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Cold chain infrastructure for fruit and vegetable crops in India: Challenges and prospects

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Abstract
India ranks second among the world's largest fruit and vegetable producers. However, weak cold chains face major damage caused by the crop, which is a major challenge. Inadequacy in handling, storage and transportation contributes to both economic losses and the fall in farmer income, which is a serious threat to national food security. Cold chains encompass pre-cooling, packhouses, cold storage facilities, refrigerated transportation, and ripening chambers, all of which play a crucial role in reducing temperature and maintaining product quality. The importance of this infrastructure cannot be exaggerated for exposure to uninterrupted farm-to-connection. This review highlights the potential benefits of an effective cold chain that helps to reduce food wastage and increase farmers' price consciousness. Many challenges still exist, including limited access to small farmers, lack of awareness, and lack of energy. This review strongly advocates supporting an integrated cold chain network through collective cold chain systems, renewable energy integration and capacity building models, as these are the major requirements for the sustainable development of the Indian economy and the protection of its early destroyed food supply.

Keywords: India, fruit and vegetable production, cold chain

1. Introduction
Post-harvest losses have emerged as a critical global challenge in the twenty-first century. According to the Food and Agriculture Organization (FAO, 2019), nearly 14 percent of all food produced worldwide is lost between harvest and the retail stage. These losses occur primarily due to inefficiencies in handling, storage, and transportation, especially in developing countries where infrastructural and technological support is inadequate. At the same time, nearly 690 million people globally suffer from hunger and malnutrition, and more than 3 billion people cannot afford a healthy diet (WHO, 2023). This paradox, where food is lost in huge quantities while millions remain food-insecure, has amplified the urgency to address post-harvest challenges as a key dimension of food security and sustainable development.

In 2021–22, India's horticultural production reached 342.33 million tonnes, surpassing foodgrain output. This reflects a significant dietary transition in the country, with consumer preferences gradually shifting from cereals to more nutrition-rich foods. Within horticulture, fruits accounted for 107.24 million tonnes (31.1%) and vegetables for 204.84 million tonnes (59.8%) of total production, representing 11.4% and 11.8% of global output, respectively. India is the world's second-largest producer of fruits and vegetables and leads in crops such as mango, banana, guava, papaya, lemon, lime, and okra. However, its share in global horticultural exports remains limited, only 1.4% for vegetables and 0.8% for fruits.

Globally, the Food and Agriculture Organization estimates that out of 1,850 million tonnes of fruits and vegetables produced, about 44% in developing countries are lost along the supply chain between harvest and consumption. In India, a study by the ICAR–Central Institute of Post-Harvest Engineering & Technology (CIPHET) reported that post-harvest losses for fruits and vegetables range between 4.58% and 15.88% of total production (Likhi, 2025) [12]. The economic cost of these inefficiencies is staggering: annual post-harvest losses are valued at more than ₹1.5 trillion, representing about 3.7% of the agricultural sector's gross value added a significant drain on India's agricultural economy and undermining the livelihoods of millions of farmers (Lamba and Sharma, 2024) [11].

An integrated cold chain comprising pre-cooling units, packhouses, refrigerated transport, ripening chambers, and cold storage plays a pivotal role in reducing perishability, extending shelf life, and ensuring that fresh produce reaches distant markets without compromising quality (NCCD-NABCONS, 2015). Cloud computing streamlines the agricultural supply chain from farm to fork. By tracking inventory levels, identifying shortages, and automating reordering processes, it ensures efficient product flow. Real-time shipment monitoring and delivery tracking minimize delays and reduce post-harvest losses, thereby complementing cold chain management (Rangar *et al.,* 2024) [25]. By minimising losses, cold chains contribute not only to improved farmer welfare and higher price realisation but also to food security and stabilisation of consumer prices. Moreover, with the rising emphasis on doubling farmers 'income and sustainable agricultural development, cold chains are increasingly viewed as an indispensable component of India's agri-food system (NCCD, 2015).

