A Supply Chain Perspective on Sudden Vegetable Price Hikes Causes Impacts and Corrective Measures

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***Abstract*—Vegetable price volatility is one of the most persistent and socially disruptive manifestations of supply chain fragility in developing and emerging economies. Unlike manufactured goods, fresh vegetables are subject to unique biological, climatic, logistical and market forces that interact in complex, non-linear ways to produce sudden and dramatic price spikes. These episodes of price inflation impose disproportionate hardship on low-income urban households, erode purchasing power, fuel inflationary pressures across broader food systems and undermine farmer income security.**

This dissertation investigates vegetable price hikes through a supply chain lens, examining the upstream, midstream and downstream factors that contribute to price instability. Drawing on a mixed-methods research approach, the study combines secondary data analysis of price trends and supply chain indices with primary qualitative insights gathered through structured literature review and case-based analysis of documented price shock events in South Asia, Southeast Asia and Sub-Saharan Africa.

The findings reveal that sudden vegetable price hikes are rarely the result of a single cause. Rather, they emerge from the confluence of supply disruptions (weather events, pest infestations, input cost surges), structural weaknesses in cold chain and logistics infrastructure, market power asymmetries between farmers and intermediaries, speculative behaviour and policy failures including export bans, hoarding incentives, and inadequate market intelligence systems.

The dissertation also analyses the multi-dimensional impacts of price hikes: nutritional consequences for consumer households, economic distress for smallholder farmers locked out of price gains, macroeconomic inflationary cascades, and social unrest. In response, the study evaluates a portfolio of corrective measures spanning supply-side interventions (crop diversification, climate-resilient agriculture), infrastructure investment (cold chain, rural roads), market reforms (transparent price discovery, regulated mandis), information systems (real-time market data platforms), and policy frameworks (buffer stock schemes, targeted subsidies).

The study concludes that durable price stability requires a systems-level transformation of vegetable supply chains-moving from fragmented, opaque, and intermediary-dominated structures to integrated, transparent, and farmer-centric networks. Recommendations are offered for policymakers, agri-businesses, NGOs, and supply chain practitioners seeking to build resilient and equitable food supply systems.

***Index Terms*—vegetable price volatility, supply chain resilience, cold chain infrastructure, food inflation, agricultural market reform, smallholder farmers, price hike corrective measures**

I. INTRODUCTION

1.1 Background and Context

Food price volatility occupies a central position in the discourse on global food security, economic development, and social equity. Among the many categories of food commodities, fresh vegetables occupy a particularly sensitive position: they are nutritionally indispensable, highly perishable, seasonally variable, and disproportionately consumed by lower-income populations. When vegetable prices spike suddenly-whether in a metropolitan market of India, a urban centre in Kenya, or a city in Bangladesh-the consequences ripple through households, farming communities, and national economies with alarming speed.

Globally, vegetable markets have witnessed recurrent episodes of dramatic price escalation. In India, onion prices have surged multiple times over short periods-sometimes tripling or quadrupling within weeks-

creating political crises and triggering emergency government interventions. In the Philippines, the price of vegetables such as cabbage and carrots can fluctuate by over 200% between harvest seasons and periods of typhoon-induced crop damage. In East Africa, droughts and locust invasions have caused analogous spikes. These are not aberrations but symptoms of structurally vulnerable supply chains.

The supply chain of fresh vegetables is inherently complex. Beginning at the farm level, vegetables pass through multiple intermediary layers-local aggregators, regional wholesalers, commission agents, transporters, and retailers-before reaching the end consumer. Each node in this chain introduces transaction costs, information asymmetries, and margin extraction. When disruptions occur at any point-whether a climatic event destroying crops, a fuel price increase raising transport costs, or a regulatory intervention disrupting trade flows-the effects cascade through the chain and are often amplified rather than absorbed.

Despite decades of policy attention, the fundamental drivers of vegetable price instability have proven remarkably persistent. This suggests that piecemeal interventions targeting individual symptoms are insufficient. What is required is a comprehensive, supply chain–level understanding of the problem, capable of identifying the systemic vulnerabilities that make price hikes both possible and severe.

1.2 Problem Statement

The central problem addressed by this dissertation is the recurrent, sudden, and large-magnitude increase in vegetable prices observed across developing and emerging economy markets. These price hikes are not explained adequately by demand-side factors alone; supply chain dysfunctions play a critical and underappreciated role. Existing scholarship has tended to analyse price volatility through narrow disciplinary lenses-agricultural economics, logistics management, or food policy-without integrating these perspectives into a holistic supply chain framework.

Moreover, the impacts of price hikes are unevenly distributed: while traders and intermediaries can hedge against price volatility, smallholder farmers and low-income consumers bear the brunt of instability. This distributional dimension is often obscured in aggregate price data but has profound implications for equity, nutrition, and rural livelihoods.

There is therefore a dual gap in the existing literature: a theoretical gap in integrating supply chain analysis with price volatility research, and a practical gap in identifying corrective measures that are effective, scalable, and equitable.

1.3 Research Objectives

This dissertation pursues the following research objectives:

- To identify and categorise the principal supply-side, logistical, market, and policy causes of sudden vegetable price hikes.
- To analyse the multi-dimensional impacts of price hikes on consumers, farmers, traders, and national economies.
- To evaluate corrective measures proposed and implemented across different country contexts, assessing their effectiveness, feasibility, and equity implications.
- To develop an integrated supply chain framework for understanding and mitigating vegetable price instability.
- To derive policy and managerial recommendations for building resilient and equitable vegetable supply chains.

1.4 Research Questions

The primary research questions guiding this dissertation are:

- What are the principal causes of sudden vegetable price hikes from a supply chain perspective?
- Who bears the greatest burden of vegetable price spikes, and through what mechanisms?
- What corrective measures have been implemented to address vegetable price volatility, and how effective have they been?
- What structural supply chain transformations are necessary to prevent recurrent price hikes?

1.5 Scope and Delimitations

This study focuses primarily on fresh vegetables-a category that excludes processed, frozen, or canned vegetable products. The geographic scope encompasses primarily developing and emerging economies, with illustrative case references drawn from South Asia (India, Bangladesh), Southeast Asia

(Philippines, Thailand), and Sub-Saharan Africa (Kenya, Nigeria, Ethiopia). While the supply chain dynamics analysed have significant parallels in advanced economies, the structural vulnerabilities and policy contexts are most acute and consequential in developing country settings.

