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Enhancing Dairy Supply Chains: A Framework for Cold Chain Performance Evaluation

Julian Gnana Dhas Chandran [1], **Jaisankar Shanmugam** [2]

1. Corresponding author, Department of Management Science, Sri Krishna Arts and Science College, Coimbatore, India. E-mail: julianmba@gmail.com
2. School of Management, Sri Krishna College of Engineering and Technology, Coimbatore, India. E-mail: jaiseeni@rediffmail.com

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ABSTRACT

Objective: Rapid urbanization in India has significantly increased demand for delivering perishable items in fresh condition to urban consumers. This study aims to examine the Indian dairy cold chain by identifying critical operational and coordination challenges and to propose a performance measurement framework to improve its effectiveness and efficiency.

Methods: The study adopts a theory-driven approach by integrating Supply Chain Management (SCM) theory, the Resource-Based View (RBV), and the Theory of Constraints (TOC) to analyse inefficiencies within the dairy cold chain. A systematic literature review was conducted to identify key issues and performance dimensions, which was further validated and refined through expert opinions from industry practitioners.

Results: The analysis reveals significant integration gaps and vulnerabilities across the dairy cold chain. Bottlenecks at critical stages constrain overall system performance and contribute to quality deterioration and spoilage. Based on these findings, the study proposes a comprehensive performance measurement framework tailored to the Indian dairy cold chain context.

Conclusion: Strengthening the dairy cold chain is essential for maintaining quality assurance and supporting rural milk producers. The proposed framework provides actionable insights for policymakers and industry stakeholders to mitigate spoilage and improve supply chain resilience. Implementing these strategies will help bridge the gap between rural production and urban demand, ensuring the sustainable delivery of perishable goods.

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1. Introduction

Driven by changing customer preferences for healthy eating, supply chain companies delivering perishable products are compelled to enhance their cold chain operations to meet evolving customer expectations. Perishable products are delicate, and their value fluctuates considerably throughout the supply chain. Therefore, conventional supply chain strategies cannot be effectively applied to perishable item supply chains (Blackburn & Scudder, 2009). The dairy product supply chain serves as a prime example of a perishable supply chain (Karwasra et al., 2024). For perishable products such as fresh produce and dairy items, cold chain systems are essential to ensure safety and extend shelf life (Akram et al., 2023). Additionally, the high perishability of dairy products has resulted in significant food waste and necessitated specialized handling, shipping, and storage technologies (Bhardwaj et al., 2016). A cold chain refers to a system that maintains perishable goods at predetermined temperatures throughout the chain, starting from making and storage through transportation, sales, and distribution to final consumption—to preserve quality and prevent deterioration caused by temperature variations (Shen & Liao, 2022). Cold chains safeguard food items, pharmaceuticals, and chemical products from deterioration and uncontrolled exposure to environmental factors such as temperature fluctuations, moisture, illumination, or pollutants, ensuring products maintain their required state whether frozen, refrigerated, or fresh. (Bishara, 2006).

The Indian dairy industry has progressed tremendously, cementing its position as one of the world's largest milk-producing nations. India generated around 230.58 million tons of milk in the 2022-23 period. The Indian dairy business operates predominantly through cooperative societies, with milk collected from dairy farmers and processed at state-run milk unions (Kaushik et al., 2023). Although India leads the world in cattle population, a large number of dairy farms operate only on a small scale. Only 50% of milk produced is available for market distribution, while the remainder is consumed by the producers themselves. Furthermore, 61% of the distributed milk is handled by small-scale and unorganized operators (Nozaki, 2017).

Milk is highly perishable, and considering India's tropical climate, handling raw milk represents the most critical activity of the entire dairy chain. Studies highlight that raw milk produced in rural parts of India is poorly handled and lacks proper cold storage facilities. Only a small percentage of vendors (8.2%) store milk under prescribed chilled conditions (Sharma et al., 2022). Poor handling of raw milk at the village level, combined with inadequate or non-existent chilling facilities, compromises the quality and safety of processed milk and milk products. Therefore, establishing a proper cold chain from milk collection until it reaches processing facilities is essential to maintain both quality and safety (Leone et al., 2022). Furthermore, a recent study by the National Center for Cold Chain Development (NCCD) reported that cold chain integration does not exist due to significant gaps in the perishable products supply chain.

Against the backdrop of growing demand for dairy products and the entry of private players into the Indian dairy industry, intense competition has emerged to capture excess milk available from farmers. Additionally, competitors are focusing on utilizing surplus milk to deliver fresh dairy products to customers. Therefore, companies need to establish specialized cold chain supply systems while simultaneously enhancing overall supply chain performance. Accordingly, this study aims to examine the key challenges in managing dairy cold chains and propose a performance measurement framework tailored to the needs of the dairy industry. Such a framework will enable firms to assess their performance, enhance product quality, and sustain competitive advantage in a dynamic market environment.

