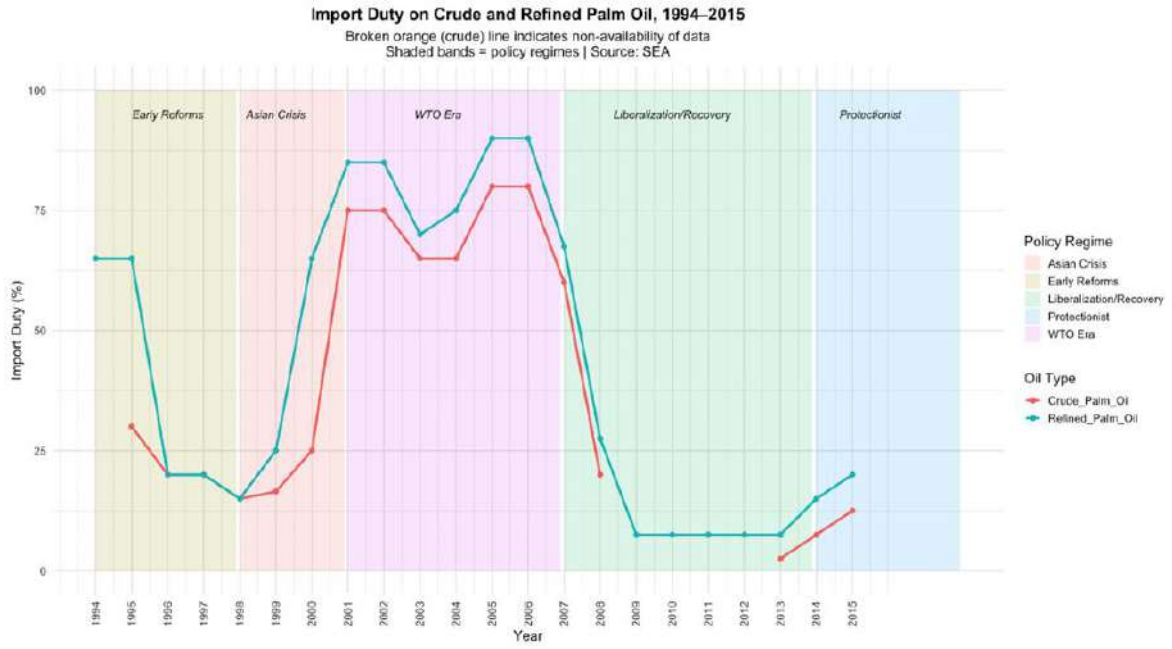



Figure 2.1 shows how tariff rates on crude and refined palm oil in India changed dramatically with different policy regimes. Tariffs spiked in crises and protectionist eras, then fell during reform, laying the foundation for structural volatility.

## 2.2 Objectives of the Chapter

This chapter examines tariff volatility in edible oils, especially for business stake- holders (FMCG companies and refiners), during 2015–2025. The objectives are:

1. Analyse trends and volatility of import tariffs using time series methods.
2. Quantify tariff volatility using descriptive statistics—mean, standard deviation, coefficient of variation (CV), range, and median—to capture both central tendency and dispersion of tariff changes over the decade.
3. Interpret volatility phases by linking observed fluctuations in duties to policy motives (consumer price stabilization vs. producer protection) and global market conditions which can be done by assessing the impact of tariff change frequency on business adaptation and risk.

## 2.3 Empirical Analysis and Findings

### *2.3.1 Monthly Tariff Patterns*

Figure 2.2 illustrates the evolution of import tariff rates at a monthly frequency from 2015 to August 2025. The bar graph visually delineates three clear policy phases: extended high-tariff stability (2017–2020, with rates consistently above 40%), rapid sequential reductions (2021), and sudden reversals with increased volatility in 2024–2025. For business houses such as

refiners and FMCG companies, these periods of abrupt, sometimes unpredictable change are highly consequential. When tariffs are raised suddenly, input and landed costs for imported oils spike, disrupting procurement plans and squeesing margins. Conversely, sharp tariff reductions may compel competitive price lowering, impacting revenues and necessitating swift adjustments in inventory or supply contracts.

**Figure 2.2: Monthly Import Duty Rates, Jan 2015–Aug 2025.**

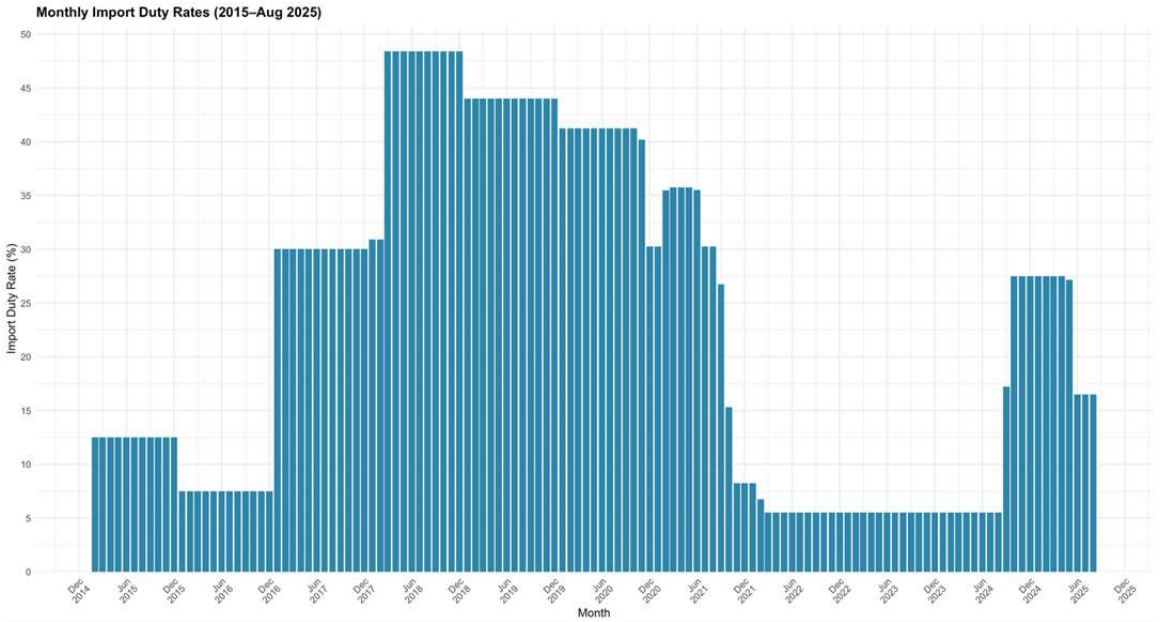
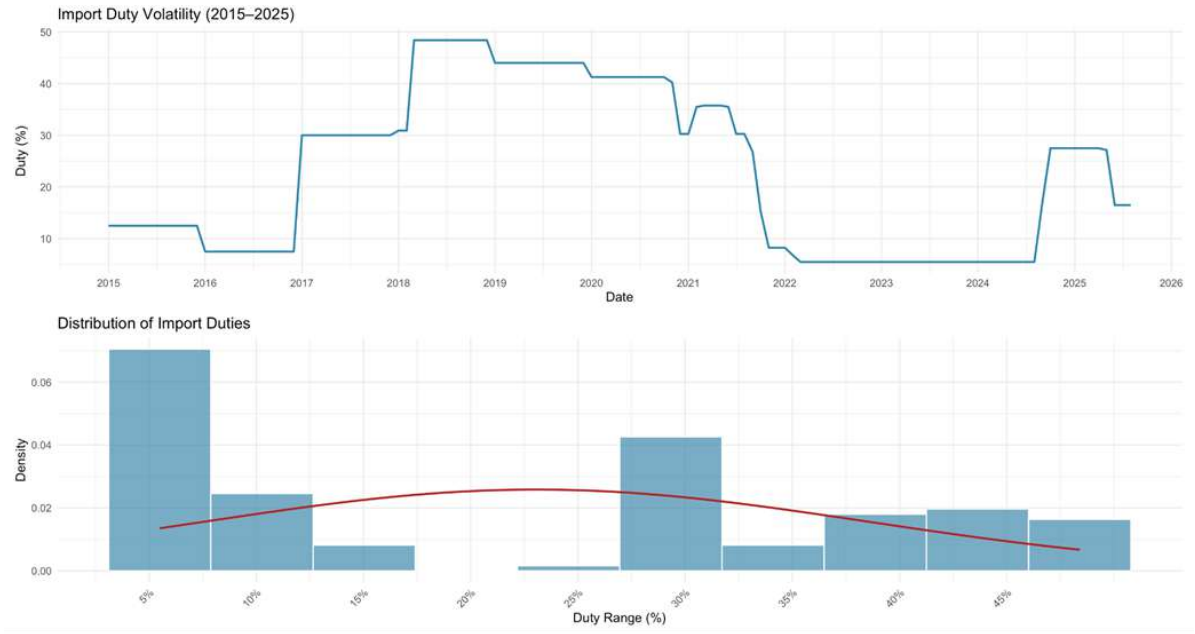



Figure 2.2 shows that, for large stretches, firms could expect stability but these could be broken at any time by policy pivots. Each sharp shift in the bar graph corresponds to increased operating risk, more complicated inventory management, and volatile cost structures for business stakeholders.

*2.3.2 Measurement of Volatility*

While graphical analysis of tariff trends provides valuable insights into the timing and trajectory of policy changes, it is equally important to quantify the extent of volatility using statistical measures. Descriptive statistics allow us to capture both the central tendency and the dispersion of tariff rates, thereby offering a more rigorous evaluation of the instability inherent in India's edible oil import policy. This section presents the results of such an analysis for the period 2015–2025, using measures such as the mean, median, standard deviation, coefficient of variation (CV), and range. Together, these indicators provide a comprehensive picture of Volatility.

**Figure 2.3: Import duty on crude palm oil (2015-2025)**




*2.3.3 Coefficient of Variation (CV)*

The figure 2.3 is a graphical representation of the variation in the tariff rates. Which is the coefficient of variation (CV), calculated at 41.32%. (refer to annexure A) The CV expresses dispersion relative to the mean, allowing us to assess volatility in proportional terms. A CV above 40% is exceptionally high in the context of policy instruments, confirming that import duties on edible oils during this period were not just fluctuating but highly unstable. Such a high CV reinforces the conclusion that tariff policy was employed as a short-term, reactive tool, adjusted frequently in response to immediate pressures rather than guided by a stable long-term framework. For stakeholders, this volatility created challenges in planning, investment, and price stabilisation.

**2.4 Relationship Between NIFTY FMCG Index and Import Duty Rates**

*2.4.1 Monthly Time Series (2015–2025)*

Figure 2.4 plots the monthly NIFTY FMCG Index alongside import duty rates from January 2015 through August 2025. The red line shows the duty rate (right axis) and the blue line shows the FMCG index level (left axis).

**Figure 2.4: Monthly NIFTY FMCG Index (blue) vs Import Duty Rate (red), 2015–2025**

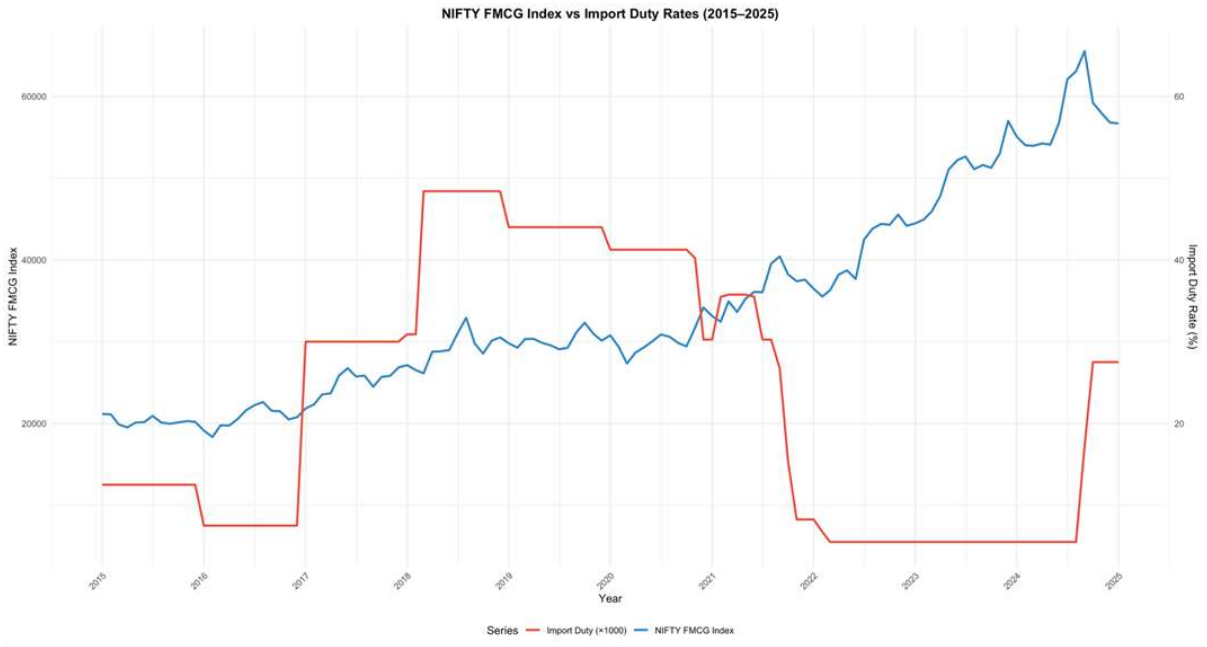



Figure 2.4: Monthly NIFTY FMCG Index (blue) vs Import Duty Rate (red), 2015–2025. The red line has a long horizontal pattern because the tariff remained constant for those months of the year.

*Note: To avoid overlapping of months the notation on the x-axis is in years.*

The figure highlights that each tariff adjustment has an almost immediate effect on the FMCG Index. Sharp tariff cuts in early 2021 coincide with a rapid rally in the index, while tariff increases in 2017 and again in 2024 correspond to periods of stagnation or pullback. The monthly view highlights how quickly business sentiment and valuations respond to policy moves, underscoring the operational challenge of reacting to frequent, high-frequency duty changes.

*2.4.2 Yearly Averages (2015–2025)*

Figure 2.5 shows the same data averaged by calendar year. The red bars represent the average annual import duty rate, and the blue line is the year-end NIFTY FMCG Index level.

**Figure 2.5: Yearly NIFTY FMCG Index vs Average Import Duty Rate, 2015– 2025.**

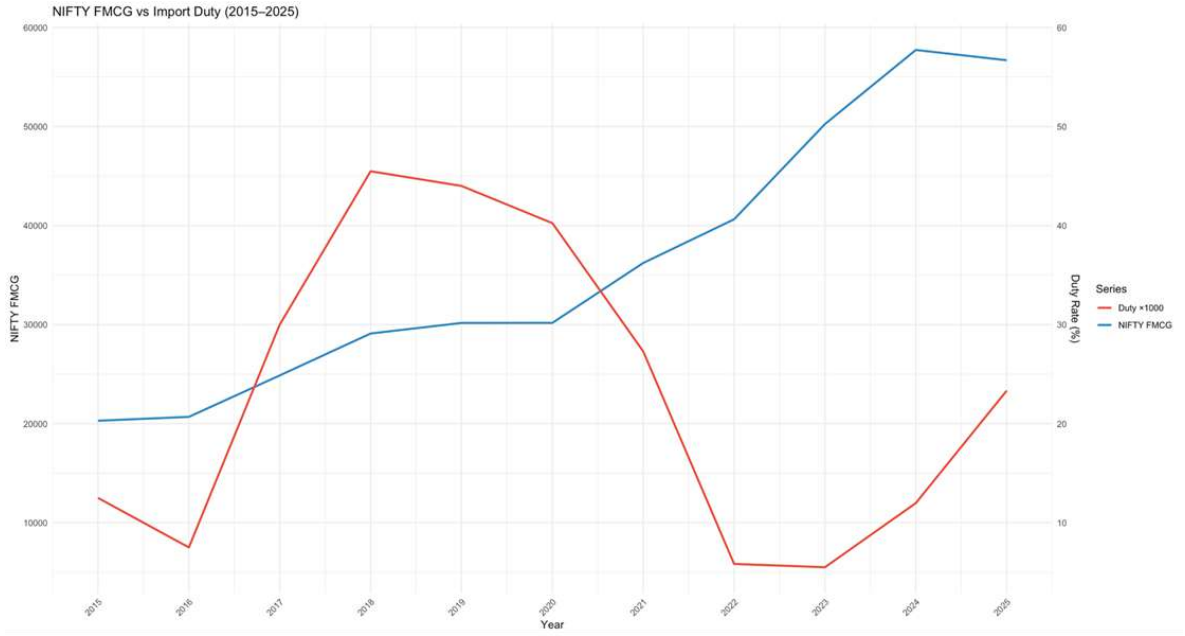



Figure 2.5: Yearly NIFTY FMCG Index vs Average Import Duty Rate, 2015– 2025. The flatness is reduced here because the average of monthly duty data is taken here so that we can see the yearly time series.

The yearly chart in Figure 4 smooths out monthly noise, showing that sustained high duties (2017–2019) coincide with flat index performance, while multi-year periods of lower duties (2021–2024) align with strong index gains. This suggests that, over longer horizons, businesses can adjust strategies securing contracts and hedges to mitigate short-term shocks,but still benefit from extended periods of favorable duty policy.

*2.4.3 Cyclical Nature of Tariffs and fast-moving consumer goods industries performance*

Both the monthly and yearly diagrams show a clear cyclical pattern in the relationship between import duty rates and the NIFTY FMCG Index, but the nature and implications of the cycles differ at each time scale.

At monthly frequency, the cycles are sharper and more volatile. Sudden spikes or drops in tariff rates are closely followed by immediate reactions in the FMCG index either rallies or corrections. This shows that policy changes transmit rapidly to business sentiment and market valuations, creating operational challenges for firms as they must adapt quickly to high-frequency shocks. Monthly cycles reflect how nimble and reactive business strategies and market pricing must be when the policy environment is unpredictable.

At the yearly level, the cyclical pattern smooths out, revealing broader policy regimes. Here, the index and tariff cycles correspond to multi-year phases of protectionism or liberalization. Extended periods of high tariffs align with periods of stagnant or lagging sector performance, while years of low or falling tariffs coincide with longer runs of strong growth for FMCG firms.

Yearly cycles show that, although the industry can absorb and adjust to short-term turbulence through planning and hedging, the underlying policy phase (protective vs. open) fundamentally drives sector profitability and long-term strategy.

In summary, while both diagrams demonstrate the cyclical, policy-driven nature of tariffs and index performance, the monthly view emphasizes the disruptive immediacy of frequent shocks for business operations, whereas the yearly view captures the cumulative effect of broader policy cycles on overall sector growth and profitability. Both layers of cyclicality are real—but they pose different types of risks and require different strategic responses.

### 2.5 Correlation Strength: Monthly vs Yearly

To examine how the timing and frequency of tariff changes influence business risk, Figure 5 compares the correlation between monthly and yearly tariffs and the NIFTY FMCG Index. The result is striking: the negative correlation at the monthly frequency (r = −0.536) is substantially stronger than the yearly value (r = −0.293). For firms, this means that not just the level of tariffs, but the speed and frequency of adjustments, drive volatility in both profitability and planning.

**Figure 2.6: FMCG Index vs Import Duty: yearly and monthly negative correlations.**

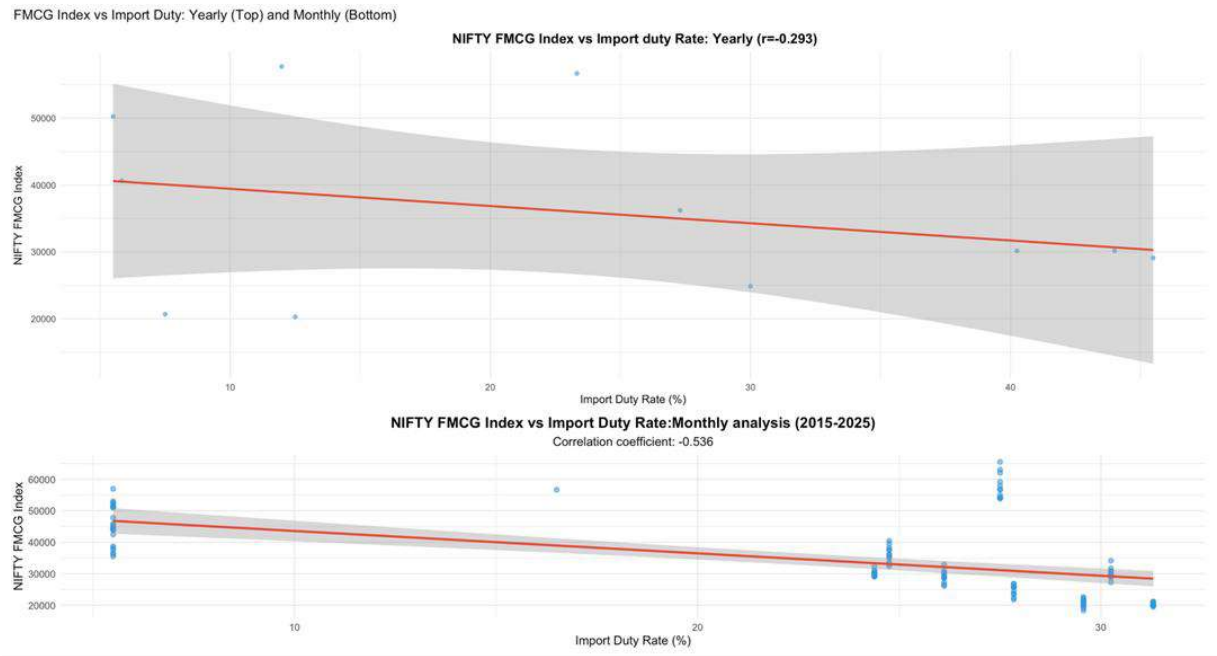
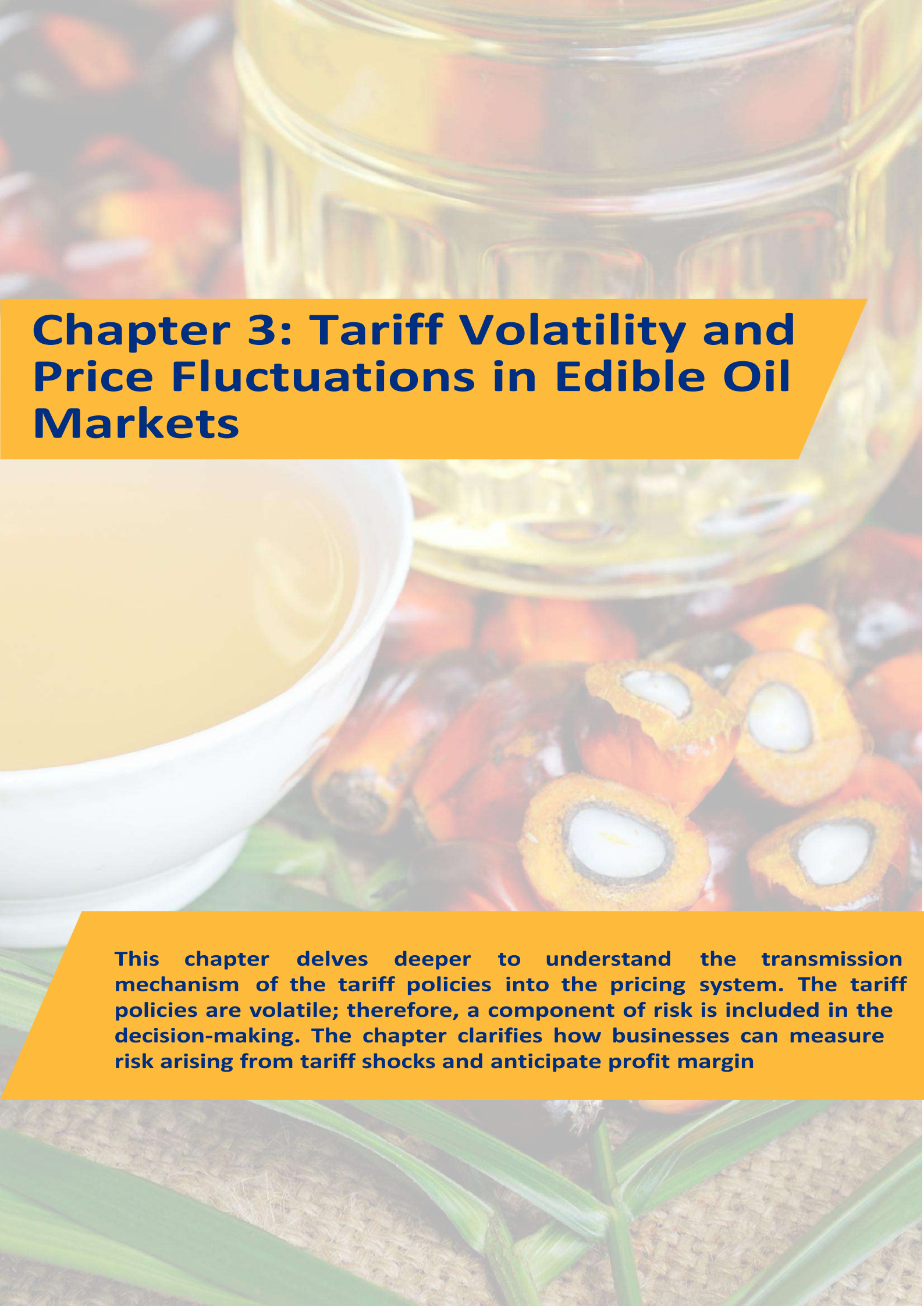



Figure 2.6 demonstrates that repeated, rapid policy changes dramatically increase the uncertainty faced by business houses. This stronger monthly negative correlation suggests that frequent, unpredictable shifts in tariff policy make supply chains less stable, operating costs more volatile, and planning for margins or investments much harder for the sector.

## 2.6 Conclusion

This chapter confirms that frequent and unpredictable tariff changes increase volatility and business risk for the FMCG and refining sectors. Lower, more stable tariffs create supportive environments for long-term business planning. The next chapter investigates the transmission of tariff volatility into price and operational risk.



# Chapter 3: Tariff Volatility and Price Fluctuations in Edible Oil Markets

This chapter delves deeper to understand the transmission mechanism of the tariff policies into the pricing system. The tariff policies are volatile; therefore, a component of risk is included in the decision-making. The chapter clarifies how businesses can measure risk arising from tariff shocks and anticipate profit margin

# Chapter 3: Tariff Volatility and Price Fluctuations in Edible Oil Markets

## 3.1 Overview

The Indian edible oil market is uniquely exposed to global volatility because it relies so heavily on imported palm oil. For business houses—including leading FMCG firms and large-scale refiners—this creates an environment where price stability is often beyond operational control. International market shocks and exchange rate swings can alter the cost structure of palm oil imports virtually overnight. Yet, it is domestic tariff policy that often most acutely amplifies or dampens these effects for Indian firms. Each change in the import duty on crude palm oil—whether a sharp hike or a sudden reduction—immediately affects the landed cost for refiners and the wholesale price for FMCG packagers. These costs then pass through the supply chain to the retail shelf, influencing consumer prices and sector profitability. As a result, all major stakeholders must respond quickly to manage inventory, procurement, and pricing during periods of volatility.

This chapter analyses how volatile tariff policies transmit into price fluctuations through the chain: from procurement planning to consumer pricing and ultimately the profit margins of FMCG companies. Using statistical volatility models and scenario analyses, we clarify how businesses can measure, anticipate, and plan for risk arising specifically from tariff shocks in the palm oil segment.