2. Literature review

Negi and Anand (2015) [18] emphasize that India's agrarian economy relies heavily on efficient value chains, with cold chain infrastructure playing a vital role in reducing post-harvest losses in the fruits and vegetables (F&V) sector. They argue that improved cold chain systems can boost farmer incomes, create rural employment, and support India's emergence as a global food leader. However, their review reveals persistent gaps in grading, sorting, packing, storage, processing, and transportation facilities, making the cold chain the weakest link in India's agricultural logistics. The authors call for intelligent and integrated systems to overcome these challenges.

Rais and Sheoran (2015) [24] observe that although India is the world's largest producer of several fruits and vegetables, a considerable gap persists between per capita demand and supply due to significant post-harvest losses. These losses are largely attributed to inefficient storage and handling practices, such as improper bagging, inadequate temperature-controlled transportation, and the absence of robust cold chain facilities across many regions. The authors highlight that poor infrastructure, high wastage, quality deterioration, and elevated costs remain the key challenges in the current supply chain system. To address these inefficiencies, they emphasize the need to adopt global best practices in packaging, storage, transportation, handling, and value-added services. Furthermore, the study stresses the importance of collaboration between government and private stakeholders to strengthen infrastructure, enhance information sharing, and deliver services that improve both efficiency and quality in the fruits and vegetables supply chain.

Singh and Negi (2018) [28] emphasize the vital role of agriculture in India's economy, contributing 17.9% to GDP, with the fruits and vegetables sector being especially important. Yet, this sector faces major post-harvest losses due to weak cold chain logistics. Their study links these losses to issues such as inadequate infrastructure, uneven distribution of facilities, obsolete technology, poor transit visibility, and high investment and energy costs. Through situational, PESTEL, and SWOT analyses, the authors assess these challenges and propose a roadmap for stakeholders and policymakers to strengthen cold chain capacity. Addressing these gaps is crucial for improving the efficiency and sustainability of India's perishable food sector.

Negi and Anand (2021) [19] highlight that despite being the world's second-largest producer of fruits and vegetables, India is also among the largest food wasters. They argue that the problem lies not in production but in the inability to deliver quality food on time, largely due to inadequate cold storage and lack of temperature-controlled transport for both farmers and retailers. Their study outlines the extent of wastage across the supply chain, its impact on food security, and the pressing need for world-class cold chain infrastructure. The authors also identify key challenges facing the sector and propose a roadmap for improvements, stressing that strengthening cold chain systems from farm to retail is critical for India's agriculture-driven economy.

Bisht and Gupta (2022) [5] examine the complexities of India's fruits and vegetables (F&V) supply chain, noting that globalization and structural changes in the food economy have heightened its importance. Their study reviews existing literature to identify critical challenges affecting the sector's efficiency, including weak cold chain management, food quality issues, nutrition concerns, and policy gaps. Using an illustrative research approach, the authors analyze how these factors impact delivery performance and distribution in perishable supply chains. The paper not only highlights the major bottlenecks but also suggests possible strategies for improving the efficiency and competitiveness of India's F&V sector, both domestically and globally.

Aravindaraj *et al.* (2020) [3] highlight cold storage as an emerging yet underdeveloped sector in India, despite the country's high production of perishables. Citing a United Nations Development Program (UNDP) report, they note that nearly 40% of India's total production is lost in transit due to wastage or damage. The study observes that growing urbanization and the expansion of organized retail, food services, and processing industries are driving demand for cold storage infrastructure. At the same time, the Government of India has introduced several policy initiatives to attract investment and promote startups in this sector. The paper provides an overview of current storage capacity, industry trends, growth enablers, and challenges, to encourage greater investor participation to strengthen India's cold storage network.

3. Necessity and Benefits of Cold-Chain for Fruits and Vegetables

The need for an efficient cold-chain in India stems from the structural vulnerabilities of its agri-food system. Fruits and vegetables, which constitute nearly 33% of agricultural output, are highly perishable commodities that require specialized handling and storage. Unlike grains, which can be stored in ambient conditions for longer durations, horticultural crops deteriorate rapidly due to their high moisture content, sensitivity to temperature, and susceptibility to physical damage during handling and transport. As a result, nearly one-third of India's horticultural production is lost annually in the absence of proper cold-chain facilities (APEDA, 2022).