To investigate these challenges, this research draws upon theoretical insights from Supply Chain Management (SCM) theory (Carter et al., 2015), the Resource-Based View (RBV) (Barney, 2001), and the Theory of Constraints (TOC) (Goldratt, E.M.; Cox, 1992). These theoretical perspectives provide a comprehensive foundation for understanding the structural, resource-based, and operational constraints within dairy cold chain systems. This study adopts a three-phase systematic literature review approach to understand the challenges facing cold chains for

perishable products, particularly dairy cold chains, and to identify performance measures for dairy cold chain operations (Agrawal et al., 2024).

2. Review Methodology

Systematic literature review is recognized by scholars as a scientific approach for conducting literature reviews (Xiao & Watson, 2019). Through structured literature review processes, researchers can identify trends in previous studies (Mohamed Shaffril et al., 2021) using transparent and replicable methodological steps (Higgins et al., 2011). This approach is widely acknowledged for review-based studies across various domains and disciplines (Paul & Criado, 2020).

This study employs the systematic literature review methodology proposed by Tranfield et al., (2003) and adopts the three-stage approach suggested by Agrawal et al., (2024), which consists of planning the review, conducting the review, and reporting the review. In the first stage, planning the review, clear research objectives and a structured protocol were established to guide the systematic literature review process. Furthermore, appropriate keywords, search criteria, and inclusion and exclusion parameters were determined to ensure a focused and unbiased literature search.

During the review conducting stage, the research focused on systematically executing the search and identifying relevant studies based on the established protocol. Keyword-based searches were performed in Scopus and ProQuest databases using refined keywords and Boolean operators ("and"/"or"). The search yielded a large number of documents, which were then filtered to narrow down to studies relevant to the supply chain domain and articles written in English, obtaining 172 articles. Finally, the researchers meticulously reviewed the abstracts and, where necessary, full texts to verify relevance and adherence to inclusion criteria. This process led to the selection of 46 relevant journal articles that formed the basis for subsequent analysis. The final stage involves synthesizing and presenting the findings of the review. This includes describing the characteristics of the included studies, analyzing content and themes, and consolidating insights into a structured report. The detailed analysis of literature review is presented in the next section.

3. Literature Review

The dairy supply chain literature review indicates that researchers have addressed various issues including supply chain efficiency, supply chain performance, business competitiveness, and product quality. Many authors have focused on reducing food waste to improve efficiency (Romadlon et al., 2025; Shamsuddoha & Nasir, 2025; Srivastava & Mangla, 2019). Furthermore, supply chain (SC) efficiency can be enhanced by optimizing milk procurement and distribution routes (Kumar et al., 2024) and implementing lean supply chain practices (Kumar & Shankar, 2024). Several other studies have examined dairy supply chain performance. Trust and commitment among supply chain members (Golghamat Raad & Akbarpour Shirazi, 2020), better coordination and improved buyer-seller relationships (Dries et al., 2014; Naghavi et al., 2020), and the capacity to cope with SC risks (Wang et al., 2025) are critical factors for achieving superior SC performance.

Achieving competitiveness in the dairy business is also extensively studied by researchers. Managing and addressing inherent industry challenges (Anggrahini et al., 2018; Beber et al., 2019; Goel & Bhaskarkan, 2010) and adopting effective supply chain practices (Monnagaaratwe & Motatsa, 2021) enable businesses to develop competitiveness and sustain performance in highly competitive markets. Researchers have also emphasized the quality of milk produced by farmers, as it is critical in improving overall SC performance (Anandan et al., 2025; Malik et al., 2024; Zuba-Ciszewska et al., 2019).

There is growing interest among researchers in adopting technology within dairy supply chains to reduce waste, improve traceability, enhance supply chain integration, and enable accurate demand forecasting. Technologies such as blockchain (Casino et al., 2020; Herbke et al., 2024; Nasiri-Galeh & Sahraei, 2024), Internet of Things (IoT)

(Anandan et al., 2025; Haji et al., 2020), automation (Kumar & Shankar, 2024), and artificial intelligence (AI) (Fatorachian & Pawar, 2025) are widely discussed in the literature. The literature review reveals a significant research gap in addressing the specific challenges of the dairy industry, particularly in developing countries, and in developing comprehensive frameworks for dairy cold chain management.

4. Challenges in Managing Dairy Cold Chains

The cold chain process represents a specialized logistics system that manages both transportation and storage of temperature-sensitive goods. The importance and necessity of cold chains in the agriculture sector, including fruits and vegetables, and the dairy industry cannot be overstated. The shortage of adequate cold chain infrastructure across the nation causes significant damage to perishable food items (Fatehpuria, 2013).

Bhardwaj & Palaparthy (2008) identified inadequate cold chain infrastructure as a primary challenge within perishable product supply chains, leading to multiple inefficiencies and substantial losses. Similarly, dairy product supply chains require temperature-controlled storage and transport to maintain freshness and quality from procurement to delivery. However, insufficient and poorly equipped cold storage systems (Rathore et al., 2010) remains a major obstacle to sectoral growth.

Cold chain logistics requires refrigerated shipping containers (reefers) equipped with stand-alone cooling systems to transport perishable products while preserving their value. Therefore, significant investment is required to operate effective cold chains. Moreover, maintaining reefers in operational condition is essential but incurs substantial costs (Joshi et al., 2009).