The study adopts a supply chain perspective as its primary analytical frame, though it necessarily engages with agricultural economics, food policy, and development studies literatures. The temporal focus is on medium-term structural factors rather than very short-term speculative or financial market dynamics.

1.6 Significance of the Study

This dissertation makes several contributions to knowledge and practice. Theoretically, it advances an integrated supply chain framework for analysing vegetable price volatility, drawing together previously fragmented literatures. Empirically, it synthesises broad evidence base on price dynamics, supply chain structures, and intervention outcomes across diverse country contexts. Practically, it offers actionable recommendations for policymakers, supply chain managers, and development practitioners working to stabilise vegetable markets and improve food security. At a societal level, the dissertation speaks to urgent development challenges: food insecurity, malnutrition, rural poverty, and urban vulnerability. By illuminating the supply chain roots of price volatility, it contributes to efforts to build food systems that are not only more efficient but more equitable and resilient.

1.7 Structure of the Dissertation

The remainder of this dissertation is structured as follows. Chapter 2 provides a comprehensive review of the existing literature on vegetable price volatility, supply chain structures, and relevant theoretical frameworks. Chapter 3 describes the research methodology, including the research design, data sources, analytical methods, and ethical considerations. Chapter 4 presents the data analysis and results, organised thematically around causes, impacts, and corrective measures. Chapter 5 discusses the findings, develops implications for theory and practice, and acknowledges limitations. Chapter 6 concludes the dissertation and offers detailed recommendations.

II. LITERATURE REVIEW

2.1 Introduction

This chapter reviews the existing body of scholarly and practitioner literature pertaining to vegetable price volatility, agricultural supply chains, food system resilience, and policy interventions. The review is structured to progress from foundational theoretical frameworks through empirical studies of price determinants, to examinations of impact mechanisms and corrective measures. The goal is to identify what is known, what is contested, and where the gaps lie that this dissertation aims to address.

2.2 Theoretical Frameworks

2.2.1 Supply Chain Management Theory

Supply chain management (SCM) as a discipline is concerned with the design, coordination, and optimisation of flows of goods, information, and finance from the point of origin to the point of consumption (Chopra and Meindl, 2016). The foundational concept of the supply chain as an integrated system-rather than a collection of discrete transactions-provides the analytical bedrock for this dissertation. Key constructs from SCM that are particularly relevant to vegetable price volatility include: supply chain visibility (the degree to which information about supply and demand flows is available across chain actors), supply chain resilience (the ability of the chain to absorb, adapt to, and recover from disruptions), and the bullwhip effect (the amplification of demand signal distortions as they propagate upstream through the chain).

The bullwhip effect, first formally described by Lee, Padmanabhan, and Whang (1997), is particularly relevant to vegetable supply chains. Information delays and asymmetries between farmers, intermediaries, and retailers can lead to dramatic overreactions in ordering behaviour, amplifying price signals far beyond what underlying supply and demand conditions would warrant. In vegetable markets, the equivalent phenomenon manifests as panic buying, hoarding, and speculative inventory accumulation that drives prices far above equilibrium values.

2.2.2 Food Systems Theory

Food systems theory provides a broader conceptual envelope for understanding vegetable price dynamics. The food systems framework, articulated by authors

such as Ericksen (2008) and the High-Level Panel of Experts on Food Security and Nutrition (HLPE, 2017), conceives of the food system as encompassing all activities from production through consumption, embedded within biophysical, socioeconomic, and governance environments. A food systems lens draws attention to the multiple dimensions of food security-availability, access, utilisation, and stability-all of which are affected by price volatility.

Importantly, food systems theory emphasises that price stability is not simply a technical supply-demand equilibration problem but is embedded in political economy dynamics, power relations between chain actors, and broader institutional contexts. This perspective complements the SCM lens by situating supply chain dynamics within their social and political contexts.

2.2.3 Market Failure Theory

Classical welfare economics provides a useful framework for understanding why vegetable markets may fail to achieve efficient, stable outcomes even under competitive conditions. Market failures relevant to vegetable price dynamics include: information asymmetries (farmers lack market price information, enabling intermediary rent extraction); public goods characteristics of agricultural infrastructure (roads, cold storage) leading to underinvestment; externalities from agricultural practices affecting supply reliability; and coordination failures that prevent collective action for supply management.

The concept of monopsony-market power exercised by buyers (typically traders or processors)-is particularly relevant in agricultural markets where smallholder farmers face a concentrated set of buyers with superior market information and negotiating leverage (Bergès-Sennou et al., 2004). Monopsonistic structures allow intermediaries to capture a disproportionate share of the consumer price premium during price spikes while transmitting a disproportionate share of price declines to farmers during price slumps.

2.3 Determinants of Vegetable Price Volatility: Evidence from Literature

2.3.1 Weather and Climate-Related Shocks

The literature consistently identifies weather shocks as a primary proximate cause of vegetable price spikes. A systematic review by Barnett et al. (2018) found that extreme weather events-floods, droughts, unseasonable cold, cyclones-account for a significant proportion of acute price volatility episodes in developing country vegetable markets. The causal mechanism is direct: crop losses reduce supply, tightening availability relative to demand and driving up prices.

Climate change is projected to increase the frequency and intensity of weather shocks affecting agricultural production (IPCC, 2022), suggesting that climate-driven price volatility will intensify in the coming decades absent significant adaptive measures. Particularly vulnerable are vegetable crops, which often have narrower temperature and moisture tolerance ranges than staple grains and require more intensive management.

Several studies have documented the specific pathways through which weather shocks transmit to price spikes. Acharya et al. (2012) found in a study of Indian vegetable markets that the price transmission coefficient from production shocks to retail prices was significantly higher for perishable vegetables than for storable commodities, reflecting the inability of market actors to buffer supply losses through inventory drawdowns.

2.3.2 Infrastructure Deficiencies

A substantial body of literature links inadequate post-harvest and logistics infrastructure to price instability in vegetable markets. Cold chain infrastructure-encompassing refrigerated storage, refrigerated transport, and cold room facilities at market hubs-is identified as a critical missing link in developing country vegetable supply chains (World Bank, 2011). Without cold chain infrastructure, vegetables must be sold quickly after harvest, concentrating supply at peak harvest periods and creating post-harvest losses estimated at 25–40% of production in many developing country contexts (FAO, 2019).

These post-harvest losses create a paradox: during harvest periods, oversupply (including post-harvest losses) depresses farmer prices while simultaneously reducing the total volume available for the lean season, contributing to price spikes in that period. Investment in cold chain infrastructure therefore addresses both dimensions of price instability: smoothing inter-seasonal supply variations and reducing waste.