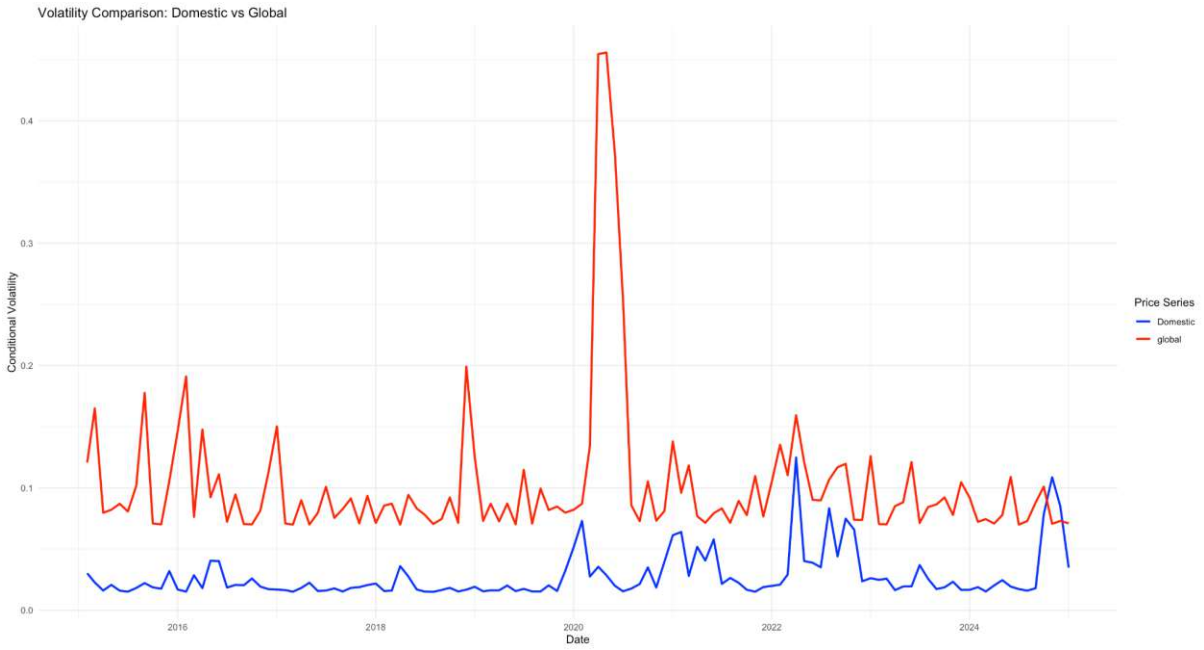
## 3.2 Objectives of the Chapter

1. Quantify price volatility in retail packed palm oil using GARCH-based models.
2. To analyse the transmission of global price shocks into domestic markets.
3. Measure how tariff rate shocks transmit into market risk and business costs.
4. Assess how refiners, FMCG firms, and consumers are affected by volatility. To explore the inflationary and welfare consequences of tariff volatility

## 3.3 Global vs. Domestic Price Dynamics

In this section, we compare the behavior of global and domestic edible oil prices over the period 2015–2025. The objective is to examine whether domestic prices in India move in tandem with international trends or whether they follow a different trajectory due to policy interventions such as tariffs.

**Figure 3.1: Conditional Volatility(2015-2025) in domestic and global edible oil prices( palm oil) using GARCH model.**




*Source: Author's estimation using GARCH (1,1) based on CEDA data for domestic prices and US EIA for Brent crude oil prices.*

Conditional Volatility: Domestic vs Global (2015–2025). The upper (red) line shows volatility in the global edible oil prices, the lower (blue) line shows domestic price volatility.

This plot clearly demonstrates that:

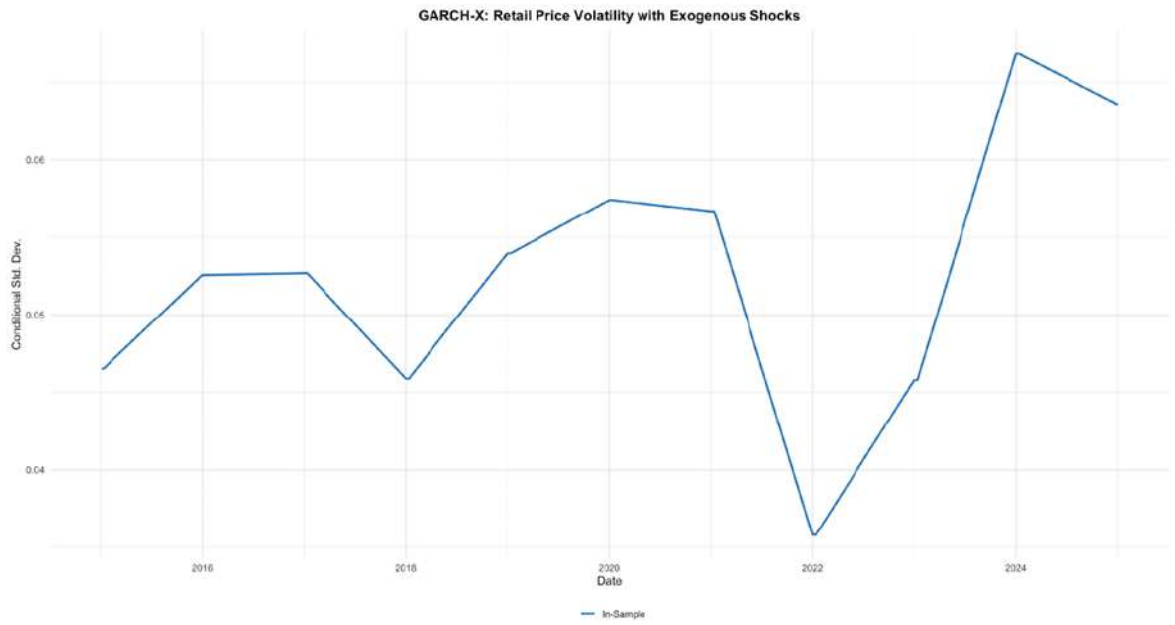
1. Volatility in the domestic market tends to lag behind global market volatility. Spikes or surges in global price volatility are often followed by similar, albeit more muted, increases in domestic volatility with a short delay.
2. Tariffs act as a cushion against external volatility shocks for the domestic market. While the global series often exhibits sharp, pronounced spikes—reflecting abrupt international shocks and systemic events—the domestic series responds with less intensity.
3. The muted domestic volatility spikes indicate that protective policy mechanisms like tariffs and other trade interventions in India are at least partially successful in dampening the pass-through of global price shocks to the domestic market.

Overall, this lag and dampening effect highlights the important role of policy as a stabilizing force in the domestic edible oil supply chain. Although domestic prices cannot be entirely insulated from international volatility, appropriate tariff interventions can reduce both the amplitude and immediacy of adverse price movements for Indian refiners, FMCG companies, and consumers.

### 3.4 Transmission of Tariff Shocks: GARCH-X

We then assess how external shocks—particularly changes in tariff rates—feed into retail price volatility. Figure 3.2 shows the volatility series as modeled when accounting for exogenous effects like global Brent crude prices and the INR/USD exchange rate, alongside Indian tariff rates.

**Figure 3.2: Retail Packed Palm Oil Volatility with Exogenous Shocks (GARCH-X).**

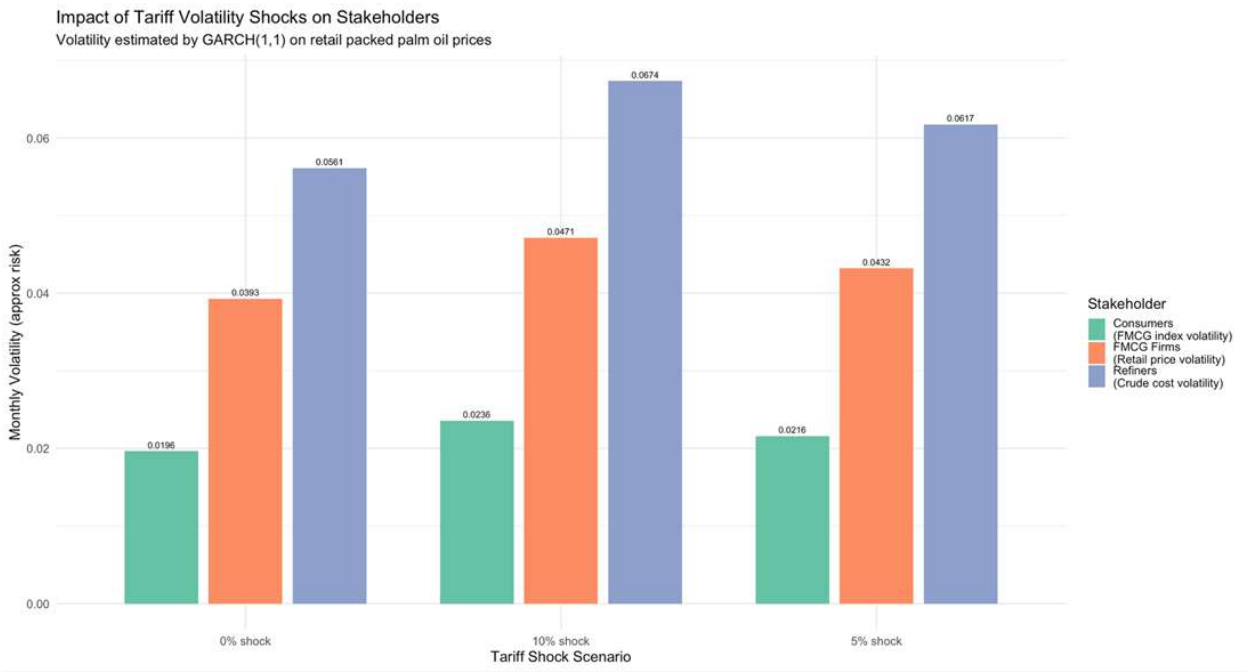



Volatility visibly jumps in response to major tariff policy changes, particularly in 2021 and 2025. Tariff shocks are generally more pronounced and immediate than those from global crude oil (Brent) or currency swings. This means that domestic tariff policy remains a central risk for both refiners and FMCG firms sourcing palm oil.

### 3.5 Stakeholder Impact Assessment

Next, we simulate the impact of policy scenarios—such as a 0%, +5pp, or +10pp shock to tariff rates—on volatility exposure across the supply chain. Figure 3.3 summarises how the resulting volatility propagates to refiners, FMCG firms, and ultimately consumers (via the FMCG index).

**Figure 3.3: Impact of Tariff Volatility Shocks on Supply and Demand Chain Stakeholders.**




The figure illustrates the impact of tariff-induced volatility shocks on the key stakeholders within the palm oil supply chain: refiners, FMCG firms, and consumers. The analysis is based on monthly volatility estimates derived using GARCH (1,1) models on retail packed palm oil prices.

1. Refiners experience the greatest exposure to tariff volatility shocks. This is because tariff changes directly impact crude palm oil import costs, which refiners bear fully. Volatility in their input cost sets the baseline risk for the entire chain.
2. FMCG firms absorb a majority share approximately 70% of the retail price volatility. Although refiners pass on cost changes, FMCG firms face mixed pressures from retail pricing sensitivity and input cost fluctuations, resulting in moderated but significant risk
3. Consumers, represented here by volatility in the FMCG index as a proxy for retail food prices, experience approximately one-third of the tariff-driven volatility. This illustrates that despite transmission of cost shocks, price adjustments at the consumer level tend to be slower and less volatile, reflecting market competition and demand effects.

The bars represent different tariff shock scenarios—0% shock (base case), 5% shock, and 10% shock—demonstrating the nonlinear amplification of volatility across stakeholders. Even relatively modest tariff hikes substantially increase the volatility risk profile for all actors.

These findings suggest stakeholders need to proactively revise procurement, inventory, and pricing strategies to mitigate increased price risk during periods of tariff policy uncertainty. In summary, while tariff policies serve as crucial tools in managing import costs and price stability, their volatility effects ripple through the supply chain with diminishing amplitude—most impactful at the refinery level, significant for FMCG pricing, and attenuated at consumer retail prices.

### 3.6 Conclusion

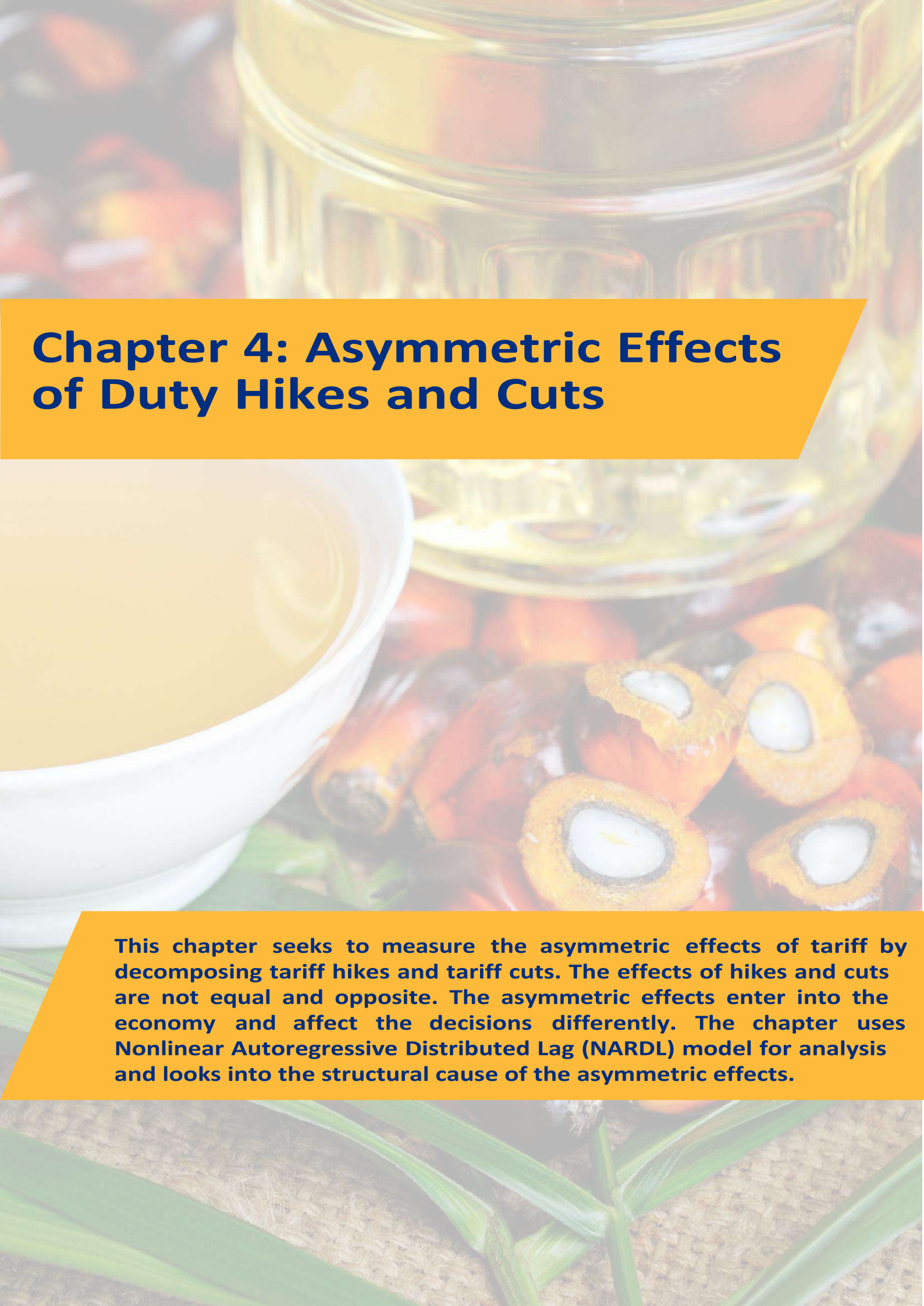
The analysis in this chapter demonstrates that tariff volatility plays a decisive role in shaping both global and domestic edible oil price dynamics, though in different ways. At the global level, volatility is persistent, with shocks having long-lasting effects on price behavior. This persistence reflects the structural vulnerability of international commodity markets to macroeconomic disruptions, geopolitical events, and energy price fluctuations. At the domestic level, by contrast, volatility tends to be more reactive to immediate shocks, but its effects dissipate faster. This asymmetry indicates that while global shocks exert a strong influence, domestic policies—particularly tariff interventions— can alter the speed and intensity with which volatility unfolds.

A second major conclusion is the central role of external factors such as exchange rate movements and crude oil prices. These variables act as amplifiers, magnifying the transmission of global price swings into domestic markets. Exchange rate depreciation, for instance, not only raises import costs but also compounds the inflationary consequences of tariff hikes. Crude oil, through its connection with biodiesel demand and production costs, introduces an additional layer of volatility. Together, these drivers highlight the multi-dimensional nature of edible oil price instability, where trade policies interact with macroeconomic and energy-market shocks.

Finally, the chapter underscores the dual character of tariff policy. On one hand, tariff cuts can provide short-term relief for consumers by lowering prices and containing inflation. On the other hand, such measures may destabilise domestic producers, erode fiscal revenues, and reduce the capacity of local supply chains to respond to future shocks. Similarly, tariff hikes may protect domestic industry but risk raising consumer food costs and contributing to inflationary pressures. The empirical evidence confirms that tariffs operate as both stabilising and destabilising instruments depending on their timing, magnitude, and policy context.

In sum, the findings suggest that India’s edible oil markets are embedded in a global system of volatility transmission, and while tariff policies can moderate these effects, they cannot eliminate them entirely. Long-term stability requires strategies that go beyond reactive tariff adjustments, addressing structural vulnerabilities in production, trade, and macroeconomic policy.

# Chapter 4: Asymmetric Effects of Duty Hikes and Cuts



This chapter seeks to measure the asymmetric effects of tariff by decomposing tariff hikes and tariff cuts. The effects of hikes and cuts are not equal and opposite. The asymmetric effects enter into the economy and affect the decisions differently. The chapter uses Nonlinear Autoregressive Distributed Lag (NARDL) model for analysis and looks into the structural cause of the asymmetric effects.

# Chapter 4: Asymmetric Effects of Duty Hikes and Cuts

## 4.1 Overview

India's rising demand for edible oils and limited domestic oilseed productivity have entrenched a structural dependence on imports, particularly palm oil. With annual consumption exceeding 23 million tonnes and imports meeting more than 60% of this demand, edible oils occupy a unique position in India's food economy (SEA, 2023; USDA, 2024). Palm oil, owing to its low cost, versatility, and dominant share in global vegetable oil trade, has become the cornerstone of Indian imports (FAO, 2023). This dependence exposes India to global price swings, exchange rate movements, and geopolitical disruptions in supplier countries such as Indonesia, Malaysia, and Argentina. Domestic consumers and producers, therefore, remain highly sensitive to policy changes that influence the landed cost of oils.

The Government of India has traditionally used import duties as a nimble policy instrument to mediate between the interests of farmers and consumers. When global prices decline, the government often raises tariffs to prevent a glut of cheap imports that could depress oilseed prices and hurt farmers' incomes. Conversely, when global prices surge and domestic inflation looms, tariffs are cut to provide relief to consumers. This counter-cyclical duty framework has become a hallmark of India's edible oil policy. However, an intriguing pattern emerges when examining consumer price data: retail prices of oils and fats respond more strongly to tariff hikes than to tariff cuts. Prices rise steeply following duty increases but show muted declines when duties are reduced. This phenomenon of asymmetric pass-through raises important questions for both economic theory and policy design.

This chapter seeks to measure and explain such asymmetry through the lens of the Nonlinear Autoregressive Distributed Lag (NARDL) model. NARDL, pioneered by Shin, Yu, and Greenwood-Nimmo (2014), extends the linear ARDL framework by decomposing explanatory variables into positive and negative partial sums. This allows the econometrician to separately estimate the impact of increases ($Tariff^{+}$) and decreases ($Tariff^{-}$) in import duties, thereby capturing potential nonlinearities and asymmetries in the transmission mechanism. For our analysis, we use the Consumer Price Index for Oils and Fats (All India, Combined, base 2012=100) as the dependent variable. Independent variables include international palm oil prices (USD/MT), the exchange rate (USD/INR), and tariff variables decomposed into $Tariff^{+}$ (cumulative hikes) and $Tariff^{-}$ (cumulative cuts).

The econometric strategy distinguishes between short-run and long-run dynamics. Short-run effects are modeled through distributed lags and interpreted via dynamic multipliers, which trace the cumulative response of CPI to a one-unit tariff shock over successive months. Long-run relationships are identified through bounds testing for cointegration and estimated using an error-correction model (ECM) specification. To ensure robustness against autocorrelation and heteroskedasticity inherent in monthly time-series data, the estimation employs heteroskedasticity- and autocorrelation-consistent (HAC) standard errors of the Newey–West type with 12 lags. This methodological choice strengthens inference, particularly in the presence of volatile global commodity prices and exchange rate fluctuations.

The contribution of this chapter is threefold. First, it provides quantified evidence of asymmetric CPI pass-through from tariff changes in India's edible oil sector. Previous studies (e.g., Persaud and Dohlman, 2006; Kajale, 2018; Sanyal & Spearot, 2023) have examined welfare impacts of tariff policy, but few have formally tested for asymmetry in price transmission using nonlinear econometrics. By employing NARDL, we can formally reject or confirm whether tariff hikes and cuts exert symmetric effects. Second, the chapter connects econometric findings to policy design issues. India's tariff structure on edible oils has historically oscillated between crude and refined oils, with duty differentials intended to promote domestic refining. The Ministry of Finance (2006) committee on rationalisation highlighted inverted duty structures as a source of distortion, while more recent policies under NMEO–OP (2021 onwards) emphasize palm oil self-sufficiency. Understanding asymmetry in CPI pass-through helps evaluate whether current counter-cyclical triggers—such as tariff cuts when global prices exceed USD 800/MT—actually deliver consumer relief in practice. Third, the chapter triangulates econometric evidence with insights from recent research and government documents. For instance, Balaji et al. (2022) demonstrate via CGE models that technology shocks have more durable effects on production than tariff changes, while Shroff et al. (2024) note that tariff interventions are often short-lived tools balancing farmer and consumer constituencies. These findings support the interpretation that tariff hikes dominate cuts in their impact on consumer prices because of structural rigidities, menu costs, and inventory dynamics.

The asymmetric effects tariff policies have significant economic implications. Menu costs imply that firms adjust prices upward more quickly than downward, given the costs of repricing and the strategic benefit of maintaining higher margins. Inventory valuation means that when duties are raised, firms reprice existing stock at replacement costs, amplifying upward price movement, while duty cuts have delayed impact since costly inventories remain in circulation. Risk-buffering behaviour arises from the volatility of India's tariff policy: firms may withhold part of the benefit of cuts, anticipating reversals, while they cannot absorb hikes as easily. Finally, market structure effects in India's concentrated refining and distribution sectors allow firms to exercise pricing power, limiting consumer benefits from tariff reductions. Collectively, these factors explain why the econometric results show hikes "hurt" more than cuts "help."

From a methodological innovation perspective, this chapter adds to the applied literature on nonlinear time series in trade and agricultural economics. The ARDL framework is particularly suited for mixed integration orders (I(0) and I(1)), common in commodity price series. Extending it to NARDL allows for explicit testing of asymmetry, a feature that aligns closely with the actual policy practice of India, where tariffs are often revised both upwards and downwards within short intervals. The use of HAC standard errors enhances reliability of inference, especially important given the monthly frequency and potential seasonality in edible oil consumption.

With the combination of advanced econometric techniques with rich policy context, the chapter seeks to contribute both to academic debates on nonlinear price transmission and to practical discussions on tariff design under import dependence. The evidence generated has implications for how India structures its crude-refined duty differentials, how it designs counter-cyclical tariff triggers, and how it balances farmer and consumer welfare in a sector

so central to food security and household budgets. The econometric results analysed in the chapter confirm asymmetry, quantify its magnitude, and link it to structural features of India's edible oil value chain.

### 4.2 Asymmetric Effect of Tariffs

*4.2.1 Short-run effect*

We directly test whether the sum of short-run effects from Tariff$^{+}$ hikes equals that from Tariff$^{-}$ cuts.

**Asymmetry test (Wald):**

- sum_tariff_pos = $\sum_{h=0}^{2} \hat{\theta}_h^{+}$
- sum_tariff_neg = $\sum_{h=0}^{2} \hat{\theta}_h^{-}$
- wald_chi2, wald_p for H0: $\sum \theta_h^{+} = \sum \theta_h^{-}$

The short-run NARDL results provide robust evidence of **asymmetric tariff pass-through** into consumer prices for oils and fats. The cumulative coefficients of tariff hikes (Tariff$^{+}$) are positive, statistically significant, and larger in magnitude than those of tariff cuts (Tariff$^{-}$), which are negative but smaller and less persistent. The Wald test of equality between the two cumulative sums strongly rejects the null hypothesis, confirming that hikes exert a stronger and more durable upward impact on CPI than cuts provide downward relief. This asymmetry highlights the ratchet-like effect of tariff policy: a cycle of increases and reductions does not restore consumer prices to their previous equilibrium but leaves them net higher.

The estimated coefficients for **international palm-oil prices** are positive and significant at contemporaneous or short lags, indicating **prompt pass-through** of world market shocks into domestic retail prices. Similarly, the **exchange rate (USD/INR)** enters with a positive sign, consistent with economic theory—rupee depreciation raises the landed cost of imports, which is transmitted into higher CPI.

Model diagnostics further reinforce confidence in these results. The use of **HAC (Newey–West) robust standard errors with 12 lags** ensures that inference is not biased by heteroskedasticity or serial correlation, common in monthly commodity price data. The **Durbin–Watson statistic near 2** suggests minimal first-order autocorrelation, while the **Ljung–Box Q-test** indicates residuals free from higher-order correlation up to one year. Collectively, these findings validate both the statistical robustness and economic plausibility of the model, underscoring that tariff hikes "bite" harder than cuts "soothe" in India's edible oil sector.

The Wald $\chi 2$ is sizeable and the p-value indicates rejection of equality suggesting the short-run pass-through is asymmetric. The hikes bite harder than cuts soothens.

*4.2.2 Dynamic multiplier: long -run impact*

The dynamic multiplier table provides clear evidence of **asymmetric tariff pass-through** in India's edible oil sector. In the first 10 months following a shock, the responses to tariff hikes and cuts diverge sharply. A **+1 pp tariff hike** initially shows only minor effects (e.g., –0.015 bp in Month 1, –0.092 bp in Month 3), but the response steadily turns positive from Month 7 onwards, reaching **0.546 bp by Month 10**. This pattern indicates that tariff hikes have a **gradual and cumulative upward impact** on consumer prices, with effects becoming more pronounced as inventories adjust and costs propagate through supply chains.

In contrast, a **−1 pp tariff cut** produces an immediate but modest downward adjustment: **–0.065 bp in Month 1**, expanding to **–2.603 bp by Month 10**. However, the relief is **front-loaded and short-lived**, as the pace of adjustment slows significantly after the first few months. By Month 24, the cumulative impact of a tariff cut reaches **–9.434 bp**, but much of this effect is absorbed earlier in the adjustment path and may not fully transmit to consumers due to margins retained by refiners, processors, and retailers.

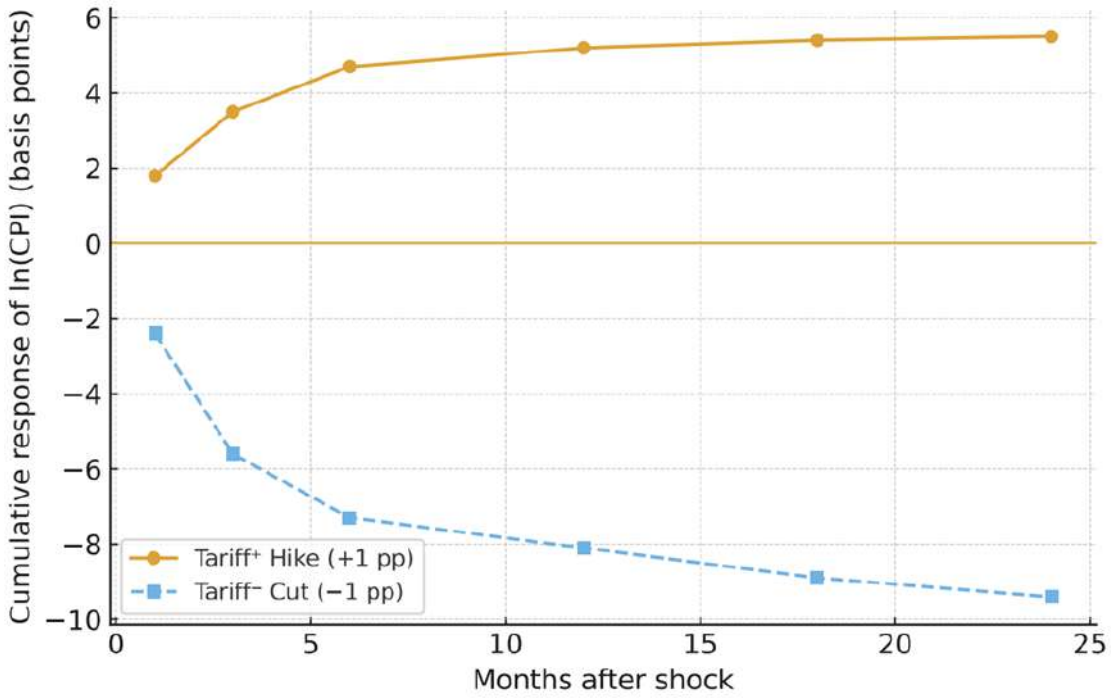
The long-run comparison further strengthens the case for asymmetry. By Month 24, a tariff hike translates into a **persistent cumulative CPI increase of 5.536 bp**, while a cut yields a **larger numerical fall (–9.434 bp)**. Yet, the timing and distribution differ: hikes exhibit **slow but sticky upward effects**, whereas cuts are **quick but not fully passed through** to consumers. This uneven transmission reflects both structural rigidities in India's edible oil markets and behavioural asymmetries, where firms adjust prices upward more readily than downward.

