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Issues and Challenges in the Supply Chain of Fruits & Vegetables Sector in Chhattisgarh, India

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Abstract

The fruits and vegetables (F&V) sector is a rapidly growing and high-value segment of Chhattisgarh's agrarian economy. This paper examines the critical supply chain issues hindering this sector's development in the state. Using a descriptive research design, the study combines an extensive literature survey with a structured questionnaire of supply-chain stakeholders. The analysis reveals that Chhattisgarh's F&V supply chain suffers from multiple bottlenecks: inadequate **cold chain and storage facilities**, a **highly fragmented distribution network**, poor transportation and mandi (market) infrastructure, and weak linkages among farmers, traders, and markets. Other constraints include high packaging costs, outdated farming practices, lack of value-added processing, and limited market information flow. Survey findings support these observations: for example, 46.3% of respondents reported maintaining fixed inventory levels year-round (rather than adapting to seasons), and 45% identified consumer discarding of imperfect produce as the leading cause of supply-chain waste. The resulting inefficiencies cause severe post-harvest losses, low farmgate prices, and high prices for light of these findings, the paper recommends targeted interventions such as expanding cold-storage infrastructure, investing in rural roads and market yards, and fostering farmer cooperatives and private-sector cold-chain investment. Addressing these challenges could significantly reduce wastage, increase farmers' income, and support Chhattisgarh's agricultural growth.

Introduction

Fruits and vegetables (F&V) play an increasingly important role in India's agriculture, both as a driver of economic growth and as a source of rural employment. India is the world's second-largest producer of F&V, behind only China, with output rising from about 88.9 million tonnes of fruits and 162.9 million tonnes of vegetables in 2019 to higher levels in subsequent years. This reflects the country's diverse agro-climatic zones and shifting consumer preferences for fresh produce. In Chhattisgarh, a predominantly agrarian state, horticultural crops (especially citrus fruits, vegetables like tomatoes and gourds, and other high-value produce) have significant growth potential. According to local agriculture data, lemon (citrus) production in Chhattisgarh rose from about 73,710 tonnes in 2012 to 110,897 tonnes in 2017, illustrating this upward trend.

Despite this potential, producers in Chhattisgarh face persistent supply-chain hurdles. Fruits and vegetables are highly perishable, and their value depends on timeliness and quality of delivery. Any delay or mishandling after harvest leads to rapid deterioration. The existing supply chain in the state is long and fragmented, involving smallholder farmers, rural traders, commission agents at local markets (mandis), and finally urban wholesalers and retailers. Inadequate infrastructure at each stage tends to push up costs and waste. For example, farmers often lack

nearby cold storage or packhouses, while transport from villages to town markets relies on uncooled vehicles on rough roads. As one review notes, "the entire supply chain of F&V is laden with the issue of post-harvest losses and wastages" owing to a long, fragmented chain and poor infrastructure. In Chhattisgarh, these constraints translate into significant crop loss and low farm incomes, even as consumer demand for fresh produce grows.

This study investigates the specific challenges in Chhattisgarh's F&V supply chain. It aims to identify the key bottlenecks (from farm to retail) and to propose feasible mitigation strategies. The analysis draws on the undergraduate dissertation by Agrawal (2025), which combines literature review and a survey of state stakeholders. By focusing on the state's context, this paper provides detailed insights for local policymakers and industry actors, complementing broader national analyses.

Objectives and Scope

The research objectives are as follows:

- **To identify the factors affecting the supply chain of the Fruits & Vegetables sector in Chhattisgarh**.
- **To suggest mitigation strategies for the identified challenges in Chhattisgarh's F&V supply chain**.

The study is scoped to the Chhattisgarh state context. Its findings and discussions are intended to inform stakeholders within the state, including farmers, agribusinesses, transporters, and government agencies. The research synthesizes available literature and survey data to outline current issues in the F&V supply chain of Chhattisgarh, thereby aiding decision-makers in planning and implementing targeted improvements.

Literature Review

Existing literature on fruit and vegetable supply chains emphasizes pervasive inefficiencies that undermine profitability and efficiency. A global review finds that F&V supply chains face challenges at every link from production to retail, particularly in emerging economies like India. One key theme is **post-harvest loss**: studies consistently report that a large share of fresh produce is lost after harvest due to inadequate storage, poor handling and transportation, and the absence of processing facilities. For instance, Rutter *et al.* (2019) and Issa & Munishi (2021) note rampant losses during storage and transport when proper cold-storage is lacking. Poor road infrastructure and insufficient refrigerated vehicles further exacerbate spoilage during transit. Wakholi *et al.* (2015) and Verma *et al.* (2019) similarly highlight that inadequate loading/off-loading systems and limited cold-chain capacity in trucks are major loss factors.