India's production trends underscore this necessity. Horticulture has been expanding at a faster rate than cereals since 2012–13, with production reaching over 300 million tonnes by 2017–18. However, the lack of parallel growth in post-harvest infrastructure has meant that farmers are unable to capture the full economic value of this production. For

small and marginal farmers, who make up more than 85% of India's farming population, this translates into a cycle of distress sales, low income realization, and continued vulnerability to market fluctuations (Tiwari *et al.,* 2022) [29]. Cold-chain systems offer a potential solution to these challenges. By creating an uninterrupted "farm-to-fork" logistics network, cold-chains allow perishable produce to be harvested, pre-cooled, sorted, graded, stored, and transported under controlled conditions until it reaches consumers. This not only reduces physical losses but also maintains the nutritional quality, safety, and marketability of fresh produce. In a country where nutritional security remains a concern-with 189 million undernourished people (14% of the population)-strengthening cold-chain systems can bridge the paradox of surplus production alongside widespread food insecurity (Kumari, 2024) [10].

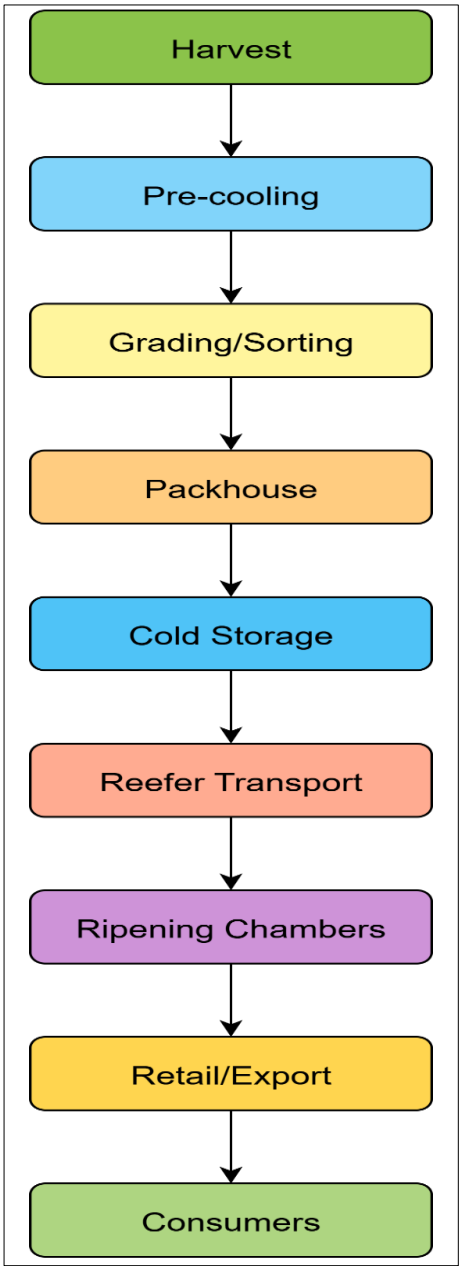

Fig 1: Farm-to-Fork cold chain flow diagram

3.1 Benefits of Cold-Chain

A. Reduction in Post-Harvest Losses

One of the most immediate and measurable benefits of cold-chain systems is the reduction of quantitative and qualitative post-harvest losses. Studies indicate that investments in pre-cooling and refrigerated transport can reduce food loss from 32 percent to 9 percent with the use of reefer trucks (Sodhi *et al.,* 2018) [28].

B. Improved Farmer Income and Price Realization

Cold-chain access allows farmers to delay sales, avoid distress selling, and target high-value markets. Evidence from Bihar's potato value chain shows that even smallholders benefited from access to cold storage, as they could store produce and sell later at better prices. Similarly, kinnow aggregators in Punjab reported higher margins when cold storage enabled them to sell off-season produce to distant markets (MOFPI, 2020). By integrating smallholders into modern supply chains, cold-chains can directly support the goal of doubling farmers 'income.