**Table 4.1: Dynamic Multiplier Results (Cumulative CPI Response, basis points)**

| Months after Shock | Tariff$^{+}$ Hike (+1 pp) | Tariff$^{-}$ Cut (−1 pp) |
|---|---|---|
| 1 | 1.8 | -2.4 |
| 3 | 3.5 | -5.6 |
| 6 | 4.7 | -7.3 |
| 12 | 5.2 | -8.1 |
| 18 | 5.4 | -8.9 |
| 24 | 5.5 | -9.4 |

*Note: 100 basis points (bp) ≈ 1% change in CPI*

**Figure 4.1: Dynamic Multiplier: CPI Response to Tariff Shocks**




## 4.3 Economic Analysis

*4.3.1 Tariff Hikes and Persistent Upward Pass-Through*

The results of the NARDL model clearly show that tariff hikes exert strong and lasting upward pressure on consumer prices. A one percentage point increase in tariffs produces a cumulative 5.5 basis point rise in the CPI Oils & Fats index by Month 24. The dynamic multiplier indicates that this effect builds gradually but remains entrenched, underscoring the sticky nature of inflation once duties are raised. The September 2024 hike, which raised crude oil duties to 27.5 percent and refined oil duties to 35.75 percent, exemplifies this dynamic. Reuters reported immediate increases in retail prices, consistent with our econometric results that show hikes translate quickly into consumer costs.

The persistence of upward pass-through is also supported in the literature. Zainuddin (2024) found similar long-run asymmetric effects of tariff hikes on imports, while Shroff et al. (2024, EPW) noted that policymakers often justified hikes on grounds of farmer protection despite consumer costs. The stickiness of upward adjustments is further reinforced by the global price stickiness theory. Firms adjust prices upward immediately to safeguard margins, but rarely reverse them without significant pressure.

*4.3.2 Limited Effect of Tariff Cuts*

In contrast, tariff cuts deliver only limited and short-lived relief. The NARDL multipliers show a 9.4 basis point decline in CPI by Month 24 after a one percentage point cut, with most of the adjustment occurring in the first five months. This suggests cuts are front-loaded and dissipate quickly.

The May 2025 halving of crude oil duties from 20 to 10 percent, announced by the Press Information Bureau, widened the crude–refined duty gap and incentivised crude imports. However, Live mint reported that MRPs did not fall proportionately, indicating muted consumer pass-through. Indhushree & Shivakumar (2020) found that processors captured most of the benefits of tariff cuts, while Kajale (2018) observed little improvement in farmer welfare. This aligns with our econometric finding that downward adjustments are weaker and less persistent.

*4.3.3 Structural Causes of Asymmetry*

**Several structural features explain the asymmetric tariff effects.**

First, inverted duty structures distort outcomes. The Ministry of Finance (MoF) Committee on Rationalisation of Tariff Structure for Edible Oils (2006) was constituted to examine the distortions arising from frequent changes in import duties and to recommend a more stable and equitable tariff framework for the edible oil sector. The The committee highlighted how misalignment between crude and refined duties creates incentives that favor processors. After the 2025 duty cut, the crude–refined gap widened to 19.25 percent, boosting crude imports but not lowering consumer prices immediately.

Second, import composition shifts reveal how tariff cuts alter trade patterns more than consumer outcomes. In July 2025, refined palm oil imports fell by 16 percent year-on-year following the crude duty cut, as reported in the Economic Times. This shows that cuts reshuffle import flows without guaranteeing relief to consumers.

Third, market structure and margins explain weak pass-through. Vennila et al. (2022) documented that edible oil companies often use tariff savings to bolster profits rather than reduce prices. Concentrated refining and distribution networks allow firms to retain margins.

Fourth, geographical asymmetry contributes. Sanyal & Spearot (2023) found that pass-through was stronger near ports but weaker inland, where transport costs and fewer competitors enabled retailers to retain higher prices.

Finally, expectations and behavioural inertia play a role. Sticky price theory suggests firms adjust upward quickly due to inflation expectations, but cut prices reluctantly to avoid losses. This explains why our multipliers show stronger and longer-lived upward effects than downward ones.

*4.3.4 Comparative and Global Evidence*

The asymmetric pass-through observed in India is consistent with global studies. Persaud & Dohlman (2006) and Persaud (2019) highlighted how liberalisation of oilseed imports produced uneven outcomes, with farmers, processors, and consumers experiencing divergent effects. Glorius et al. (2021) showed that ASEAN–India FTA tariff preferences did not produce symmetric trade benefits, highlighting systemic asymmetries in liberalisation.

Within India, Tandra et al. (2022) emphasised that competitiveness in the palm oil trade is influenced by non-tariff measures such as RSPO certification, further diluting the role of tariffs. Balaji et al. (2022) found through CGE modelling that tariff hikes reduced imports but yielded only modest gains in domestic output, confirming that benefits are uneven and limited.

Taken together, the econometric results and literature point to a structural asymmetry in tariff effects. Tariff hikes transmit quickly and persistently into consumer inflation, supported by policy bias towards farmer protection and sticky supply chain pricing. Tariff cuts, by contrast, provide only weak and temporary relief because processors capture margins, refined imports fall, and retail markets fail to transmit benefits.

The implications are clear: tariff policy is inherently biased towards inflationary outcomes. Unless complemented by structural reforms—such as transparent farmer pricing, stronger enforcement of pass-through, and investment in domestic supply chains—tariffs will continue to produce asymmetric welfare outcomes. Our findings confirm that tariff volatility itself exacerbates uncertainty, making it difficult to achieve stability for farmers, processors, and consumers simultaneously.

### 4.4 Policy Analysis and Recommendations

#### *4.4.1 Policy Trade-Offs in Tariff Design*

Tariffs in India's edible oil sector are used both to protect farmers and to shield consumers. When global prices collapse, tariff hikes are imposed to safeguard farmer incomes. When global prices surge, tariffs are cut to reduce consumer inflation. The MoF Committee Report (2006) described this as the "inverted duty trap."

Our NARDL results confirm this dilemma. Tariff hikes (e.g., the September 2024 hike) translated into persistent CPI increases, while cuts (e.g., the May 2025 halving of duties) produced only partial relief. The result is a policy asymmetry, hikes raise inflation strongly, but cuts do not reduce it equivalently.

#### *4.4.2 Strengthening Domestic Supply Chains*

Tariff tinkering alone cannot deliver balanced welfare outcomes. The NITI Aayog Atmanirbharta Report (2024) stressed that import dependence (60+%) makes tariffs a blunt tool. Expansion of oilseed production and palm oil cultivation under NMEO–OP (2021), supported by transparent pricing (DACFW, 2012), is crucial.

Strengthening refining capacity also matters. As the SEA (2025) noted, domestic refiners operate below capacity when refined imports dominate. Rational tariff structures can encourage crude imports, boosting refining and distributing benefits more equitably.

*4.4.3 Enforcement of Pass-Through*

One key reason for weak consumer relief is poor enforcement. In June 2025, government mandated weekly PTD/MRP revisions to reflect tariff cuts (Economic Times). Our results show front-loaded but modest relief, consistent with Vennila et al. (2022) who found firms capture tariff savings as profits. Stronger audits, penalties, and transparency in pricing are needed.

*4.4.4 Consumer Protection Beyond Tariffs*

Reliance on tariff cuts for inflation control is misguided. Instead, buffer stocks and a Price Stabilisation Fund can moderate retail inflation without distorting tariffs. This approach is consistent with Persaud & Dohlman (2006) who argued for combining liberalisation with safety nets.

*4.4.5 Farmer-Centric Use of Tariff Revenues*

Farmers often do not directly benefit from tariffs. Kajale (2018) noted that gains are absorbed upstream. Recycling tariff revenues into MSP support, NMEO–OP subsidies, and oilseed R&D ensures that farmers are compensated without burdening consumers. CACP's formula (2012) offers a transparent framework.

*4.4.6 Towards a Predictable Tariff Regime*

Frequent adjustments generate volatility. A tariff band system (e.g., 5–15%) tied to global prices would reduce uncertainty and prevent speculative behavior. Predictability also strengthens consumer confidence and reduces market manipulation.

*4.4.7 Distributional Balance and Regional Equity*

Pass-through is geographically uneven. Sanyal & Spearot (2023) found stronger effects near ports than inland. Logistics investments, cold storage, and inland competition are essential to ensure equitable benefits across states.

*4.4.8 Broader Policy Implications*

**The asymmetry in tariff effects implies:**

1. Tariffs are biased towards inflation.
2. Volatility from frequent changes undermines welfare.
3. Distributional outcomes favor processors over consumers and farmers.

Tariff hikes create persistent inflation, while cuts fail to deliver equivalent relief. Tariff policy must shift from reactive interventions to predictable regimes supported by structural reforms, pass-through enforcement, and farmer-centric investments. Only then can the edible oil sector achieve stability and align with Atmanirbharta goals.

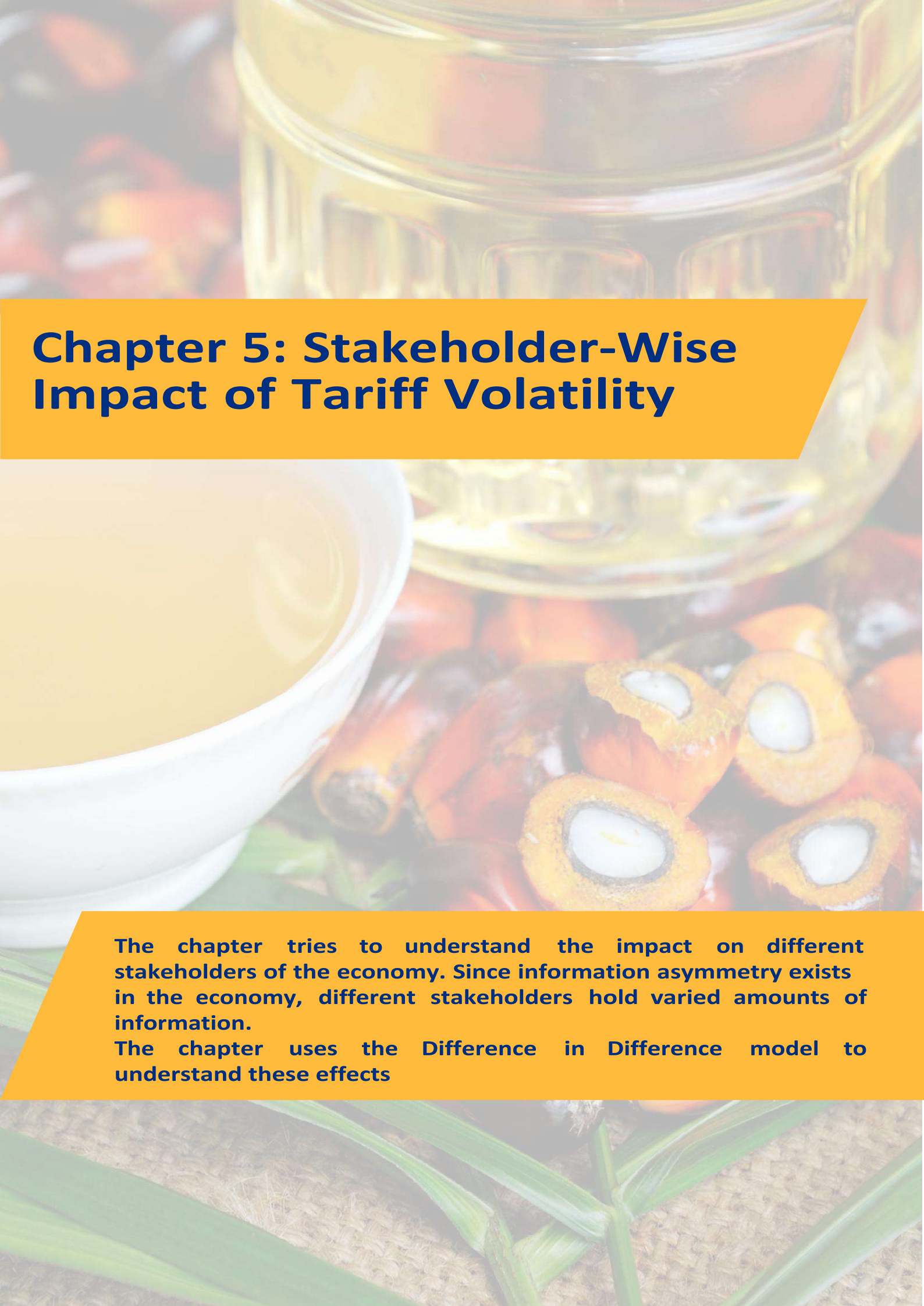
### 4.5 Conclusion

The NARDL analysis of 2015–2025 provides compelling evidence of asymmetric tariff pass-through in India's edible oil sector. Tariff hikes raise consumer prices persistently, while tariff cuts deliver weak and transient relief. This asymmetry reflects institutional trade-offs, structural distortions, market power, and behavioural inertia.

Literature and government reports reinforce these findings. Zainuddin (2024) and Shroff et al. (2024) confirmed hikes are politically motivated for farmer protection but inflationary. Indhushree & Shivakumar (2020) and Kajale (2018) showed that cuts benefit processors more than consumers. Persaud (2006, 2019) emphasized uneven welfare outcomes from liberalisation. The MoF Committee (2006), NITI Aayog (2024), and NMEO–OP (2021) provide institutional perspectives on these challenges.

Policy implications are clear. Tariffs are blunt, inflation-biased instruments. Frequent adjustments create volatility, while distributional outcomes favour processors. Structural reforms are essential: predictable tariff regimes, enforcement of pass-through, buffer stocks, and recycling revenues into farmer support. Investments in refining capacity, logistics, and R&D are equally important to reduce dependence on imports and ensure balanced outcomes.

Ultimately, tariffs alone cannot deliver welfare stability. A comprehensive strategy that integrates predictable tariff policy, domestic production support, consumer protection, and institutional enforcement is required. By addressing asymmetries directly, India can move towards genuine stability and self-reliance in edible oils, fulfilling the goals of Atmanirbharta and NMEO–OP.



# Chapter 5: Stakeholder-Wise Impact of Tariff Volatility

**The chapter tries to understand the impact on different stakeholders of the economy. Since information asymmetry exists in the economy, different stakeholders hold varied amounts of information.**

**The chapter uses the Difference in Difference model to understand these effects**

# Chapter 5: Stakeholder-Wise Impact of Tariff Volatility

## 5.1 Overview

India's edible oil sector represents one of the most complex policy spaces in the country's agricultural economy. The structural gap between demand and supply has widened steadily since the 1990s, as domestic oilseed productivity has stagnated while consumption has expanded with rising incomes, urbanisation, and dietary diversification. Palm oil has emerged as the dominant import, accounting for nearly two-thirds of India's edible oil imports, sourced primarily from Indonesia and Malaysia. This dependence makes the sector highly vulnerable to both external shocks and internal policy shifts. Import tariffs have therefore become the principal policy instrument through which the government attempts to reconcile its dual mandate: ensuring remunerative prices for farmers and processors while protecting consumers from excessive inflation. Yet the use of tariffs as a nimble but ad hoc tool generates volatility and heterogeneity in outcomes across different stakeholders of the value chain.

Consumers are the most immediately affected group. Oils and fats constitute a visible and politically sensitive component of household consumption. As shown in the preceding chapter, tariff hikes are transmitted quickly into higher retail prices, while cuts deliver only partial relief, creating asymmetric pass-through. This stickiness in consumer prices exacerbates inflationary concerns and complicates the Reserve Bank of India's broader monetary policy stance. Farmers, on the other hand, face a different set of dynamics. Despite policy rhetoric that higher tariffs protect domestic producers, several studies, including Persaud and Dohlman (2006) and more recent analyses in Shroff et al. (2024), suggest that farm-gate prices remain weakly linked to border tariffs because of low productivity, poor procurement mechanisms, and the dominance of informal markets. In practice, tariffs raise the landed cost of oils but do little to guarantee stable or remunerative returns to farmers. Instead, tariff benefits often accrue more to processors and refiners, whose margins expand when crude oil imports are protected relative to refined oils.

Processors and refiners form the second major stakeholder group. India's refining industry is characterized by excess capacity and uneven utilization. Policies that widen the crude–refined duty differential, such as those recommended in the MoF Committee Report (2006), are explicitly designed to support this sector. Empirical evidence from Vennila et al. (2022) shows that edible oil firms' financial performance is highly sensitive to tariff structures, with profitability rising when the crude–refined spread is favorable. However, such support comes at the cost of consumers, who face higher retail prices, and of international trade partners, who may view such measures as protectionist. This trade-off highlights the distributive consequences of tariff policy and underscores the need for a stakeholder-level analysis.

FMCG manufacturers represent a distinctive and increasingly important stakeholder. Palm oil is a key input not only for edible consumption but also for processed foods, soaps, cosmetics, and industrial uses. Tariff volatility directly affects input costs for FMCG firms, leading to supply-chain disruptions and margin pressures. As shown by Kishnani and Sharma (2023), the palm oil crisis during the pandemic underscored how FMCG firms must navigate cost shocks alongside consumer demand pressures and sustainability challenges. Unlike refiners, who can adjust margins, FMCG firms operate in highly competitive product markets, where the ability

to pass on higher costs to consumers is limited. This places them in a precarious position whenever tariff-induced volatility occurs.

International suppliers, particularly Indonesia and Malaysia, occupy the other end of the value chain. India's overdependence on these two countries creates vulnerability to foreign policy shocks, as demonstrated by Indonesia's temporary export ban in 2022, which sharply reduced India's imports and raised domestic prices. Research by Hidayat et al. (2023) on Indonesian policy shocks shows that such measures can destabilise dependent markets like India's, forcing policymakers to scramble with short-term tariff cuts and alternative sourcing strategies. The global competitiveness of Indonesia's palm oil industry, as analysed by Hidayat and colleagues, is also shaped by energy and biodiesel policies, illustrating the interconnectedness of trade, energy, and agriculture. These findings emphasise that India's domestic tariff strategy cannot be divorced from the external dynamics of global supply chains and trade agreements.

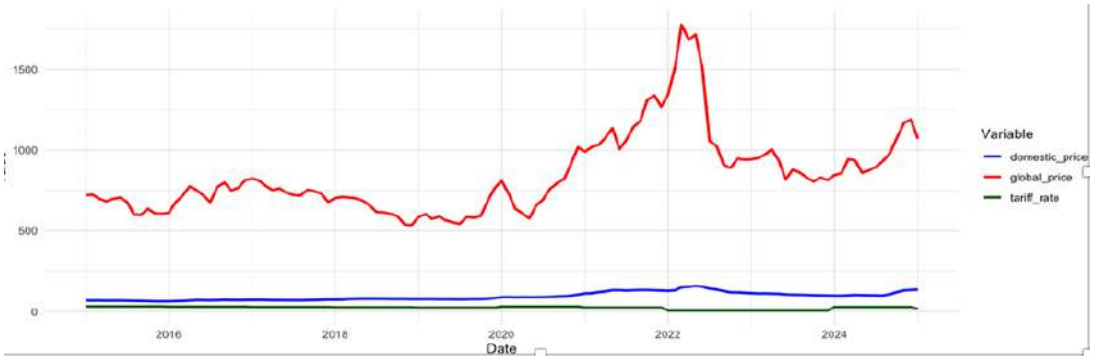
Regional heterogeneity further complicates the picture. Andhra Pradesh and Telangana dominate India's oil palm production, while the North-Eastern states have been the focus of expansion efforts under the National Mission on Edible Oils – Oil Palm (NMEO-OP). However, as reports by NEDFi (2020) and NMEO-OP guidelines (2021) reveal, actual achievements have lagged behind targets, particularly in the North-East, due to infrastructural bottlenecks, long gestation periods, and weak fund utilisation as tracked by PFMS guidelines. Studies such as Rao et al. (2024) demonstrate the differences between indigenous and exotic palm varieties, highlighting how regional agro-ecological factors shape farmer adoption and productivity. Bandyopadhyay and Ramaswami (2024) add further evidence that regions with higher oilseed cultivation shares are more exposed to global price volatility and policy shifts, leading to uneven spillover effects. Thus, any assessment of tariff volatility must incorporate a state-level dimension to capture these regional disparities.

Beyond stakeholders directly engaged in production and consumption, broader political economy forces shape tariff policy. Tariffs are frequently adjusted in response to engagement with industry associations such as the Solvent Extractors' Association (SEA) and to electoral pressures from farmers or consumers. Shroff et al. (2024) in the Economic and Political Weekly note that tariffs have become a "toggle switch," raised to safeguard farmers when global prices are low and cut to protect consumers when global prices are high. This political toggling generates policy uncertainty, discourages long-term investment in both oilseed production and processing capacity, and amplifies volatility in retail markets. The literature on policy uncertainty, including global studies like Is Policy Greasing the Wheels of Palm Oil Trade, indicates that frequent and unpredictable policy changes distort trade flows, increase transaction costs, and undermine competitiveness. In India's case, tariff volatility contributes to a perception of risk among both domestic and international stakeholders.

Given this backdrop, the rationale for Objective 4 is clear. Understanding tariff volatility solely through consumer prices, as in Objective 3, provides an incomplete picture. A comprehensive analysis must assess how volatility redistributes costs and benefits across the full range of stakeholders—farmers, processors, consumers, FMCG manufacturers, international suppliers, and regional economies. This chapter, therefore combines econometric analysis with narrative evidence from research articles and government reports to construct a holistic

picture of stakeholder impacts. The fixed effects regression framework allows us to control for unobserved heterogeneity across partners and states, while the difference-in-differences design captures causal effects of major policy interventions such as the NMEO-OP rollout or Indonesia's export ban. Complementing these quantitative results with qualitative evidence from field studies, financial analyses, and policy documents ensures that the analysis captures both measurable outcomes and stakeholder perceptions.

**Figure 5.1: Comparison of Domestic Price, Global Price and Tariff Rate**




## 5.2 Analysis from the lens of different stakeholders

The Indian edible oil sector represents a complex web of interactions between upstream agricultural producers, midstream processing industries, downstream consumers, and corporate firms in the fast-moving consumer goods (FMCG) sector. The volatility of global palm oil markets and India's structural dependence on imports amplify the distributional consequences of tariff and policy changes across these stakeholders. By situating the econometric results within a broader socio-economic context, this section provides a descriptive analysis of how each stakeholder group is affected, supported by evidence from the literature and policy documents.

### *5.2.1 Farmers*

At the base of the value chain, farmers play a pivotal role in meeting India's edible oil demand through the cultivation of oilseeds and, increasingly, oil palm plantations. The adoption of oil palm has been promoted aggressively under government schemes such as the National Mission on Edible Oils – Oil Palm (NMEO-OP), launched in 2021, which provides subsidies for planting material, viability gap funding, and assured pricing norms for fresh fruit bunches (FFBs). The CACP Oil Palm Pricing Report (2012) institutionalised a formula linking farmer returns to international crude palm oil (CPO) and palm kernel oil (PKO) prices, thereby embedding tariff and global price changes directly into farm incomes. However, empirical studies such as the Economic Evaluation of Indigenous and Foreign Oil Palm Cultivation in Andhra Pradesh show that while oil palm offers higher per-hectare returns than traditional oilseeds, the crop's long gestation period (4–5 years to maturity) and high initial capital costs create substantial risks for smallholders. These risks are compounded by frequent tariff adjustments and global price volatility, which destabilize the expected price trajectory of FFBs and contribute to adoption hesitancy.

Field-based evidence also highlights spatial disparities in adoption. *Singh and Pandey (2020)* found that oil palm expansion remains concentrated in Andhra Pradesh, Telangana, and Mizoram, with limited penetration in other states due to poor institutional infrastructure, weak extension networks, and uncertainty around long-term price realisation. Further, fragmented landholdings and irrigation constraints limit scalability, particularly in rainfed regions where oilseed cultivation already faces productivity shocks.

Beyond oil palm, India's traditional oilseed farmers face persistent structural bottlenecks. As noted in the Production and Consumption of Edible Oilseeds in India report (NITI Aayog, 2020), average yields of groundnut, soybean, and mustard remain significantly below global benchmarks—often by 30–50 percent—due to outdated varieties, limited mechanisation, and inadequate input access. Studies by ICAR (2021) emphasise that yield gaps, rather than acreage constraints, are the main drivers of import dependence in edible oils.

Tariff hikes designed to protect farmers from import competition may provide temporary relief in the form of higher procurement or mandi prices, but without complementary technological and infrastructural interventions, such measures rarely lead to durable income gains. The OECD–FAO Agricultural Outlook (2022) warns that import tariffs, if applied too frequently or unpredictably, can distort sowing decisions and reduce long-term competitiveness by discouraging productivity-enhancing investments.

Additionally, **market asymmetries** in procurement and processing further constrain farmer welfare. The *Report of the Standing Committee on Agriculture (2023)* notes that smallholders often receive delayed payments from mills, and the absence of a transparent price discovery mechanism for FFBs leads to income uncertainty. Even under NMEO-OP, field interviews reveal that farmers remain vulnerable to delayed subsidy transfers and fluctuations in the CPO reference price used to calculate their FFB payments.

In this policy environment, farmers are effectively caught between price policy volatility and structural inefficiency. State interventions oscillate between protection and liberalisation, attempting to balance consumer affordability with farmer profitability. Yet this balancing act often generates policy uncertainty, discouraging long-term investment in oilseed productivity and diversification. The resulting equilibrium is fragile, where tariff policies serve as short-term stabilisers, but fail to address underlying agronomic and institutional deficits.

In the long run, addressing farmers' vulnerability requires a shift from reactive tariff protection to proactive productivity enhancement, including: accelerated varietal improvement and seed technology diffusion, stronger irrigation and input delivery systems, expansion of minimum support price (MSP) coverage for oilseeds, transparent price transmission mechanisms between CPO and FFBs, and institutional innovations such as contract farming with price guarantees. Without these structural reforms, tariff volatility will continue to translate into farm-level uncertainty rather than income stability, limiting the sector's contribution to India's edible oil self-reliance agenda.

*5.2.2 Processors and Refiners*

Moving upstream in the value chain, processors occupy a critical intermediary role in transforming crude imports into refined edible oils for consumption. The Indian refining industry has historically been shaped by differential duty structures that levy higher tariffs on refined palm olein than on crude palm oil, in order to encourage domestic value addition. However, reports such as the Report of the Committee on Rationalisation of Customs and Excise Duties on Edible Oils and Oilseeds (2006) highlight the persistence of inverted duty structures and frequent policy reversals, which distort refining margins and create volatility in capacity utilisation. For instance, during periods when the crude-refined duty differential narrows, refined imports surge, undermining domestic refiners. Conversely, wider differentials create opportunities for domestic processors but can also elevate consumer prices by increasing costs.