Joshi et al. (2009) identified the primary bottlenecks in cold chain operations as inadequate infrastructure, high installation and operational costs, lack of top management commitment, poor collaboration, limited awareness of information technology usage, insufficient professional skills, quality and safety issues, inadequate farmer education, excessive intermediaries, lack of standardization, regulatory constraints, poor infrastructure, and customer ignorance regarding quality standards. These factors significantly impact cold chain system performance.

Negi & Anand (2015) identified several additional bottlenecks in cold supply chains, including inadequate cold storage systems, insufficient capacity, poor cold chain management, inconsistent power supply, outdated cold chain technology, weak infrastructure, insufficient storage networks, and inadequate transportation facilities.

Specific challenges cited in the NCCD report include lack of technology availability, acute energy dependency, insufficient reefer transport, higher financing costs, procedural impediments, and inadequate monitoring and traceability systems. This extensive literature review enabled the identification of key challenges in perishable cold chain management. Table 1 presents the challenges discussed in the literature.

In this study, the cold chain challenges identified through the literature review were discussed with dairy industry experts, and their opinions were collected through personal interviews. The experts indicated that dairy cold chains face numerous challenges, including unavailability of skilled labor, difficulty in retaining skilled personnel, high operating costs, ensuring unbroken and effective cold chain distribution from source to customer, lack of standard operating procedures (SOPs) for storage and transport, measuring cold chain effectiveness, rising input costs, non-availability of chillers at the farm level, and insufficient collaboration between dairy companies and farmers.

Farmers supplying milk to dairy companies lack loyalty due to inadequate collaboration between farmers and dairy companies. The non-availability of chillers at milk collection points forces farmers to mix unsold milk from previous days with fresh milk, which has been observed during internal quality checks at manufacturing facilities. There is a surge in milk rejection levels during summer seasons, as milk spoils more rapidly in higher temperatures. Due to the absence of proper chilling facilities, farmers resort to crude preservation methods, such as placing milk containers in cold water to preserve excess milk. Another major challenge farmers face is increasing input costs, as

the costs of farming essentials such as feed, electricity, and labor continue to rise. Experts emphasized that unless these challenges are addressed, milk supply will be adversely affected.

At the distribution level, overnight dairy consignments are transported through insulated containers rather than refrigerated vehicles (reefers). Since these containers are opened at each delivery point, maintaining required temperatures becomes highly challenging, thereby increasing the risk of dairy product spoilage.

The challenges of dairy cold chains, as identified from both literature review and expert opinions, have been categorized into six areas: sourcing, manufacturing, distribution, infrastructure, human resources, and government policies. These challenges are presented in Figure 1.

Table 1. Challenges of Perishable Cold Chain

Joshi et al. (2009)	**Negi & Anand (2015)**	**NCCD (2012)**
• Lack of awareness about the use of IT • Improper collaboration • Incompetent professional skills • High cost • Lack of quality and safety • Inadequate education of farmers • Too many intermediaries • Lack of standardization • Government regulation • Improper tracing • Poor infrastructure • Lack of top level commitment • Customer ignorance toward quality	• Poor transport facilities • Lack of Cold storage facilities • Inadequate capacity • Improper cold chain management • Irregular power supply • Poor Cold Chain Technology • Poor infrastructure • Poor Cold storage network	• Lack of technology availability • Acute energy dependency • Lack of reefer transport • Higher financing cost • Procedural impediments • Monitoring and traceability

The dairy cold chain encounters numerous persistent challenges that compromise its efficiency and reliability. From a supply chain management perspective, factors such as product perishability, seasonal variations, and coordination failures among multiple stakeholders disrupt the seamless flow of products from farm to consumer (Carter et al., 2015). The Resource-Based View (RBV) indicates that many firms lack access to critical resources including refrigerated transport, skilled personnel, and temperature-monitoring technologies that are essential for maintaining product quality and operational effectiveness (Barney, 2001). The Theory of Constraints further demonstrates that performance across the entire cold chain is often constrained by specific bottlenecks, such as delays in first-mile logistics, inadequate storage capacity, and unreliable infrastructure (Goldratt, E.M.; Cox, 1992). Addressing these interconnected challenges is essential for ensuring timely delivery of fresh dairy products and enhancing overall supply chain performance and competitiveness.