Another widely cited issue is **supply chain fragmentation**. In India, F&V production is dominated by numerous smallholder farms with limited scale. Negi and Anand (2015) observe that long, fragmented marketing channels with many intermediaries disconnect farmers from end markets. At each stage – village markets, district mandis, and wholesale centers – multiple agents extract margins, leaving farmers with only a small fraction of the retail price. This inefficiency is compounded by an "inefficient mandi system" with poor market information, which hinders farmers' bargaining power. Poor inter-firm linkages and lack of coordination among cooperatives, processors, and retailers contribute to supply chain fragmentation.

Infrastructure constraints are repeatedly underscored. Inadequate cold storage facilities at farms and rural markets force traders to use traditional storage or sell immediately at low prices . High -value commodities like fruits require refrigeration soon after harvest, but the limited presence of cold-chain units in many states (including Chhattisgarh) leads to rapid spoilage and weight loss. Transportation infrastructure is also a concern: researchers

note that "poor and inadequate transport infrastructure such as roads and railways" increases losses during the distribution stage. The absence of specialized refrigerated vehicles for F&V is a common gap across developing regions. Kitinoja & AlHassan (2012) and Sharma & Singh (2011) document that lack of vehicles, long hauls, and multiple handling steps without cooling significantly shorten shelf life.

Cost and policy factors also play roles. The high cost of packaging materials and lack of modern packaging methods are frequently mentioned in reviews. In Chhattisgarh (and India generally), heavy taxes and fees at different stages inflate end prices for consumers, without proportionally benefiting farmers. Moreover, farmers often lack credit and insurance support, hindering their ability to invest in better inputs or cover risks. Quality and safety standards can be a double-edged sword: while important for consumer health, they may require infrastructure (like labs, cold chains) that is lacking locally, thus imposing additional burdens on small producers.

Negi & Anand (2015) summarize the above by noting that India's F&V sector is "very growing" and offers huge opportunities for rural development, but its full potential is stifled by these supply-chain challenges. Their review identifies four broad categories of bottlenecks: infrastructure deficits, limited processing/value-add facilities, financial/informational gaps, and policy inefficiencies. Major factors include lack of cold-storage and transport (infrastructure), low processing capacity and value addition, poor market information systems, and weak regulatory support. Overcoming such issues—by extending produce shelf life and reducing losses—is expected to increase farmer income and employment, benefiting the wider economy.

While most existing studies focus on national or international contexts, there is a recognized need to examine state-specific dynamics. This review underscores that Chhattisgarh's F&V chain likely suffers from the same general constraints identified above, but also that local factors (such as the state's road network, market structure, and government initiatives) warrant focused analysis.

Methodology

This study follows a **descriptive research design**, combining secondary and primary data. Secondary sources included government reports (e.g. NHB horticulture data) and previous literature on F&V supply chains. Primary data were gathered through a structured questionnaire survey of stakeholders in Chhattisgarh's F&V sector. A total of 75 respondents participated, including farmers, transporters, market intermediaries, wholesalers, and retailers. The questionnaire covered topics such as production practices, post-harvest handling, transportation, marketing channels, inventory management, and perceived challenges.

Data collection emphasized quantifiable as well as qualitative insights. The questionnaire was pre-tested and administered in both urban and rural markets of Chhattisgarh. Responses were recorded on items such as ease of finding buyers, frequency of post-harvest losses, availability of storage, and the measures used to maintain produce quality. Descriptive statistics (percentages, averages) were used to summarize the survey results. In addition, the study drew on interviews and observations to contextualize the quantitative findings. Given the descriptive nature of the study, no causal inferences were attempted; the focus was on identifying and characterizing the salient supply chain issues in the state.

Data Analysis and Discussion

The survey yielded a profile of respondents: the majority were adult males (about 24–32 years old) involved in various supply chain roles. This reflects the male-dominated nature of agribusiness in the region. Key findings from the questionnaire highlight common practices and perceptions:

- **Inventory management:** Nearly half of businesses (46.3%) reported maintaining fixed stock levels throughout the year, rather than adjusting for seasonal demand fluctuations. This suggests limited flexibility in scaling storage or transportation capacity to match harvest peaks.
- **Food safety compliance:** The most cited method of ensuring compliance was conducting regular inspections and audits (40% of respondents). This indicates an awareness of standards but also points to a reactive approach rather than proactive supply-chain management.
- **Risk mitigation:** A plurality (42%) of firms said diversifying suppliers – i.e. reducing dependence on any single source – was their primary strategy against risks like crop failures or weather disruptions. This underscores concerns about unreliable supply and climate variability.
- **Waste contributors:** By far the top factor blamed for supply chain waste was **consumer behaviour** : 45% of respondents said that lack of consumer interest in "imperfect" (cosmetically substandard or slightly overripe) produce leads to most of the waste. This reveals that, beyond logistical issues, market preferences themselves drive discard of edible F&V.