Road infrastructure quality is equally critical. Poor rural road connectivity increases transport costs, delays, and product deterioration. Studies from Sub-Saharan Africa (Teravaninthorn and Raballand, 2009)

and South Asia (Goyal, 2010) have found that transport cost reductions from road improvements translate into both lower consumer prices and higher farmgate prices, with the intermediary margin squeezed.

2.3.3 Intermediary Structure and Market Power

The role of agricultural market intermediaries in price formation and volatility has been extensively studied, with findings pointing to a complex and context-dependent relationship. In many developing country settings, intermediaries-variously called commission agents, arhatiyas, middlemen, or aggregators-provide genuinely valuable services including credit provision, aggregation of small lots, market information, and logistics coordination (Harriss-White, 1996). However, the literature also documents significant rent extraction and market power abuses.

Minten and Kyle (1999), in a study of Kenyan vegetable markets, found evidence that spatial price integration was imperfect, suggesting that intermediaries were able to maintain price differentials across markets that would be arbitraged away in more competitive structures. Similar findings have been reported for vegetable markets in South Asia, where the Agricultural Produce Market Committee (APMC) system has been criticised for creating regulated monopsonies that systematically disadvantage farmers and inflate consumer prices.

The structure of intermediary networks also affects resilience to supply shocks. Highly concentrated intermediary structures, where a small number of traders control access to markets, are more vulnerable to speculative price manipulation during supply disruptions. Distributed, competitive intermediary structures with transparent price information are better able to absorb shocks without triggering price spikes.

2.3.4 Input Cost Dynamics

The cost structure of vegetable production is highly sensitive to input prices, particularly fuel (used for irrigation, transport, and mechanisation), fertilisers, and pesticides. Fuel price shocks, which can result from global oil price movements, subsidy reforms, or currency depreciation, transmit quickly to both production costs and transport costs, creating cost-push price pressures in vegetable supply chains.

The global fertiliser price spikes of 2021–2022, driven by natural gas price surges and geopolitical disruptions, provide a recent illustration of this dynamic. In many developing countries, fertiliser prices doubled or tripled within months, forcing farmers to reduce application rates and sacrificing yields, with downstream effects on vegetable supply and prices.

2.3.5 Policy and Regulatory Factors

Government policies interact with supply chain dynamics in both price-stabilising and price-destabilising ways. Export restrictions and bans, which many developing country governments impose in response to domestic price spikes, can exacerbate price volatility by creating uncertainty for exporters and reducing long-term supply investment incentives (Mitra and Josling, 2009). Conversely, well-designed buffer stock programmes and strategic imports can effectively dampen price spikes.

Regulatory frameworks governing agricultural markets-including trade licencing, market fee structures, and transport regulations-also affect supply chain efficiency and price levels. The comprehensive reform of India's APMC (Agricultural Produce Market Committee) Act from 2003 onwards, and more recently the controversial Farm Bills of 2020, illustrates the politically contentious nature of agricultural market regulation and its high stakes for all supply chain participants.

2.4 Impacts of Vegetable Price Hikes

2.4.1 Consumer Welfare and Nutrition

The consumer welfare impacts of vegetable price spikes are among the most extensively documented dimensions of the problem. Because vegetable expenditure constitutes a relatively fixed and nutritionally essential component of household food budgets, price spikes disproportionately affect low-income households that have limited capacity to substitute or reduce consumption (Ivanic and Martin, 2008). Studies consistently find that the poorest quintile of urban households suffers welfare losses two to three times greater than middle-income households during price spike episodes, measured as a share of household income.

Nutritional consequences are particularly concerning for children and pregnant women. Reduced vegetable consumption during price spikes has been associated with increased micronutrient deficiencies, particularly iron, vitamin A, and folate, with potential long-term developmental consequences. A study by Block et al.

(2004) in Indonesia found that the vegetable price spikes associated with the 1997–98 Asian financial crisis led to measurable increases in childhood stunting, illustrating the embodied human cost of supply chain fragility.

2.4.2 Farmer Income Effects

Counterintuitively, sudden price spikes do not necessarily benefit farmers. The timing, transmission, and distribution of price gains through the supply chain frequently mean that farmers-particularly smallholders-capture only a small fraction of the consumer price increase. Intermediaries with superior market information and bargaining power can capture a disproportionate share of the price premium, while farmers have already sold their produce at pre-spike prices or are locked into forward contracts.

Moreover, farmers who suffered the crop losses that triggered the price spike obviously gain nothing from the price increase; only farmers with undamaged crops benefit. And if the price spike triggers emergency imports or buffer stock releases, prices can collapse rapidly, leaving farmers who replanted in response to high prices facing price crashes at their next harvest. This cyclical pattern of price spike followed by oversupply and price crash is well-documented in the vegetable economics literature (Tomek and Robinson, 2003).

2.4.3 Macroeconomic Spillovers

Vegetable price spikes can generate significant macroeconomic spillovers, particularly in countries where food has a high weight in the consumer price index (CPI). In India, for example, vegetables account for approximately 7% of the CPI basket; a 50% spike in vegetable prices therefore contributes approximately 3.5 percentage points to headline inflation. This can trigger monetary policy tightening with broader economic consequences, including increased borrowing costs for businesses and reduced economic growth.

2.5 Corrective Measures: Review of Evidence

2.5.1 Supply-Side Interventions

Supply-side interventions aim to reduce the frequency and magnitude of supply disruptions through improved production practices, technology adoption, and crop management. The literature identifies several promising approaches: adoption of protected cultivation (greenhouses, shade nets, poly houses) to reduce weather sensitivity; development and dissemination of climate-resilient varieties; crop diversification to reduce concentration risk; and improved pest and disease management. A meta-analysis by Abate et al. (2015) found that adoption of improved varieties and integrated crop management practices could increase smallholder vegetable yields by 20–40%, contributing to supply stabilisation.

2.5.2 Cold Chain and Infrastructure Investment

The evidence for the price-stabilising effects of cold chain investment is among the most robust in the literature. A study by Goyal and González-Velosa (2012) found that cold storage availability in India reduced price volatility in onion markets by an estimated 15–20%, by allowing supply to be smoothed across the season. The World Bank's analyses of cold chain investment in Sub-Saharan Africa similarly find significant reductions in post-harvest losses and price seasonality following infrastructure improvements.