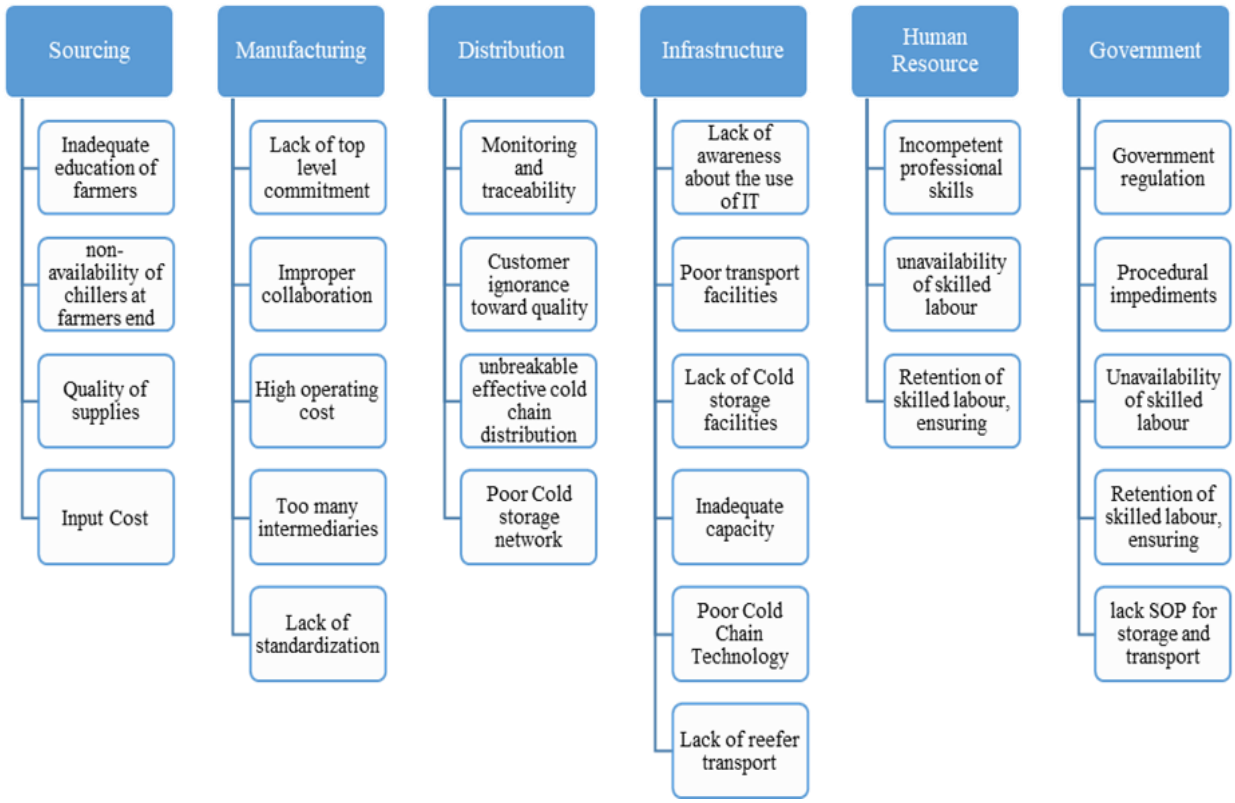

Figure 1. Challenges of Dairy Supply Chain

5. Performance Measures of Dairy Cold Chain

The competitive nature of the business environment compels supply chains to enhance the efficiency and effectiveness of their operations. This can be achieved by developing appropriate performance metrics and assessing SC performance to ensure the sustenance and sustainable development of the business.

Research in this area indicates that researchers have given significant emphasis to SC performance measurement. Sahay et al., (2003) argue that gauging SC performance of SC partners across the chain is vital for recognizing fundamental supply chain problems and ensuring customer satisfaction in today's highly competitive, rapidly changing marketplace. Effective performance measures enhance SC performance and enable its members to reap the benefits of superior operations.

The general supply chain comprises multiple interconnected stages, where the effectiveness of each stage impacts the others. Hence, developing a comprehensive performance measurement system (PMS) is essential for accurate supply chain performance evaluation (Prakash & Pant, 2014). SC performance reflects how well the supply chain meets end-consumer demands by ensuring product availability and timely supply at the least cost (Coluccia et al., 2021).

The SC performance is influenced by multiple factors, including SC management and planning decisions, along with SC design-related decisions (Pero et al., 2010). Estampe et al. (2013) suggest that SC performance can be

evaluated through customer satisfaction and cost, with the primary objective being to achieve highly engaged customers who collaborate in value creation with other stakeholders while minimizing overall chain ownership costs.

In this study, we critically examined the literature related to supply chain performance measures. The various frameworks developed by researchers to measure the performance of conventional supply chains, perishable supply chains, and cold chains have been reviewed and presented in this section. With input from the literature and dairy industry experts, we propose a framework to measure the dairy cold chain.

5.1 Performance Measures of Supply Chain

Many researchers have attempted to develop a comprehensive framework to measure supply chain performance. Common methods that have been widely used by researchers for assessing SC performance comprise task-related Key Performance Indicators (KPIs), Balanced Scorecards (BSC), and the Supply Chain Operations Reference (SCOR) framework.

Chae (2009) elucidates the significance of describing the roles and responsibilities of members in an organization to ensure that KPIs work in practice. KPIs offer overall visibility into the supply chain and help assess the accuracy of supply and demand planning (e.g., forecast accuracy) and execution performance (e.g., actual sales versus forecasted plan). KPIs reveal the gap between planning and execution and provide opportunities to identify and correct potential problems.

Gunasekaran et al. (2001) discussed three levels at which supply chain management (SCM) can be measured: strategic, tactical, and operational. Further, Gunasekaran et al. (2004) presented a framework for performance measures and metrics, considering four major supply chain activities/processes: planning, sourcing, manufacturing/assembly, and delivery. These metrics were classified at the strategic, tactical, and operational levels to clarify the appropriate management authority and responsibility for performance.