C. Market Expansion and Access to Distant Markets

Cold-chain systems extend the reach of perishable produce beyond local mandis, enabling access to urban and export markets. For example, farmer producer companies (FPCs) in Haryana have used cold-chain facilities to access premium markets in Delhi, Mumbai, and even international destinations. This geographic diversification reduces farmers 'dependence on local intermediaries and strengthens their bargaining position (Nuthalapati and Sharma, 2021) [20].

D. Food Security and Consumer Welfare

For consumers, cold-chains ensure year-round availability of fresh produce at stable prices. By smoothing seasonal fluctuations, cold storage facilities prevent gluts during peak harvest and scarcity during lean months, thereby curbing food inflation. At the national level, reducing losses enhances aggregate food availability, which is crucial in meeting the dietary needs of a growing population (PIB, 2025).

E. Quality, Safety, and Export Competitiveness: Cold-chain infrastructure also enhances compliance with food safety and quality standards, which is vital for accessing export markets. By maintaining controlled environments, cold storage and transport reduce microbial contamination, pesticide residue risks, and spoilage. For export-oriented crops such as grapes, mangoes, and pomegranates, cold-chain adoption improves India's competitiveness in international markets (Agnihotri, 2025) [1].

4. Status of Cold-Chain Infrastructure in India

A. Installed Capacity and Regional Diversity

India's cold storage capacity stands at approximately 37 million metric tons (MT), which is substantially lower than the annual production of perishable commodities, estimated at 104 million MT. This shortfall leads to considerable post-harvest losses, particularly in fruits and vegetables. The distribution of cold storage facilities is highly concentrated in a few states, with Uttar Pradesh, West Bengal, Gujarat, Punjab, and Andhra Pradesh/Telangana accounting for about 77% of the total capacity. This uneven distribution exacerbates regional disparities, limiting access to cold storage in other parts of the country (Shahi, 2024) [26].

B. Dominance of Potato Storage: Potatoes are the predominant commodity stored in cold storage facilities,

occupying approximately 65% of the total capacity. This focus on a single crop reflects the historical development of cold storage infrastructure, which was primarily designed to meet the needs of potato farmers. However, this specialization limits the versatility of cold storage facilities and their ability to accommodate a broader range of perishable products (Paul *et. al.,* 2018) [21].

C. Infrastructure Gaps

While cold storage facilities are essential, they represent only one component of a comprehensive cold chain system. Other critical elements, such as pack houses, ripening chambers, and refrigerated transportation (reefer trucks), are severely lacking. The National Centre for Cold Chain Development (NCCD) has highlighted that the gap in India's cold chain is not merely due to a lack of cold storage capacity but also due to deficiencies in these other components, which are necessary to implement farm-to-fork connectivity. These gaps result in inefficiencies and increased food wastage, as perishable goods deteriorate during handling and transit (BEE-WB Report, 2022).

5. Public-Private Initiatives in Cold-Chain Development

India's cold chain infrastructure plays a pivotal role in reducing post-harvest losses, enhancing food security, and improving farmers' incomes. Despite substantial government support and private sector innovation, the sector faces significant challenges in terms of capacity, efficiency, and regional distribution.

5.1 Government Initiatives and Subsidies

The Indian government has recognized the importance of cold chain infrastructure and has implemented several schemes to bolster its development:

A. Pradhan Mantri Kisan Sampada Yojana (PMKSY): Launched in 2016, PMKSY encompasses multiple components aimed at enhancing food processing and reducing wastage. One of its key components is the Integrated Cold Chain and Value Addition Infrastructure Scheme, which provides financial assistance for setting up cold storage and processing units (PIB, 2025).

B. Operation Greens: Introduced in 2018, this scheme focuses on the long-term intervention for the integrated development of the tomato, onion, and potato (TOP) value chain. It aims to stabilize prices and ensure remunerative prices to farmers through integrated production, processing, and logistics (MOFPI, 2024).

