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Understanding the Benchmarking and Decision Making Approach in Cold Chain Supply Management in Current Scenario

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***Abstract*—**A cold chain protects food, pharmaceutical, and chemical goods against deterioration due to inappropriate temperature, humidity, light, or pollutants. Here we analyze the existing scenario's benchmarking and decision-making methodologies for improved future cold chain logistics and supply chain management.
Keywords: pharma, benchmarking, cold chain supply

I. INTRODUCTION

In cold chain logistics, temperature-sensitive items and products are transported safely throughout the supply chain. It significantly depends on science to analyze and adapt the temperature-perishability relationship. Any perishable commodity would certainly need cold chain management. Meat, fish, fruit, medical supplies, and medications are examples.

While transportation is a relatively new notion, temperature-sensitive items have been transported since the late 1700s, when the British employed ice to keep seafood fresh. In the late 1800s, it carried perishables. Due to a European meat scarcity, South America sent frozen meat to France and Australia, while New Zealand sent it to the UK. Cold chain technology has always been and will always be vital to global commerce.

Cold chain logistics is complex. Among the elements are:

• Cold storage - Places to keep items waiting to be sent.

• Cooling systems - Systems that bring and maintain food temperature throughout processing, storage, and transportation.

• Cold shipping - Maintains product temperature and humidity.

• Cold processing - Sanitary cold processing facilities.

• Cold distribution - involves distributing items in cartons or crates.

A. Cold Chain Systems

Cold chain transportation uses numerous strategies to keep cargo cold. The length of the journey, the size of the cargo, andThe season affect the method.The season all influences the technique used.In India, government agencies establish policies, build infrastructure, and set rules. Agencies like MoFPI, NHB, and APEDA help build infrastructure.The National Centre for Cold Chain Development (NCCD) is an independent body within the Department of Agriculture, Cooperation, and Farmer Welfare

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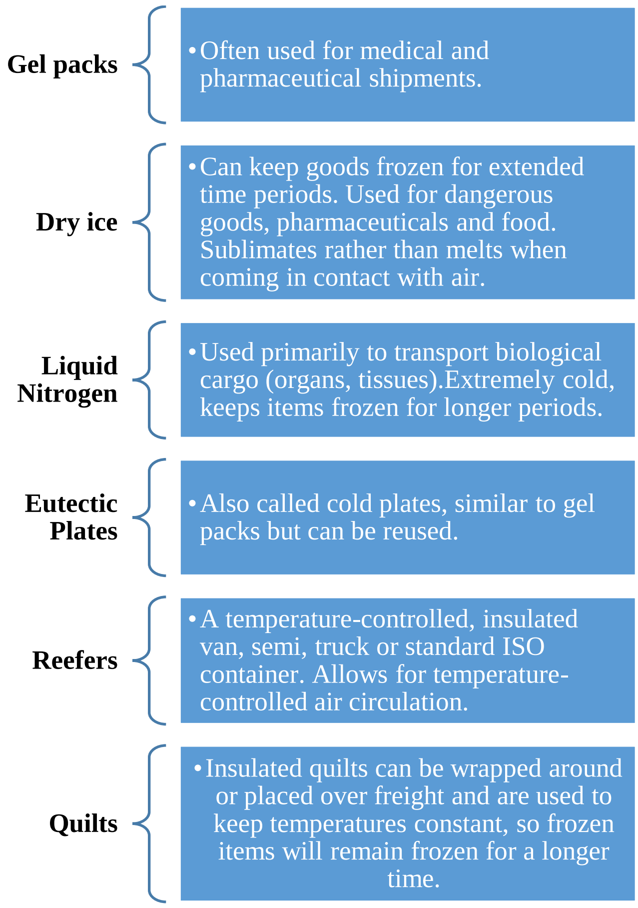

B. Common Cold Store Issues

It promotes research, develops technological standards and procedures, and builds human resources for the country's cold chain infrastructure. Like in the USA Federal agencies including US Customs, IATA, TSA, FDA, DOT, and others have established norms and criteria for cold chain logistics. These rules are set up to guarantee product safety. Each has