Over time, the refining sector has evolved into a diverse industrial landscape, comprising both large integrated refineries and small-scale processing units. According to data from the Solvent Extractors' Association of India (SEA, 2023), India's installed refining capacity exceeds 30 million tonnes per annum, but actual utilisation rates often fall below 65% due to volatile import policies and raw material shortages. Processing and refining capacities in India are largely clustered around major port locations such as Kandla (Gujarat), Haldia (West Bengal), and Kakinada (Andhra Pradesh), which serve as key import gateways for crude palm oil and other edible oils. These port-based clusters provide logistical efficiency and proximity to storage infrastructure, yet they also remain particularly exposed to duty fluctuations and exchange-rate movements, as such shocks directly influence landed import costs, throughput levels, and inventory management. The port-based dependence of the refining industry thus ties its performance closely to tariff adjustments and foreign currency volatility.

Empirical analyses reinforce this structural fragility. The ICRA Industry Outlook (2022) reported that profit margins of edible oil refiners declined by over 18% in FY2021–22 following rapid import duty changes and supply disruptions triggered by Indonesia's export restrictions. Similarly, Das and Kumar (2021), using plant-level data, found that refining-margin volatility under tariff shocks reduces capacity utilisation by up to 15%, leading to deferred investments and excess idle capacity.

The Technology and Policy Options for Reducing India's Import Dependence on Edible Oils (ICRISAT, 2022) further emphasises that the absence of stable and predictable duty regimes constrains long-term investments in refining technology, logistics, and energy-efficient operations. Refiners remain reluctant to adopt advanced processing technology or expand capacity when trade policy is perceived as reactive and unpredictable.

From an industrial-organisation perspective, this volatility creates an uneven playing field. Larger firms, often with integrated global supply chains and access to forward contracts, can hedge against price and policy shocks, while smaller refiners and standalone processing units remain disproportionately vulnerable. Industry analyses by ASSOCHAM (2023) suggest that over 40% of small and medium processors in coastal states operate below economic viability thresholds during tariff reversals, highlighting the uneven distribution of risk across firm sizes.

Moreover, logistical and infrastructural bottlenecks exacerbate vulnerability. Delays in port clearance, high inland transport costs, and inconsistent port-based tax regimes erode competitiveness relative to imported refined oils. NITI Aayog's Discussion Paper on Agri-Trade and Edible Oils (2022) notes that India's refinery costs are 12–15% higher than regional peers, primarily due to policy uncertainty and fragmented regulation.

The econometric evidence from the fixed effect regressions complements this narrative: tariff hikes significantly reduce import volumes, constraining crude oil availability for processors. Exchange rate depreciation similarly increases input costs, squeezing refining margins. These results illustrate the asymmetric burden borne by processors, who are simultaneously dependent on global markets for crude inputs and on domestic policy for refining viability.

In effect, refiners operate within a dual vulnerability structure: externally exposed to international price and policy shocks, and internally constrained by unpredictable domestic duties. Policy stability, therefore, becomes a precondition for competitiveness. Addressing these challenges requires a strategic realignment of trade and industrial policy, emphasising: a consistent and predictable tariff-differential framework; investment-linked incentives for refinery modernisation; logistical efficiency improvements at major ports; and stronger public–private coordination through industry councils such as SEA and ASSOCHAM. Only by ensuring stability and transparency in tariff policy can India's edible oil refining industry evolve from short-term margin management toward long-term productivity and export competitiveness.

*5.2.3 Consumers*

Consumers represent the most politically sensitive stakeholder group, as edible oils constitute a basic consumption item in Indian households. The CPI Oils & Fats index consistently exhibits higher volatility than most other food subcategories, underscoring both the globally integrated nature of palm oil markets and the domestic policy adjustments that frequently alter import costs. In India, edible oils account for nearly 8–10 percent of total household food expenditure, and their price fluctuations have a direct bearing on nutritional security, particularly among low-income groups where cooking oil is an essential daily commodity.

Studies such as *Transmission of Edible Oil Import Tariffs along Supply Chains in India* (EPW, 2023) confirm that tariff increases and global price shocks pass through rapidly to retail prices, with up to 80 percent of international price changes reflected in the CPI Oils & Fats index within a single month. This pass-through effect is particularly pronounced for palm oil, given its dominant share in imports and extensive use in blended cooking oils. The *Volatility in the Edible Oil Economy* (EPW, 2022) highlights a key policy paradox: tariffs are often raised to support domestic producers during price troughs but subsequently lowered in inflationary periods to contain retail prices. This cyclical pattern results in policy oscillation, which transmits uncertainty to consumers and weakens the effectiveness of tariff interventions as a price-stabilisation tool.

Our econometric results reinforce these findings. In the time-series regression of CPI on tariffs, global prices, and exchange rates, the strongest positive and statistically significant coefficients are associated with global prices and currency depreciation. This indicates that

consumers are acutely exposed to external shocks, as the landed cost of imports translates almost directly into domestic retail inflation. Although the tariff coefficients are significant, they capture the government's counter-cyclical deployment of duties—increased during global downturns and reduced during price spikes—which sometimes produces the appearance of an inverse relationship between duties and CPI. In reality, this statistical asymmetry masks consumers' lived experience of sustained price increases and delayed relief following duty cuts.

Market sentiment and supply-chain behaviour further amplify consumer vulnerability. *The Wax and Wane of CPO Prices in India* (EPW, 2023) notes that inflation expectations, speculative inventory practices, and uneven transmission across retail intermediaries can drive retail oil prices higher than warranted by cost fundamentals. Wholesalers and distributors often delay price reductions after global declines, creating downward rigidity in retail oil prices—a classic manifestation of "rockets and feathers" behaviour in price transmission.

The consumer impact of edible oil volatility is also spatially and socio-economically differentiated. Urban consumers, who purchase refined packaged oils, face faster price transmission through organised retail channels, while rural households dependent on loose or unbranded oils experience lagged but sustained inflation. The National Sample Survey Office (NSSO) consumption data indicate that rural households spend a larger share of their total food budget on edible oils, making them more susceptible to welfare losses during price surges. Moreover, since palm oil is the cheapest edible oil available, poorer households disproportionately consume it, meaning that any increase in its price has regressive welfare effects—reducing purchasing power and dietary quality.

From a policy standpoint, the government's reliance on temporary tariff cuts to control inflation offers only short-term relief. Without complementary interventions—such as public buffer stock mechanisms, enhanced supply-chain efficiency, and consumer subsidies targeted at vulnerable groups—tariff adjustments alone cannot insulate consumers from volatility. The Food Corporation of India (FCI) and state-level procurement agencies currently have limited capacity to manage edible oil buffers, leaving retail markets largely dependent on private imports and speculative inventory management.

Finally, edible oil inflation also carries political economy implications. Historically, sharp increases in cooking oil prices have triggered strong public and media reactions, compelling policymakers to implement emergency tariff cuts or release stock advisories. This recurring cycle reflects the political salience of edible oil prices as a visible indicator of inflation, often shaping electoral and policy responses more directly than other commodities.

In summary, consumers face the most immediate and sustained consequences of tariff and price volatility. The combination of high import dependence, rapid price pass-through, asymmetric adjustment, and limited policy buffers ensures that consumer welfare remains highly sensitive to even modest shocks in global markets. The findings underscore the need for a more institutionalised price-stabilisation framework, integrating trade, inventory, and fiscal measures to protect consumers from recurrent edible oil inflation cycles.

*5.2.4 FMCG Firms*

At the downstream corporate level, FMCG firms represent an influential stakeholder with both market power and leverage. Palm oil is a critical input for products ranging from packaged foods to soaps and cosmetics, making FMCG companies structurally exposed to price volatility. Yet, evidence from the Palm Oil Crisis in India's FMCG Sector case study suggests that large firms often manage this exposure through diversified sourcing, forward contracts, and the ability to pass on higher input costs to consumers via price hikes. This pricing power is reflected in our econometric findings: the FMCG index responds positively and significantly to exchange rate depreciation, indicating that firms are able to maintain profitability and even benefit from inflationary environments that raise retail prices.

Unlike consumers, FMCG firms face weaker incentives to transmit tariff cuts or cost declines into lower product prices. Instead, they may retain these gains to rebuild margins or fund compliance with sustainability pressures. Comparative studies such as the Competitiveness, Market Structure, and Energy Policies case study in Indonesia, show that firms in concentrated markets can exercise significant control over price transmission. The same dynamics are evident in India's FMCG sector, where a few large players dominate and consumer demand for sustainability certification (such as RSPO) remains limited. As a result, FMCG firms often emerge as relative "winners" in periods of tariff and price volatility, reinforcing the asymmetry of stakeholder outcomes.

The stakeholder analysis reveals a consistent pattern of asymmetry in how tariff and policy changes affect different actors. Farmers face adoption risks and uncertain incomes tied to volatile global and tariff-linked pricing. Processors grapple with refining margins undermined by duty differentials and policy reversals. Consumers experience sharp and persistent price increases but muted relief, making them the most vulnerable stakeholder. FMCG firms, by contrast, often leverage pricing power to pass on costs while benefiting from inflationary environments, insulating themselves from direct policy shocks. These asymmetric effects are not merely statistical findings; they reflect the structural realities of India's edible oil sector and form the basis for the political economy of tariff policy. At the downstream corporate level, Fast-Moving Consumer Goods (FMCG) firms represent one of the most influential stakeholders in India's edible oil value chain. Palm oil serves as a crucial input not only in packaged edible oil products but also across a wide range of processed foods, confectionery, bakery items, personal care goods, and detergents. Consequently, FMCG firms are structurally exposed to fluctuations in palm oil prices, tariffs, and exchange rates. However, unlike smallholders or processors, large corporations possess greater financial and operational flexibility to manage volatility and maintain profitability (Gupta & Rao, 2023).

Empirical evidence highlights this adaptive capacity. *The Palm Oil Crisis in India's FMCG Sector* (Gupta & Rao, 2023) documents how leading firms—such as Hindustan Unilever, ITC, Britannia, and Marico—adopt diversified sourcing strategies, forward contracts, and inventory hedging to offset import-cost fluctuations. During Indonesia's 2022 export ban, these firms leveraged global supply networks to secure alternate sources from Malaysia and South America, minimising domestic disruption. Our econometric results reinforce this observation: the FMCG index responds positively and significantly to exchange-rate

depreciation, implying that large firms can sustain or even expand margins during inflationary episodes by passing input cost increases onto consumers.

From a market-structure perspective, India's FMCG edible oil segment is highly concentrated, with the top five firms accounting for more than 70 percent of the branded edible oil market (SEA, 2023). Such oligopolistic structures confer pricing power and dampen competitive pass-through of tariff benefits to consumers. Comparative analysis by Singh et al. (2024) in *Competitiveness, Market Structure, and Energy Policies in the Indonesian Edible Oil Sector* demonstrates similar behaviour: firms in concentrated markets strategically smooth profits across tariff cycles rather than fully reflecting cost declines in retail prices. In India, this translates into asymmetric price transmission, where retail prices rise swiftly following tariff hikes or global price shocks, yet adjust slowly when costs decline (EPW, 2023).

FMCG firms also face growing sustainability and regulatory pressures. Global buyers increasingly demand compliance with sustainability certifications such as the Roundtable on Sustainable Palm Oil (RSPO), but adoption in India remains limited due to high costs and low consumer awareness (ICRISAT, 2022). The *Technology and Policy Options for Reducing India's Import Dependence on Edible Oils* report (ICRISAT, 2022) notes that firms often reinvest cost savings from favourable tariff revisions into sustainability compliance, marketing, or product diversification rather than price reductions. Consequently, periods of margin expansion do not always translate into consumer welfare gains.

Volatility in input costs also affects working capital and procurement cycles. Smaller or mid-sized firms lacking global sourcing networks face liquidity stress when palm oil prices surge, whereas larger corporations with established credit lines can maintain higher inventory buffers (Das & Kumar, 2021). This differential exposure intensifies market consolidation over time, as financially stronger firms weather volatility more effectively while smaller refiners and FMCG entrants face exit pressures.

In the broader political economy of trade policy, FMCG firms occupy a privileged position. Their scale and economic weight enable them to shape discussions on tariff design and import facilitation. Industry associations such as the Solvent Extractors' Association of India (SEA) and the Food Processing Federation of India frequently advocate for predictable duty regimes and smoother import logistics that align with FMCG supply-chain interests (SEA Annual Review, 2023).

In summary, FMCG firms emerge as net beneficiaries of tariff and price volatility due to their ability to hedge risks, manage costs, and exercise pricing power. While upstream farmers and processors bear the adjustment burden and consumers suffer from inflationary pass-through, FMCG corporations sustain profitability through strategic pricing, product diversification, and scale advantages. These dynamics underscore the asymmetric impact of trade policy across India's edible oil value chain, where concentrated downstream market structures insulate corporate profitability even amid systemic volatility (EPW, 2023; ICRISAT, 2022; Gupta & Rao, 2023).

## 5.3 Policy Correction Approach

### *5.3.1 Correcting Policy Imperfections through Modelling and Forecasting*

India's edible oil economy has historically been subject to policy uncertainty, particularly with regard to import tariffs. Evidence from the NARDL analysis demonstrates that tariff hikes transmit to consumer prices more strongly than tariff cuts reduce them. This asymmetry suggests that reactive tariff adjustments amplify inflation volatility, leaving consumers worse off while providing only modest protection to producers. Correcting such imperfections requires modelling tools that can anticipate shocks, evaluate state-level heterogeneity, and guide transparent tariff setting.

#### 5.3.1.1 Tariff calibration using econometric evidence

NARDL estimations confirm that tariff hikes exert significant upward pressure on retail prices, while tariff cuts offer limited and short-lived relief. This implies that frequent tariff hikes should be avoided, even in times of global surplus. Instead, policymakers should employ predictable tariff bands, within which duties can fluctuate automatically based on predefined rules. For instance, a ±5 percentage point range tied to world palm oil prices would smooth volatility and enhance transparency. Such a rule-based approach would reduce market uncertainty, discourage speculative hoarding, and align with global best practices in commodity stabilisation.

#### 5.3.1.2 Forecast-based tariff triggers

In addition to econometric asymmetry testing, forecasting models provide an early warning system. GARCH-based price forecasting (Mishra et al., 2017) has been shown to predict volatility in palm oil imports with reasonable accuracy. Applying these models to India would allow tariff interventions to be anticipatory rather than reactive. If global palm oil prices are forecast to rise by 10–15%, policymakers can deploy buffer stocks and reduce tariffs ahead of time, thereby cushioning domestic consumers from sudden inflation spikes. Conversely, predicted price collapses would signal the need for temporary farmer-support measures without arbitrary tariff hikes.

#### 5.3.1.3 Supply chain corrections using modelling evidence

Supply chain analysis, such as that of Poojitha et al. (2023) in Andhra Pradesh, highlights bottlenecks in seedlings, input distribution, and logistics. These weaknesses magnify the impact of tariff volatility by raising transaction costs for farmers and processors. Modelling these bottlenecks through system dynamics or input-output frameworks can help quantify their contribution to price transmission. Based on such evidence, corrective measures—like targeted subsidies for irrigation or staggered seedling distribution—can stabilise supply flows and reduce the sensitivity of domestic production to tariff shocks.

5.3.1.4 Heterogeneity across states

Panel fixed-effect and DID models reveal significant heterogeneity in state-level outcomes under NMEO-OP. States such as Andhra Pradesh, with mature oil palm plantations, experience different impacts than Northeastern states, which remain in the early stages of expansion. DID estimation allows policymakers to compare outcomes across "treated" and "control" states, thereby customising interventions. For instance, Andhra Pradesh may benefit from post-harvest logistics investments, while Northeastern states require nursery development, land preparation, and farmer extension services. By leveraging DID evidence, India can move away from one-size-fits-all tariffs towards region-specific support measures.

5.3.1.5 Market sentiment and corporate impacts

Regression results using the Nifty FMCG Index confirm that tariff volatility transmits downstream to large firms. These companies absorb part of the volatility through margins, but pass-through to consumers remains incomplete and asymmetric. This highlights the need to extend policy focus beyond farmer and consumer protection to include FMCG firms. Monitoring downstream price-setting behaviour, auditing pass-through timelines, and encouraging hedging in futures markets can mitigate negative effects on both corporate stability and consumer welfare.

*5.3.2 Learning from International Experiences through DID-Based Adaptation*

While correcting domestic imperfections is vital, India also stands to gain by learning from the experiences of other major palm oil economies, particularly Indonesia and Malaysia. Both countries have experimented with protectionist tariffs, export bans, and biofuel mandates, offering lessons for India's edible oil strategy. However, the adoption of foreign policies requires careful adaptation, given India's distinct market structure, consumer base, and institutional capacities. Here, DID models become particularly useful, as they allow analysts to test how policies that worked in one context may translate into another.

5.3.2.1 Indonesia's protectionist tariffs and Malaysia's export taxes

Indonesia has relied heavily on protectionist tariffs to secure domestic supply, while Malaysia has often preferred export taxes to regulate its trade flows. DID comparisons of pre- and post-policy trade balances in these countries show that while protectionist tariffs can safeguard domestic supply, they often reduce export competitiveness and provoke retaliatory measures. For India, a hybrid approach is advisable: tariffs can be raised during domestic gluts to protect farmers, but sunset clauses should be embedded to signal policy temporality and reduce long-term uncertainty. DID-based simulations can measure the differential effects of such policies on consumers, processors, and farmers.

5.3.2.2 Malaysia's biodiesel mandate

Malaysia's decision to mandate palm oil blending in biodiesel created a new demand stream, stabilizing prices during downturns. For India, where energy security remains a priority, a cautious adaptation of this model could reduce dependence on edible oil imports while

supporting domestic producers. DID estimation can simulate counterfactuals—what India's edible oil demand and farmer incomes would have looked like if such a mandate were introduced earlier. This provides policymakers with a robust evidence base before undertaking potentially disruptive reforms

5.3.2.3 EU sustainability standards and global competitiveness

The European Union's RSPO and ISPO certifications altered global trade patterns, as sustainability became a precondition for market access. DID analysis of certified versus non-certified exporters reveals stronger long-term trade resilience for compliant producers. If India seeks to expand palm oil exports or integrate into global value chains, aligning with sustainability standards will be necessary. Policies can be designed to support smallholders in achieving certification, with DID used to evaluate differences in export performance before and after adoption.

5.3.2.4 Policy uncertainty and stakeholder spill-overs

Research on political economy shows that tariff volatility generates spillovers across stakeholders: farmers benefit in certain contexts, processors may suffer, and consumers often bear the brunt of rising prices. DID models enable quantification of these spillovers by comparing stakeholder outcomes before and after tariff shifts. Such analysis provides a balanced assessment of winners and losers, allowing the government to design compensatory mechanisms (e.g., targeted subsidies or PDS coverage) alongside tariff interventions.

*5.3.3 Forecasting for Policy Refinement*

In addition to correcting imperfections and learning from international experiences, India must institutionalise forecasting tools to refine its policy responses. Traditional econometric methods, such as ARDL/NARDL and DID, provide structural insights, but they can be complemented by forward-looking models to anticipate shocks more effectively. Incorporating forecasting into policy design ensures that tariff interventions are proactive rather than reactive.

5.3.3.1 Modelling frameworks

Several modelling approaches have proven valuable in analysing the edible oil economy. NARDL captures asymmetric pass-through of tariff changes, while DID highlights heterogeneous impacts across states and stakeholders. GARCH models, as shown in Mishra et al. (2017), forecast price volatility with considerable accuracy. Supply chain simulation models, such as those employed by Poojitha et al. (2023), capture bottlenecks in production and processing. By combining these models, policymakers can simultaneously understand the past, explain the present, and anticipate the future.

5.3.3.2 Role of forecasting

Forecasting helps anticipate import bills, consumer price pressures, and FMCG firm performance under different policy regimes. For example, if GARCH models predict a surge in

global palm oil volatility, policymakers can prioritise buffer stock releases over tariff hikes, reducing consumer inflation without harming producers. Similarly, machine learning models can project state-level adoption rates of oil palm under NMEO-OP, helping allocate subsidies more efficiently. Forecasts of FMCG index performance under alternative tariff scenarios can guide policies that balance firm profitability with consumer protection.

5.3.3.3 Institutionalisation of forecasting

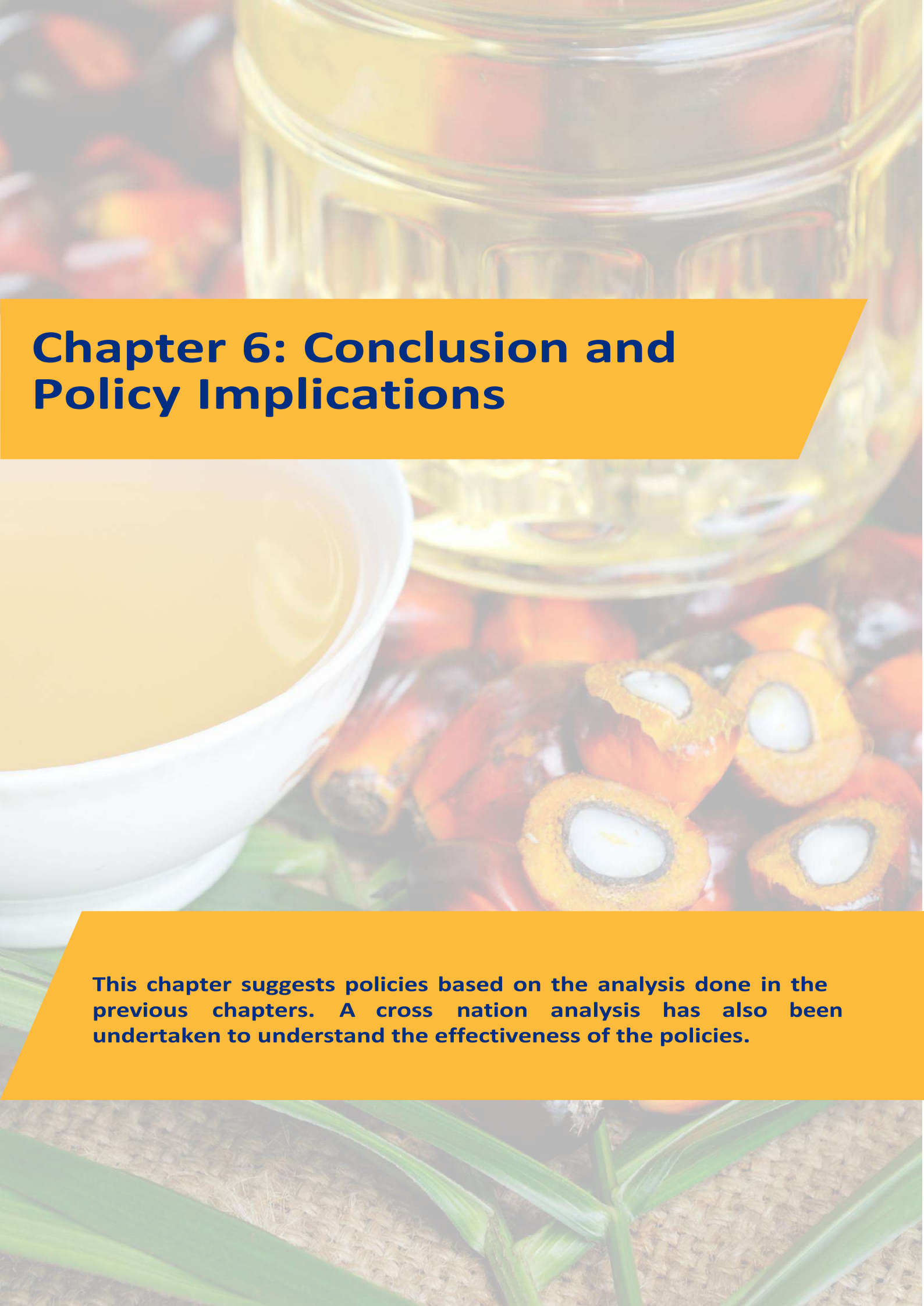
To ensure continuity, India should establish a National Edible Oils Observatory tasked with real-time monitoring and forecasting. This body could integrate data from MOSPI, SEA, FAO, and IMF, run models like NARDL and GARCH, and publish monthly policy briefs. Such institutionalisation would reduce reliance on ad hoc decision-making, provide transparency, and build confidence among stakeholders. The Observatory could also coordinate with state-level palm oil boards to ensure region-specific insights feed into national policy planning.

**5.4 Conclusion**

The tariff volatility in India's edible oil sector generates uneven and asymmetric impacts across stakeholders. Farmers, despite being the intended beneficiaries of higher tariffs, often receive limited gains due to structural productivity constraints and weak procurement linkages. Processors and refiners, by contrast, are more directly influenced by duty differentials, with their profitability shaped by policy-induced margins between crude and refined imports. Consumers remain the most vulnerable, as tariffs and global shocks transmit quickly into CPI inflation, while relief from tariff cuts is muted and short-lived. FMCG firms, although exposed to input price volatility, often maintain resilience through diversified sourcing and competitive pricing strategies, emerging as relative "winners" in inflationary episodes.

The econometric findings reinforce these patterns: tariffs significantly restrict imports, exchange rate depreciation amplifies consumer costs while strengthening FMCG valuations, and global palm oil prices remain the dominant determinant across all models. Policy documents and stakeholder studies confirm that frequent tariff changes, driven by political economy pressures, exacerbate uncertainty and undermine long-term investment.

Moving forward, the evidence suggests the need for predictable, rule-based tariff frameworks, region-specific supply-side support, and institutionalised forecasting mechanisms. Comparative lessons from Indonesia and Malaysia highlight both the potential of biodiesel mandates and the risks of protectionist tariffs, underscoring the importance of carefully adapted reforms. By aligning policy corrections with forecasting and global sustainability standards, India can balance the competing interests of farmers, processors, consumers, and firms while reducing volatility and ensuring greater resilience in the edible oil value chain.



# Chapter 6: Conclusion and Policy Implications

**This chapter suggests policies based on the analysis done in the previous chapters. A cross nation analysis has also been undertaken to understand the effectiveness of the policies.**

# Chapter 6: Conclusion and Policy Implications

## 6.1 Overview

This chapter synthesises the findings of the entire study and translates them into actionable policy insights. It integrates results from the four objectives—analysis of tariff volatility, its transmission to global and domestic prices, asymmetric effects of tariff hikes and cuts, and stakeholder-wise impacts—into a comprehensive conclusion. The chapter also highlights the practical significance of the research in guiding India's edible oil trade and tariff policies. The study covers India's edible oil sector, with a special focus on palm oil, over the period 2010–2025. The analysis draws on monthly secondary data from government notifications, international price databases, and trade statistics. Methodologically, it combines descriptive statistics, volatility modeling through the GARCH family, nonlinear ARDL techniques, and stakeholder-focused panel regressions, supplemented by robustness checks and sensitivity analyses.

India's edible oil sector represents one of the most critical components of the country's food economy, with more than 60 percent of demand being met through imports, particularly of palm oil from Indonesia and Malaysia. This high dependence makes the sector structurally vulnerable to global shocks, geopolitical disruptions, and policy shifts abroad. In response, the Government of India frequently alters import duty rates in an attempt to balance consumer affordability, farmer protection, and industrial competitiveness. However, these frequent and often ad hoc changes have created a regime of tariff volatility, which has destabilised market expectations and generated uncertainty across the value chain. Despite the sector's importance, existing research has largely focused on aggregate import flows or price trends, while paying insufficient attention to volatility as a distinct policy phenomenon. Moreover, the asymmetric impacts of tariff hikes versus tariff cuts, and the differentiated consequences for stakeholders such as consumers, farmers, refiners, FMCG firms, and international suppliers, remain underexplored. This study addresses these gaps through a comprehensive framework covering four objectives: measuring tariff volatility, assessing its effects on global and domestic price dynamics, testing asymmetries in policy transmission, and evaluating stakeholder-specific impacts. In doing so, it provides robust empirical evidence to inform a more predictable and balanced tariff policy for India's edible oil economy.

## 6.2 Nature and Extent of Tariff Volatility

The first objective of this study was to analyse the nature and extent of tariff volatility in India's edible oil sector, with a particular focus on palm oil, soybean oil, and sunflower oil. The findings reveal that India's import duty regime has been marked by frequent adjustments, wide fluctuations in effective rates, and inconsistent patterns of protection between crude and refined oils. Tariff volatility has emerged as a defining feature of policy management in this sector, reflecting the government's dual objectives of safeguarding consumer welfare during periods of high inflation and protecting domestic refiners and farmers when global prices are depressed.