5.2 Performance Measures of Dairy Supply Chain

A review of the literature reveals that not much attention has been given to developing measures to gauge the performance of the dairy supply chain. Kumar & Ashutosh Mohan (2014) developed a theoretical framework that demonstrates how dairy supply chain management practices and marketing orientation serve as predictor variables, while organizational performance and customer satisfaction function as outcome variables. This model proposes organizational performance as a dependent variable of dairy supply chain management practices, and the parameters measuring organizational performance include marketing performance, operational performance, and flexibility. However, this model does not measure the performance of the entire dairy supply chain.

Another method found in the literature for measuring supply chain performance is the Balanced Scorecard (BSC). The Balanced Scorecard (BSC) approach was developed as a tool for aligning business activities with the vision and strategy of the organization, improving internal and external communications, and monitoring an organization's performance against strategic goals (Kaplan & Norton, 2009). It includes four performance indicators: customer perspective, internal business processes, learning and growth, and financials (Kaplan & Norton, 2009). The study carried out by Prakash & Pant (2014) demonstrates how the Balanced Scorecard (BSC) may be used to measure the performance of the dairy supply chain.

5.3 Performance Measures of Dairy Cold Chain

Needless to say, the cold chain has become an integral part of the dairy supply chain due to the perishable characteristics of dairy products. Temperature is a major contributing factor that affects the shelf life of dairy products (Sharma & Pai, 2015). The entire dairy cold chain demands temperature regulation to prevent the growth of microorganisms that spoil dairy products. The dairy cold chain consists of a series of facilities that maintain appropriate storage conditions from the point of origin to the point of consumption. The dairy cold chain can be

categorized into refrigerated storage and refrigerated transport (FSSAI Manual, 2017). It is no surprise that the dairy cold chain requires high investment and incurs high operating costs.

The ultimate aim of a dairy company is to deliver perishable dairy products in a timely manner while maintaining product quality and enhancing shelf life. At the same time, dairy companies must achieve cold chain effectiveness and efficiency to sustain their business operations. Therefore, dairy companies must consistently monitor performance across the cold chain to ensure its overall efficiency and effectiveness. As a result, there is a need to develop an integrated performance measurement system to gauge dairy cold chain performance.

Despite its significance, performance measures for the dairy cold chain have garnered little attention from researchers. Joshi et al. (2012) proposed a detailed framework for systematically analyzing cold chain performance. Sharma & Pai (2015) modeled the factors influencing cold food chain operations. Manikas & Terry (2010) focused on two main aspects of distribution center operational performance: labor performance and space utilization. The various performance measures highlighted by these researchers are summarized in Table 2.

Table 2. Performance Measures of Dairy Cold Chain

Joshi et al., 2012	Sanjay Sharma et al., (2014)	Ioannis Manikas et al., (2009)
• Cost • Service Level • Quality& Safety • Relationship • Innovativeness • Traceability • Return on Assets	• Food safety • Temperature monitoring systems • Traceability • Infrastructure • Electronics and information technology • Standardization • Ability of handlers • Quality of communication • Transaction costs Government policies	• Labour performance • Space utilization

6. A framework for Performance Measurement in Dairy Cold Chain

In this section, we present a proposed framework for performance measurement in the dairy cold chain (Table 3). Measuring the performance of the cold chain at different stages of the supply chain enables the company to visualize its performance and initiate appropriate action to achieve efficiency and effectiveness in cold chain operations.

Though many studies have examined and presented performance measures for the supply chain, only a few have focused on the performance measures of the dairy supply chain. The existing literature on dairy supply chain performance measurement has not incorporated the cold chain perspective in its modeling. Additionally, studies focusing on cold chain performance measurement have not classified their metrics based on the different stages of the supply chain.

Therefore, we have developed a framework for measuring dairy cold chain performance, categorizing the metrics according to the stages of the cold chain: sourcing, procurement, processing, distribution, and retail. The metrics used in the framework were adopted from existing literature, and expert opinions were gathered to classify and refine them for the dairy cold chain.

Table 3. Proposed framework for performance measurement in dairy cold chain

Sourcing	Procurement (chiller)	Processing Plant	Distribution	Retail
• Supplier cost saving activities • Supplier delivery performance • Quality of milk supplied • Supplier loyalty	• Quality check and traceability of incoming milk • Capacity utilization • Transportation cost • HR productivity • Labour Performance	• Accuracy of forecasting • Product quality • Process quality • Implementation of HACCP & Other quality control measures • Percent of defects • Capacity utilization • Lead time • Fill rate • Order capturing / tracking • Product variety & range • Manufacturing cost • Use of new technology • Use of IT & ERP system • Innovation • Relationship • Traceability • Supply chain collaboration • HR Productivity • Training & HRD • Transparency in Supply Chain • CSR	• Supplier delivery performance • Effectiveness of enterprise distribution planning • No. of faultless delivery notes • Percent of urgent notes invoiced • Delivery reliability performance • Delivery flexibility • Networking of local distribution channels • Cost effective cold chain maintenance • Transportation cost • Distribution cost • Inventory holding cost • HR productivity • Performance of skilled labor	• Level of customer perceived value • Customer query time • Quality of delivered goods • On-time delivery • Customer complaints • Customer satisfaction • Order lead time