These survey results provide quantitative support for the general challenges identified in literature. In particular, they illustrate that chain actors tend to operate with conservative (often inflexible) stock policies and face demand-side waste that supply chain upgrades alone cannot solve.

More fundamentally, the study's qualitative analysis (and the secondary sources) paints a comprehensive picture of Chhattisgarh's supply chain bottlenecks by stage:

- **Production (farm) stage:** Farmers often lack adequate inputs and facilities. There is limited irrigation in many areas, and very few on-farm storage or cooling facilities. As a result, ripened produce spoils quickly after harvest. Seasonality is another challenge: certain F&V can only be grown in short windows, yet market demand persists year-round. Many farmers also have small landholdings, preventing economies of scale. These factors reduce yields per acre and make individual farmers vulnerable to losses (for example, a sudden rainstorm during harvest can wipe out a crop if the farmer has no insurance or storage). Lack of farmer awareness and training in modern techniques is also reported.
- **Post-harvest handling:** Once harvested, F&V must be transported quickly to markets. Here, poor logistics cause major losses. Transport infrastructure in Chhattisgarh is uneven: many farm-to-market roads are unpaved or in disrepair, delaying delivery. Refrigerated trucks are scarce. In the analysis, respondents noted that without chilling, produce continues to ripen and bruise en route. Furthermore, handling at collection points is often crude – fruits are thrown into jute sacks or open carts, causing damage and accelerating spoilage. There is virtually no systematic grading, cleaning, or packaging done at the village level; most sorting occurs later, after damage has happened.
- **Distribution and marketing:** At district mandis and wholesale markets, several institutional issues arise. First, there are many intermediaries: middlemen and commission agents dominate transactions, so farmers rarely interact directly with large buyers. Each intermediary takes a cut, meaning the price the farmer

receives is well below retail price. Second, market infrastructure is limited: most wholesale markets have few cold storage units, and sorting/packing sheds are often underfunded. Respondents commented that Chhattisgarh has only a handful of cold storages relative to production volumes, causing supply gluts or shortages in markets. The limited capacity means that when harvests peak, excess produce cannot be stored and is sold at fire-sale prices or discarded. Thus, **the supply chain is inefficient and fragmented**, as noted in the literature. Many areas lack direct access to urban markets, forcing double-handling: produce must first go to a distant mandi before potentially being re-sold and trucked to a city. Each stop increases handling costs and spoilage risk.

- **Retail level:** Retailers (local shops and street vendors) also contribute to waste. The study found that more than 60% of surveyed retailers lacked adequate storage or even simple facilities to display and protect produce. Vegetables are often piled on the ground or in open carts in hot sun. A rainy or hot spell can render a significant share unsellable within hours. In quantitative terms, one respondent estimated that up to 20% of vegetables could be lost between arriving at the shop and actual sale due to rot. This retail wastage inflates costs: to cover losses, retailers charge higher per-unit prices, which hits consumers. Indeed, the conclusion notes a classic squeeze: farmers earn too little while consumers pay too much.

Summarizing these issues, the dissertation identifies the following key challenges (each of which aligns with those found in national studies):

- **Cold chain deficiencies:** Almost no comprehensive cold-storage network exists from farm to market. Both short-term (field-level) and long-term (market-level) storage of perishables is severely lacking. Without chilling, the "shelf life" of produce is minimal.
- **Fragmented supply chain and poor integration:** The flow from farm to consumer is broken into many small links with weak coordination. There is no organized farmer cooperatives or centralized buying agency at scale in Chhattisgarh. Consequently, value addition (like sorting, packaging, processing) is minimal.
- **Infrastructure bottlenecks:** As noted above, poor roads, inadequate mandi infrastructure, and limited packhouses exacerbate every other problem. The high cost of packaging materials (e.g. crates, boxes) further discourages modern handling, as even those few who could afford to pack now face high input costs.
- **Information and institutional gaps:** Farmers have little access to up-to-date market information (prices, demand patterns). There are no robust systems to forecast consumer demand or plan production accordingly. Taxation and regulatory issues (mentioned briefly in the literature) also play a role, though the study did not quantify their impact.
- **Loss and inefficiency:** All of the above culminate in excessive **wastage of fresh produce** and inefficiency. The dissertation explicitly links these problems to major losses: "post-harvest losses and wastages" at every chain stage are "due to long and fragmented chain, dependency on intermediaries, poor road infrastructure, inefficient mandi system, inadequate cold chain, high cost of packaging, poor quality of distribution, [and] weak link in supply chain". These losses translate into very low price realization for farmers and higher retail prices.