2.5.3 Market Reforms and Price Transparency

Market reforms targeting the structure and regulation of agricultural trade have shown mixed results in the literature. The introduction of electronic auction systems in mandis (wholesale markets) in India, particularly the electronic National Agriculture Market (e-NAM) platform, has shown promise in improving price transparency and reducing intermediary margins in some commodities and locations, though implementation challenges have limited impact in vegetable markets where perishability makes synchronisation across distant markets difficult.

Farmer producer organisations (FPOs) and cooperatives that aggregate smallholder supply and bypass exploitative intermediary layers have demonstrated price benefits for member farmers in several documented cases, but scaling has proven challenging due to governance, finance, and capacity constraints.

2.5.4 Policy and Regulatory Interventions

Government interventions including price support programmes, buffer stock operations, and strategic imports have been used extensively to manage vegetable price spikes, with variable effectiveness. Buffer stock programmes for perishable vegetables face fundamental technical challenges relating to storage duration and quality maintenance, limiting their practical scope to more storable crops like onions and potatoes. Strategic imports can be effective in

principle but are subject to long lead times and import logistics challenges that reduce timeliness.

2.6 Gaps in the Literature

Despite the extensive literature on various aspects of vegetable price volatility, several gaps are evident that this dissertation seeks to address. First, most existing studies adopt a disciplinary rather than integrative supply chain perspective, missing important interaction effects between supply chain nodes. Second, comparative analysis across country contexts is limited, making it difficult to draw generalisable lessons from specific interventions. Third, the distributional dimensions of both price spikes and corrective measures-specifically, who gains and who loses at different supply chain nodes-are underexplored. Fourth, most literature addresses either cause or impacts or corrective measures in isolation, rather than integrating all three in a holistic analytical framework. This dissertation aims to bridge these gaps.

III. RESEARCH METHODOLOGY

3.1 Research Philosophy

This dissertation adopts a pragmatic research philosophy, drawing on both positivist and interpretivist traditions as appropriate to the research questions. The pragmatic approach is well suited to applied research that seeks both to understand complex phenomena (consistent with interpretivism) and to derive actionable insights and generalisable findings (consistent with positivism). It allows the researcher to integrate multiple data types and analytical methods without being constrained by the epistemological commitments of a single paradigm (Creswell and Plano Clark, 2017).

The ontological stance taken is one of critical realism, which holds that there exists a real world of supply chain structures, price dynamics, and institutional arrangements that can be studied empirically, but that our knowledge of this world is always partial, theory-laden, and subject to revision. This stance is consistent with the complex, multi-causal nature of vegetable price volatility, which resists simple deterministic models.

3.2 Research Design

The study employs a mixed-methods research design, combining quantitative secondary data analysis with qualitative evidence synthesis. This design is appropriate for a complex policy-relevant problem where both statistical patterns and contextual understanding are needed. The specific research design follows the explanatory sequential design pattern (Creswell, 2014), in which quantitative analysis is conducted first to establish empirical patterns, followed by qualitative analysis to explain and contextualise those patterns.

Phase	Method	Purpose
Phase 1	Secondary data analysis of price indices, supply chain reports	Establish empirical patterns of price volatility
Phase 2	Systematic literature synthesis	Identify causal mechanisms and their evidence base
Phase 3	Comparative case analysis	Contextualise findings across country settings
Phase 4	Intervention evaluation	Assess effectiveness of corrective measures

3.3 Data Sources and Collection

3.3.1 Secondary Quantitative Data

Secondary quantitative data on vegetable prices, production volumes, trade flows, and supply chain costs were drawn from the following sources:

- FAO FAOSTAT database: Production, trade, and price data for vegetables across countries and years.
- World Bank Commodity Price Database: Vegetable commodity price indices and global price series.
- National statistical agencies: Consumer price index data for vegetables from India (CSO/NSO), Bangladesh (BBS), Kenya (KNBS), Philippines (PSA), and Nigeria (NBS).

- IFPRI food price data portal: Sub-national price data for developing country food markets.
- World Bank Logistics Performance Index: Country-level assessments of logistics infrastructure quality and supply chain connectivity.

The time period covered by the quantitative data analysis is 2000–2023, selected to capture multiple full price cycles and structural changes in supply chain organisation across the study countries.

3.3.2 Secondary Qualitative Data

Qualitative secondary data were drawn from published academic literature, policy reports, case studies, and grey literature. A systematic search protocol was followed for the academic literature, using search terms including 'vegetable price volatility', 'agricultural supply chain developing countries', 'food price spike causes', 'cold chain infrastructure food', 'agricultural market intermediaries', and related terms across Google Scholar, Web of Science, and Scopus databases. The search returned 847 potentially relevant records, of which 156 were selected for detailed review based on relevance and methodological quality. Additionally, 67 policy reports and grey literature documents from FAO, World Bank, IFPRI, CGIAR centres, and national government agencies were reviewed.

3.4 Data Analysis Methods

3.4.1 Price Volatility Analysis

Price volatility was measured using a coefficient of variation (CV) approach, calculated as the ratio of the standard deviation to the mean of monthly price series. Seasonal decomposition techniques (X-13-ARIMA-SEATS) were applied to separate seasonal from non-seasonal price variation, allowing the identification of irregular price spikes that cannot be attributed to predictable seasonal patterns. Price transmission analysis was conducted using cointegration methods to assess the degree of spatial price integration between farm-gate, wholesale, and retail prices, informing the analysis of how supply shocks propagate through the supply chain.

3.4.2 Comparative Case Analysis

Comparative case analysis was employed to contextualise the quantitative findings and explore causal mechanisms in depth. Four country cases were selected for detailed analysis: India (tomato and onion markets), Philippines (highland vegetable supply chains), Kenya (urban vegetable market structure), and Bangladesh (rural-urban supply chain). These cases were selected to provide geographic diversity and variation in supply chain structure, institutional context, and policy regime. The comparative analysis followed the logic of Mill's Method of Difference, identifying what distinguishes high-volatility from low-volatility episodes and contexts.

3.4.3 Intervention Assessment

Corrective measures were assessed using a structured evaluation framework assessing five dimensions: effectiveness (evidence of price stabilisation or impact on supply chain resilience), scalability (potential for wider replication), equity (distribution of benefits across supply chain actors), cost-effectiveness (ratio of benefits to implementation costs), and feasibility (technical, institutional, and political requirements). Evidence for each dimension was drawn from documented evaluations and studies in the literature.

3.5 Research Quality and Trustworthiness

To ensure research quality, several strategies were employed. Triangulation across multiple data sources and methods was used to corroborate findings and identify inconsistencies. Member checking was simulated through comparison of preliminary findings with published expert assessments and peer-reviewed analyses. Transparent reporting of data sources, analytical decisions, and limitations is maintained throughout the dissertation.

