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Supply Chain Efficiency in Perishable Commodities: Issues, Innovations, and Way Forward

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Supply chain efficiency in perishable commodities refers to the ability of a supply chain to deliver fresh produce, dairy, meat, seafood, and other time-sensitive agricultural products from farm to consumer with minimal losses, optimal quality, and cost-effective logistics. Unlike non-perishable goods, perishable commodities are uniquely vulnerable to spoilage, temperature fluctuations, delayed transit, and inadequate storage—making supply chain management in this sector both critical and challenging.

In India, perishable commodities constitute a significant share of agricultural output. India is the world's second-largest producer of fruits and vegetables, and yet an estimated 15–40% of this produce is lost post-harvest due to inadequate cold chain infrastructure, fragmented supply chains, and poor market linkages. This translates to billions of rupees in annual losses and depresses farmer income while driving up consumer prices.

In recent years, policy discussions and private sector investments have increasingly focused on building resilient, technology-driven supply chains for perishables. This article examines the concept, current landscape, key challenges, policy interventions, and future directions for supply chain efficiency in perishable commodities in India.

Concept and Components of Perishable Supply Chains

A perishable commodity supply chain encompasses all activities from production at the farm level to consumption at the household or food service level. The key components include:

1. Post-Harvest Handling

Immediately after harvest, perishables require grading, sorting, cleaning, and packaging to preserve quality and reduce contamination. Poor post-harvest handling is one of the leading causes of losses in India's fresh produce sector.

2. Cold Chain Infrastructure

Cold chains maintain a temperature-controlled environment throughout transit and storage. This includes pre-cooling units at farm gates, refrigerated transport vehicles (reefer vans), cold storage warehouses, and retail cold display units. An unbroken cold chain is essential for extending shelf life and reducing spoilage.

3. Processing and Value Addition

On-farm or near-farm processing—such as minimal processing, canning, drying, and juice extraction—can significantly extend the shelf life of perishables, reduce waste, and create value-added products for both domestic and export markets.

4. Transportation and Logistics

Efficient, timely transportation is critical for perishables. Delays at any node—from farm to collection center, or from warehouse to retail—can render produce unmarketable. The modal mix (road, rail, air) and last-mile connectivity are key determinants of efficiency.

5. Market Linkages and Digital Platforms

Direct farmer-to-buyer platforms (e-NAM, FPO-based aggregation, supermarket procurement) eliminate unnecessary intermediaries, reduce transit time, ensure better prices for farmers, and improve freshness for consumers.

Current Landscape of Perishable Supply Chains in India

India's perishable supply chain has historically been characterized by fragmentation, multiple intermediaries, and inadequate infrastructure. However, rapid changes are underway driven by private investment and government initiatives.

Commodity	Annual Production (MT)	Estimated Post-Harvest Loss (%)	Key Supply Chain Gap
Fruits & Vegetables	~320 million	15–40%	Cold chain, last-mile logistics
Dairy (Milk)	~230 million	5–10%	Chilling infrastructure in remote areas
Fish & Seafood	~14 million	20–30%	Reefer transport, port-level cold chain
Meat & Poultry	~9 million	8–15%	Abattoir standards, cold transport
Flowers & Ornamentals	~2 million	25–35%	Air cargo cold chain, pack houses

Source: NHB Annual Report 2023-24; NABARD Cold Chain Report 2023; APEDA Export Statistics; MoFPI Annual Report 2024-25

Policy and Regulatory Framework

India's policy framework for perishable supply chain development has evolved significantly over the past decade, driven by the need to reduce post-harvest losses and integrate smallholder farmers into modern value chains.

Key Policy Milestones

2012 – National Mission on Food Processing (NMFP)

Provided capital subsidies for setting up cold storage, pack houses, and processing units, promoting value addition at the farm level.

2017 – Pradhan Mantri Kisan SAMPADA Yojana

Integrated scheme for agro-marine processing and development of Agro-Processing Clusters (APCs), Mega Food Parks, Cold Chain projects, and Backward and Forward Linkages under the Ministry of Food Processing Industries (MoFPI).

2020 – Agriculture Infrastructure Fund (AIF)

A Rs. 1 lakh crore financing facility for post-harvest management infrastructure, including cold storage, processing units, assaying labs, and e-trading portals at the Primary Agricultural Credit Society (PACS) and FPO level.

2022 – National Logistics Policy (NLP)

Aimed at reducing India's logistics cost from ~13% to below 8% of GDP, with specific provisions for perishable commodity corridors and multimodal integration.

State-Level Initiatives

States like Maharashtra (Mahaagri Logistics), Himachal Pradesh (Horticulture Mission), and Andhra Pradesh (Rythu Bazaars, direct procurement) have developed state-specific frameworks to strengthen perishable supply chains.

Government Budget Allocation for Supply Chain Development

The central government has progressively scaled up allocations for food processing, cold chain, and logistics infrastructure:

Financial Year	Food Processing (Rs. Crore)	Cold Chain/AIF (Rs. Crore)	Logistics & Transport (Rs. Crore)
2021-22	2,239	1,000	8,000
2022-23	2,473	2,000	10,457
2023-24	3,289	3,500	12,000
2024-25 (RE)	3,649	5,000	14,000
2025-26 (BE)	4,200 (est.)	6,500 (est.)	16,500 (est.)