C. National Centre for Cold-chain Development (NCCD): Established to promote and develop integrated cold chains in India, NCCD recommends standards and protocols for cold-chain infrastructure, suggests guidelines for human resource development, and recommends appropriate policy frameworks for the development of cold chains (NCCD, 2023).

5.2 Private Sector Innovations and Startups

The private sector has introduced several innovative solutions to address the challenges in cold chain logistics:

A. Celcius: Celcius is a cold-chain marketplace, connecting small, medium, and large-scale cold storage facilities across the nation. By offering a digital platform, Celcius facilitates the seamless movement of perishable goods, ensuring efficient storage and transportation. This initiative addresses the fragmented cold-chain infrastructure in India, providing farmers with better access to storage options and reducing wastage (Dubey, 2021) [8].

B. Inficold

Inficold specializes in solar-powered cold storage solutions, catering to sectors like dairy, horticulture, poultry, and meat processing. Their technology is particularly beneficial in rural areas with unreliable electricity supply, offering an eco-friendly and cost-effective alternative to traditional cold storage methods (Himanshi, 2025) [9].

C. WayCool

WayCool, founded in 2015, is an Indian agritech startup focused on building a demand-driven food supply chain to reduce waste and improve farmer incomes. It sources from over 2 lakh farmers and supplies 1.69 lakh retailers daily across India and the Middle East. Using AI and ML, the company has created a "phy-gital" model that keeps food wastage below 2%. Financially strong, WayCool has raised USD 361 million in 27 rounds, reaching a valuation of USD 757 million (Bhati, 2024) [4].

D. Saptakrishi (Sabjikothi)

Saptakrishi, through its **Sabjikothi initiative**, aims to provide affordable cold storage solutions for farmers. This initiative targets smallholder farmers who often face significant losses due to the perishability of horticultural crops. By offering low-cost cold storage, Sabjikothi helps farmers preserve their produce for longer periods, allowing them to time the market and obtain better prices. The initiative also supports community-based storage models, where multiple farmers can share a facility, reduce individual investment costs while improving overall access to cold-chain services (Naushad and Prasad, 2023) [17].

6. Challenges in Sustainable Cold-Chain Development

A. Limited Access for Small and Marginal Farmers

Cold-chain facilities are disproportionately accessed by medium and large farmers or by commercial traders. Small and marginal farmers-who account for nearly 86% of India's farming households-are often excluded due to high costs, limited volumes, and lack of bargaining power. Since cold storage charges are levied per unit, farmers with small quantities of produce face disproportionately high per-unit costs. India's highly fragmented supply chain, dominated by middlemen, limits market access for small and marginal farmers and reduces their profits. This disintegration also leads to nearly 40% post-harvest losses in perishables, underscoring the need for efficient cold chain management (Dangwal *et al.,* 2024) [4].

B. Lack of Awareness, Skills, and Training

A major non-infrastructure challenge is the limited knowledge among farmers about the benefits of cold storage, optimal temperature regimes, and scientific post-harvest handling. Many farmers perceive cold storage as relevant only for potatoes or export commodities, while neglecting its role in preserving horticultural produce, dairy, or fisheries. Training and awareness programs through Krishi Vigyan Kendras (KVKs), Farmer Producer

Organisations (FPOs), and agricultural universities are often sporadic, resulting in limited adoption of best practices in storage and logistics.

C. Limited Use of Solar Compressor
Running compressors only when solar power is available limits their operation to about 4–6 hours a day, which in turn requires larger-capacity compressors and oversized refrigeration components such as the evaporator, condenser, and thermal storage.

D. Efficiency Issue in Micro Cold Stores
Small compressors, commonly used in micro cold stores, often operate with lower energy efficiency compared to larger compressors. This results in higher power consumption, reduced cooling performance, and increased operational costs, making small-scale cold storage less viable (Tiwari *et al.,* 2022) [29].