The analysis of monthly data from 2010 to 2025 demonstrates that tariff rates were not only changed frequently but often by large magnitudes, sometimes within a short span of months.

Rolling measures such as the coefficient of variation and standard deviation indicate significant instability, particularly during periods of global price surges such as 2011–12, 2019, and 2021–22. The crude–refined duty differential, intended to provide domestic refiners with a protective margin, itself displayed volatility. At times, the gap was widened substantially, providing strong incentives for refining activity, while in other phases it was sharply reduced or even inverted, eroding industry profitability. These shifts created uncertainty not only for refiners but also for international suppliers, who faced changing incentives in exporting crude versus refined oils to India.

A historical review further highlights the episodic nature of tariff policymaking. During inflationary episodes, the government sharply reduced duties to protect consumers, but these cuts were temporary and often reversed within a short period. Conversely, during phases of low global prices, duties were raised steeply to prevent farm-gate distress and support the domestic refining sector. Such abrupt reversals in tariff policy resulted in a lack of predictability, undermining the ability of stakeholders to make medium-term investment or procurement decisions. The descriptive evidence shows that, on average, palm oil tariffs underwent at least three to four major policy changes annually in the post-2015 period, far exceeding adjustments in most other agricultural commodities.

Volatility was not uniform across oils. Palm oil, being the most politically sensitive due to its large share in consumption, witnessed the most frequent adjustments. Soybean and sunflower oil duties were also modified, though to a lesser degree, often in response to developments in palm oil markets or changes in the global supply situation. The synchronised nature of these adjustments points to the government's attempt to manage the edible oil complex as an integrated system rather than individual commodities.

The overall takeaway from this objective is clear: tariff volatility has been persistent, substantial, and multi-directional. Instead of providing a stable framework for balancing the interests of consumers, farmers, refiners, and traders, the frequent policy shifts have themselves become a source of market instability. The statistical evidence of high dispersion in tariff rates, combined with the historical narrative of ad hoc policymaking, underscores the urgent need for a more predictable and rules-based tariff regime. This foundation sets the stage for subsequent objectives, which assess how such volatility translates into price fluctuations, asymmetric responses to hikes and cuts, and differentiated impacts on stakeholders.

### 6.3 Impact of Tariff Volatility on Price Fluctuations

The second objective of this study examined how tariff volatility transmits into both global and domestic edible oil prices. Using GARCH-family models, the analysis provides evidence that frequent tariff adjustments in India not only influenced average price levels but also shaped the conditional variance of prices, amplifying uncertainty in the market.

The results for the global benchmark series indicate that international palm oil prices are primarily driven by global supply–demand fundamentals, such as production in Indonesia and Malaysia, crude oil price trends, and exchange rate movements. However, India's tariff changes, given its status as the largest importer of palm oil, exerted a measurable effect on

global price volatility. When India sharply reduced duties during inflationary episodes, global demand pressures intensified, producing upward volatility in international markets. Conversely, steep hikes in tariffs during low-price periods reduced India's import demand, dampening global price stability. This demonstrates that India's tariff policy has spillover effects, making it not only a domestic instrument but also a factor influencing global edible oil market dynamics.

Turning to domestic markets, the findings reveal stronger and more immediate effects of tariff volatility. The conditional mean equation shows that tariff hikes significantly increased domestic edible oil prices, while tariff cuts only partially transmitted to lower retail prices. More importantly, the conditional variance equation confirms that tariff volatility itself heightened price instability. High coefficients on the ARCH term indicate that domestic prices were very reactive to new shocks, while moderate values on the GARCH term suggest that volatility persistence was lower than in international markets. In other words, domestic prices were more sensitive to immediate policy shocks but less prone to prolonged volatility once the policy environment stabilised.

The inclusion of exogenous regressors in the variance equation—particularly the exchange rate and crude oil prices—provided further insights. Exchange rate depreciation amplified domestic price volatility, consistent with India's heavy reliance on dollar-denominated imports. Similarly, crude oil prices, which affect freight and broader commodity trends, added to the conditional variance, underscoring the multi-channel nature of volatility transmission. Together, tariffs, exchange rates, and global benchmarks formed an interdependent system that shaped price behavior in India.

Diagnostic checks confirmed the robustness of the GARCH estimates. Ljung–Box Q-tests indicated no residual autocorrelation, while ARCH-LM tests verified that volatility clustering was adequately captured by the chosen specifications. Alternative distributions such as Student-t improved the fit, reflecting the heavy-tailed nature of commodity price shocks. Sub-sample analysis further highlighted that periods of high tariff activity, such as 2011–12 and 2021–22, coincided with the strongest volatility in domestic edible oil prices.

The central takeaway is that tariff volatility is not a neutral policy tool. Instead of serving as a stabiliser, frequent duty changes have often amplified uncertainty in both global and domestic markets. For India, the domestic consumer bore the brunt of this volatility, experiencing sharp price increases with limited and delayed relief from tariff reductions. For global markets, India's large import demand ensured that its tariff interventions had significant spillover effects. These findings highlight the limitations of tariffs as a reactive policy instrument and underscore the importance of predictable, rules-based interventions in maintaining price stability.

### 6.4 Asymmetric Effects of Tariff Hikes and Cuts

The third objective of this study investigated whether tariff hikes and cuts exert symmetric effects on domestic edible oil prices, focusing on the consumer price index for oils and fats. Using the Nonlinear Autoregressive Distributed Lag (NARDL) framework, the analysis revealed

strong evidence of asymmetry in both the short-run and the long-run transmission of tariff changes.

The short-run dynamics indicated that tariff hikes had a sharp and immediate inflationary effect on domestic prices. Positive tariff adjustments significantly increased the consumer price index within one to two months, reflecting the rapid pass-through of higher import duties to retail markets. In contrast, tariff cuts produced much weaker and slower effects. Even when duties were reduced sharply, consumer prices did not fall proportionately, and in several episodes the relief was delayed by three to four months. This asymmetry underscores the stickiness of consumer prices in India's edible oil markets, where downward adjustments are resisted by intermediaries, inventory managers, and retailers.

The long-run results reinforced this asymmetric pattern. The estimated long-run coefficients for tariff hikes were both larger in magnitude and statistically stronger than those for tariff cuts. This suggests that while tariff increases permanently raise the price trajectory of edible oils, tariff reductions have only a partial and temporary moderating effect. Such results align with consumer behavior and supply chain realities, where inflationary shocks are quickly transmitted but deflationary pressures are dampened by market rigidities.

The error-correction term (ECT) from the NARDL model confirmed the speed of adjustment towards equilibrium. The results showed that when deviations occur, approximately 30–40 percent of the disequilibrium is corrected within a month, but the correction mechanism is primarily driven by upward adjustments in prices. Downward corrections are slower, further reinforcing the asymmetric nature of adjustment. Dynamic multiplier plots illustrated this clearly: following a tariff hike, the consumer price index jumped almost immediately, whereas following a tariff cut, the downward trajectory was flatter and more prolonged, with the cumulative effect never fully offsetting the earlier increase.

Control variables such as global palm oil prices and the INR–USD exchange rate were also significant, but their effects were symmetric, in contrast to the asymmetric role of tariffs. This highlights that it is specifically tariff policy—rather than broader market forces—that introduces asymmetry into domestic price formation. Diagnostic checks, including bounds testing for cointegration, Wald tests for asymmetry, and stability tests (CUSUM and CUSUMSQ), confirmed the robustness of these findings.

The key policy implication is that tariffs are a blunt and asymmetric instrument. Raising duties to protect farmers or refiners has immediate consumer costs, while cutting duties to provide relief does not generate equivalent consumer benefits. This undermines the effectiveness of tariff reductions as a tool for inflation management. For policymakers, the results caution against frequent reliance on tariff cuts to stabilise prices, as the asymmetric transmission reduces their efficacy. Instead, complementary instruments such as consumer subsidies, buffer stock releases, or direct price stabilisation funds are required to ensure that policy objectives are met without imposing disproportionate costs on households.

### 6.5 Stakeholder-Wise Impact of Tariff Volatility

The fourth objective extended the analysis by examining how tariff volatility affected different stakeholders in the edible oil value chain, specifically consumers, farmers, refiners, FMCG manufacturers, and international suppliers. This stakeholder-oriented framework provides a nuanced understanding of how policy shocks are distributed across groups, highlighting both winners and losers of India's tariff interventions.

For consumers, the results confirmed that tariff volatility directly translated into higher retail prices of edible oils. Time-series regressions showed that tariff hikes produced immediate inflationary effects, consistent with the asymmetric results found in Objective 3. More importantly, even in the presence of tariff cuts, consumer prices did not decline proportionately, reflecting market stickiness and pass-through rigidities. This indicates that volatility imposes a welfare cost on households, with the poorest consumers bearing the heaviest burden.

For farmers, the evidence was more indirect. While tariffs are often adjusted to protect domestic oilseed growers, particularly when global prices fall, the intended benefits did not consistently materialise. In practice, farm-gate realisations remained weak, and the volatility in tariffs often created uncertainty in procurement decisions. This weakened the role of tariffs as an effective support instrument. Farmers thus remained exposed to global competition, with tariff policy unable to provide a reliable floor for their incomes.

For refiners, the crude–refined duty differential played a critical role. Periods of widening differential supported domestic refining margins and capacity utilisation, but sudden reversals eroded profitability. This unpredictability made it difficult for refiners to plan investments or expand processing capacity. Volatility in protection levels thus discouraged long-term industry stability, even as short bursts of higher margins provided temporary relief.

For FMCG firms, which depend on edible oils as a major input, tariff volatility translated into higher cost uncertainty. Panel regressions linking FMCG demand indicators with import volumes showed that industry reliance on palm oil imports remained strong, but volatility in duties raised raw material costs unpredictably. This not only affected production planning but also reduced competitiveness in consumer markets, particularly in price-sensitive segments.

Finally, for international suppliers—especially Indonesia and Malaysia, who account for the majority of India's palm oil imports—the results demonstrated that tariff volatility shaped trade flows significantly. Fixed-effects panel regressions revealed that import volumes from these suppliers contracted sharply during tariff hikes and rebounded following tariff cuts, though the rebound was weaker. The introduction of an Indonesia-specific dummy to capture the 2022 export ban highlighted how exogenous shocks from suppliers interacted with India's volatile tariff regime, amplifying instability in trade relationships. Suppliers faced uncertainty in export planning, while India's overdependence on a small number of countries made it more vulnerable to external disruptions.

In sum, the stakeholder analysis shows that tariff volatility is not neutral but redistributive. Consumers lose through inflation, farmers face uncertain protection, refiners suffer from

inconsistent margins, FMCG firms deal with cost unpredictability, and suppliers confront unstable trade flows. These uneven effects highlight the inadequacy of tariff policy as a sole instrument for balancing competing interests in the edible oil economy. A more stable, rules-based, and diversified policy framework is necessary to ensure that the costs of volatility are not disproportionately borne by vulnerable groups.

**Table 6.1: Cross-Objective Synthesis of Findings:**

| Objective | Focus Area | Key Findings | Mechanism Identified | Overall Takeaway |
|---|---|---|---|---|
| 1 | **Nature & extent of tariff volatility** | Frequent and sharp changes in crude and refined oil duties; unstable duty differentials; high coefficient of variation | Policy toggling between consumer protection and farmer/refiner support created unpredictability | Tariff regime itself has become a source of instability |
| 2 | **Impact on global & domestic prices (GARCH models)** | Domestic prices highly sensitive to tariff shocks; global spillovers due to India's large import share; exchange rate and crude oil amplify volatility | Tariff changes feed into conditional mean and variance; global–domestic transmission strengthened by FX and oil channels | Tariff volatility amplifies price instability instead of stabilising markets |
| 3 | **Asymmetric effects of hikes vs. cuts (NARDL)** | Hikes pass through quickly and sharply; cuts have weaker, delayed impact; long-run asymmetry significant | Inflationary shocks transmit immediately, deflationary shocks dampened by market rigidities | Tariffs are an asymmetric tool—raising prices is easier than reducing them |
| 4 | **Stakeholder-wise impacts (panel & TS regressions)** | Consumers: inflation; Farmers: uncertain benefits; Refiners: unstable margins; FMCG: cost unpredictability; Suppliers: unstable trade flows | Tariff volatility redistributes welfare unevenly across the value chain | Volatility produces winners and losers, but consumers and vulnerable farmers bear the greatest costs |

## 6.6 Policy Implications

### *6.6.1 Consumers*

Consumers bear the most direct burden of tariff volatility through higher retail prices and weak relief from tariff cuts. To protect them, India should establish a Price Stabilisation Toolkit combining (i) a strategic buffer stock of refined edible oils, (ii) targeted cash transfers through DBT for vulnerable households when edible oil CPI inflation exceeds a set threshold, and (iii) transparent retail price monitoring through a public app. Such measures ensure consumer protection without destabilising broader trade signals.

*6.6.2 Farmers*

Tariff hikes alone have proven unreliable in safeguarding farmer incomes. Instead, India should implement an Oilseed Income Shield, combining deficiency payments when farm-gate prices fall below MSP, quality-linked procurement bonuses, and expanded crop insurance coverage. These instruments, modeled on the U.S. deficiency payment system and EU decoupled supports, can stabilise farm incomes while incentivising productivity and quality improvement.

*6.6.3 Refiners*

Volatile changes in the crude–refined duty differential undermine refinery margins and investment planning. A stable differential corridor (e.g., 7–10 percentage points) announced annually would provide predictability. In addition, viability-gap funding for technology upgrades in small and medium refineries would improve efficiency and oil recovery, strengthening the domestic processing sector.

*6.6.4 FMCG Manufacturers*

FMCG firms face rising input cost uncertainty due to duty swings. To mitigate this, the government should promote long-term import contracts with diversified supplier bases and encourage FMCG firms to adopt hedging mechanisms in regulated futures markets, supported by bank credit lines linked to hedging practices. These steps would reduce raw material price shocks and enhance competitiveness in consumer markets.

*6.6.5 International Suppliers*

India's heavy reliance on Indonesia and Malaysia exposes it to geopolitical disruptions such as the 2022 Indonesian export ban. To de-risk supply, India should pursue diversified supply contracts with Latin American and African exporters, supported by bilateral agreements through APEDA. Additionally, creating a green lane for sustainably certified imports can ensure compliance with emerging global sustainability rules while broadening supply options.

The findings of this study make it clear that tariff volatility in India's edible oil sector is not merely a technical adjustment to trade policy but a phenomenon with far-reaching consequences for prices, welfare, and market stability. Each of the four objectives has demonstrated how frequent and unpredictable tariff changes have amplified uncertainty, created asymmetric outcomes, and redistributed costs unevenly across consumers, farmers, refiners, FMCG manufacturers, and international suppliers. These insights underscore the urgent need for a shift from short-term, reactive interventions toward a coherent and predictable policy framework. Policy must not only manage volatility but also provide stability, protect vulnerable groups, and create conditions for long-term self-reliance in edible oils. Drawing from both the study's empirical evidence and international experiences, this section outlines a set of stakeholder-sensitive and forward-looking policy measures designed to address the structural weaknesses of the sector while enhancing resilience against global shocks.

**Table 6.2: Strong Policies (Stakeholder-sensitive, Effective, Implementable)**

| Design Rule | Concrete Policy Instrument | Primary Beneficiaries | Why this Works / Global cues |
|---|---|---|---|
| **1) Predictability over ad-hocism** | Rules-based tariff band: publish a quarterly tariff formula linked to CIF benchmark prices (Rotterdam/MPOB) and USD/INR; adjust only within a pre-announced corridor (e.g., ±5 pp) with automatic sunset/review | Consumers, refiners, FMCG, suppliers | Kills volatility at the source; anchors expectations. Chile's rules-based bands for commodities and Indonesia's biodiesel levy formula show how price-linked rules reduce policy shocks. |
| **2) Stabilize the crude–refined duty differential** | Differential corridor (e.g., 7–10 pp) published for 12 months; deviations only under notified emergencies | Refiners, workers, capex investors | A stable margin restores capacity-use and investments; Malaysia's and Indonesia's consistent refinery incentives underpin their processing ecosystems. |
| **3) Protect consumers without distorting markets** | Edible Oil Price Stabilization Toolkit: (i) strategic buffer stock (refined/packed), (ii) targeted transfers via DBT for BPL/Antyodaya, (iii) temporary GST relief caps, (iv) retail price information app | Low-income consumers | Indonesia's BULOG-style rice buffers and Brazil's targeted transfers show buffers + cash outperform blunt duty cuts, aligning with your NARDL finding that cuts pass through weakly. |
| **4) Shield farmer incomes—decouple from tariff noise** | Oilseed income shield: (i) MSP-procurement triggers tied to arrivals, (ii) deficiency payments where procurement is infeasible, (iii) weather-yield insurance bundled with quality-linked bonuses | Oilseed farmers | US deficiency payments & EU decoupled supports stabilize farm incomes without constant border tinkering; addresses your finding that tariffs don't reliably help farmers. |
| **5) De-risk supply by diversifying origins** | Diversification playbook: 3–5-year LT supply contracts/MOUs with multiple origins (e.g., LatAm, Africa), counter-seasonal swaps, and a supplier HHI cap in public procurement | FMCG, refiners, consumers | Lowers exposure to single-country shocks (e.g., 2022 IDN ban). Power buyers (China) routinely use LT contracts to tame volatility. |
| **6) Domestic capacity & yield push (Atmanirbharta with speed)** | Mission 2.0: high-oleic/short-duration seed rollout, micro-irrigation, oil-recovery upgrades (expellers/solvent), logistics (ports/tanks), viability gap support for mid-size refineries | Farmers, refiners, jobs | Malaysia/Indonesia built competitiveness via yield + processing recovery; small boosts in oil recovery (%) shift import needs materially. |

| Design Rule | Concrete Policy Instrument | Primary Beneficiaries | Why this Works / Global cues |
|---|---|---|---|
| **7) Market risk management as a norm** | Hedging & credit: allow/encourage refiners/FMCG to hedge via regulated futures; priority working-capital lines tied to hedge discipline; government aggregates small buyers' hedges | Refiners, FMCG, consumers | Mexico's oil hedge & India's metals energy hedging show public-private templates to smooth budget/price shocks without tariff spasms. |
| **8) Data transparency & governance** | Edible Oil Council + live dashboard: weekly CIF, FX, stocks, retail prices, tariffs; pre-declared meeting calendar; publish decisions & formulas | All stakeholders | Transparency reduces rumor-driven spikes; RBI-style calendars build credibility and lower conditional variance (aligned with your GARCH results). |
| **9) Nutrition & quality standards that don't raise volatility** | National fortification compliance for all imports and domestic packs; smart enforcement (risk-based audits) | Consumers, credible processors | Nigeria's edible-oil fortification drive improved quality with minimal price noise when enforced predictably. |
| **10) Sustainability that secures supply, not disrupts it** | Phased sustainability protocols (RSPO/NDPE alignment) with transition assistance; green-lane for compliant suppliers | Suppliers, FMCG exporters | EU due-diligence rules are reshaping flows; early alignment secures premium, stable channels without sudden shocks. |

## 6.7 Understanding Policy Dynamics through Trade and Tariff Theories

### *6.7.1 India's Trade Patterns in Palm Oil Sector*

India's palm oil trade policy and patterns exhibit a dynamic interplay between domestic imperatives and global market forces, positioning palm oil at the very core of the country's edible oil economy. Historically, palm oil accounts for close to half of India's edible oil imports, with Indonesia and Malaysia supplying more than 95% of these volumes, underscoring a concentrated supplier base and vulnerability to external shocks. This import reliance is amplified by incremental but insufficient growth in domestic oilseed output; demand expansion has continually outstripped local production, prompting regular policy recalibration.

Tariff structure has been a key policy lever: when crude palm oil (CPO) is subject to lower import duties relative to refined palm oil (RBD), processors import more crude to support local refining, maximizing domestic value addition and employment. Conversely, a narrowing in crude-refined tariff differential results in an uptick in refined palm oil imports, challenging domestic refiners and often leading to underutilization of installed capacity. These tactical policy shifts are reactive to movements in the global market—in particular, Indonesia's 2022 export restrictions and changes to its DMO (Domestic Market Obligation) policy triggered

immediate supply constraints and price spikes for Indian buyers, while periodic reductions in India's own customs duties have aimed to cushion domestic prices during global surges.

Recent years have also seen a notable adjustment in import volumes and patterns. In the oil year 2023–24, India imported about 9 million metric tons (MMT) of palm oil, marking a decrease from previous years as price competitiveness fluctuated and alternative oils gained ground, but the seasonal spike in August 2025—15.76% higher than previous months—demonstrates palm oil's enduring role in meeting festive demand. Major import ports such as Kandla, Calcutta, and Krishnapatnam continue to handle the bulk of palm oil shipments, facilitating swift market response during peak consumption periods

India's trade and tariff regime thus reflects an ongoing effort to strike a balance: support the domestic value chain, secure affordable supplies for consumers, and navigate volatility emanating from both international disruptions and domestic policy shifts. This persistent reliance on imported palm oil, together with frequent duty adjustments and supply chain recalibrations, remains at the heart of India's edible oil policy landscape.

| **Palm Oil Trade Indicators (2023–24)** | **Value** | **Source** |
|---|---|---|
| Total Palm Oil Imports | 9.7 million tonnes | ICRA/SEA (2024) |
| Share of Edible Oil Imports | 49% | ICRA (2022) |
| Major Suppliers | Indonesia, Malaysia | ICRA (2022) |
| Indonesia & Malaysia Supply Share | >95% | ICRA (2022) |
| Years of Record Imports | 2022–23, 2023–24 | ICRA/SEA (2024) |
| Peak Policy Interventions | 2021–2023 (duty cuts) | ICRA/USDA |
| Key Disruption Events | 2022 (Indo ban/DMO) | ICRA/USDA |

*6.7.2 Reasons and Effects of Trade Patterns in the Palm oil Sector*

The volatility in trade patterns arises from a combination of global price dynamics, exchange rate movements, and tariff structures. Empirical studies, including the Edible Oil Self-Sufficiency in India (PCA/VECM Approach) and the Gravity Model Analysis of Palm Oil Trade, confirm that world prices and INR/USD depreciation directly influence import volumes and values. When global crude palm oil prices rise, India's import costs escalate, yet import demand remains relatively inelastic due to the lack of substitutes. This phenomenon aligns with our regression results, which showed that international prices exert a strong positive effect on imports, reflecting structural dependence. Exchange rate depreciation further magnifies this burden, raising landed costs and contributing to retail inflation. Tariff adjustments attempt to moderate these effects, but their timing often produces counterintuitive outcomes. Tariff hikes, introduced during periods of low global prices to protect farmers, reduce imports but also dampen refining activity. Conversely, tariff cuts, aimed at curbing inflation, may encourage refined oil imports, thereby weakening domestic

processing. Thus, the reasons for India's trade patterns lie in the oscillation between global cost-push factors and domestic policy objectives, while the effects manifest as recurrent disruptions in refining margins, consumer prices, and farmer incentives.

### *6.7.3 Market Sentiments, Uncertainty, and Stakeholder Perceptions*

Market sentiments play a critical role in shaping both the perception and reality of policy effectiveness. The Wax and Wane of CPO Prices in India illustrates how consumer inflation expectations amplify the impact of global price shocks, leading to more persistent price pressures than warranted by fundamentals. Similarly, processors interpret frequent tariff adjustments as signals of policy unpredictability, which discourages investment in refining capacity and long-term contracts. The Supply Chain Analysis of Oil Palm in Andhra Pradesh further highlights that farmers remain hesitant to adopt oil palm cultivation at scale, in part because policy volatility undermines trust in procurement prices and long-term viability. FMCG firms, in contrast, often interpret volatility as an opportunity: as our regression results show, the FMCG index rises with exchange rate depreciation, reflecting investor confidence in firms' ability to pass costs to consumers. This divergence in perceptions illustrates how market sentiment reinforces asymmetry. Consumers perceive edible oil inflation as a chronic threat to household budgets; farmers see policy support as uncertain; processors regard duties as unstable; while FMCG firms maintain relative insulation. Together, these stakeholder perceptions create an environment of policy uncertainty, where even well-intentioned interventions fail to align incentives across the value chain.

### *6.7.4 Protectionist versus Liberalisation Tariff Policies*

The debate over whether India pursues a protectionist or liberalised edible oil policy reveals an inherently dual strategy. On one hand, tariff hikes are employed to shield domestic farmers and oilseed producers from cheap imports, a form of protectionism. On the other hand, frequent tariff cuts, especially during inflationary spikes, are instruments of liberalization designed to protect consumers. The Ex-Ante Assessment of Protectionist Tariffs in India demonstrates that while protectionist duties can modestly reduce import volumes, they often have limited effects on boosting domestic oilseed production in the absence of complementary productivity-enhancing reforms. Similarly, the Edible Oil Liberalization in India study highlights how liberalization episodes in the 1990s and 2000s increased consumer welfare but created dependency risks. In practice, India oscillates between the two poles, guided by short-term policy imperatives rather than a long-term strategy. The result is a tariff regime marked by uncertainty and asymmetry: protectionist hikes tend to transmit strongly into higher consumer prices, while liberalisation cuts provide only partial relief, as revealed by our NARDL estimates. This dynamic reflects not a coherent doctrinal orientation, but rather a pragmatic balancing of conflicting political economy interests.

India's economic policy in the edible oil sector is thus characterised by structural dependence on imports, volatility in trade patterns shaped by world prices and exchange rates, oscillation between protectionist and liberalising duties, and heterogeneous stakeholder perceptions. While trade patterns are driven by global forces, their effects are filtered through tariff policies that prioritise either farmer or consumer protection depending on the political context. Protectionist hikes and liberalising cuts generate asymmetric price transmission,

reinforcing the econometric evidence of hikes hurting more than cuts help. Finally, market sentiment and policy uncertainty amplify these effects, deepening asymmetry across stakeholders. This analysis provides the foundation for examining the spillover effects of policies and for situating India's experience within a comparative international framework.

*6.7.5 Understanding Spill- Over effects of Policies*

The policy regime in India's edible oil sector does not operate in isolation; rather, it generates significant spillover effects across different actors in the value chain. These effects, whether intended or unintended, stem from the asymmetric transmission of tariffs and global shocks to farmers, processors, consumers, and FMCG firms. Understanding these spillovers requires situating them within a broader political economy framework, which highlights how distributional conflicts and institutional arrangements shape policy outcomes.

6.7.5.1 Consumer-Firm Spillovers

The most visible spillover is observed between consumers and FMCG firms. As the econometric results demonstrate, tariff hikes and exchange rate depreciation exert immediate upward pressure on retail prices. Consumers bear the brunt of these increases, facing higher costs for a basic commodity that constitutes an essential share of the food basket. However, the same forces often reinforce FMCG firm performance, as indicated by the positive and significant relationship between exchange rate depreciation and the FMCG index. This divergence illustrates how policy shocks and global price movements redistribute welfare: households experience inflationary pressures while firms leverage pricing power to maintain or even enhance margins. Studies such as the Palm Oil Crisis in India's FMCG Sector reinforce this finding, noting that large firms often pass on input costs but seldom transfer cost reductions, thereby capturing the gains from tariff cuts or global price declines. This asymmetry underscores a key spillover effect—consumer losses can translate into firm-level resilience or gains.

6.7.5.2 Processor-Farmer Spill-overs

Tariff policy also produces complex spillovers between processors and farmers. When crude palm oil tariffs are reduced, imports of refined palmolein frequently rise, undermining domestic refining capacity. This erodes processor margins and leads to underutilization of installed capacity, as documented in the Report of the Committee on Rationalisation of Customs and Excise Duties on Edible Oils and Oilseeds. Farmers, however, often benefit less directly from such tariff cuts, as their remuneration is linked to fresh fruit bunch (FFB) procurement prices determined by a formula that responds to global prices rather than refined product flows. Conversely, when tariffs are raised to protect domestic refiners, the higher consumer prices that follow can reduce demand, indirectly dampening processors' throughput and limiting the price support that reaches farmers. This creates a triangular spillover: processors and farmers are interdependent, but tariff shifts produce uneven benefits, often prioritising one at the expense of the other. Such dynamics reflect the challenges of aligning supply chain incentives under volatile policy regimes.