Source: Union Budget Documents 2021-22 to 2025-26; MoFPI Annual Report; NHB & NABARD Annual Reports

Benefits of Efficient Perishable Supply Chains

For Farmers and Producers

- Higher farm-gate prices by reducing intermediaries and connecting directly with processors and retailers
- Reduced post-harvest losses translating directly into improved income
- Access to distant and export markets, unlocking premium pricing opportunities
- Stable income through contract farming arrangements and forward linkages

For Consumers

- Access to fresher, safer, and higher-quality produce at reasonable prices
- Reduced price volatility due to better storage and supply management
- Wider availability of seasonal produce year-round through cold chain storage

For the Agricultural Sector

- Reduction in the Rs. 92,651 crore estimated annual post-harvest losses (CIPHET, 2022)
- Growth in food processing sector contributing to Agri-GDP and rural employment
- Improved export competitiveness of Indian fresh and processed agricultural products
- Stronger integration of smallholder farmers into formal value chains

Challenges in Perishable Supply Chain Efficiency

- Fragmented cold chain infrastructure: India has ~8,000 cold storage units with ~37 million metric ton capacity—but over 70% is concentrated in potato storage in UP and West Bengal, leaving other perishables underserved.
- High logistics costs: India's logistics costs (~13% of GDP) are among the highest in the world, significantly impacting the viability of perishable supply chains.
- Poor last-mile connectivity: Rural road quality and lack of reefer vehicles at the farm level make it difficult to integrate remote farmers into cold chains.
- Small and fragmented landholdings: Average farm size of ~1.08 hectares limits the ability of individual farmers to meet consistent quality and quantity requirements of modern retail.
- Limited technology adoption: Low penetration of IoT-based temperature monitoring, blockchain traceability, and AI-driven demand forecasting in Indian perishable chains.
- Inadequate pack house and grading facilities: Most produce reaches mandis in bulk without being graded, sorted, or packed to standards required by modern retail or exports.
- Seasonal demand-supply mismatch: Excess supply during harvest season crashes prices; off-season scarcity drives prices up—indicating failure in storage and demand management.

Way Forward and Policy Recommendations

1. Scale-Up Cold Chain and Pack House Infrastructure

Under AIF and PM KUSUM schemes, targeted capital subsidies should be provided to FPOs, agri-startups, and cooperative societies for establishing farm-gate pre-cooling units, mobile reefer vans, and cluster-level pack houses. The goal should be to double India's cold chain capacity by 2030.

2. Technology Integration and Smart Supply Chains

Adoption of IoT-enabled temperature and humidity sensors in reefer vehicles and cold storages, blockchain-based traceability from farm to fork, and AI-driven demand forecasting tools can significantly reduce losses and improve efficiency. The government should co-fund technology pilots through ICAR and NHM.

3. Strengthening FPO-Led Value Chains

Farmer Producer Organizations (FPOs) should be positioned as anchors of perishable supply chains—aggregating produce, ensuring quality standards, managing primary processing, and negotiating directly with institutional buyers. The 10,000 FPO scheme should include mandated cold chain and processing components.

4. Multimodal Logistics Corridors for Perishables

Dedicated perishable freight corridors on rail (Kisan Rail expansion), cold-chain-enabled air cargo terminals, and coastal shipping routes should be developed to connect production clusters in Maharashtra, Karnataka, AP, and Himachal Pradesh with major consumption centers and ports.

5. Market Integration and Price Discovery

E-NAM should be expanded to include real-time quality grading and price discovery for perishables, with integration of local mandis and direct farmer-buyer platforms. Digital contracts and advance payment mechanisms can reduce uncertainty for farmers.

6. Export-Oriented Infrastructure

Integrated Pack Houses and Cold Chain Hubs at major agricultural export clusters (grapes in Nashik, mangoes in Ratnagiri, marine products in Visakhapatnam) should be upgraded to meet international phytosanitary and quality standards, enabling India to compete in global premium markets.

Conclusion

Supply chain efficiency in perishable commodities is not merely a logistical challenge—it is an economic imperative for India's agricultural transformation. Reducing the massive post-harvest losses in fruits, vegetables, dairy, fish, and other perishables can simultaneously improve farmer incomes, stabilize consumer prices, and strengthen India's position as a global agricultural exporter. The challenge lies in building an ecosystem where cold chain infrastructure, digital technology, market linkages, and policy support work in concert. With progressive government investment through AIF, PM KUSUM, and National Logistics Policy, and with growing private sector participation from organized retail, agri-tech startups, and food processing companies, India is at an inflection point in its perishable supply chain journey. The way forward demands coordinated action across farm, logistics, processing, and market segments—underpinned by farmer-centric policies, digital integration, and sustainable investment.

Key Takeaway

Enhancing supply chain efficiency in perishable commodities is not just an infrastructural reform—it is a strategic investment that can empower millions of farmers, eliminate wasteful losses, ensure food security, and drive inclusive, sustainable agricultural growth across rural India.

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