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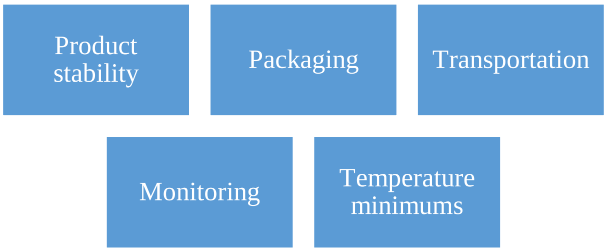
its own minimums for temperature, time, and packing. Aside from these government sector restrictions, shipping businesses establish their own high-quality requirements.Among the regulations are:



A. Common Cold Chain Issues

Issues with cold supply chain management might hinder freight shipments. Drivers are usually quite aware of these possible concerns and will do their utmost to avoid them.

• Product quality concerns - Food and product quality difficulties are common. It is necessary to clean and sort before packing and loading.

The packing must be suitable to avoid contamination and shipping damage. Air flow is another concern.

Documentation — The cold supply chain management process must be fully documented. Especially during travel, data loggers that record storage temperatures and conditions might assist avoid spoilage.

• Delays in shipment/transport — Delays are a problem for any shipper, but they may be disastrous when dealing with cold chain logistics.

Changes in temperature may be a major issue in cold chain logistics. Incorrect pre-cooling, harsh weather, or other factors like malfunctioning cooling systems or transporters might cause it.

II. BOOK REVIEW

A. Cold Chain (CCS) Benchmarking

First, Scholars both at home and abroad have made progress in the subject of cold chain logistics. On the basis of the then-current global government subsidy systems, Huang et al. [1] develop a three-stage Stackelberg game model comprising government, retailers, and agricultural firms. They suggest a government subsidy system to maximise societal welfare and investigate how it affects the interests of all supply chain actors. A freshness loss compensation plan for agricultural products is used to an elastic quantity contract to form a relationship contract. Xiong et al. [2] analyse the influence of cold chain facility subsidy mode on the stability of relationship contract in different organisational modes. Li et al. [3] create a government-supervised evolutionary game model of logistics resource input. With continually changing input and output of logistical resources, several evolutionary stabilising solutions may be produced. Suppliers and manufacturers will be less enthusiastic about investing in cold chain logistics if free-riders gain considerably from other participants' resource contribution. Cold chain logistics investment becomes the evolutionary stability technique of suppliers and manufacturers when government penalty or subsidy reaches the threshold level. Mancur [4] proposes a penalty and subsidy system for cold chain players that free-ride. As a result, Zhu and Dou [5] developed a three-stage game model for green supply chain management. It offers a reference for government and final manufacturer decision-making in green supply chain management by simulating three parameters: subsidy coefficient per unit product, greenness degree of final manufacturer's items, and final manufacturer's pricing. This research refers to the pharmaceutical industry's customers and analyses the influence of cold chain logistics on the present pharmaceutical supply chain's consumers. This study benchmarks the appropriate and crucial route of cold chain logistics and supply chain as a key aspect of the preference and freshness of pharmaceutical product.