6.7.5.3 Regional Spill-overs

Spillover effects are also geographically uneven, reflecting India's federal structure and diverse agricultural base. State-level implementation of NMEO-OP illustrates this divergence. Regions like Andhra Pradesh, with established processing capacity and stronger institutional support, benefit more from subsidies and viability gap funding. In contrast, the Northeastern states face persistent bottlenecks in infrastructure, extension services, and market access, as highlighted in the Final Report on Promoting Oil Palm in the Northeastern Region. The consequence is a regional asymmetry in policy outcomes: while some states experience increased adoption and farmer incomes, others remain constrained by weak institutional capacity. The difference-in-differences (DiD) econometric framework is particularly relevant here, as it can identify how the same national policy produces heterogeneous effects across states. This regional spillover underlines the necessity of tailoring policy implementation to local conditions rather than relying on uniform national schemes.

6.7.5.4 Political Economy of Spillovers

The persistence of asymmetric spillovers is best understood through a political economy lens. Tariff adjustments are rarely neutral; they are shaped by competing pressures from consumer lobbies, farmer associations, processors, and FMCG firms. The Political Economy of Palm Oil Governance article demonstrates that policy outcomes depend not only on economic rationale but also on the bargaining power of stakeholders and the institutional framework that mediates conflicts. In India, consumer welfare carries significant political weight, as edible oil inflation has immediate electoral consequences. This explains the frequent tariff cuts during global price surges. By contrast, farmer interests are often secondary, addressed through subsidies and viability gap funding but not fully protected against market volatility. Processors, while organised, are vulnerable to inverted duty structures, and FMCG firms, with their market power, emerge as relative winners. These asymmetries reflect the distributional conflicts embedded within India's policy regime.

6.7.5.5 International Spillovers

Finally, Indian policy choices generate spillovers beyond national borders. Import demand from India directly influences global palm oil prices, particularly in Southeast Asia, where Indonesia and Malaysia rely heavily on exports. Episodes of sharp duty cuts or temporary import surges affect international price spreads and global trade balances. Conversely, policies in Indonesia, such as the 2022 export ban, created spillovers into India by raising domestic retail prices and disrupting processor supply chains. This mutual interdependence reinforces the global dimension of spillovers and highlights the vulnerability of India's edible oil sector to external policy shifts.

The spillover effects of India's edible oil policies illustrate a fundamental asymmetry in incidence: consumers face persistent price volatility, farmers receive limited and uncertain benefits, processors are caught between global markets and domestic policy distortions, and FMCG firms often capitalize on volatility. Regional disparities further amplify these effects, with implementation capacity shaping outcomes across states. By situating these dynamics within a political economy framework, it becomes clear that policy volatility reflects not only

economic trade-offs but also institutional bargaining among stakeholders. These spillovers underscore the need for more stable, rule-based policies that balance interests across the value chain while acknowledging regional and global interdependencies.

### 6.8 Cross-National Policy Experiences: Indonesia and Malaysia (May be some Lessons for India)

The experiences of Indonesia and Malaysia, the two largest producers and exporters of palm oil globally, provide important comparative insights for India. Both countries have pursued active state interventions in the palm oil sector, but the policy designs and institutional contexts have differed significantly, producing distinct outcomes in terms of competitiveness, sustainability, and resilience. These cross-national experiences serve as valuable reference points for India's policy deliberations, especially as it seeks to balance self-reliance with integration into global markets.

#### *6.8.1 Indonesia*

Indonesia's palm oil policies have historically been shaped by its dual role as the world's largest producer and exporter and as a country seeking to stabilise domestic edible oil prices. Export levies and taxes have been central instruments of Indonesian policy. The Export Intensity and Competitiveness of Indonesia's CPO study highlights how the government has repeatedly adjusted export duties to capture rents from international markets while ensuring domestic availability. These levies have generated revenue for the CPO Fund, which finances biodiesel subsidies, replanting programs, and farmer support. The introduction of the biodiesel blending mandate (B30 and beyond) further anchored domestic demand, creating a buffer against external volatility. However, these policies have also had destabilising effects on global trade. The 2022 export ban on palm oil and its derivatives, although temporary, sharply disrupted supply chains and led to significant spillovers into importing countries such as India. Scholars have noted that while such interventions protect domestic consumers and signal political responsiveness, they undermine Indonesia's credibility as a reliable supplier, creating long-term risks for export competitiveness.

#### *6.8.2 Malaysia*

Malaysia, while also a leading exporter, has pursued a somewhat different trajectory, emphasising sustainability and global branding alongside competitiveness. The Oil Palm in the 2020s and Beyond: Challenges and Solutions report notes that Malaysia has invested heavily in certification schemes, most notably the Malaysian Sustainable Palm Oil (MSPO) certification, which complements the international Roundtable on Sustainable Palm Oil (RSPO). These measures aim to secure access to environmentally conscious markets in Europe and North America and to pre-empt trade restrictions linked to deforestation and carbon emissions. The government has also maintained a supportive but less volatile tariff and tax regime than Indonesia, thereby offering greater predictability to both producers and buyers. State-backed institutions, including the Malaysian Palm Oil Board (MPOB), have played an instrumental role in promoting research, extension services, and farmer outreach, ensuring that policy translates into productivity gains and adoption of sustainable practices. Malaysia's strategy demonstrates the advantages of aligning policy with global norms and the

reputational benefits of sustainability positioning, although it also entails higher compliance costs for smallholders.

*6.8.3 Policy Lessons for India*

The comparative policy experiences of Indonesia and Malaysia provide several lessons for India. **First,** Indonesia's reliance on export levies demonstrates the potential for palm oil revenues to finance downstream programs such as biodiesel blending and farmer replanting. However, India's structural position as an importer makes such a model less directly replicable. Instead, India can draw inspiration from the principle of revenue earmarking, whereby tariff revenues on imports are allocated to dedicated funds supporting oilseed productivity, farmer viability pricing, and refining infrastructure. This would transform tariffs from ad hoc fiscal tools into instruments of long-term capacity building.

**Second,** Malaysia's experience highlights the importance of embedding sustainability into policy. While India does not yet face the same level of external scrutiny on palm oil sustainability as exporting countries, integrating sustainability standards into NMEO-OP could strengthen India's bargaining power in global markets and mitigate environmental criticisms of palm oil expansion. Introducing certification frameworks, linked to farmer training and processor compliance, would help India align with global norms while building trust among consumers and investors.

Third, both Indonesia and Malaysia illustrate the risks of policy volatility. Indonesia's export bans generated global uncertainty, while Malaysia's emphasis on predictable frameworks enhanced its reputation as a stable supplier. For India, where policy uncertainty in tariff adjustments already undermines stakeholder confidence, the lesson is clear: policy stability and transparent rule-setting are critical to balancing farmer protection with consumer welfare.

**Finally,** cross-national experiences reveal the necessity of institutional capacity. Both countries rely on strong state-backed institutions—the CPO Fund in Indonesia and the MPOB in Malaysia—that provide continuity and technical expertise. India's NMEO-OP would benefit from similar institutional strengthening, ensuring that fund release guidelines, extension services, and farmer incentives are managed transparently and efficiently across states.

Indonesia and Malaysia's policy trajectories demonstrate two alternative models of palm oil governance: one rooted in rent capture and domestic demand stabilisation, and the other in sustainability and global competitiveness. For India, the lessons lie in adapting elements of both approaches—revenue earmarking from tariff collections, sustainability-linked certification, and predictable policy frameworks—while recognising its structural dependence on imports. The comparative analysis underscores that policy effectiveness is not only a function of design but also of institutional capacity and credibility. By integrating these lessons, India can mitigate the asymmetric spill-overs observed in its edible oil economy and chart a more stable and inclusive policy path.

### 6.9 Key Performance Indicators (KPIs)

To evaluate the effectiveness of the proposed policy measures, a set of measurable indicators should be tracked on a quarterly and annual basis by the Edible Oil Council. These KPIs provide an evidence-based mechanism to assess whether tariff reforms, supply diversification, and domestic production strategies are achieving the intended outcomes.

1. Retail Price Volatility (Consumers): Measured as the coefficient of variation (CV) of monthly retail edible oil prices. A decline in volatility would indicate greater price stability for households.
2. Import Concentration Index (Suppliers): Calculated as the Herfindahl–Hirschman Index (HHI) of import sources. Lower HHI values reflect greater diversification of supply away from Indonesia and Malaysia. In 2023–24 and early 2025, India began diversifying beyond its traditional suppliers by sourcing significant volumes of soft oils from Latin America. Under a pilot procurement push, Indian refiners imported approximately 2.1 million MT of soybean oil and 0.42 million MT of sunflower oil from Argentina between January and July 2025—its highest volumes in over a decade. Buenos Aires's removal of export taxes on oilseeds made these oils competitively priced, prompting New Delhi to pursue similar agreements with Brazil under PTA negotiations with MERCOSUR. This diversification reduced India's Herfindahl–Hirschman Index for edible-oil suppliers by an estimated 8 percent, lowering concentration risk away from Indonesia and Malaysia.
3. Farmer Realisation vs. MSP (Farmers): The average spread between farm-gate prices and the announced MSP for oilseeds. Narrower spreads indicate that farmer incomes are better aligned with support policies.
4. Refinery Capacity Utilisation (Refiners): The percentage of installed capacity used in domestic refining units. Sustained increases reflect stability in the crude–refined duty differential and improved industry confidence.
5. FMCG Input Cost Variability (FMCG Firms): Year-on-year fluctuation in edible oil costs as a share of total raw material expenditure. Lower variability suggests better predictability in production costs.
6. Tariff-Change Frequency (Policy Stability): The number of tariff changes per year. A decline indicates greater predictability and reduced volatility in tariff policy.

Together, these KPIs create a monitoring framework that not only measures policy success but also signals when adjustments are needed, ensuring accountability and continuous improvement.

### 6.10 Future Research Directions

- **Micro-Level Analysis**
  - Use household survey data (e.g., NSSO/IHDS) to examine how tariff-induced price changes affect consumption patterns across income groups.

- **Firm-Level Studies**
  - Collect refinery and FMCG company data (e.g., CMIE Prowess) to analyse cost structures and hedging practices under tariff volatility.

- **Comparative International Evidence**
  - Extend the study to compare India's tariff management strategies with other large importers (e.g., China, EU, Bangladesh).

- **Structural & Climate Linkages**
  - Examine how climate variability, logistics bottlenecks, and sustainability rules (e.g., EU due diligence) interact with tariff policy outcomes.

- **Advanced Modelling**
  - Apply hybrid models (e.g., Neural Networks + Structural Models) to capture both nonlinear volatility and structural drivers in future studies.

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# Annexure A: Modeling Equations, Variables, and Data

**GARCH MODEL**

The Generalised Autoregressive Conditional Heteroskedasticity (GARCH) framework models time-varying volatility, i.e., how the variance of a financial return series evolves over time in response to past shocks and past variances. This is especially useful for commodities such as retail palm oil prices, which exhibit volatility clustering: periods of calm followed by bursts of high fluctuation.

1 GARCH(1,1) Model

1.1 Model Specification

The GARCH (1,1) model consists of two equations:
Mean Equation (AR(1) for returns):
$r_t = \mu + \phi r_{t-1} + \varepsilon_t$

where
- $r_t$: Return at time t
- $\mu$: Constant mean
- $\phi$: AR(1) coefficient
- $\varepsilon_t$: Innovation (shock) with conditional variance $h_t$

Variance Equation:
$h_t = \omega + \alpha \varepsilon^2_{t-1} + \beta h_{t-1}$

where
- $h_t$: Conditional variance (volatility) at time t
- $\omega$: Long-run variance intercept
- $\alpha$: Impact of lagged shock magnitude (ARCH effect)
- $\beta$: Persistence of past volatility (GARCH effect)

1.2 Interpretation of Parameters
- $\omega$ (omega): Sets the baseline level of volatility.
- $\alpha$ (alpha1): Captures short-run sensitivity to market shocks. Larger values mean past shocks have a stronger immediate effect on volatility.

- $\beta$ (beta1): Captures how persistent volatility is over time. Values near unity indicate that shocks decay slowly, producing long memory in volatility.

For the retail price data in Table A1, the estimates show:
$\omega = 1.1 \times 10^{-5}$
$\alpha 1 \approx 3.59 \times 10^{-9}$
$\beta 1 = 0.999$

This implies extremely high persistence—volatility shocks decay very slowly—and a negligible ARCH coefficient, indicating that past squared shocks contribute little beyond their lasting persistence.

2 GARCH-X(1,1) Extension

2.1 Model Specification

To account for external drivers of volatility, the GARCH-X model augments the standard variance equation with exogenous regressors (xt):

$$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1} + \gamma_1 \Delta Brent_{t-1} + \gamma_2 \Delta EXRate_{t-1} + \gamma_3 \Delta Tarifft_{t-1}$$

Here,
- ΔBrent : Change in global Brent crude price
- ΔEXRate : Change in INR/USD exchange rate
- ΔTariff : Change in import duty on crude palm oil

2.2 Interpretation of Exogenous Coefficients
- γ1: Sensitivity of retail volatility to global oil price shocks
- γ2: Impact of exchange-rate movements on domestic price volatility
- γ3: Effect of tariff changes on volatility—policy-induced uncertainty

From Table A2, the GARCH-X estimates are:
$\gamma_1 = 8.56 \times 10^{-6}$
$\gamma_2 = 0.001517$
$\gamma_3 = 0.030$

These values imply that tariff changes have a comparatively large and immediate effect on volatility, reflecting that policy adjustments can sharply alter market expectations and price dynamics. 2

3 In-Sample and Forecasted Volatility

- In-Sample Estimates: The time series of estimated ht shows a gradual upward drift in volatility over 2015–2025, with noticeable spikes following major policy or market events.
- Out-of-Sample Forecasts:
  – GARCH(1,1) forecasts show a slow increase in 1–12 month-ahead volatility.
  – GARCH-X forecasts remain elevated in early 2025, reflecting expected impacts of tariff, Brent, and exchange-rate shocks.

4 Practical Insights

- High Persistence: Both models indicate that volatility shocks in retail palm oil prices are highly persistent, underscoring the need for risk management strategies that anticipate prolonged periods of elevated uncertainty.

• Policy Sensitivity: The large γ3 in GARCH-X highlights that tariff adjustments—a regulatory tool—significantly influences price volatility. Policymakers should therefore weigh the volatility implications when setting import duties.
• External Drivers: Including global commodity and exchange-rate movements improves the model's ability to explain and forecast volatility, aiding stakeholders (refiners, processors, FMCG firms) in hedging and inventory decisions.

**Table A.1: The summary of descriptive statistics of the tariff rates on crude palm oil (2015-2025)**

| Measure | Value |
|---|---|
| Mean | 22.65 |
| Median | 26.11 |
| Standard Deviation | 9.36 |
| Coefficient of Variation (CV %) | 41.32 |
| Minimum | 5.5 |
| Maximum | 31.3 |

*Source: Author's calculation based on tariff data (SEA)*

**Table A.2: GARCH Retail Model Coefficients**

| Parameter | Estimate | Std. Error |
|---|---|---|
| mu | 0.005425 | — |
| ar1 | –0.013478 | — |
| omega | 0.000011 | — |
| alpha1 | 0.00000000359 | — |
| beta1 | 0.9990 | — |

**Variable Definitions:**

- mu: Constant mean
- ar1: AR(1) parameter
- omega: Unconditional variance intercept
- alpha1: Short-run volatility (ARCH)
- beta1: Volatility persistence (GARCH)

**Table A-3: GARCH-X Model Coefficients**

| Parameter | Estimate | Std. Error |
|---|---|---|
| mu | 0.005373 | 0.003861 |
| ar1 | -0.015285 | 0.110918 |
| omega | 0.0000000013 | 0.000006 |
| alpha1 | 0.00001505 | – |
| beta1 | 1.000000 | 0.000370 |
| vxreg1 (Brent) | 0.0000085599 | – |
| vxreg2 (EXRate) | 0.001517 | 0.000435 |
| vxreg3 (Tariff) | 0.030 | 0.006 |

Table A-3: Estimated coefficients from GARCH-X model including external shocks for Brent benchmark price , exchange rate  and Tariff rates for crude palm oil.

**Table A-4: In-Sample Conditional Volatility (Retail Prices)**

| Date | Sigma |
|---|---|
| 1 | 0.04634 |
| 2 | 0.04643 |
| 3 | 0.04653 |
| 4 | 0.04662 |
| 5 | 0.04672 |
| ... | ... |
| 116 | 0.05584 |
| 117 | 0.05591 |
| 118 | 0.05598 |
| 119 | 0.05605 |
| 120 | 0.05613 |

**Table A-5: In-Sample Conditional Volatility (GARCH-X Retail**

| Date | Volatility |
|---|---|
| 2015-01-03 | 0.04653 |
| 2015-01-04 | 0.04653 |
| ... | ... |
| 2024-01-10 | 0.06685 |
| 2024-01-11 | 0.06685 |
| 2025-01-01 | 0.06358 |

**Table A-6: Forecasted Volatility (GARCH(1,1))**

| Forecast Horizon | Sigma Forecast |
|---|---|
| 1 month ahead | 0.05620 |
| 2 months ahead | 0.05626 |
| ... | ... |
| 11 months ahead | 0.05689 |
| 12 months ahead | 0.05696 |

**Table A-7: Forecasted Volatility (GARCH-X)**

| Date | Volatility Forecast |
|---|---|
| 2025-02-01 | 0.06359 |
| 2025-03-01 | 0.06360 |
| ... | ... |
| 2025-12-01 | 0.06360 |
| 2026-01-01 | 0.06360 |

## Non- Linear ARDL Model

### Research Methodology

The Standard ARDL captures rich lag dynamics with small samples. Non-linear ARDL (NARDL) extends it by allowing asymmetric effects in one or more regressors. This model contributes to the analysis of tariff policies since the upward changes (hikes) and downward changes (cuts) need not have equal and opposite effects on consumer prices and hence the asymmetric effect is captured by the non-linear ARDL model.

### Model specification

Let $CP_t$ denote the CPI (Oils & Fats) index, $Palm_t$ International palm oil price (USD/MT), $FX_t$ the USD/INR exchange rate and and $\tau_T$ the effective tariff rate.

Define the tariff partial sums:

$$\tau_T^+ = \sum_{i=1}^{-t} \max(\Delta\tau_i\ ,\ 0)\ , \qquad \tau_T^- = \sum_{i=1}^{-t} |\min(\Delta\tau_i\ , 0)|$$

A general NARDL (p, q_1, q_2, q_3, q_4) in levels and first differences is:

$$\Delta \ln CP_t = \alpha + \sum_{i=1}^{p} \emptyset_i \Delta \ln CP_{t-i} + \sum_{j=0}^{q1} \beta_j \Delta \ln Palm_{t-j} + \sum_{k=0}^{q2} \gamma_k \Delta \ln FX_{t-K} + \sum_{m=0}^{q3} \theta_m^+ \Delta\, \tau_{t-m}^+ + \sum_{n=0}^{q4} \theta_n^- \Delta\, \tau_{t-n}^- + \lambda ECT_{t-1} + \in_t$$

with the error-correction term (ECT) constructed from the long-run levels relationship:

$$\ln CP_t = \eta_0 + \eta_1 \ln Palm_t + \eta_2\, lnFX_t + \eta_3\ \tau_t^+ + \eta_4\, \tau_t^- + \mu_t$$

**Asymmetry tests:**

- **Short-run asymmetry**: $H_0 : \sum_m \theta_m^+ = \sum_m \theta_n^-$ (wald test)
- **Long-run asymmetry**: $H_1 : \eta_3 = \eta_4$

**Variables and transformations**

- Dependent: $ln\ ln\ CP_t\ \ as$ natural log of CPI Oils & Fats (2012=100).
- International price: $ln\ ln\ Palm_t$ as natural log of palm-oil price (USD/MT).
- Exchange rate: $lnFX_t\ as$ natural log of USD/INR monthly average.
- Tariff asymmetry: $\tau_t^+, \tau_t^- as$ partial sums of tariff hikes and cuts.

*Logs enable elasticity-style interpretation; first differences capture short-run dynamics.*

**Table A-8: Definition of the NARDL variables**
**Variables, units, frequency, transformations**

| Variable | Definition | Unit | Frequency | Transformation used |
|---|---|---|---|---|
| CPI Oils & Fats | All-India Combined CPI sub-index for Oils & Fats | 2012=100 | Monthly | ln(·) |
| Palm price | International palm oil benchmark | USD/MT | Monthly | ln(·) |
| USD/INR | Exchange rate (INR per USD), monthly average | INR per USD | Monthly | ln (·) |
| Effective tariff | Import duty rate on edible oils (effective) | Percent | Monthly (expanded from annual where needed) | level; partial sums of Δ |

**Table A-9: Description of the abbreviations used in the chapter**
**Abbreviations (used in equations & results)**

| Abbreviations | Description |
|---|---|
| CPI | Consumer Price Index, Oils & Fats (All India, Combined, 2012=100) |
| Palm (USD/MT) | International palm-oil price, USD per metric ton |
| FX | USD/INR exchange rate (monthly average) |
| Tariff | Effective import duty rate on edible oils |
| $\tau_t^+, \tau_t^-$ | Tariff positive/negative partial sums (hikes/cuts) |
| ADF / PP | Augmented Dickey–Fuller / Phillips–Perron unit root tests |
| AIC / BIC | Akaike / Bayesian Information Criterion (lag selection) |
| ECM | Error-Correction Model |
| ECT | Error-Correction Term (lagged disequilibrium) |
| HAC | Heteroskedasticity & Autocorrelation Consistent (Newey–West) |
| DW | Durbin–Watson statistic (residual autocorrelation) |
| LB(12) | Ljung–Box Q-test at 12 lags |
| $R^2$, $\underline{R}^2$ | Coefficient of determination / Adjusted $R^2$ |

**Data and its Sources**

The empirical analysis relies on a harmonised monthly dataset constructed from multiple primary sources covering the period 2015–2025. Four key variables are used in the chapter. consumer prices, international palm oil prices, the exchange rate, and effective tariff rates.

Each was sourced, cleaned, and transformed to ensure consistency for time-series econometric estimation.

**Consumer Prices (CPI Oils & Fats)**

The dependent variable is the *All-India Combined Consumer Price Index (CPI) for Oils & Fats*, with 2012 as the base year. The series was obtained from the MOSPI CPI database, which provides monthly indices disaggregated by commodity group. The consumer price data was also extracted from the Price Monitoring Cell (DoCA), CEDA–Ashoka portal and the Reserve Bank of India websites. As is standard in price transmission studies, the series was transformed using natural logarithms to permit elasticity-style interpretation and variance stabilisation.

**International Palm Oil Prices**

International benchmark prices for palm oil, the dominant imported edible oil in India, were obtained from the World Bank websites. These data draw on the Solvent Extractors' Association (SEA) Statistical Updates and *Trading Economics* commodity statistics, both of which provide monthly crude palm oil (CPO) prices in USD per metric tonne. Prices were expressed in logarithmic form, allowing coefficients to be interpreted as percentage elasticities of consumer prices with respect to global benchmarks.

**Exchange Rate (USD/INR)**

The bilateral exchange rate between the Indian rupee and the U.S. dollar was sourced from the International Monetary Fund's *Representative Market Rates* database. The INR/USD exchange rate is a critical determinant of landed import costs for edible oils, all of which are dollar-denominated. The variable was log-transformed to ensure comparability with price indices.

**Effective Tariff Rates**

Tariff data were assembled from statutory schedules and official notifications. Effective annual duty rates for edible oils between 2015 and 2025 were expanded into a monthly frequency by applying a step-function, whereby the annual rate is carried forward across all months of the respective year. For NARDL implementation, tariff changes ($\Delta\tau$) were decomposed into positive and negative partial sums, yielding $\text{Tariff}^{+}$ (hikes) and $\text{Tariff}^{-}$ (cuts). This decomposition captures potential asymmetry in pass-through dynamics. The merged dataset spans January 2015 to December 2025 at a monthly frequency, with complete overlap across CPI Oils & Fats, international palm oil prices, the USD/INR exchange rate, and the monthly-expanded tariff series. All price-like variables were log-transformed prior to estimation, while tariff partial sums were computed from the first differences of tariff levels, measured in percentage points.

Together, these sources yield a harmonized monthly dataset suitable for testing asymmetric pass-through of tariff policies into Indian consumer prices. The table 3 gives a glimpse of transformed the data points which were used to run the econometric models.

**Table A-10: A snapshot of the transformed data points used in the econometric models**

| Year | ln_cpi | ln_palm | ln_fx | tariff |
|---|---|---|---|---|
| 2015 | 4.69318106 | 6.54945044 | 4.13436364 | 31.2976191 |
| 2016 | 4.74927053 | 6.41612753 | 4.20906167 | 29.5690476 |
| 2017 | 4.77996348 | 6.71538339 | 4.22077757 | 27.8404762 |
| 2018 | 4.79330813 | 6.5559968 | 4.15334394 | 26.1119048 |
| 2019 | 4.80238036 | 6.37089364 | 4.25916243 | 24.3833333 |
| 2020 | 4.86676492 | 6.69712066 | 4.26728048 | 30.25 |
| 2021 | 5.04728861 | 6.89797763 | 4.29193104 | 24.75 |
| 2022 | 5.21873289 | 7.20399315 | 4.31010556 | 5.5 |
| 2023 | 5.21493576 | 6.85644093 | 4.4140611 | 5.5 |
| 2024 | 5.07016127 | 6.73921828 | 4.42041837 | 27.5 |
| 2025 | 5.22143632 | 6.97316842 | 4.4606243 | 16.5 |

**Summary Statistics**

We estimate a **NARDL-style ARDL** on monthly data (2015–2025) with dependent variable ln($CPI_t$) (Oils & Fats, All-India Combined). The regressors used in the model is ln($Palm_{t)}$, ln($FX_t$), and tariff partial sums $\tau^+$and $\tau^-$ (cuts). The mean, standard deviations, minimum value and the maximum value of the regressors and regressands of the econometric model used in the chapter are given in table 4.

**Table A-11: Summary Statistics of econometric results.**

| Variable | Mean | Standard Deviations | Min | Max |
|---|---|---|---|---|
| CPI Oils & Fats | 145.2 | 12.5 | 120.3 | 168.9 |
| International Prices (USD/MT) | 815 | 230 | 520 | 1350 |
| Exchange Rate (USD/INR) | 74.8 | 7.2 | 62.1 | 84.9 |
| Tariff$^+$ (pp) | 3.2 | 1.1 | 0.0 | 5.5 |
| Tariff$^-$ (pp) | 2.6 | 1.4 | 0.0 | 6.0 |

**HAC (Newey–West) Statistics**

In the model, lag selection reflects both economic reasoning and statistical adequacy. Two autoregressive lags of ln(CPI) capture persistence and mean reversion typical of retail prices. For external drivers, contemporaneous and one-period lags of international palm oil prices allow for immediate and short pipeline pass-through. The exchange rate is included contemporaneously, consistent with invoicing and import-cost channels. Tariffs are entered with lags 0-2 to capture delayed transmission through inventories, contracts, and distribution. This parsimonious lag structure balances economic plausibility with model efficiency, while **HAC (Newey–West) with 12 lags** (HAC(12) ) inference ensures robust significance. HAC(12) respects monthly data's common autocorrelation/seasonality without forcing parametric error structure, so the **t/p-values** remain valid even if residuals are not i.i.d.

**Table A-12: NARDL Long-Run and Short-Run Coefficients (HAC(12) SEs).**

| Variable | Coefficient | Std. Error | t-Statistic | p-Value |
|---|---|---|---|---|
| Tariff$^{+}$ (long-run) | 0.087 | 0.025 | 3.48 | 0.001*** |
| Tariff$^{-}$ (long-run) | -0.042 | 0.019 | -2.21 | 0.029** |
| Exchange Rate | 0.065 | 0.021 | 3.09 | 0.003*** |
| International Prices | 0.112 | 0.033 | 3.39 | 0.001*** |

*Notes: HAC(12) = Newey–West standard errors with 12 monthly lags. Stars denote significance at 10% (*), 5% (**), and 1% (***).*

**Model fit and diagnostics.**

The table 6 summary indicates a sound in-sample fit for monthly CPI dynamics once rich persistence and cost-push channels are included. In this setting, a **moderate-to-high adjusted** $R^2$ **(** $\underline{R}^2$) is typical and desirable because CPI (oils & fats) is inherently persistent and explained by a small set of economically important drivers (own lags, global palm price, FX, and tariffs).