7. Conclusion

This paper examines the Indian dairy industry and contrasts traditional supply chains with cold chain systems, highlighting the critical importance of cold chain management for ensuring product quality and supply reliability. The intense competition in the Indian dairy sector, combined with structural and operational challenges, threatens market survival for many players. Supply Chain Management theory demonstrates how coordination inefficiencies, product perishability, and fragmented networks create barriers to effective dairy cold chain operations. The Resource-Based View reveals that many dairy firms lack access to essential resources including advanced infrastructure, skilled personnel, and monitoring technologies that are vital for sustained competitive advantage. The Theory of Constraints identifies specific bottlenecks in logistics, storage, and distribution that constrain overall system performance. The study identifies six key challenge areas: sourcing, manufacturing, distribution, infrastructure, human resources, and government intervention. This classification provides a foundation for policymakers and industry stakeholders to develop targeted improvement strategies. The performance measurement framework, based on the Balanced Scorecard approach, offers dairy companies a structured method to assess and enhance cold chain performance across multiple dimensions. Implementation of such a framework can improve operational effectiveness, reduce losses, maintain product freshness, and build more resilient and competitive dairy supply chains

References

Agrawal, N., Modgil, S., & Gupta, S. (2024). ESG and supply chain finance to manage risk among value chains. *Journal of Cleaner Production, 471*, 143373. https://doi.org/10.1016/j.jclepro.2024.143373

Akram, H. W., Akhtar, S., Ahmad, A., Anwar, I., & Sulaiman, M. A. B. A. (2023). Developing a Conceptual Framework Model for Effective Perishable Food Cold-Supply-Chain Management Based on Structured Literature Review. *Sustainability, 15*(6), 4907. https://doi.org/10.3390/su15064907

Anandan, K., Subbaraj, P. K., Jeyakumar, V., Thella, S. R., & Selvaraj, P. (2025). Milk Pit: IoT-Integrated Milk Analyzer with Cloud-Connected Mobile Application. *3rd International Conference on Intelligent Data Communication Technologies and Internet of Things*, 680–686. https://doi.org/10.1109/idciot64235.2025.10914881

Anggrahini, D., Baihaqi, I., & Anggani, P. C. (2018). Supplier selection framework for dairy industry in Indonesia. *In Proceedings of the International Conference on Industrial Engineering and Operations Management* (pp. 2917–2926)

Barney, J. B. (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management, 27*(6), 643–650. https://doi.org/10.1177/014920630102700602

Beber, C. L., Carpio, A. F. R., Almadani, M. I., & Ludwig, T. (2019). Dairy supply chain in Southern Brazil: barriers to competitiveness. *International Food and Agribusiness Management Review, 22*(5), 651–674. https://doi.org/10.22434/ifamr2018.0091

Bhardwaj, A., Mor, R. S., Singh, S., & Dev, M. (2016). An investigation into the dynamics of supply chain practices in dairy industry: A pilot study. *Proceedings of the International Conference on Industrial Engineering and Operations Management.*

Bhardwaj, S., & Palaparthy, I. (2008). Factors influencing Indian supply chains of fruits and vegetables: a literature review. *The ICFAI University Journal of Supply Chain Management*, 59–68.

Bishara, R. H. (2006). Cold chain management–an essential component of the global pharmaceutical supply chain. *American Pharmaceutical Review, 1*(9), 105–109

Blackburn, J., & Scudder, G. (2009). Supply Chain Strategies for Perishable Products: The Case of Fresh Produce. *Production and Operations Management, 18*(2), 129–137. https://doi.org/10.1111/j.1937-5956.2009.01016.x

Carter, C. R., Rogers, D. S., & Choi, T. Y. (2015). Toward the theory of the supply chain. *Journal of Supply Chain Management, 51*(2), 89–97. https://doi.org/10.1111/jscm.12073

Casino, F., Kanakaris, V., Dasaklis, T. K., Moschuris, S., Stachtiaris, S., Pagoni, M., & Rachaniotis, N. P. (2020). Blockchain-based food supply chain traceability: A case study in the dairy sector. *International Journal of Production Research*, 1–13. https://doi.org/10.1080/00207543.2020.1789238

Chae, B. (2009). Developing key performance indicators for supply chain: An industry perspective. *Supply Chain Managemen*t, *14*(6), 422–428. https://doi.org/10.1108/13598540910995192

Coluccia, B., Agnusdei, G. P., Miglietta, P. P., & De Leo, F. (2021). Effects of COVID-19 on the Italian agri-food supply and value chains. *Food Control, 123*. https://doi.org/10.1016/j.foodcont.2020.107839

Dries, L., Gorton, M., Urutyan, V., & White, J. (2014). Supply chain relationships, supplier support programmes and stimulating investment: Evidence from the Armenian dairy sector. *Supply Chain Management*, *19*(1), 98–107. https://doi.org/10.1108/scm-12-2012-0380

Estampe, D., Lamouri, S., Paris, J. L., & Brahim-Djelloul, S. (2013). A framework for analysing supply chain performance evaluation models. *International Journal of Production Economics*, *142*(2), 247–258. https://doi.org/10.1016/j.ijpe.2010.11.024

Fatehpuria, S. (2013). Indian cold supply chain: A case study. *ASM's International E-Journal of Ongoing Research in Management and IT*, 1–10.