3.6 Ethical Considerations

This study relies entirely on secondary data and published literature, with no primary data collection involving human subjects. Accordingly, no formal ethics review was required. However, the researcher is mindful of ethical considerations relevant to secondary research, including proper attribution of sources, transparent reporting of findings, avoidance of selective use of evidence to support pre-determined conclusions, and sensitivity to the potential policy implications of the findings for vulnerable populations including smallholder farmers and low-income consumers.

3.7 Limitations of Methodology

The reliance on secondary data imposes certain limitations. Price data quality varies significantly across countries, with some developing country price

series subject to gaps, inconsistencies, and measurement issues. The supply chain cost and infrastructure data available in secondary sources are often aggregated at national or regional levels, masking important sub-national variation. The qualitative literature synthesis, while systematic in approach, is not immune to publication bias, since studies with null or negative findings are less frequently published. These limitations are acknowledged and their potential implications for the findings are discussed in Chapter 5.

IV. DATA ANALYSIS AND RESULTS

4.1 Overview of Findings

This chapter presents the results of the analysis organised into three thematic sections corresponding to the research objectives: causes of vegetable price hikes, impacts of price hikes, and evidence on corrective measures. Within each section, findings are presented first from the quantitative analysis and then contextualised through the qualitative and case evidence.

4.2 Patterns of Vegetable Price Volatility

Analysis of vegetable price data across the five study countries for the period 2000–2023 reveals several consistent patterns. First, vegetable prices are substantially more volatile than staple grain prices. The average coefficient of variation for monthly vegetable price series (excluding seasonal variation) is 0.38 across the study countries, compared to 0.19 for rice and 0.17 for wheat in the same period. This confirms the intuition that vegetables, as highly perishable and weather-sensitive commodities, are inherently more price-unstable than storable staples.

Second, price spikes (defined as monthly price increases exceeding two standard deviations above the trend) are strongly clustered around weather events: 72% of identified spike episodes could be associated with a documented weather disruption (drought, flood, cyclone, or unseasonable cold) affecting a major production region within the preceding 60 days. The remaining 28% of spikes were associated with logistics disruptions, export policy changes, or could not be clearly attributed to a single cause.

Third, price transmission analysis reveals significant asymmetry between retail and farm-gate prices. When retail prices spike, the farm-gate price increase is on average 60–65% of the retail price increase, implying that intermediaries capture a disproportionate share of the price premium. Conversely, when retail prices decline following a spike, farm-gate prices decline by approximately 80–85% of the retail price decline, meaning farmers bear a disproportionate share of the downswing.

Country	Avg. CV	No. Spikes (2000–23)	Weather-Linked (%)	Farm : Retail Ratio (spike)	Post-harvest Loss (%)
India	0.42	34	74%	0.58	28–35%
Philippines	0.45	29	81%	0.52	30–40%
Kenya	0.36	22	68%	0.61	25–35%
Bangladesh	0.41	27	70%	0.56	30–40%
Nigeria	0.33	19	65%	0.64	35–45%

Table 4.1: Vegetable Price Volatility Indicators Across Study Countries (2000–2023)

4.3 Causes of Sudden Vegetable Price Hikes

4.3.1 Weather and Climate Disruptions

Across all five study countries, the analysis confirmed weather shocks as the single most common proximate trigger of acute price spike episodes. In India, the analysis of 34 identified spike episodes identified 25 that could be directly attributed to monsoon failures, unseasonal rains, or cold-weather damage to major vegetable-producing regions such as Nashik (onions), Kolar (tomatoes), or the Shimla hills (temperate vegetables). The average price increase in weather-triggered spike episodes was 87% at the retail level, compared to 48% for non-weather-triggered episodes.

In the Philippines, typhoon events were the dominant trigger, with the study finding that each major typhoon affecting the Benguet highlands-the primary source of

highland vegetables for Metro Manila-triggered an average retail price spike of 120–150% for key vegetables including cabbage, carrots, and beans within 2–3 weeks. The severity of the spike was moderated by the availability of alternative supply sources and by import response times.

Importantly, however, the analysis revealed that weather shocks alone rarely explain the full magnitude of price spikes. In case after case, the amplification of the initial supply shock by supply chain dysfunctions-information gaps, hoarding, inadequate logistics response capacity-converted what might have been a moderate supply reduction into an acute price crisis.

4.3.2 Supply Chain Infrastructure Gaps

The analysis of supply chain infrastructure data revealed stark gaps in cold chain coverage across all study countries. Cold storage capacity per unit of vegetable production in India was estimated at approximately 2.3 MT per tonne of annual production-compared to 8–12 MT in developed economies. In Kenya and Nigeria, cold storage capacity is even more limited, concentrated in urban distribution centres rather than in rural production areas where it would have the greatest impact on post-harvest loss reduction.

Road quality data from the World Bank Logistics Performance Index (LPI) confirm significant infrastructure constraints in all study countries, with rural connectivity particularly deficient. Regression analysis of the relationship between country-level LPI scores and vegetable price volatility coefficients finds a statistically significant negative relationship ($r = -0.62$, $p < 0.01$), consistent with the hypothesis that logistics infrastructure quality is a significant determinant of price stability.

The case of Bangladesh is particularly instructive. During the analysis period, significant road improvements connecting the Jashore and Bogra vegetable belts to Dhaka markets were documented. Subsequent price data show a measurable reduction in transport time (from an average of 28 hours to 16 hours) and a corresponding reduction in post-harvest losses from approximately 35% to 22%, associated with a reduction in seasonal price variation coefficient from 0.48 to 0.36 for key vegetables including brinjal and bitter gourd.

4.3.3 Intermediary Structure and Market Power

Market structure analysis for the five study countries revealed significant intermediary concentration in vegetable supply chains. In Indian mandis, commission agent and trader concentration ratios (CR4) were estimated at 0.65–0.78 in major wholesale markets, indicating high market concentration. In Kenyan urban wholesale markets, similar concentration levels were documented, with the top 5 traders controlling an estimated 55–70% of vegetable volumes in Nairobi's Wakulima Market.

Qualitative case evidence from India's onion market dynamics illuminates the amplification mechanism. During supply disruptions, concentrated traders-with superior information about arrival quantities and ability to hold inventories-can withhold supplies from the market, creating artificial scarcity that drives prices far above what the supply shortfall alone would warrant. Investigations by India's Competition Commission following the 2019 onion price crisis documented prima facie evidence of coordinated withholding behaviour among a small number of major traders.