B. Decisions

The cold chain protects food, pharmaceutical, and chemical goods. It helps avoid product deterioration due to incorrect temperature and humidity exposure. Protects them from light or pollutants to keep them frozen (Bishara, 2006) [6]. The cold chain must be maintained from the point of production or processing to the point of consumption, including loading, unloading, handling, and storage (Salin and Nayga Jr., 2003) [7]. The quality of food and pharmaceutical goods handled in a cold chain is largely dependent on temperature and other environmental factors. Food insecurity harms people's health and costs farmers and businesses money (Marucheck et al. 2011) [8]. Lack of traceability, transit delays and breakdowns, temperature abuse, cross-contamination in transport and storage are just a few of the dangers that food dealers face (Srivastava et al. 2015) [9]. Furthermore, around 20-30% of perishable items are wasted throughout the supply chain (SC) (Virtanen et al.,2014, Mena et al. 2014) [10,11] ignoring home trash, which accounts for 19% of all food bought (Mena et al. 2014) [11]. Awareness and accessibility of product (environment) data from all stages of the cold chain has therefore been stressed to assure food safety and quality (Kim et al., 2016) [12]. This data capturing allows for real-time monitoring and traceability of food goods (Ringsberg, 2014; Kelepouris et al., 2007) [13, 14] and helps control risk (Kim et al., 2016). Digital data collecting technologies like RFID and WSN have the potential to enhance product traceability (Ringsberg, 2014, Raab et al., 2011) [13],[15] the cold chain and efficiently manage risk (Marucheck et al., 2011) [16]. Combined with optimization models, data gathering and monitoring may help design optimum transit (Wang et al. 2010)[17] or storage plans (Raab et al., 2011) to decrease risk This kind of data analytics is gaining popularity in cold chain logistics due to its ability to enhance flexibility, control demand volatility, and reduce costs while allowing businesses to make better choices (Wang et al. 2010; Shi et al., 2010; Wang et al., 2012; Nakandala et al., 2016) [17],[18],[19],[20]. For example, Lineage Logistics utilises sensor data to modify refrigeration systems, reduce temperature fluctuation, assure product integrity, optimise transport lanes, and monitor products for recalls. This also helps Lineage Logistics save electricity (Whelan, 2015) [21]. However, cold chain data has been underused, since it has been used to assess individual shipments' integrity (Joshi et al. 2012) [22]. Based on conversations with top managers responsible for logistics, food safety, quality, and system development and design, Food temperature is often monitored but not transferred in transportation, say White and Cheong (2012). Moreover, such details are only utilised at the destination to approve or deny freight (White and Cheong, 2012) [23]. Monitoring and control collaboration among supply chain stakeholders is generally lacking, and temperature data are seldom transmitted within cold chains. Raab et al. A lack of knowledge about the features of various systems and the optimum solution for their company's needs is cited as a reason for lack of complete implementation providing temperature control across the whole cold chain in meat supply chains by Raab et al. (2011)[15]. A previous practitioner study found similar problems about providing traceability throughout the cold chain. To follow suppliers' traceability information from the distribution centre to the store or suppliers' direct-store-delivery (DSD), for example, the retailer's distribution and store systems were not ready (Maras, 2016). While electronic traceability usage is expanding, there are still problems with data homogeneity and standards throughout the supply chain, and data transmission across supply chain participants. For example, overcoming historical traditions and learning automated collecting processes (Maras 2016) [24]. There is a lack of literature on specialised technologies like RFID (Askin et al., 2010; Ruiz-Garcia et al., 2011; Butcher and Grant, 2012) Regarding food goods or cold chain members, such as temperature monitoring in meat supply networks (Raab et al, 2011) Temperature warnings in cod supply networks (Hafliason et al., 2012)[28], and fresh fruit supply chain design for quality and cost. (Blackburn et al., 2009) For distribution of frozen fruits (Giannakourou and Taoukis, 2003) [30], and for production scheduling and distribution of dairy goods (Bilgen et al., 2013) [31]. While Akkerman et al. (2010) [32] focus on food distribution quality, safety, and sustainability, Zhang and Wilhelm (2011)[33] focus on the speciality crop business. Shukla and Jharkharia (2013) [34] evaluate the supply chain for fresh fruits, flowers, and vegetables. A complete examination of data collection, digitization and analytics for improved decision making in different points of the cold chain for various product categories is lacking. This review is essential to guide future study in this emerging yet under-researched topic with strong management consequences. To address this need, we evaluated research articles to see how cold chain data may be utilised for management and decision-making. Sub-questions help us answer the aforementioned research question. What data has to be gathered throughout the cold chain network, and what technologies and methods can be employed to collect and communicate that data? Finally, we suggest further study to show how such data-driven decision-making might assist enhance cold chain performance.

III. FUTURE

Even for the same commodity/product, the agricultural, pharmaceutical, and food supply chains in the nation are exceedingly complicated, and there is no single point solution. Moreover, the issues impeding the growth of the cold chain industry are interconnected. Integrated solutions are required to solve issues such as massive food waste despite high production, increased competitiveness in agri-exports from other nations, and significantly, improved local supply chains benefiting all stakeholders from farmers to consumers.