7. Solutions to Mitigate the Challenges
a) Promoting collective models like FPOs, cooperatives, and cluster-based storage can help small and marginal farmers pool produce and share costs. Additionally, subsidized tariffs and decentralized micro cold stores can improve affordability and accessibility.
b) Strengthening capacity-building programs through KVKs, FPOs, and agri-universities with regular, hands-on training can bridge farmers 'knowledge gaps. Awareness campaigns on the wider benefits of cold storage across horticulture, dairy, and fisheries will encourage broader adoption of scientific post-harvest practices.
c) Integrating with micro windmills could expand compressor operating hours to 8–12 h without battery backup and ensure grid-independent installation. Extended working hours with smaller compressors and components save initial cost and increase system performance.
d) It is necessary to locate and build a small compressor that is both efficient and capable of managing low global warming potential (GWP) refrigerants such as R-290, R-744, R-454B, R-600a, and R-32.

8. Conclusion
Post-harvest losses in India's fruits and vegetables sector remain a critical barrier to food security, farmer income, and supply chain efficiency. Weak cold chain infrastructure, limited access for small and marginal farmers, knowledge gaps, and low adoption of energy-efficient technologies exacerbate these losses. Collective models like FPOs, cluster-based storage, and decentralized micro cold stores can enhance accessibility and affordability. Capacity-building programs and awareness campaigns are vital for promoting scientific post-harvest practices. Integration of renewable energy sources, such as solar and micro windmills, along with efficient low-GWP compressors, can improve operational performance and sustainability. Strengthening cold chain systems end-to-end-from farm to retail-is essential for reducing wastage, ensuring quality, and supporting India's agrarian economy.

References

1. Agnihotri D. Ministry of Food Processing Industries: Transforming India's food processing landscape. IMPRI Impact and Policy Research Institute. 2025. Available from: https://www.impriindia.com/insights/ministry-food-processing-industries/
2. Agricultural and Processed Food Products Export Development Authority. Archive news (APEDA AgriExchange). [cited 2025 Aug 18]. Available from: https://agriexchange.apeda.gov.in/Market/MarketNews/ArchiveNews?page=562&utm_source
3. Aravindaraj K, Chinna AR, Paul J. A review: Present scenario of cold chain storage facilities in India. AIP Conf Proc. 2020;2207(1):020009. DOI: 10.1063/5.0000095.
4. Bhati R. Top agritech startups in India: Revolutionizing agriculture with innovation. IPO Central. 2024. Available from: https://ipocentral.in/top-agritech-startups-in-india/.
5. Bisht S, Gupta A. An insight into Indian fruits and vegetables SMEs supply chain: Indian agrarian sectors. ECS Trans. 2022;107(1):11169.
6. Bureau of Energy Efficiency, World Bank. Cold chain energy efficiency in India: Analysis of energy efficiency opportunities in packhouses (BEE-WB Report). New Delhi: Bureau of Energy Efficiency; 2022. Available from: https://beeindia.gov.in/sites/default/files/publications/files/BEE-WB%20India%20Cold%20Chain%20EE_02-03-22.pdf
7. Dangwal A, Chauhan A, Mishra P. Marketing: The biggest challenge in Indian agriculture. The AgBiz Today. 2024;1(1):14-6.
8. Dubey N. The only cold-chain marketplace startup in India—Celsius. BISinfotech. 2021. Available from: https://www.bisinfotech.com/the-only-cold-chain-marketplace-startup-in-india-celsius/
9. Himanshi. Rethinking cold storage: Inficold's role in supporting agriculture and healthcare. Story Network. 2025. Available from: https://storynetwork.in/rethinking-cold-storage-inficolds-role-in-supporting-agriculture-and-healthcare/
10. Kumari S. India's cold chain logistics: Ensuring freshness from farm to table. Food Infotech. 2024. Available from: https://www.foodinfotech.com/indias-cold-chain-logistics-ensuring-freshness-from-farm-to-table/
11. Lamba S, Sharma N. Choosing the right track to cut post-harvest losses. The Hindu. 2024.
12. Likhi A. Cold-chain infra key to minimising food loss. The Tribune. 2025. Available from: https://www.tribuneindia.com/news/comment/cold-chain-infra-key-to-minimising-food-loss-491798
13. Ministry of Food Processing Industries. Study on infrastructure gaps – Kinnow. Government of India; 2020. Available from: https://www.mofpi.gov.in/sites/default/files/study_on_infrastructure_gaps_-_kinnow_0.pdf
14. Ministry of Food Processing Industries. Operation Greens scheme. Government of India; 2024. Available from: https://www.mofpi.gov.in/en/Schemes/operation-greens-scheme?utm_source
15. National Centre for Cold-chain Development. All India Cold-chain infrastructure capacity (assessment of status & gap). Prepared by NABARD Consultancy Services. New Delhi: National Centre for Cold-chain Development; 2015. Available from:

https://nccd.gov.in/PDF/CCSG_Final%20Report_Web.pdf
16. National Centre for Cold-chain Development. National Centre for Cold-chain Development. Government of India; 2023. Available from: https://www.nccd.gov.in/
17. Naushad M, Prasad N. How Sabjikothi is helping farmers to save their money? Just Agric. 2023;3(10):250-3.
18. Negi S, Anand N. Cold chain: A weak link in the fruits and vegetables supply chain in India. IUP J Supply Chain Manag. 2015;12(1):48-62.
19. Negi S, Anand N. Wastage and Cold Chain Infrastructure Relationship in Indian Food Supply Chain. In: Research Anthology on Food Waste Reduction and Alternative Diets for Food and Nutrition Security. IGI Global; 2021. p. 1150-1165.
20. Nuthalapati CSR, Sharma R. Requirement and availability of cold-chain for fruits and vegetables in the country (Research Study Report). New Delhi: Institute of Economic Growth; 2021. Available from: https://desagri.gov.in/wp-content/uploads/2024/03/2021-22-Requirement-and-Availability-of-Cold-Chain-for-Fruits-and-Vegetables-in-the-Country.pdf
21. Paul V, Ezekiel R, Pandey R. Effective utilization of cold storage space: Demands for more multi-chamber cold stores and increased utilization of potatoes for processing. Indian Food Ind Mag. 2018;37(4):44.
22. Press Information Bureau. Boosting food processing & storage infrastructure in India. Ministry of Food Processing Industries; 2025. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2101244
23. Press Information Bureau. Support for farmers to reduce post-harvest losses and enhance cold chain infrastructure. Ministry of Food Processing Industries; 2025. Available from: https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2102853&utm_source
24. Rais M, Sheoran A. Scope of supply chain management in fruits and vegetables in India. J Food Process Technol. 2015;6(3):427.
25. Rangar S, Jadoun RS, Singh A. Cloud computing technology: A fertile ground for agripreneurship. Int J Arts Educ Res. 2024;13(4):46-55.
26. Shahi J. Cold storage and logistics: Key to India's growth. Global Launch Base. 2024. Available from: https://www.globallaunchbase.com/post/cold-storage-and-logistics-key-to-india-s-growth?utm_source
27. Singh BK, Negi S. Cold chain logistics: An impediment in the perishable food industry of India. Int J Logist Econ Globalisation. 2019;7(4):332-52.
28. Sodhi MM, Singh S, Agnihotri C. Cold chain development for fruits & vegetables in India (Working Paper No. 12749). eSocialSciences; 2018. Available from: https://ideas.repec.org/p/ess/wpaper/id12749.html
29. Tiwari AK, Harischander H, Rane MV. Cold storage in India for small farmers: Current status and challenges. Paper presented at the International Refrigeration and Air Conditioning Conference; West Lafayette, IN: Purdue University; 2022.
30. World Health Organization. 122 million more people pushed into hunger since 2019 due to multiple crises, reveals UN report. Geneva: WHO; 2023. Available from: https://www.who.int/news/item/12-07-2023-122-million-more-people-pushed-into-hunger-since-2019-due-to-multiple-crises--reveals-un-report.