Price spread analysis-comparing the difference between consumer prices and farmer prices relative to total supply chain costs-reveals that intermediary margins widen significantly during price spike episodes. Across the case countries, the average intermediary margin (as a proportion of the retail-farmgate price difference) increased from 42% during normal periods to 61% during price spike episodes, consistent with the exercise of market power during supply scarcity.

4.3.4 Input Cost Dynamics

Analysis of input cost trends reveals strong co-movement between fertiliser and diesel prices and subsequent vegetable price volatility. Granger causality tests on quarterly data for India and Bangladesh find that fertiliser price increases Granger-cause vegetable price increases with a lag of one to two growing seasons, consistent with the time required for higher input costs to reduce planted area and subsequent supply. The 2021–22 fertiliser price spike (global urea prices increased by over 200% in 12 months) is associated with above-average vegetable price spikes in 2022–23 across all study countries.

4.3.5 Policy Failures and Regulatory Distortions

The analysis identified several policy-related amplifiers of vegetable price volatility. Export restrictions, imposed by India on onions in September 2019 and April 2022 in response to domestic price rises, were found to have contributed to price

instability through announcement effects and uncertainty, paradoxically increasing domestic hoarding anticipating further restrictions. Buffer stock programmes, while useful for storable commodities like onions and potatoes, have not been effectively extended to more perishable vegetables.

The case analysis also identified significant market information failures. In all five study countries, real-time price and arrival data at major wholesale markets were either unavailable or not accessible to farmers in forms they could use for planting and marketing decisions. This information asymmetry systematically disadvantaged farmers and enabled intermediary rent extraction.

4.4 Impacts of Vegetable Price Hikes

4.4.1 Consumer Welfare Impacts

Analysis of household expenditure survey data from India (NSSO), Kenya (KIHBS), and Bangladesh (HIES) during documented price spike periods confirms significant consumer welfare impacts. Low-income urban households in the bottom quintile of the income distribution experienced real income losses equivalent to 4–8% of monthly household income during acute price spike episodes lasting 4–8 weeks. Middle-income households experienced losses of 1.5–3% of monthly income.

Dietary diversity analysis using HDDS (Household Dietary Diversity Score) data from Kenya found that vegetable consumption frequency declined by 15–25% among low-income households during price spike periods, with households substituting toward cheaper but less nutritious staples. This finding has direct nutritional implications, particularly for vulnerable groups.

4.4.2 Farmer Income Effects

The farm-level impact analysis reveals the complex and often paradoxical relationship between price spikes and farmer welfare. Among a sample of 240 documented price spike episodes across the study countries for which both retail and farmgate price data were available, only 38% resulted in a sustained farmgate price increase of more than 20% above pre-spike levels. In 62% of cases, the farmgate price benefit was smaller, delayed, or absent entirely, with the gains captured primarily by intermediaries.

Furthermore, farmers who reduced plantings in response to previous price crashes-a common adaptive behaviour-were positioned to benefit least from subsequent spikes, as their production volumes were low precisely when prices were high. This procyclical response contributes to the boom-bust pattern of vegetable price cycles.

4.4.3 Macroeconomic Impacts

Econometric analysis of the relationship between vegetable price volatility and headline inflation confirms significant macroeconomic spillovers. A one standard deviation increase in vegetable price volatility is associated with a 0.8–1.2 percentage point increase in headline CPI inflation in the following month in the study countries, with effects persisting for 2–3 months. This inflationary effect is largest in India and Bangladesh, where vegetables carry higher CPI weights. The inflationary impact triggers monetary policy responses in some cases, with central bank analysis citing vegetable prices as a key upside inflation risk in multiple monetary policy committee minutes reviewed.

4.5 Assessment of Corrective Measures

4.5.1 Supply-Side Interventions

The evidence on supply-side interventions confirms their potential but highlights implementation challenges. Protected cultivation (greenhouse and shade net) programmes in India (under the National Horticulture Mission) have demonstrated yield increases of 30–50% and reduced weather-related crop losses, but adoption remains limited by high upfront capital costs. Subsidised protected cultivation infrastructure has reached only an estimated 2–3% of smallholder vegetable farmers, leaving the vast majority still exposed to full weather risk.

Crop diversification programmes, while theoretically sound as a risk management strategy, face adoption constraints rooted in market access (diversified portfolios require access to multiple buyer relationships and market intelligence), credit (diversification requires working capital to manage multiple crops), and knowledge (each crop has distinct agronomic requirements). Documented cases of successful diversification are largely concentrated among better-resourced farmers with land holdings above 2 hectares.

4.5.2 Cold Chain and Logistics Interventions

Cold chain investment programmes show the strongest and most consistent evidence of price-stabilising effects. The World Bank-funded cold chain development project in Odisha, India resulted in a

documented reduction in post-harvest losses for vegetables from 38% to 21% over a four-year implementation period, with corresponding improvements in farmgate price realisation of 15–22% and a reduction in seasonal price variation. Similar results have been documented from cold chain investments in Bangladesh (under the NATP project) and Kenya (supported by USAID cold chain programmes).

The critical success factors identified across these cases include: placement of cold storage facilities at the primary production zone level (not only at urban distribution centres); integration of cold storage with collection and sorting infrastructure; access by smallholder farmers (not only large commercial operators); and maintenance and operational support over the post-construction period.

4.5.3 Market Reform Interventions

India's e-NAM (electronic National Agriculture Market) platform, launched in 2016, provides the most extensively documented case of market reform intervention in the study countries. Analysis of price data for 585 mandis (wholesale markets) integrated into the platform by 2021 shows a statistically significant reduction in price dispersion across spatially linked markets (consistent with improved arbitrage), and an average reduction in intermediary margin of approximately 2–3 percentage points for participating commodities. However, the impact on price volatility for perishable vegetables specifically has been more limited, as the platform's matching and logistics coordination functions work best for storable commodities that can be transported to distant buyers.

4.5.4 Policy and Institutional Interventions

Assessment of policy interventions reveals a mixed picture. Buffer stock operations for onions and potatoes (conducted by NAFED in India and equivalent bodies in Bangladesh) have been effective in dampening acute price spikes when implemented with sufficient speed and scale. Analysis of 12 documented buffer stock intervention episodes in India found that they reduced the peak price increase by an average of 35–40% relative to counterfactual estimates, though timing delays (average of 4–6 weeks from price spike onset to market injection) limited their effectiveness.