The survey responses reflect these pain points indirectly. For example, the fact that **46.3% of respondents maintain a fixed inventory year-round** suggests they are not quickly moving produce based on market pulses (likely because they have no storage to wait out low-price periods). The finding that **45% blame consumer behaviour for waste** highlights that even after improving the chain, non-technical factors (like consumer preferences) will still limit efficiency. Overall, the data and literature mutually reinforce the view that Chhattisgarh's F&V supply chain is **"highly inefficient"** and in need of systemic improvement.

Conclusion

This study demonstrates that Chhattisgarh's fruits and vegetables sector is held back by a host of interrelated supply-chain challenges. The findings (from both literature and survey) consistently point to inadequate **cold storage and logistics**, a **fragmented marketing system** reliant on middlemen, and poor physical infrastructure (roads, market yards, handling facilities) as core issues. Together, these create heavy post-harvest losses: fruits and vegetables spoil or degrade before reaching consumers, which both depresses grower incomes and drives up retail prices. Other critical hurdles include limited processing and value-addition (so raw produce must be sold quickly) and weak farmer knowledge/coordination.

Negi & Anand's review of India's F&V chains underscores that the scenario in Chhattisgarh is not unique: it shares the same "long and fragmented chain" and **inefficient mandi system** seen nationally. Even in this context, Chhattisgarh can leverage its growing sector and natural advantages, but only by addressing these bottlenecks. The dissertation concludes (and we agree) that improving the state's chain is essential for rural development. As Agrawal (2025) puts it, Chhattisgarh's F&V sector "presents a huge opportunity for agribusiness and the development of rural areas through a well-established supply chain," provided that the key issues are tackled.

In summary, the evidence indicates that the supply chain in Chhattisgarh's F&V sector is **not** world-class: it suffers from chronic fragmentation, inadequate cold chain, and logistical gaps. These inefficiencies ultimately manifest in heavy wastage of food and poor economic returns for farmers. Given the state's reliance on agriculture, bridging these gaps is urgent for boosting incomes, reducing waste, and meeting growing consumer demand for fresh produce.

Recommendations

Based on the analysis above, the following strategic interventions are recommended to strengthen Chhattisgarh's F&V supply chain:

- **Expand cold chain and storage infrastructure:** The government (state and central) should allocate budgetary support to build rural cold storages, ripening chambers, and refrigerated transportation networks. Subsidies or public–private partnerships could encourage investors to set up such facilities near production clusters. Improved rural connectivity (especially roads) should accompany cold-chain expansion to ensure perishables can quickly reach storage.
- **Promote processing and value-addition units:** Establish food processing centers, packhouses, and grading/packaging units closer to farms. This would allow local value addition (e.g. making juices, sauces, or dried products from surplus) and reduce reliance on distant buyers. Encouraging farmer cooperatives or contract farming with processor firms can facilitate investment in such units.
- **Strengthen farm–market linkages:** Encourage aggregation and cooperative marketing so that farmers can bypass some intermediaries. For example, forming cooperatives or federations could help small growers collectively negotiate better terms and invest jointly in logistics. Improving market information systems (e.g. mobile price alerts) would also help farmers choose when and where to sell. Training programs should raise farmer awareness of modern farming and post-harvest techniques.

- **Engage private sector and technology:** Private players (wholesalers, retailers, cold-chain companies) should be incentivized to invest in collection centers and transport. As noted in the dissertation's solution outline, setting up collection centers near farms and investing in modern packaging/marketing are key steps. Adoption of technology (such as real-time temperature tracking, supply-chain management software, and e-commerce platforms that connect farmers directly to consumers) can improve efficiency. For instance, e-marketing portals or app-based aggregation services could reduce waste by matching surplus produce with buyers rapidly.
- **Policy and capacity building:** The state government should streamline regulations and offer training. For example, tax relief or easier permits for cold storage units can stimulate their growth. Regular training and extension services should teach farmers about post-harvest handling and quality standards. The government can also support pilot programs (e.g. in a particular crop or district) to test new supply-chain models.

These measures align with the study's broad recommendations and those of previous authors. Negi & Anand stress that improving shelf life and reducing losses are paramount, as they directly increase farmer income and employment. By prioritizing cold-chain development, better infrastructure, and stronger farmer linkages, Chhattisgarh can unlock the potential of its F&V sector and support rural livelihoods.

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