Various players have highlighted cold sector infrastructure development as a crucial determinant for growth, with government backing. According to previous research, there is still a large gap between real and desired needs, and enhancing infrastructure to meet particular shortages at various supply chain stages is required. A comprehensive approach to all supply chain phases is required.

In order to develop an integrated model, major commodity producing clusters should be identified and infrastructure designed for them. Smaller cool rooms/IQF plants should be built to handle additional appropriate commodities in the area. This creates a regional network and expands the use of the infrastructure.

• Use of railway network: India has a well-connected railway network with a steady electricity grid. This may be utilised to improve reefer transportation connections. Key intents to make this actionable.

Making accessible enough refrigerated containers with grid connection, and c. Relative significance in clearing trains transporting perishable goods.

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• Development of smaller shared multi-commodity storages by pooling two or three neighbouring communities would provide small farmers unlimited access.

It is equally vital to develop front-end infrastructure in the markets to have a real effect and obtain the advantage of cold chain. Currently, just a tiny fraction of the product is handled by organised retail, and the unorganised sector is severely lacking. Smaller suppliers cannot afford the large capital needs. Smaller machines for processing perishables should be made available at cheap cost to local sellers.

The Indian cold chain infrastructure is still falling behind technologically. However, the fragmented supply chain and lack of past data on produce prevents fully using the benefits of cold chain. Aspects of technology to be addressed include:

• Supporting low-cost technology research and development to meet local supply chain issues.

• Creation of commodity-specific packaging and temperature models.

• India needs to use more effective monitoring and tracking methods. WSN and IoT technologies will be used to develop monitoring and tracking models that reflect local circumstances.

• Low-cost, small-capacity reefer trucks using PCM technology will be created to link challenging locations.

It is becoming more important for governments to develop climate-friendly alternative technologies as they phase out ozone depleting substances (ODS) and high-GWP HFCs.

• Small and large scale demonstration projects and economic incentives should help technology transfer.

• Manufacturing sector should be encouraged to offer cost-effective technology.

Currently, several authorities such as MoFPI, NHB, APEDA, and state governments are supporting the cold chain industry.

• Lack of well-balanced supply chains is one of the key reasons why farmers cannot earn higher rates for their goods. To boost agricultural supply chains, a well-integrated cold chain infrastructure should be built, taking into account the constraints and demands of small-scale farmers and rural communities.

• A clear distinction between supporting basic research and research for commercialization. Projects targeted at commercialising technology should be prioritised by MOFPI.

• Local enterprises should be supported in developing technologies like RFID, WSN, and IoT to reduce costs and improve flexibility.

• Encouragement and subsidisation of small-scale conventional and renewable energy units at the farm and village level.

• Encouraging small players to use front-end services.

Identification of important loss making commodities and areas, identification of underlying causes and justifying the necessity for cold chain and phase wise strategy to decrease loss.

• Public-private partnerships should be encouraged to conduct research to commercialise innovative technology.

FSSAI sets defined product and storage guidelines for frozen and other temperature sensitive foods. The supply chain participants do not fully comprehend the food safety concerns of frozen or temperature sensitive items. Food safety threats stemming from supply chain failures need product/product group specific recommendations and risk mitigation measures.

The latest HFC phase-down agreements have made it important to examine alternatives to HFCs. Transitioning to these and other sustainable technologies would reduce prices and save energy and emissions. However, enabling policies, updated safety standards, and market incentives are required.

IV. CONCLUSION

From Bishara (2006) to Shukla (2010), several innovations in cold chain logistics and supply chain management have been made (2013-18). From packaging solutions to virtual CCS models for testing and optimization, solar powered cold storage and third party logistics (3PL), everything is changing and in the near future, Industry 4.0 will lead to better handling of Cold chain logistics with the introduction of crypto technologies and gossip protocols related to Block chain and Hashing. We may conclude that cold chain logistics and supply chain are on the correct track, but we need a robust network of material handling to keep up with the rapid changes.

Due to the present and future pandemic circumstances, solid infrastructure and technological development will be required via effective policy execution.

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