Export restrictions have proven counterproductive in most documented cases, creating announcement effects and hoarding incentives that amplified the domestic price spike they were designed to ameliorate. A well-documented comparative case is provided by India's contrasting approaches in different onion price crisis episodes: the 2019–20 episode, characterised by a rapid and poorly signalled export ban, saw prices spike more severely and for longer than the better-managed 2010–11 episode, which combined a more transparently communicated export restriction with faster buffer stock deployment.

V. DISCUSSION, IMPLICATIONS AND LIMITATIONS

5.1 Discussion of Findings

The findings of this dissertation, taken together, paint a complex but coherent picture of vegetable price hike dynamics. They confirm and extend the existing literature in several important ways, while also revealing tensions and nuances that complicate simpler narratives.

The central finding-that sudden vegetable price hikes are the product of interacting supply chain vulnerabilities rather than single-cause shocks-is consistent with systems thinking approaches to supply chain resilience (Christopher and Peck, 2004) and with the growing literature on supply chain complexity (Bozarth et al., 2009). Weather events or other supply shocks are necessary but not sufficient causes of acute price spikes; what converts moderate supply disruptions into price crises is the amplification provided by cold chain gaps, information asymmetries, intermediary market power, and inadequate policy response mechanisms.

The finding that intermediary margins widen systematically during price spike episodes-capturing a disproportionate share of the price premium at the expense of both farmers and consumers-is consistent with theoretical models of market power exploitation under supply scarcity. This finding has direct implications for market reform priorities, suggesting that structural measures to reduce intermediary concentration and improve price transparency should be central to any strategy for price stabilisation.

The paradoxical finding that price spikes do not reliably benefit farmers-despite representing a significant deterioration in consumer welfare-is particularly important for policy. It suggests that framing vegetable price volatility as a simple conflict between farmer interests (who presumably benefit

from high prices) and consumer interests (who prefer low prices) is misleading. In reality, both groups can be harmed by price volatility, while intermediaries who can strategically position themselves in the information gap between supply and demand often capture the gains. This reframing has implications for building political coalitions in support of supply chain reform.

5.2 Theoretical Implications

At a theoretical level, this dissertation contributes to supply chain management theory by demonstrating the applicability of SCM frameworks-particularly concepts of supply chain resilience, visibility, and the bullwhip effect-to agricultural supply chains in developing country contexts. While these concepts have been developed primarily in the context of manufactured goods supply chains in advanced economies, the findings demonstrate their explanatory power for understanding food commodity price dynamics.

The dissertation also contributes to food systems theory by providing a more granular supply chain–level analysis than is typical in that literature. Food systems analyse often treat the 'supply chain' as a relatively undifferentiated middle element between production and consumption; this study demonstrates the importance of unpacking the internal structure and dynamics of the supply chain to understand price formation and volatility.

A theoretical contribution of particular significance is the conceptualisation of vegetable price spikes as the outcome of a multi-node, multi-mechanism supply chain failure rather than a simple demand-supply imbalance. This perspective-which we term the 'cascade amplification model' of price spikes-provides a framework for understanding how modest primary shocks are transformed into acute price crises through the sequential action of supply chain vulnerabilities at multiple nodes.

5.3 Practical Implications

5.3.1 Implications for Policymakers

For policymakers, the findings underscore the inadequacy of reactive, single-instrument approaches to vegetable price management. Export bans, import surges, and buffer stock operations-the traditional toolkit of emergency price management-can play a role in acute crisis management, but they do not address the structural supply chain vulnerabilities that generate recurrent price crises. A shift toward preventive, supply chain investment-led strategies is indicated.

The findings also highlight the importance of policy sequencing and complementarity. Cold chain investment is most effective when complemented by market reforms that ensure farmer access to the infrastructure and market information systems that enable transparency in price formation. Market reforms are most effective when farmers have sufficient collective bargaining capacity (through cooperatives or producer organisations) to exercise new rights and market access. These complementarities suggest the need for integrated, multi-component policy programmes rather than single-instrument interventions.

5.3.2 Implications for Agri-Business and Supply Chain Managers

For supply chain practitioners and agri-businesses, the findings point to several strategic priorities. Investments in supply chain visibility-including digital price and arrival data collection systems, farmer-facing information platforms, and predictive analytics for supply forecasting-can reduce information asymmetries that amplify price shocks. Vertical integration or collaborative long-term contracting arrangements with farmer producers can reduce spot market exposure and smooth supply fluctuations. Cold chain investment, even at relatively small scale at the primary collection level, can generate significant post-harvest loss reductions and supply smoothing benefits.

5.3.3 Implications for Development Organisations

For development organisations and NGOs working on food security and rural livelihoods, the findings suggest that supply chain development should be a central component of food system intervention strategies, not merely a downstream add-on. Specifically, building the capacity of farmer producer organisations to aggregate supply, negotiate market access, and manage collective cold chain assets can address multiple supply chain vulnerabilities simultaneously. Investment in last-mile rural road connectivity and community-level cold storage infrastructure addresses the infrastructure gap at the most critical-and most neglected-supply chain node.

5.4 Limitations

Several limitations of this study merit acknowledgement. The reliance on secondary data for the quantitative analysis means that the findings are subject to the quality limitations of the underlying data sources, which vary significantly across countries and time periods. In particular, farm-gate price data from the study countries are often collected less frequently and with less methodological rigour than retail consumer prices, limiting the precision of price transmission and margin analysis.

The comparative case analysis, while informative, is based on documented cases in the published literature, which may over-represent interventions that have been subject to rigorous evaluation and may under-represent failed interventions that were not systematically documented. This introduces a potential positive bias in the assessment of corrective measures.

The study is focused on developing and emerging economies and may not fully capture the dynamics of vegetable supply chains in advanced economies, where cold chain infrastructure is more developed, market institutions more transparent, and policy frameworks more sophisticated. The extent to which findings generalise across income levels should be treated with caution.

Finally, the supply chain perspective, while providing valuable analytical leverage, is necessarily selective and incomplete. Political economy dynamics, cultural practices around food consumption, gender dimensions of vegetable marketing, and community-level resilience mechanisms are all areas that a supply chain lens illuminates incompletely. These dimensions warrant further research using complementary theoretical frameworks.

VI. CONCLUSION AND RECOMMENDATIONS

6.1 Summary of Conclusions

This dissertation has investigated the causes, impacts, and corrective measures related to sudden vegetable price hikes from a supply chain perspective. The study has developed and applied a comprehensive analytical framework-the cascade amplification model-that conceptualises price hikes as the product of supply chain vulnerabilities interacting across multiple nodes to convert primary shocks into acute price crises.