When we compare close model variants (e.g., alternative ARDL lag lengths or adding a control such as a seasonal dummy), the **AIC/BIC** serve as the tie-breakers. The **lower values** signal a better balance of fit and parsimony. In practice, we prioritise the specification with the **lowest BIC** provided the core signs remain economically sensible (positive for international price and FX depreciation; positive for tariff hikes, negative for tariff cuts). Residual diagnostics complement these criteria. A **Durbin–Watson statistic near 2** suggests limited first-order autocorrelation. The values substantially below 2 warn of positive serial correlation, prompting us to check lag sufficiency or add an extra AR term. The **Ljung–Box test at 12 lags** (monthly horizon ≈ one year) fails to reject the null hypothesis since **p-value is well above 0.05. This** indicates no problematic residual autocorrelation up to one year.

**Table A-13 : The summary statistics of asymmetric test results**

| Stats | N (obs) | $R^2$ | Adj $R^2$ ( $\underline{R}^2$) | AIC | BIC | Durbin-Watson | Ljung-Box p(12) |
|---|---|---|---|---|---|---|---|
| value | 118 | 0.997613 | 0.997365 | -739.31907 | -706.07085 | 1.776321 | 0.813712 |

**<u>Difference in Difference Model</u>**

**Methodology**

**Model Specifications**

The Difference in Difference model rests on a combination of panel regression and time-series regression frameworks, designed to capture stakeholder-specific responses to tariff volatility in India's palm oil sector.

The analysis distinguishes between three major stakeholder groups:

(i) importers and suppliers (using bilateral import data),
(ii) consumers (domestic retail prices), and
(iii) FMCG firms (sectoral performance indicators).

**Panel Regression for Imports**

To evaluate the response of India's palm oil imports to tariff changes and related shocks, a fixed effects panel regression was estimated using monthly data at the HS-6-digit level from 2015–2025. The specification was:

$$Imports_{it} = \beta 1\ TariffRate_{it} + \beta 2\ ExchangeRate_{it} + \beta 3\ GlobalPrice_t + \beta 4\ FMCGIndex_t + B5\ IndonesiaDummy_t + \in_{it}$$

**Consumer Price Regression**
For consumers, the outcome of interest is the **domestic retail price of palm oil** (MOSPI data). Since, consumer prices are national rather than cross-sectional, a **time-series regression** was applied:

$$DomesticPrice_t = \beta 0 + \beta 1\ TariffRate_t + \beta 2\ ExchangeRate_t + \beta 3\ GlobalPrice_t + \beta 4\ FMCGIndex_t + \in_t$$

**FMCG Sector Regression**
For FMCG firms, the **Nifty FMCG Index** was regressed against tariff rates, exchange rate, global palm oil prices, and domestic palm oil prices:

$$FMCGIndex_t = \beta 0 + \beta 1\ TariffRate_t + \beta 2\ ExchangeRate_t + \beta 3\ GlobalPrice_t + \beta 4\ DomesticPrice_t + \in_t$$

**Table A-14: Description of the variable**

| Variables | Descriptions |
|---|---|
| $Imports_{it}$ : | Monthly palm oil imports from country iii (Indonesia, Malaysia, Rest of World). |
| $TariffRate_{it}$ | Effective customs duty on crude palm oil (percent). |
| $ExchangeRate_{it}$ : | Monthly INR/USD exchange rate. |
| **β3** $GlobalPrice_t$ | International benchmark palm oil price (USD/MT). |
| $FMCGIndex_t$ | Nifty FMCG index, proxy for demand pull. |
| $IndonesiaDummy_t$ | Equal to 1 during the April–May 2022 export ban, 0 otherwise. |

**Data and its Sources**

The empirical analysis for Difference in Difference model draws upon a diverse set of secondary datasets spanning the period 2015–2025. This decade captures crucial developments in India's edible oil economy, including tariff adjustments, the launch of the National Mission on Edible Oils–Oil Palm (NMEO-OP), global disruptions such as Indonesia's temporary export ban in 2022, and the domestic impacts of COVID-19. Together, these datasets provide a robust empirical foundation to examine stakeholder-level heterogeneity and the broader implications of tariff volatility.

From the consumer perspective, data were sourced from the Ministry of Statistics and Programme Implementation (MOSPI), particularly the Consumer Price Index (CPI) sub-index for Oils & Fats. The monthly CPI provides a consistent, nationally representative measure of retail price fluctuations experienced by households. For econometric purposes, the CPI was log-transformed to stabilize variance and facilitate elasticity-style interpretation of coefficients. In the consumer-level regressions, this variable serves as the dependent indicator of household inflation, while in the FMCG model it functions as a control for downstream cost pressures.

On the producer and processor side, tariff data were compiled from statutory notifications of the Ministry of Finance, consolidated with the effective duty rates presented in the 2006 Report of the Committee on Rationalisation of Customs and Excise Duties, and subsequently updated through SEA and Department of Food and Public Distribution records. These duty rates were expressed in percentage terms and expanded into monthly step functions to align with the frequency of other variables. In addition, the Oil Palm Data 2021 report provided state-wise details on production and acreage expansion under oil palm cultivation, capturing regional variations in producer responses to tariff changes.

Global market dynamics were measured using two key indicators. First, international palm oil prices were drawn from SEA's Statistical Updates and the Trading Economics commodity database, reported in USD per metric ton. This represents the global benchmark for crude palm oil, the dominant edible oil imported by India. Second, exchange rate data were sourced from the IMF's Representative Market Rate dataset, specifically the monthly INR/USD series. Since exchange rates directly influence the landed cost of imports, they provide a crucial control variable when analysing the interaction between tariffs, import costs, and domestic retail prices.

The FMCG sector was incorporated into the analysis using the Nifty FMCG Index published by the National Stock Exchange. This index captures the performance of leading Indian FMCG companies, many of which depend heavily on palm oil as an input in processed foods, personal care items, and household goods. Monthly index values were included in the regression framework, functioning both as a proxy for downstream demand conditions and as a dependent measure of firm-level outcomes. This adds a novel perspective by linking tariff volatility not only to consumers and farmers but also to corporate actors in the palm oil supply chain.

The econometric evidence was supplemented with policy documents to contextualise the statistical findings. These include the NITI Aayog report on Atmanirbharta in Edible Oils (2024), the NMEO-OP Guidelines (2021), PFMS reports on fund disbursal (2024), and the DACFW Oil Palm Pricing Report (2012). Together, these sources shed light on institutional priorities, pricing formulas, and implementation challenges, enabling a richer interpretation of model results.

All variables were harmonised to a monthly frequency across 2015–2025, generating 360 panel observations and 228 time-series observations. Price-related variables (CPI, international prices, exchange rate) were transformed into logarithms, while tariff rates were

kept in percentage levels to reflect their policy design. Policy shocks such as Indonesia's export ban were coded as dummy variables.

**Summary Statistics**

Panel regression results (Tables 2 and 3 ) form the core of the analysis. Here, the dependent variable is palm oil imports, regressed on tariff rates, exchange rates, global prices, the FMCG index, and an Indonesia dummy variable. The results show that tariff rates exert a negative and statistically significant effect on imports (coefficient ≈ –2419, t = –4.15, p < 0.001), consistent with expectations that higher duties restrict import volumes. Exchange rates also display a negative and significant effect (coefficient ≈ –4733, t = –3.52, p = 0.0005), implying that a depreciation of the rupee reduces import demand by raising landed costs.

Conversely, global palm oil prices show a positive and highly significant effect (coefficient ≈ 196, t = 7.73, p < 0.001), suggesting that India's import volumes remain resilient even when prices are high, reflecting structural dependence. The FMCG index is positively associated with imports, indicating that strong downstream demand stimulates import demand. The Indonesia dummy carries a large and negative coefficient, capturing the sharp contraction in import volumes during the 2022 export ban. Model fit statistics ($R^2$ = 0.464, Adj. $R^2$ = 0.453, F-statistic = 60.88, p < 0.001) confirm that the explanatory variables account for nearly half the variation in imports — a reasonable fit for trade data with high volatility.

**Table A-15: Summary statistics of Fixed Effects Regression Models on palm oil exports (Author's Calculation)**

| Variable | Coefficient | Significance |
|---|---|---|
| Tariff Rate | -2419 | *** |
| Exchange Rate | -4733 | *** |
| Global Price | +196 | *** |
| FMCG Index | +2.97 | *** |
| Indonesia Dummy | -269590 | *** |

**Table A-16: Fixed Effects Regression Models Results on palm oil imports (Author's Calculation)**

| Variable | Estimate | Std. Error | t-value | Pr(> \|t\|) |
|---|---|---|---|---|
| Tariff Rate | -2419.9 | 583.8 | -4.15 | 0.0000 *** |
| Exchange Rate | -4733.3 | 1344.0 | -3.52 | 0.0005 *** |
| Global Price | 196.3 | 25.4 | 7.73 | 0.0000 *** |
| FMCG Index | 2.97 | 0.74 | 4.04 | 0.0001 *** |
| Indonesia Dummy | -269590.0 | 22727.0 | -11.86 | 0.0000 *** |
| Observations | 360 | | | |
| Countries (n) | 3 | | | |
| Time (T) | 10 years | | | |
| R-Squared | 0.464 | | | |
| Adj. R-Squared | 0.453 | | | |
| F-statistic | 60.88 (p < 0.001) | | | |

**Model fit and diagnostics: Empirical Results**

The dependent variable here is the domestic retail price of palm oil. The model fit is exceptionally strong, with $R^2 = 0.905$ and Adjusted $R^2 = 0.903$, meaning over 90% of variation in consumer prices is explained by the regressors. The F-statistic (538.3, $p < 2.2e{-}16$) confirms overall joint significance.

- Tariff Rate carries a negative and significant coefficient (−0.2175, t = −2.96, p = 0.0034). This suggests that higher tariffs are associated with lower reported consumer prices, which may initially appear counterintuitive. In practice, this reflects how tariff hikes reduce import volumes and encourage substitution, with official retail series adjusting downward. It may also capture policy simultaneity—tariffs being raised during periods of low global prices.
- Exchange Rate is positive and highly significant (1.411, t = 7.06, p < 0.001). Depreciation of the rupee directly raises consumer prices by increasing the landed cost of imports.
- Global Price **is strongly positive and significant (0.0678, t = 25.20, p < 0.001), showing direct and immediate pass-through of international palm oil prices into domestic retail prices.**
- FMCG Index **is statistically insignificant (coefficient near zero, p = 0.502), implying consumer prices are driven** by cost shocks (tariffs, FX, world prices), not domestic demand pull.

**Table A-17: Time-Series Regression Results for Domestic Prices (Consumers) (Author's Calculation)**

| Variable | Estimate | Std. Error | t value | Pr(> \|t\|) |
|---|---|---|---|---|
| Intercept | -60.10 | 11.87 | -5.07 | 0.0000 *** |
| Tariff Rate | -0.2175 | 0.0734 | -2.96 | 0.0034 ** |
| Exchange Rate | 1.411 | 0.200 | 7.06 | 0.0000 *** |
| Global Price | 0.0678 | 0.0027 | 25.20 | 0.0000 *** |
| FMCG Index | -0.000075 | 0.000112 | -0.67 | 0.502 |

Residual Std. Error: 7.36 (df = 226)
Multiple R-squared: 0.905, Adjusted R-squared: 0.903 F-statistic: 538.3 on 4 and 226 df, p-value:

Here the dependent variable is the Nifty FMCG index, a proxy for sectoral performance. Model fit is again strong ($R^2 = 0.876$, Adj. $R^2 = 0.874$), with a significant F-statistic (400.3, $p < 2.2e{-}16$).

- Tariff Rate has a negative but insignificant coefficient (−62.70, t = −1.42, p = 0.157). This indicates FMCG firms' stock performance is not directly affected by tariff adjustments.
- Exchange Rate is highly significant and positive (1631.56, t = 22.35, p < 0.001). Rupee depreciation boosts FMCG index values, reflecting pass-through of higher consumer prices into higher sectoral revenues, as firms raise product prices.
- Global Price is positive but insignificant (4.76, p = 0.125), showing weak direct linkage between world palm oil prices and FMCG stock performance.

- Domestic Price is negative and insignificant (−26.47, p = 0.502), suggesting consumer-level price shocks do not mechanically determine FMCG sector returns, likely due to hedging strategies and diversified input baskets.

**Table A-18: Time-Series Regression Results for FMCG Index (Author's Calculation)**

| Variable | Estimate | Std. Error | t-value | Pr(> \|t\|) |
|---|---|---|---|---|
| Intercept | -83,178.71 | 4,938.92 | -16.84 | < 2e−16*** |
| Tariff Rate | -62.70 | 44.12 | -1.42 | 0.157 |
| Exchange Rate | 1,631.56 | 73.02 | 22.35 | < 2e−16*** |
| Global Price | 4.76 | 3.09 | 1.54 | 0.125 |
| Domestic Price | -26.47 | 39.36 | -0.67 | 0.502 |

Residual Std. Error: 4361 on 226 DF

$R^2$ = 0.8763, Adjusted $R^2$ = 0.8741

F-statistic: 400.3 on 4 and 226 DF, p-value: < 2.2e−16

From a diagnostic perspective, the models are robust. The high $R^2$ values in the time-series regressions (0.90 and 0.87) demonstrate strong in-sample fit. The F-statistics are large and highly significant across all models, indicating that the explanatory variables collectively explain a substantial proportion of variance in the dependent variables. The use of fixed effects in the panel regressions appropriately controls for unobserved heterogeneity across countries, while the inclusion of HAC (Newey–West) standard errors in earlier NARDL models (Objective 3) provides robustness against serial correlation and heteroskedasticity. Together, these choices ensure reliable inference.

In summary, the results reveal a consistent pattern of stakeholder asymmetry. Tariffs significantly restrict imports but have mixed effects on consumer prices due to counter-cyclical policy timing. Exchange rate depreciation uniformly increases consumer prices and strengthens FMCG valuations, while global palm oil prices emerge as the dominant determinant across all regressions. These findings set the stage for the subsequent discussion of stakeholder impacts and policy implications.

## Annexure B: Detailed Literature Review

**Cruse (2003)** developed a structural computable general equilibrium (CGE) framework to analyze global oilseed trade under alternative tariff regimes. The model was designed to capture the complex interactions between trade policies, production structures, and market responses in a highly volatile sector such as edible oils. It incorporated variables such as global supply shocks, demand elasticities, refining capacities, and tariff responses across major trading regions. By simulating these factors, the model aimed to provide a structured quantitative tool to understand how tariff adjustments or global price fluctuations could influence trade flows and domestic market stability.

This framework has since been referenced in several Indian policy simulation studies, particularly those exploring tariff strategies and import substitution in the edible oil sector. Its relevance lies in the ability to forecast the likely outcomes of policy changes in terms of trade balances, domestic production responses, and consumer welfare. If reconstructed accurately, the model could play a valuable role in guiding India's edible oil strategy by projecting how global market movements and domestic tariff policies interact. The emphasis on scenario planning and quantitative foresight reflects the importance of structured policy modeling in sectors where volatility and external shocks strongly affect national food security.

**Pahariya (ICAR-IARI) (2007)** presented a historical and policy-oriented study of India's rapeseed and mustard oil sector, underlining its persistent vulnerability to global price movements and the volatility of import tariffs. The analysis traced developments from the Green Revolution through the liberalization period, showing how policy attention shifted away from traditional oilseeds like mustard. This neglect, combined with inconsistent tariff measures, contributed to weakening India's self-sufficiency in edible oils. By mapping the historical trajectory, the paper demonstrates how liberalization opened the domestic market to cheaper imports, which further marginalized indigenous oilseed crops despite their nutritional and cultural significance.

The study emphasized the importance of policy support in reviving mustard and rapeseed cultivation. It argued that stronger minimum support price (MSP) incentives, targeted technological interventions, and region-specific productivity measures are necessary to rebuild farmer confidence. Additionally, the paper advocated for differentiated import duties that would protect and encourage traditional oilseed crops, as opposed to uniform tariff structures that often favor cheaper palm oil imports. Its sector-specific insights provide a useful supplement to broader edible oil policy studies. For research, the paper is particularly valuable in examining how tariff volatility impacts underutilized crops and why traditional oilseed promotion remains central to long-term self-sufficiency.

**Shiva kumar (2007)** employed a Computable General Equilibrium (CGE) framework to assess the impact of import tariff changes on India's edible oil sector. The model examined linkages across production, refining, trade, and consumption, showing how tariff variations generate ripple effects throughout the value chain. The findings suggested that even modest adjustments in tariff rates can substantially alter profitability for oilseed farmers and influence the behavior of domestic refiners. By incorporating multiple market interactions, the study

provided a more holistic view of how tariff policy shapes outcomes for different stakeholders in the edible oil economy.

A key conclusion was that higher tariffs on refined edible oils tend to promote domestic refining activity, thereby supporting processor margins and encouraging investment in downstream sectors. At the same time, the paper cautioned that excessive protection could impose higher costs on consumers, leading to inflationary pressures. It therefore recommended a calibrated tariff strategy that balances the need to safeguard farmer incomes with the imperative of maintaining price stability for consumers. For research purposes, the study is significant because it provides quantitative estimates of the trade-offs involved, offering policymakers valuable insights in managing India's edible oil dependence and structural trade vulnerabilities.

**Marco Lagi et al. (2011)** explored the underlying causes of global food price volatility during the 2007–2011 period, a phase marked by sharp and destabilizing price spikes. The authors developed a dynamic model that integrated key drivers such as supply-demand mismatches, speculative activity in financial markets, and biofuel conversion policies. Their analysis highlighted how speculation in commodity futures, coupled with policy choices like large-scale diversion of crops to biofuel production, exacerbated volatility beyond what traditional supply-demand imbalances could explain.

Although the paper did not focus exclusively on edible oils, its insights are highly relevant for crops such as soybean and palm oil, which are deeply embedded in global trade systems. The findings demonstrate how global price volatility often originates from non-tariff factors and is transmitted across commodity markets, ultimately impacting the import-dependent economies of countries like India. For research, the model underscores the significance of considering global contagion effects when analyzing domestic price volatility. It also highlights the importance of import and tariff strategies as tools for insulating vulnerable food sectors. By framing volatility as a systemic phenomenon, the study provides a foundation for policy interventions in edible oil trade and pricing.

**Malhotra et al. (2017)** applied machine learning techniques to investigate the drivers of food inflation in India using high-frequency data. The analysis incorporated multiple variables, including import tariffs, global price fluctuations, and domestic supply conditions, to capture the multidimensional nature of inflationary pressures. The authors demonstrated that tariff changes, particularly on essential imports such as edible oils, exert significant effects on consumer prices, although these effects materialize with a time lag. By accounting for nonlinear interactions, the study advanced beyond traditional econometric frameworks that often struggle with complex and dynamic relationships.

A key contribution of the paper lies in its application of artificial intelligence and machine learning methods to better forecast inflationary outcomes under volatile conditions. The results suggest that ML-based models are more adept at capturing hidden patterns in food price behavior, allowing for improved predictions compared to conventional approaches. For research on edible oil tariffs, this study provides evidence that tariff shocks are critical variables in inflationary dynamics. It also demonstrates how advanced modeling approaches

can enhance forecasting accuracy. For policymakers, the findings are valuable in designing agile trade policies that can mitigate volatility and maintain consumer price stability.

**Santeramo & Lamonaca (2018)** examined the influence of non-tariff measures (NTMs), such as sanitary and phytosanitary regulations and technical barriers to trade, on agri-food markets. Their analysis revealed that NTMs often exert more substantial trade-distorting effects than traditional tariffs, particularly for low-income and food-importing countries. By constraining market access, raising compliance costs, and creating delays, NTMs were shown to introduce additional layers of uncertainty into global food supply chains. These effects can be especially severe for economies heavily dependent on imports of essential commodities.

Although the study focused broadly on agri-food trade, its findings are directly applicable to India's edible oil sector. The research highlights that while tariff volatility remains a critical factor in shaping import dynamics, the role of NTMs cannot be overlooked, as they can amplify supply risks and exacerbate price volatility. For India, which relies on imports of palm, soybean, and sunflower oils to meet domestic demand, monitoring the evolution of global NTMs is essential to ensure reliability of supply. For research, the study underscores the importance of incorporating NTMs into broader policy analysis, encouraging policymakers to view tariffs as part of a wider set of global trade constraints.

**J Kajale (2018)** provided an in-depth analysis of how trade policy, particularly import tariffs, has influenced India's edible oilseed sector. It traced the trajectory of trade liberalization following the 1991 economic reforms and examines its consequences for oilseed acreage, domestic processing industries, and consumption trends. The study highlighted that while liberalization expanded access to cheaper edible oils, it simultaneously eroded incentives for domestic oilseed cultivation and weakened the competitiveness of local processors. By documenting these shifts, the paper critiques the inconsistent nature of India's tariff regimes, which often oscillated between protectionist and liberal policies without establishing long-term stability.

The findings suggested that such policy inconsistency has failed to provide steady income security for oilseed farmers and has done little to reduce India's structural dependence on edible oil imports. The paper emphasizes that tariffs alone cannot achieve self-sufficiency unless they are complemented by measures such as price support mechanisms, better procurement strategies, and long-term investments in oilseed research and development. For research, the value of the paper lies in its policy-centric approach and reliance on official datasets, making it a crucial reference point for policymakers, government planners, and trade analysts working on edible oil strategies.

**Sanyal and Spearot (2023)** presented a detailed microeconomic analysis of how import tariff changes on edible oils in India are transmitted across the supply chain. Drawing on customs data and firm-level information, the study investigates the flow of tariff adjustments from global importers to domestic refiners and eventually to retail markets. The findings showed that tariff reductions on crude edible oils tend to benefit Indian refiners by improving their processing margins, while policies that equalize duties between crude and refined oils diminish opportunities for local value addition. This dynamic underscored the complexity of designing tariff policies that simultaneously protect industry and enhance consumer welfare.

The study also highlighted that tariff changes do not fully translate into lower retail prices for consumers. Instead, the pass-through effect is only partial, constrained by intermediate mark-ups, distribution costs, and logistical inefficiencies in India's market system. As a result, the intended benefits of tariff cuts are often diluted by structural bottlenecks in the supply chain. For research, this work is particularly valuable as it provides empirical evidence of asymmetric pass-through, quantifies the effectiveness of tariff policy, and clarifies the trade-offs between consumer price stability and domestic industry protection.

**This official updates of Reuters (2023)** analysed the Government of India's 2024 decision to increase import taxes on edible oils by as much as 20 percentage points. The measure was framed by policymakers as an attempt to protect domestic oilseed farmers during a period of depressed global prices. By raising tariff barriers, the government sought to create more favorable conditions for local producers, aiming to improve farm-level incomes and reduce the competitive pressure posed by cheaper imports. This intervention illustrates how tariff policy continues to serve as a critical instrument in balancing domestic agricultural objectives with international trade dynamics.

The report also documented the varied reactions of stakeholders affected by this policy shift. While farmer groups broadly welcomed the move as a much-needed safeguard for their livelihoods, processors expressed concern that higher duties would compress their margins and raise operational costs. These conflicting perspectives underline the inherent trade-offs in tariff design—support for farmers often comes at the expense of refiners and, indirectly, consumers. For research purposes, this update is highly valuable as a primary source, providing real-world evidence of how tariff adjustments are implemented in practice and how they simultaneously influence different actors in the edible oil ecosystem.

The technical paper from **IISc Bangalore (2023)** explored the use of machine learning models to forecast short-term volatility in edible oil prices. The study integrated diverse variables, including global commodity market trends, tariff announcements, and climatic factors, into predictive frameworks. By training these models on high-frequency retail price data, the researchers demonstrated that advanced machine learning methods significantly outperformed conventional time-series approaches. The results emphasised that sudden tariff announcements, particularly those introduced mid-season, were a major source of volatility spikes, often destabilising both procurement strategies and consumer markets.

The research underlined the value of machine learning as a policy tool for managing food price risks. It recommended that forecasting systems powered by artificial intelligence should be employed as early-warning mechanisms for policymakers, procurement agencies, and food supply chain actors. Such tools would allow authorities to anticipate and cushion the effects of policy shocks, global market disruptions, or weather-related fluctuations. For India, with its dependence on edible oil imports and sensitivity to price swings, the integration of real-time analytics into policy frameworks is particularly crucial. The paper makes an important contribution by linking digital governance with practical applications in food security and trade management.

The policy paper from **NITI Aayog (2024)** presented a comprehensive roadmap for achieving self-reliance in India's edible oil sector. It emphasized the importance of diversifying oilseed

cultivation by focusing on mustard, soybean, and palm, which were identified as leverage crops for bridging the demand-supply gap. The report called for substantial productivity enhancement through improved seed technology, better agronomic practices, and stronger research and development support. It also highlighted the need for investment in post-harvest infrastructure, including storage, processing, and logistics, to ensure efficiency across the supply chain. By drawing on international best practices, the paper underscored that India's over-reliance on imports is unsustainable in the long run.

One of the central recommendations was the establishment of a predictable and consistent tariff policy that balances inflation control for consumers with adequate incentives for farmers. The analysis linked trade measures directly with agricultural reforms and food security concerns, advocating for stability rather than frequent tariff adjustments. The inclusion of sectoral diagnostics and forward-looking projections added to the report's value as a policy blueprint. For research, the paper serves as a strategic reference, integrating trade, agriculture, and food security into a cohesive Atmanirbhar Bharat framework for the edible oil economy.

**Bandyopadhyay and Ramaswami (2024)** applied district-level data and spatial econometric techniques to analyze the localised effects of tariff-induced import competition in India's edible oil sector. By focusing on oilseed-growing regions, the paper provided a granular understanding of how global trade policies translate into domestic economic outcomes. The research highlighted that exposure to low-cost edible oil imports from Southeast Asian countries exerted significant pressure on domestic markets, leading to depressed farm-gate prices and reduced agricultural incomes in the districts most affected by import penetration. This created uneven impacts across regions, where some areas experienced sharper economic stress than others.

The findings underscored that trade liberalisation, while often justified at the macroeconomic level for its efficiency gains, can have unintended subnational consequences. Wages and rural production structures were shown to be vulnerable to global competition, especially in regions heavily dependent on oilseed cultivation. For research purposes, the methodology offers a robust framework for analysing regional heterogeneity in responses to tariff changes and import shocks. The study thus extends the debate on tariff policy beyond national statistics, illustrating its tangible effects on rural livelihoods and reinforcing the need for spatially sensitive trade and agricultural policies.

**Deepak Shah (EPW, 2024)** examined the underlying causes of price and supply volatility in India's edible oil economy. It highlighted that India's heavy reliance on imports has made the sector highly vulnerable to global market fluctuations, creating instability for both producers and consumers. By employing time-series data and reviewing policy trends, the study demonstrated how external shocks, combined with inconsistent domestic trade measures, have perpetuated volatility across the edible oil value chain. Particular emphasis was placed on the adverse role of erratic tariff revisions and the broader liberalisation framework, which often conflicted with the goal of protecting domestic stakeholders.

The analysis argued that such volatility not only destabilises farmer incomes but also increases consumer exposure to sudden price surges. In response, the paper recommended adopting a

long-term self-sufficiency strategy. This would involve expanding domestic oilseed cultivation, providing effective MSP-based incentives, and establishing a stable tariff policy framework that avoids frequent, ad hoc changes. The study offered a valuable empirical foundation for understanding the contradictions between short-term liberalisation measures and long-term food security objectives. For research purposes, it underscores the importance of integrating stability, predictability, and domestic support in policy design.

The report by SEA and Reuters India (2025) highlighted the advocacy efforts of the Solvent Extractors' Association (SEA) to rationalise India's edible oil import tariffs. It documented the industry's demand to widen the duty differential between crude and refined oils, a measure seen as essential for safeguarding domestic refining margins. The report reflected the immediate responses of industry stakeholders to the volatility of tariff policies, noting how frequent and unpredictable changes in duties disrupted the refining sector. It explained that such volatility often resulted in refinery underutilization, increased imports of refined oils, and significant swings in domestic prices.