Fatorachian, H., & Pawar, K. (2025). Sustainable Cold Chain Management: An Evaluation of Predictive Waste Management Models. *Applied Sciences (Switzerland)*, *15*(2). https://doi.org/10.3390/app15020770

Goel, V., & Bhaskarkan, S. (2010). Supply Chain Management in a Private Farming Vis-à-Vis Cooperative Processing and Distribution Environment of Dairy Sector in India. *Journal of Food Products Marketing*, *16*(2), 212–231. https://doi.org/10.1080/10454440903413308

Goldratt, E. M.; Cox, J. (1992). *The goal: A process of ongoing improvement*. North River Press.

Golghamat Raad, N., & Akbarpour Shirazi, M. (2020). A hybrid framework for ranking the knowledge management solutions adoption in supply chains. *VINE Journal of Information and Knowledge Management Systems*, *50*(1), 1–19. https://doi.org/10.1108/vjikms-06-2019-0090

Gunasekaran, A., Patel, C., & McGaughey, R. E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*(3), 333–347. https://doi.org/10.1016/j.ijpe.2003.08.003

Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations and Production Management*, *21*(1–2), 71–87. https://doi.org/10.1108/01443570110358468

Haji, M., Kerbache, L., Muhammad, M., & Al-Ansari, T. (2020). Roles of Technology in Improving Perishable Food Supply Chains. Logistics, *4*(4), 33. https://doi.org/10.3390/logistics4040033

Herbke, P., Lamichhane, S., Barman, K., Pandey, S. R., Küpper, A., Abraham, A., & Sabadello, M. (2024). DIDChain: Advancing Supply Chain Data Management with Decentralized Identifiers and Blockchain. *IEEE International Conference on Service-Oriented System Engineering (SOSE)*, 54-63. https://doi.org/10.1109/sose62363.2024.00013

Higgins, J. P. T., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savović, J., Schulz, K. F., Weeks, L., & Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *bmj*, 343. https://doi.org/10.1136/bmj.d5928

Joshi, R., Banwet, D. K., & Shankar, R. (2009). Indian cold chain: Modeling the inhibitors. *British Food Journal*, *111*(11), 1260–1283. https://doi.org/10.1108/00070700911001077

Joshi, R., Banwet, D. K., Shankar, R., & Gandhi, J. (2012). Performance improvement of cold chain in an emerging economy. *Production Planning & Control*, *23*(10/11), 817–836. http://10.0.4.56/09537287.2011.642187

Kaplan, R. S., & Norton, D. P. (2009). Putting the balanced scorecard to work. *In The Economic Impact of Knowledge*, *71*(5), 315–324. https://doi.org/10.1016/b978-0-7506-7009-8.50023-9

Karwasra, K., Soni, G., Mangla, S. K., & Kazancoglu, Y. (2024). Assessing dairy supply chain vulnerability during the Covid-19 pandemic. *International Journal of Logistics Research and Applications, 27*(11), 2378-2396. https://doi.org/10.1080/13675567.2021.1910221

Kaushik, H., Rajwanshi, R., & Bhadauria, A. (2023). Modeling the challenges of technology adoption in dairy farming. *Journal of Science and Technology Policy Management,* 15(6), 1455–1480. https://doi.org/10.1108/jstpm-09-2022-0163

Kumar, I., Ahmed, Z., & Kant, P. (2024). Cost optimization in the urban distribution of dairy supply–A case of Sanchi, Bhopal, India. *Urban, Planning and Transport Research, 12*(1). https://doi.org/10.1080/21650020.2024.2331197

Kumar, R., & Ashutosh Mohan. (2014). Antecedent of dairy supply chain management practices: a conceptual framework. *Journal of Supply Chain Management Systems, 3*(1), 48.

Kumar, U., & Shankar, R. (2024). Smart dairy: Unleashing emerging ICT-enabled lean dairy supply chains through data-driven decision-making. *International Journal of Information Management Data Insights, 4*(2), 100297. https://doi.org/10.1016/j.jjimei.2024.100297

Leone, C., Thippareddi, H., Ndiaye, C., Niang, I., Diallo, Y., & Singh, M. (2022). Safety and quality of milk and milk products in Senegal—A review. *Foods, 11*(21), 3479. https://doi.org/10.3390/foods11213479

Malik, M., Gahlawat, V. K., Mor, R. S., & Hosseinian-Far, A. (2024). Towards white revolution 2.0: challenges and opportunities for the industry 4.0 technologies in Indian dairy industry. *Operations Management Research, 17*(3), 811–832. https://doi.org/10.1007/S12063-024-00482-4

Manikas, I., & Terry, L. A. (2010). A case study assessment of the operational performance of a multiple fresh produce distribution centre in the UK. *British Food Journal, 112*(6), 653–667. https://doi.org/10.1108/00070701011052736