The principal conclusions are as follows. First, sudden vegetable price hikes are systemic supply chain failures, not merely the inevitable outcome of weather shocks or demand fluctuations. The supply chain's capacity to buffer, absorb, and adapt to primary shocks is systematically undermined by cold chain gaps, logistics deficiencies, information asymmetries, intermediary market power, and policy failures. Addressing these structural vulnerabilities is the key to reducing the frequency and severity of price spikes.

Second, the impacts of price spikes are disproportionately borne by low-income consumers and smallholder farmers-the two groups least able to hedge against volatility-while intermediaries with superior market information and positioning often capture the windfall gains from scarcity premiums. This distributional dimension makes price volatility not merely an efficiency problem but an equity and food security problem.

Third, corrective measures show greatest effectiveness when they address structural supply chain vulnerabilities rather than managing symptoms through emergency interventions. Cold chain investment, market information systems, farmer collective action, and transparent market governance are the interventions with the strongest evidence base and greatest transformative potential.

Fourth, durable price stability requires a systems-level transformation of vegetable supply chains-moving from fragmented, opaque, and intermediary-dominated structures to integrated, transparent, and farmer-centric networks. This transformation is technically feasible and economically attractive, but requires sustained political will, coordinated investment, and attention to the institutional and capacity dimensions that often undermine technical solutions.

6.2 Recommendations

6.2.1 Recommendations for Policymakers

Based on the analysis, the following policy recommendations are advanced:

- Develop and implement national cold chain development strategies that prioritise rural production zone coverage, with special attention to primary collection and aggregation points where the most significant post-harvest losses occur. Public investment in cold chain infrastructure should be structured to ensure

smallholder access, potentially through cooperative ownership models.

- Establish real-time, publicly accessible vegetable market information systems providing price, arrival, and forecast data at all major wholesale markets, and develop farmer-facing mobile platforms to disseminate this information. The e-NAM model in India provides a useful template, with lessons to be learned from its implementation challenges.
- Reform agricultural market regulations to reduce entry barriers for buyers, eliminate artificial intermediary monopolies, and create a level playing field for farmer organisations seeking to market directly. This includes reviewing Agricultural Produce Market Committee (APMC) or equivalent regulations in countries where these create intermediary capture.
- Replace reactive export restriction policies with pre-established, rule-based, and transparently communicated trade management frameworks that provide market predictability while retaining the capacity for emergency intervention. Avoid export bans that trigger speculative hoarding.
- Invest in climate-resilient vegetable production infrastructure, including improved irrigation systems, protected cultivation incentives, and support for climate-adapted variety development and dissemination, to reduce the frequency and severity of weather-triggered supply shocks.
- Strengthen competition oversight in agricultural commodity markets, with particular attention to concentration in wholesale markets and among commission agents, and develop rapid-response investigative capacity for suspected market manipulation during price spike episodes.

6.2.2 Recommendations for Agri-Business and Supply Chain Actors

- Invest in digital supply chain visibility tools-including IoT-enabled tracking, predictive analytics, and mobile market platforms-to reduce information asymmetries and enable more responsive logistics management during supply disruptions.
- Develop collaborative supply chain relationships with farmer producer organisations based on transparent pricing, volume commitment, and shared investment in supply chain infrastructure, reducing dependence on spot market transactions that are most vulnerable to price volatility.
- Invest in decentralised cold chain assets at the primary aggregation level, either through direct investment or through long-term lease arrangements with farmer cooperatives, to reduce post-harvest losses and smooth supply delivery.
- Develop supply chain scenario planning and resilience assessment capabilities to identify and mitigate key vulnerabilities before disruptions occur, rather than managing price crises reactively.

6.2.3 Recommendations for Development Organisations

- Integrate supply chain development as a core component of food security and agricultural development programmes, with explicit attention to cold chain infrastructure, market information systems, and farmer collective action capacity.
- Invest in farmer producer organisation development, providing not only formation and governance support but also market linkage facilitation, access to finance, and cold chain asset management training.
- Support national and regional research and monitoring systems to build the evidence base on supply chain dynamics and intervention effectiveness, addressing the current data gaps that limit policy learning.
- Advocate for international cooperation on fertiliser market regulation and strategic reserve development to reduce the vulnerability of vegetable production systems to global input price shocks.

6.3 Directions for Future Research

This dissertation has illuminated several directions for future research that would advance both theoretical knowledge and practical application in this domain. Longitudinal studies of specific supply chain interventions-particularly cold chain investments and market information systems-with rigorous before-and-after and control group designs would strengthen the evidence base on intervention effectiveness. Distributional analysis examining how supply chain transformation affects the income and welfare of different supply chain actors-farmers of different scale, different categories of intermediary, urban and rural consumers-is needed to understand the equity

implications of alternative supply chain development pathways.

The application of complexity science methods, including agent-based modelling, to simulate price dynamics under different supply chain structures would allow ex-ante evaluation of structural interventions that cannot be easily tested through randomised experiments. Cross-country comparative analysis with larger samples and more systematic data collection would allow more rigorous identification of the supply chain characteristics that are most strongly associated with price stability.

Finally, the political economy of supply chain reform-understanding why beneficial reforms are resisted, what coalitions can drive reform, and how implementation challenges can be overcome-deserves much more research attention. The technical analysis of what should be done is considerably more developed than the political economy understanding of how to make it happen.

6.4 Concluding Remarks

Vegetable price spikes are among the most immediate and tangible manifestations of food system fragility for billions of people across developing and emerging economies. When tomatoes become unaffordable or onions disappear from markets, the human cost is direct: nutritional deprivation, household budget stress, and for farmers who have lost their crop, livelihood devastation. These are not abstract economic statistics; they are lived experiences that shape daily life for hundreds of millions of households.

The supply chain lens brought to bear in this dissertation offers a distinctive and actionable perspective on these challenges. It reveals that the gap between a well-functioning, price-stable vegetable supply chain and the fragile, volatile chains observed across so many developing country contexts is not primarily a matter of natural endowment, technology, or even finance-though all of these matter. It is fundamentally a matter of institutional architecture: how supply chains are organised, who has access to market information, how intermediary power is governed, and how collective investment in shared infrastructure is mobilised.

Getting these institutional questions right-designing supply chains that are transparent, competitive, inclusive of smallholder farmers, and capable of absorbing shocks without cascading price crises-is one of the most consequential challenges in food system development. This dissertation is offered as a contribution to the analytical foundations needed for that endeavour.

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