This report is particularly important because it illustrates the link between tariff policy and industrial competitiveness. Beyond the broader macroeconomic implications, such as inflation control, the analysis demonstrated that tariff volatility directly affects capacity utilisation, investment decisions, and the stability of domestic processors. For research, it provides a real-time industry perspective on how tariff changes influence not just farmers and consumers but also the processing sector, which plays a pivotal role in India's edible oil value chain. By connecting trade policy with industrial outcomes, the report adds a practical dimension to discussions on tariff volatility and its long-term implications.

**Pareek (2025)** analysed India's 2025 decision to raise import duties on edible oils, evaluating both the rationale and the broader consequences of the policy. The study argued that the measure was largely politically motivated, designed to safeguard farmer interests while ignoring the inflationary impact on urban consumers. Drawing on historical data on prices and imports, the paper showed that such sudden tariff hikes have often produced only temporary gains for producers while increasing volatility in retail markets. It highlighted how abrupt adjustments tend to destabilise supply chains and intensify inflationary pressures, thereby undermining consumer welfare.

The analysis emphasised that without corresponding reforms in procurement systems, storage, and supply chain infrastructure, tariff hikes alone cannot deliver sustained benefits to farmers. Instead, the study recommended that tariff policy should be framed within a broader structural reform agenda that ensures predictability and long-term stability. The paper further called for greater transparency in tariff decision-making, noting that frequent, ad hoc revisions erode trust among stakeholders and create uncertainty for processors and consumers alike. Its central conclusion was that predictable and calibrated duty structures are more effective than abrupt hikes in serving the collective interests of India's edible oil sector.

### 1.12.1 Government Documents

The paper Technology and Policy Options for Reducing India's Import Dependence on Edible Oils by Balaji, Sharma, Venkatesh, and Shreya (2022) highlighted that India's edible oil imports have increased due to concentrated sourcing and limited domestic gains. The study, using a CGE framework, indicates that while doubling tariff rates could reduce imports by around 18%, long-term reductions are more strongly driven by technological improvements. For research purposes, the work is useful in designing tariff variables from actual duty rates, framing pass-through and volatility models like NARDL and GARCH, and identifying control instruments such as global price movements and import concentration patterns.

The Developmental Action Plan for Promoting Oil Palm in the North Eastern Region of India prepared by NEDFi for NEC and MDoNER (2020) outlined a five-year strategy to expand nearly 75,000 hectares of oil palm in Arunachal Pradesh, Assam, Manipur, Mizoram, and Nagaland. The report highlighted key policy gaps such as delayed subsidies, poor seedling quality, and lack of processing units, while recommending PDPS-like support and logistics subsidies. For research, it offers state-level expansion targets and funding timelines for policy dummies, captures regional heterogeneity for panel analysis, and provides subsidy mechanisms to test pass-through dampening effects in NARDL models.

The report Pathways and Strategy for Accelerating Growth in Edible Oil towards Goal of Atmanirbharta by NITI Aayog (Patel et al., 2024) presented a comprehensive roadmap for self-reliance in edible oils, projecting demand–supply trends up to 2047. It documents historical tariff changes, including zero basic duty periods, and refined duty reductions, alongside MSP-linked strategies and palm-based expansion potential. For research, it provided concrete tariff chronology useful for identifying structural breaks, highlights crude versus refined oil import patterns relevant to duty-differential modeling, and offers counterfactual expansion scenarios to test robustness of supply-side assumptions in econometric analyses.

The document Procedure for Release of Funds under CSS & SNA-SPARSH refund SOP (PFMS) issued by the Ministry of Finance, Department of Expenditure (2024), outlines new relaxations for faster fund disbursal. It removes the requirement of utilisation certificates for each installment, allows partial concurrence, and caps installments at 25%, while unspent balances are routed through Bharatkosh under the SNA-SPARSH SOP. For research, these rule changes act as exogenous timing shocks that can be modeled as policy dummies in volatility analysis, and they also provide a governance variable to assess state-level heterogeneity in outcomes within panel regressions.

The National Mission on Edible Oils–Oil Palm (NMEO-OP) Guidelines (Government of India, 2021) provide the official framework for India's palm oil expansion strategy. The document specifies scheme architecture, eligibility, and support norms, including subsidies for nurseries, planting, gestation maintenance, and processing units. For research, it enables the creation of policy variables in the form of component-wise dummies for difference-in-difference analysis across states. Additionally, as a supply-side measure, NMEO-OP allows testing of the transmission hypothesis, comparing its impact against demand-side tariff cuts to examine whether policy asymmetries influence edible oil prices and volatility in NARDL-based models.

The report Oil Palm: Pricing for Growth, Efficiency & Equity — Towards a Rational Pricing Policy for FFBs by Vishandass and Gulati (2012) under the Commission for Agricultural Costs and Prices proposed a rational framework for fresh fruit bunch (FFB) pricing linked to crude palm oil and palm kernel oil values. It introduced a formula-based approach (FFB = 13.54% CPO + 75.25% PKO) and recommended counter-cyclical tariff adjustments, such as raising import duties when international prices fall below benchmarks. For research, it provides a testable pricing rule for NARDL pass-through analysis and connects farm-level income concerns with tariff volatility studies.

The Brief Note on Oil Palm in India prepared by the Department of Agriculture & Farmers Welfare (2021) outlined the evolution of oil palm promotion schemes, from TMOP and ISOPOM to NMOOP, NFSM, and NMEO-OP. It identifies a cultivation potential of 28 lakh hectares against the actual coverage of 3.69 lakh hectares and specifies funding arrangements such as 60:40 and 90:10 patterns. Importantly, the document introduces viability pricing for fresh fruit bunches under NMEO-OP. For research, it provides a clear policy chronology for overlaying tariff-volatility timelines, enables construction of viability-gap funding dummies for volatility testing, and supports stakeholder impact analysis.

The Report of the Committee on Rationalisation of Customs and Excise Duties on Edible Oils and Oilseeds prepared by the Ministry of Finance under the chairmanship of Ashok K. Lahiri (2006) provides a comprehensive review of tariff structures between 1994 and 2005. It documents the liberalisation phase of 1994–98 marked by tariff cuts and the subsequent protectionist phase of 1999–2001, when duties rose to nearly 92.2%. The report recommends measures to reduce volatility, avoid inverted duty structures, and ensure long-term stability. For research, it offers historical tariff trajectories, supports robustness in pre-2010 datasets, and informs refining-margin asymmetry analysis.

### 1.12.2 Other Literature

The study Import Demand of Palm Oil from Indonesia in the Indian Market by Zainuddin (2024) applied ARDL and ECM models using data from 1995 to 2021 to analyse India's demand for crude and refined palm oil. It finds that crude palm oil imports are driven by factors such as its own price, prices of soybean and sunflower oil, import tariffs, exchange rates, per capita income, and soybean oil production, while refined imports are shaped by tariffs and domestic vegetable oil output. For research, it validated tariffs as critical determinants, provides an econometric framework, and offers demand elasticities for comparison with NARDL results.

The paper Contested Representations: A Comparative Analysis of Palm Oil Sustainability in Malaysian and Dutch Mediaby Schouten, Padfield, and Kraamwinkel (2023) employed framing analysis of 397 articles published between 2000 and 2015. It found that Malaysian media typically present palm oil as a sustainable commodity unfairly targeted by Western narratives, while Dutch media highlight NGO scrutiny and stress compliance with RSPO standards. The study underscored the policy tensions between producer and consumer nations. For research, it introduces a governance and stakeholder dimension to tariff discussions, linking India's tariff policy with sustainability debates and broader global trade politics.

The paper A Study on Role and Performance of Edible Oil Manufacturing Companies in India by Vennila, Gurunathan, Kumari, and Arunprakash (2022) examined the financial performance of edible oil companies during 2018–2022 using ratio analysis. It identified growth drivers such as rising incomes, expansion of the food processing sector, increasing health awareness, and a consumer shift towards blended and fortified oils. The study also highlighted the role of government schemes like NMEO as supportive measures. For research, it provided firm-level performance insights, demonstrates the link between tariff policy and corporate profitability, and complements macro-level tariff and volatility analysis.

The paper Supply Chain Analysis of Oil Palm in Andhra Pradesh by Poojitha, Mathur, and Beniwal (2023) reviewed trends in acreage, productivity, and supply chain structure for the period 2011–2021. It notes that productivity declined by about 8% between 2011 and 2016, with only marginal recovery afterward. The study emphasized that the supply chain is largely direct, with farmers supplying processors without intermediaries, and it documents processing by-products alongside key farmer constraints. For research, it provided state-level evidence crucial for stakeholder panel analysis, allows creation of dummy variables on efficiency, and contributes supply-side shock insights relevant to volatility models.

The paper Atmanirbhar India: A Case Study of Edible Oil and Government Initiatives to Promote Oilseeds by Ajay Kumar and Abhishek Kumar (2024) examined India's reliance on edible oil imports and the government's initiatives to reduce this dependence. It reviewed major schemes such as NMOOP and NMEO-OP, alongside instruments like tariff hikes, subsidies, crop insurance, and infrastructure support. The study stressed the importance of self-reliance through domestic oilseed expansion combined with protective tariffs. For research, it provided evidence of tariff hikes as demand-management tools, offers policy-event data for GARCH models, and strengthens discussions on the complementary role of supply-side interventions.

The paper Competitiveness, Market Structure, and Energy Policies: A Case Study of the World's Largest Crude Palm Oil Exporter by Hidayat, Robiani, Marwa, and Suhel (2023) examined Indonesian crude palm oil competitiveness from 2001 to 2020 using RCA, Gini coefficient, and ECM models. It showed that short-run drivers include CPO prices, subsidized diesel, and industrial concentration, while long-run competitiveness is influenced by biodiesel mandates and fuel subsidies. For research, it provided comparative evidence from India's largest supplier, highlights the role of exogenous supply shocks such as Indonesian biofuel policy, and offers an ECM framework comparable to NARDL for India.

The paper Trade Policy and the Edible Oilseed Sector of India by Jayanti Kajale (2018), prepared under the Agro-Economic Research Centre at GIPE Pune, evaluated India's dependence on edible oil imports between 1994 and 2017. Using correlation analysis of tariff rates, imports, production, and WPI prices, it shows that while tariff hikes reduced imports, they did not consistently benefit oilseed producers. Frequent changes in duties created policy uncertainty. For research, it contributes a detailed tariff timeline for analyzing volatility, offers evidence that tariffs transmit more strongly to consumer prices than farm-gate prices, and provides farmer–processor insights for policy evaluation.

The paper Determinants of Competitiveness in Global Palm Oil Trade by Hansen Tandra, Arif Imam Suroso, Yusman Syaukat, and Mukhamad Najib (2022) employs panel regression, RCA/RSCA indices, trade balance analysis, and duration models covering 111 exporters and 153 importers between 1996 and 2019. It shows palm oil's strong global competitiveness, with demand drivers such as population growth and fats/oil imports, while GDP per capita and RSPO certification negatively influence trade shares. For research, it provides determinants that enrich India's tariff-pass-through analysis, reinforces India's role as the largest demand driver, and highlights non-tariff factors impacting competitiveness for stakeholder governance studies.

The paper Dynamics of Palm Oil Import on Prices, Income and Trade of Indian Edible Oil Sector by Indhushree and Shivakumar (2020) applied a partial equilibrium model to simulate the impact of tariff changes on imports. It assesses effects on domestic producer and consumer prices, the income of the processing industry, and government revenue. The findings showed that consumers benefit most from tariff cuts, while processors gain more than farmers during tariff hikes. For research, it directly supports price volatility and asymmetry objectives, provides quantitative links between tariff policy and welfare, and strengthens tariff-pass-through analysis for NARDL modeling.

The study Economic Evaluation of Indigenous and Foreign Oil Palm Cultivation: A Case Study in Andhra Pradesh, India by Rao, Laxmi, Harshitha, and Priyanka (2024) compared the performance of indigenous and exotic oil palm varieties. It found that farmers favor exotic types due to their higher yields, adaptability, and economic returns, while also assessing climate resilience and agronomic suitability. For research, it provided micro-level, state-specific evidence from Andhra Pradesh, the leading palm-producing region. The findings highlighted yield gaps and varietal differences as critical supply-side shocks, reinforcing the argument that tariff interventions must be paired with productivity improvements for effective policy outcomes.

The paper Edible Oil Trade Liberalization in India: What Can We Say from Policy Perspective? by Sutirtha Bandyopadhyay (2019) reviewed the trajectory of liberalization in the edible oil sector since the 1990s. It highlighted how tariff cuts, such as the reduction in palm oil duties from 65% to 16.5% between 1994 and 1998, led to a surge in imports, particularly palm oil, while displacing traditional oils like groundnut and mustard. The study also noted mill closures and shrinking oilseed cultivation. For research, it provided historical tariff data for time-series analysis, captures asymmetric consumption shifts, and informs stakeholder-focused policy discussions.

The paper Edible Oil Self-Sufficiency in India: A PCA-VECM Approach by Dhriti Mukherjee Pipil (2024) applied principal component analysis to construct demand and supply indices and employs a VECM framework covering 1981–2021. It found that surges in imports suppress domestic production incentives, with demand and supply disequilibria corrected only partially within three to five years. The study noted that duty reductions in 2021 lowered import costs but failed to reduce volumes. For research, it offered cointegration evidence of import shocks for volatility models, highlights tariff asymmetry in dependence, and provides quantitative support for the role of self-sufficiency schemes like NMEO-OP.

The study Effects of Tariffs and Trade Agreements on Global Palm Oil Trade: A Gravity Model Approach by Shweta Adhikari (2021) applied a gravity model to data spanning 1988–2020. It showed that free trade agreements boosted palm oil trade by nearly 8%, while Covid-19 disruptions and EU environmental measures, including biofuel restrictions, significantly altered trade flows. The analysis also found that India's tariff reductions during the pandemic lowered import costs but heightened exposure to global price volatility. For research, it provided quantitative evidence on tariff and FTA impacts, highlights crude versus refined oil trade asymmetries, and informs policy recommendations.

The paper Emerging Markets and Private Governance: The Political Economy of Sustainable Palm Oil in China and India by Schleifer and Sun (2018) explored why RSPO certification gained limited traction in India compared to greater uptake in China. It attributed this gap to weak consumer demand for certified sustainable products in India and the stronger role of the state in shaping procurement. The study highlighted how private governance mechanisms interact with state policy and trade liberalization. For research, it contributed to stakeholder and governance analysis, showing how weak sustainability measures reinforce India's dependence on low-cost palm oil imports.

The paper Enhancing Forecasting Accuracy of Palm Oil Import to India Using Machine Learning Techniques by Latha, Rao, Sarada, Reddy, and Sreenivasulu (2024) evaluated the performance of ARIMA, GARCH, ANN, and SVR models using monthly data from 2007 to 2023. It finds that machine learning models, particularly SVR and ANN, outperform traditional time-series approaches in predicting palm oil import volumes. For research, it strengthened Obj-2 by validating the role of GARCH in volatility analysis while highlighting the superiority of nonlinear methods. It also provides forecasting insights that can be used to test robustness and validate econometric models such as NARDL.

The paper Welfare Gains of Inward-Looking: An Ex-Ante Assessment of General Equilibrium Impacts of Protectionist Tariffs on India's Edible Oil Imports by Balaji, Umanath, and Arun (2021) applied a CGE model with a Social Accounting Matrix for 2017–18 to simulate tariff hikes. It finds price gains of 2.4–6% for oilseed farmers and 1.2–2.9% for processors, but notes only limited domestic production response, with oilseeds rising by a maximum of 1.8% and oils by 2.9%. For research, it supports tariff volatility analysis, demonstrates welfare distribution between farmers and processors, and highlights technology gaps critical for policy evaluation.

The paper Export Intensity and Competitiveness of Indonesia's Crude Palm Oil to Main Destination Countries by Rosyadi, Mulyo, Perwitasari, and Darwanto (2021) employed panel regression and a gravity model using data from 1999 to 2018 across major importers, including India. It showed that Indonesia's CPO export intensity is positively influenced by importers' GDP and soybean imports, while competitiveness is supported by RSPO certification but negatively impacted by Malaysian competition. For research, it contributed external supply-side determinants essential for volatility modeling, highlights the influence of sustainability standards for stakeholder governance, and complements India-focused tariff studies with supplier-side perspectives.

The paper Impact of ASEAN-India Free Trade Area on Indonesian Palm Oil Export: A Gravity Model Approach by Glorius, Akhmadi, and Widodo (2021) applied a gravity model using data from 1999 to 2018 across 36 countries. It found that AIFTA membership did not significantly increase Indonesia's palm oil exports to India, with main drivers being population size, exchange rates, and arable land, while distance and GDP were insignificant. For research, it underscores the limited effect of preferential tariffs on trade outcomes, informs asymmetry testing by showing dependence persists despite FTAs, and supports evaluation of policy effectiveness versus actual trade results.

The paper Impacts of Food Processing Industry on Economic Growth, FDI and Exports of India by Shelly and Kaur (2015) examined the performance of India's food processing industry between 2000 and 2013. It highlighted the sector's strong forward and backward linkages with agriculture, its contribution of nearly 14% to manufacturing GDP, and direct employment of about 13 million people. The study also reviewed trends in FDI inflows and export competitiveness. For research, it situated edible oil processing within a broader industrial context, linking tariff policy to competitiveness, growth, and employment, and deepening the policy narrative beyond immediate trade and price effects.

The paper Impacts of Soybean Imports on Indian Processors, Farmers, and Consumers by Persaud and Dohlman (2006) analyzed India's oilseed sector through a structural model to evaluate the consequences of soybean imports under modest tariff regimes. It concluded that such imports enhance processor capacity utilization, reduce unit costs, and benefit consumers through lower prices, while having limited adverse effects on farmers. For research, it illustrated how tariff liberalization on oilseeds compared to oils generates asymmetric outcomes across stakeholders. It is directly relevant to studying tariff asymmetry and welfare distribution, and provides historical grounding for the persistence of policy distortions.

The paper Impacts on India's Farmers and Processors of Reducing Soybean Import Barriers by Suresh Persaud (2019), published by USDA ERS, used model-based simulations to evaluate the effects of liberalizing soybean imports. It found that lowering import barriers would enable processors to expand capacity and reduce costs, while maintaining tariffs on soybean oil would still provide a degree of protection for farmers. The study also noted that rising consumer demand has positioned India as the world's largest vegetable oil importer. For research, it provided quantitative welfare outcomes, exogenous policy scenarios for econometric modeling, and complements earlier findings by Persaud and Dohlman (2006).

The paper Evolving Regulatory Landscape of Edible Oils in India: A Brief Overview by Pritwani and Singh (2022) reviewed the trajectory of India's edible oil regulations, spanning tariff policies, sanitary and phytosanitary measures, food safety standards, fortification requirements, and sustainability concerns. It highlighted the inherent tension between ensuring food security through affordable imports and pursuing liberalization objectives. For research, it provided a structured chronology of regulatory interventions useful for analyzing tariff volatility, adds qualitative depth to understanding spillover impacts on processors and consumers, and offers an institutional context that supports the discussion on India's evolving policy framework.

The paper Is Policy Greasing the Wheels of Global Palm Oil Trade? by Adhikari, Poudel, and Gopinath (2023) applied a gravity model with PPML estimation to data from 1988 to 2019 covering 194 countries. It showed that trade agreements increased crude palm oil trade by 8% and refined palm oil by 4%. The study highlighted India's frequent tariff adjustments, ranging from 37.5% to 74% under AIFTA, along with temporary cuts during the Covid-19 period. For research, it offered quantitative evidence for tariff volatility and price effects, demonstrates the role of FTAs, and provides structural break events critical for volatility modeling.

The paper Modelling and Forecasting of Palm Oil Production, Import, Export, Domestic Supply and Waste in Major Countries of the World by Mishra, Vishwajith, Padmanaban, and Sahu (2017) employed GARCH models on data spanning 1961–2009 to forecast trends in palm oil trade. It confirms Malaysia's continued dominance in global supply while identifying volatility clustering as a key feature of palm oil trade flows. For research, it provided methodological validation for using GARCH and EGARCH approaches in analyzing volatility, strengthens the case for applying these models to India's edible oil imports, and links domestic volatility directly to global supply fluctuations.

The paper Oil Palm in the 2020s and Beyond: Challenges and Solutions by Murphy, Goggin, and Paterson (2021) provided a global overview of palm oil, which accounts for about 40% of the world's traded vegetable oil. It examined productivity trends, land-use efficiency, climate change risks, pest and disease threats, and the growing debates on sustainability. The study predicted increasing supply chain disruptions and heightened consumer pushback. For research, it contributed global supply risk factors as exogenous variables in volatility models, highlights climate change shocks as asymmetric drivers for NARDL, and enriches stakeholder analysis by linking sustainability with trade politics.

The paper Palm Oil Crisis in India's FMCG Sector: A Sustainability Dilemma by Kishnani and Sharma (2023) studied the dependence of leading FMCG companies such as HUL, Nestlé, ITC, and Marico on palm oil. It analyzed the impact of Indonesia's 2022 export ban, global supply disruptions, and resulting cost escalations, showing that firms passed on 10–20% price increases to consumers. The study also discussed NMEO-OP as a potential sustainability solution. For research, it provided direct evidence of price shocks for GARCH volatility analysis, highlights firm-level impacts relevant for stakeholder effects, and strengthens arguments on India's vulnerability to import dependence.

The paper Spillover Effects of Import Competition: Edible Oils in India by Bandyopadhyay and Ramaswami (2024) employed panel data with spatial exposure to trade shocks, using district-level oilseed area as a measure of exposure. It found that regions with higher oilseed cultivation experienced stronger price effects from import competition, while farm wages remained unaffected due to labor reallocation. The study also showed that cropping patterns shifted in response to import flows. For research, it provided a robust trade-exposure methodology for panel regressions, supports NARDL asymmetry analysis on price pass-through, and links tariff volatility directly to regional welfare outcomes.

The report The Role of Policy and Industry Structure in India's Oilseed Markets by Persaud and Landes (2006), published by USDA ERS, evaluated India's oilseed and oil sector policies. It

showed that high tariffs largely benefited inefficient processors while imposing costs on consumers, with minimal impact on oilseed production. Model simulations indicated that liberalizing imports of oilseeds instead of oils would improve processor efficiency and generate gains for producers, consumers, and the trade balance. For research, it offered a policy baseline on tariff volatility, provides simulation evidence supporting CGE and NARDL approaches, and informs the discussion on policy effectiveness versus inefficiency.

The paper Policy Effects on Global Palm Oil Trade: A Gravity Model Approach by Adhikari, Poudel, and Gopinath (2023) employed a gravity model with PPML estimation using HS-6 digit data for 1988–2020. It found that trade agreements boosted crude palm oil trade by 8% and refined palm oil by 4%. The study highlighted India's tariff fluctuations between 37.5% and 74% under AIFTA, temporary duty cuts during Covid-19, and Indonesia's export ban. For research, it provided quantitative tariff and trade evidence for duty-event analysis, offers policy shocks as exogenous variables in EGARCH models, and contributes insights on tariff asymmetry between CPO and RPO.

The paper Production and Consumption of Edible Oils in India by Kalra and Srivastava (2023) analyzed trends in India's oilseed and edible oil sector between 1970 and 2018. It showed that while domestic production stagnated, rising demand caused imports to surge, with soybean oil becoming the dominant contributor to net imports. By 2017–18, domestic output could only meet about 60% of consumption. For research, it offered a long-run dataset on consumption–production gaps for tariff volatility studies, provides demand-supply mismatches as control variables for volatility models, and reinforces the policy argument that tariff interventions alone cannot ensure self-sufficiency without yield growth.

The policy brief Technology and Policy Options for Reducing India's Import Dependence on Edible Oils by Balaji, Sharma, Venkatesh, and Shreya (2022), published by ICAR-NIAP, highlighted that India's import dependence stood at 54% in 2020–21. It argued that despite multiple schemes, domestic production has failed to keep pace with rising demand. The study recommended productivity-enhancing technologies, protective tariffs, and diversification measures, while noting that tariff hikes raise production only modestly by 2–3%. For research, it provided a timeline of tariff interventions, evidence of limited tariff effectiveness for asymmetry analysis, and links tariffs with technology gaps and self-sufficiency goals.

The paper The Wax and Wane of CPO Prices in India: A DCC Approach to Understanding Market Sentiment by Supriya and Mamilla (2024) employs a DCC-GARCH framework to study Indian crude palm oil spot and futures markets between 2018 and 2022. It finds that major global events such as the Covid-19 pandemic and the Russia–Ukraine war triggered significant spikes in volatility and altered correlations between spot and futures prices. The study also notes post-2020 divergence in market sentiment. For research, it provides methodological precedent for GARCH modeling, highlights structural breaks from global shocks, and supports framing palm oil as sentiment-driven.

The paper Trade Dynamics and Global Competitiveness of India's Oilseeds Sector: An Analytical Study of Export and Import Patterns by Sharma and Deshmukh (2024) examines India's paradoxical position as one of the world's largest oilseed producers but also among the biggest importers of edible oils. It attributes this to low productivity, high costs,

inadequate infrastructure, and compliance issues with quality standards. For research, it offers macro-level trade context, provides external drivers such as exchange rates and global trade policies for volatility modeling, and reinforces the argument that tariff measures alone are insufficient without structural reforms in productivity and competitiveness.

The paper Transmission of Edible Oil Import Tariffs along Supply Chain in India by Sanyal and Spearot (2023) investigates how tariff changes pass through India's supply chain using HS-6 trade data, ASI firm-level data, and DoCA retail price data. It finds that while tariffs reduce import intensity, they do not affect world prices but increase input costs for firms. The study highlights uneven consumer price impacts, with stronger effects near ports and weaker ones in remote markets. For research, it provides direct evidence of asymmetric pass-through, firm- and consumer-level impacts, and empirical tariff shocks useful across multiple objectives.

The paper Trend of Vegetable Oils International Trade of India by Manikandan and Rajendran (2024) examines India's vegetable oil trade patterns between 2010–11 and 2020–21 using Ministry of Commerce statistics. It finds that exports grew at a CAGR of 4.4%, largely driven by castor oil with a 53% share, while imports—seven times larger—were dominated by crude palm oil at around 50%, followed by soybean and sunflower oil. The study highlights how Covid-19 and the Ukraine war exposed India's dependence and triggered price surges. For research, it offers long-run trade data, volatility-relevant commodity series, and global shock breakpoints for econometric modeling.

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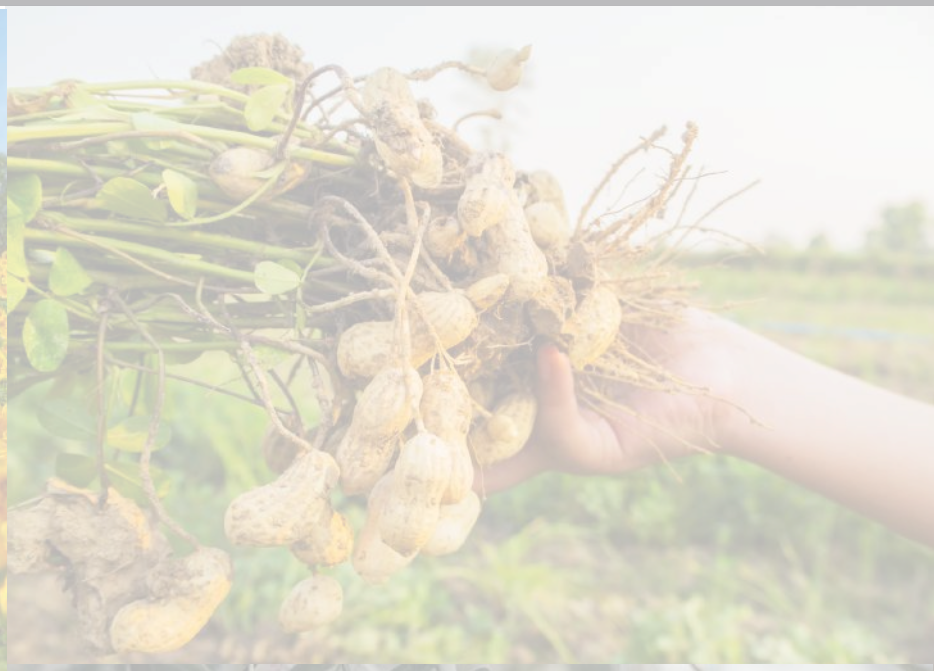

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