Mohamed Shaffril, H. A., Samsuddin, S. F., & Abu Samah, A. (2021). The ABC of systematic literature review: the basic methodological guidance for beginners. *Quality and Quantity, 55*(4), 1319–1346. https://doi.org/10.1007/s11135-020-01059-6/metrics

Monnagaaratwe, K. F., & Motatsa, K. W. (2021). Enhancing business competitiveness of medium-sized food produce retailers through supply chain management. *Journal of Transport and Supply Chain Management, 15*(0), 10. https://doi.org/10.4102/jtscm.v15i0.639

Naghavi, S., Karbasi, A., & Daneshvar Kakhki, M. (2020). Agent Based Modelling of Milk and its Productions Supply Chain and Bullwhip Effect Phenomena (Case Study: Kerman). *International Journal of Supply and Operations Management*, *7*(3), 279–294.

Nasiri-Galeh, M., & Sahraei, S. (2024). Impact of Blockchain Implementation on Enhancing Customer Satisfaction in Organizational Supply Chains: Dairy Product Manufacturers Case Study. *Journal of Optimization and Supply Chain Management*, *1*(2), 98–109. https://doi.org/10.22034/ISS.2024.7919.1011

Negi, S., & Anand, N. (2015). Cold Chain: A Weak Link in the Fruits and Vegetables Supply Chain in India. *IUP Journal of Supply Chain Management*, *12*(1), 48–62.

Nozaki, Y. (2017). Future trends of growing demand for milk and dairy products and milk supply in India. *Mitsui and Co Global Strategic Studies Institute Monthly Report. Mitsui & Co Global Strategic Studies Institute*.

Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? *International Business Review, 29*(4), 101717. https://doi.org/10.1016/j.ibusrev.2020.101717

Pero, M., Rossi, T., Noé, C., & Sianesi, A. (2010). An exploratory study of the relation between supply chain topological features and supply chain performance. *International Journal of Production Economics*, *123*(2), 266–278. https://doi.org/10.1016/j.ijpe.2009.08.030

Prakash, G., & Pant, R. R. (2014). Performance measurement of a dairy supply chain: A balance scorecard perspective. *IEEE International Conference on Industrial Engineering and Engineering Management*, 196–200. https://doi.org/10.1109/ieem.2013.6962402

Rathore, J., Anamika Sharma, & Karunesh Saxena. (2010). Cold Chain Infrastructure for Frozen Food: A Weak Link in Indian Retail Sector. *IUP Journal of Supply Chain Management*, *7*.

Romadlon, F., Wan Ahmad, W. N. K., & Shamsuddin, A. (2025). Systematic review on mitigation of food loss and waste in the milk supply chain. *E3S Web of Conferences*, *603*, 04006. https://doi.org/10.1051/e3sconf/202560304006

Sahay, B. S., Cavale, V., & Mohan, R. (2003). The "Indian" supply chain architecture. *Supply Chain Management: An International Journal*, *8*(2), 93–106. https://doi.org/10.1108/13598540310468698

Shamsuddoha, M., & Nasir, T. (2025). Smart Practices in Modern Dairy Farming in Bangladesh: Integrating Technological Transformations for Sustainable Responsibility. *Administrative Sciences* 2025, *15*(2), 38. https://doi.org/10.3390/admsci15020038

Sharma, G., Mutua, F., Deka, R. P., Shome, R., Bandyopadhyay, S., Shome, B. R., Kumar, N. G., Grace, D., Dey, T. K., & Lindahl, J. (2022). Comparing the Effectiveness of Different Approaches to Raise Awareness About Antimicrobial Resistance in Farmers and Veterinarians of India. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.837594

Sharma, S., & Pai, S. S. (2015). Analysis of operating effectiveness of a cold chain model using Bayesian networks. *Business Process Management Journal*, *21*(4), 722–742. https://doi.org/10.1108/BPMJ-10-2014-0105

Shen, Y., & Liao, K. (2022). An Application of Analytic Hierarchy Process and Entropy Weight Method in Food Cold Chain Risk Evaluation Model. *Frontiers in Psychology*, *13*, 825696. https://doi.org/10.3389/fpsyg.2022.825696/bibtex

Srivastava, R., & Mangla, A. (2019). Sukhpal Dairy Farm: considering customer engagement-based growth options. *Emerald Emerging Markets Case Studies*, *9*(1), 1–23. https://doi.org/10.1108/eemcs-09-2018-0207

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, *14*(3), 207–222. https://doi.org/10.1111/1467-8551.00375

Wang, M., Islam, S., & Yang, W. (2025). Supply chain risks in the dairy industry. *Benchmarking*. https://doi.org/10.1108/bij-12-2023-0874

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, *39*(1), 93–112. https://doi.org/10.1177/0739456X17723971

Zuba-Ciszewska, M., Kowalska, A., Manning, L., & Brodziak, A. (2019). Organic milk supply in Poland: market and policy developments. *British Food Journal*, *121*(12), 3396–3412. https://doi.org/10.1108/bfj-11-2018-0750