

## A cold call on cold chains in India

Cold supply chains or simply cold chains play a vital role in the food supply chain and also in several non-food supply chains. India, which is witnessing a high growth in several areas is surprisingly poor in cold chains and subsequently not able to prevent the loss of agricultural, horticultural and marine produce, which lose their life quickly without the support of proper storage and transportation systems. Considering the huge loss, it is time to revamp the cold chain industry to build capacity and efficiency. This case study discusses the present scenarios and lists out the priorities for the government as well as private players. The data used are all from secondary sources and as such the author would not vouch for their accuracy and completeness. However, the case study raises serious questions over the existing cold chains and emphasizes on the development of cold chain infrastructure and network to meet the local and global challenges. The characters are only used for dramatic effect and do not represent real persons. The case study is only to illustrate the situational issues and not to highlight any good or bad practices of decision making.

### Prologue

Dr. Shamantak, a Professor in the area of Supply Chain Management in a premier business school in India was keenly reading the following announcement that appeared on his computer's screen. He read with interest and appreciation and started thinking of participating in the event as cold chain has been his research domain in the recent times.

“Join India's Biggest Trade Show on Cold Chain Industry

**INDIA COLD CHAIN SHOW 2017** is the most dynamic B2B trade show serving India's cold supply chain industry. For half a decade, it has been the sole trading voice for cold storage infrastructure, refrigeration, reefer transport, temperature controlling, IT solutions and data storage solutions.



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It is an exclusive platform where Indian & international brands, manufacturers and suppliers meet end-users, distributors, consultants and industry players from various regions of India and all over the World. They build networks, get acquainted to the most evolving trends and technologies and enhance their modernization plans. This must-attend event presents up-to-date technologies/Products, consultant business opportunities, provide widespread competition array and far reaching media coverage.”

(Source: <http://indiacoldchainshow.com/>)

Dr. Shamantak started seriously thinking of presenting a paper or attending sessions in the big event on cold chain, and recalled an incident that happened several months ago. He was visiting his native town located in the neighboring district and he was travelling in a cab. On his way he had stopped by a roadside tea shop. He observed a nearby garden with tomatoes fully grown and ripening and very attractive to watch. With a smile on his face, he remembered how much price he had given a few days ago for a kilogram of tomatoes near his residence and he was horrified at the sky rocketed price. So here is the guy about to make a killing in the market, he thought to himself. As if reading his thoughts, he heard someone telling him, are you calculating the profit the garden fellow would make in the market. He turned around and saw a villager and guessed him to be a farmer. The dialogue between the two went as follows:

Dr. Shamantak - I am from the city and do you know how much is the price of tomatoes?

Farmer - Ya, I have heard, but how does it matter?

Dr. Shamantak - Come on, anyone would bet and brag about the big profits around with a price like that.

Farmer - Agreed, but it is the transportation and storage that we are worried which often doesn't help us to take and offer our fresh produce to the market.

Dr. Shamantak - Why? What happens?

Farmer - You know, we dump them in a lorry (a truck) which travels sometimes hundreds of kilometers before reaching the destination, and by the time it reaches the market, half of the tomatoes would be dead or leaking out and earns a price which is far off the market price what you pay. So preserving the properties including the freshness of the vegetables is a major concern for us, and we are looking for possible solutions.

Dr. Shamantak - I accept your point, so what do you need?

Farmer - Well, a special vehicle fitted with a cold storage so that the tomatoes while being transported to their destination, don't lose their freshness and also have the possibility of surviving longer on the shelves of the retailer.

Dr. Shamantak nodded his head in approval and ran towards the honking cab driver. As he resumed his travel he recalled the special vehicle released by India's top automobile producer Tata Motors, which responded to the vegetables and fruits grower's demand and alleviated the grower's concern while transporting the perishable items.

The special vehicle as observed in <http://www.refrigeratedtruckindia.in/refrigerated-trucks.html>, is described as follows:

#### **Tata super ace refrigerated truck**

We supply a qualitative range of truck refrigeration that are designed in adherence to international quality standards suitable for Tata Super Ace chassis. Catering to the demands of food processing industry, the Tata Super Ace Refrigerated trucks are used for transporting ice creams, vegetables and various other perishable goods. Developed using advance technology, our range of trucks is known for excellent cooling and low maintenance. Further, we offer these trucks at the most competitive rates that suits to clients' budget.

Features: Hassle-free maintenance, Longer functional life, Optimum performance



**Figure 1 : Tata Ace Refrigerated Pickup van.**

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Several other automakers in India like Ashok Leyland, Mahindra, and Eicher Motors, also offer refrigerated trucks and vans which can get inside the farms and gardens to enable the farmers to load the freshly plucked fruits, flowers, and vegetables into the vehicle for further transport and distribution. This process greatly ensures longer life for the items carried and commanded a higher price in the market.

If these kinds of vehicles are available to the farmers, why are they not using them, and instead carry the farm produce in ordinary vehicles and lose on quality and quantity? This is a question anybody would ask when they come to know that fruits and vegetables are not properly transported to the market and quite often allowed to rot.

Is it ignorance or cost factor coming in the way or not willing to adopt the new practices?

#### **Overview of cold chains and its strategic importance in India**

Cold chains are specialized supply chains that play an important role in collecting, storing, transporting, and distributing certain type of products or items which have to be kept under a specified temperature and moisture, to protect or maintain their properties so as to extend their shelf life. Thus cold chains add immense value to those perishable items and enable better recovery of the investment. Typical examples of products handled by cold chains include milk, flowers, vegetables, fruits, flowers, and certain pharmaceutical products and in some special cases even the dead bodies of human beings, while taking them to the mortuary.

But with respect to India, there is a discordant note to the cold chains.

As quoted in from <https://nomadic.com/blog/poor-cold-chain-logistics-waste-40-of-crops-worth-over-14-billion-each-year/>

Poor, cold chain logistics, waste 40% of crops worth over \$14 billion each year By Author Team Nomadic Posted on 16 Jun 2017Categories Industry News

“15% of India’s population live in hunger, while \$14 billion worth of crops is wasted each year due to poor cold chain facilities and disorganized logistics.

India is among the world’s largest food producers. Yet, India’s Food Banking Network estimates that 15% of the population goes hungry every day, 1 in 4 children are malnourished and 3,000 die every day from illnesses related to poor diets. Although there is an abundance of food in the country, disorganized supply chains fail to transport, store and distribute produce effectively. Due to failed

cold chain transits, poor warehouse conditions and traffic delays, India waste 40% all harvested agricultural produce - that is more fruits and vegetables than the entire United Kingdom consumes and more grain than Australia produces each year. Besides contributing to poor health conditions and threatening the well-being of hundreds of millions of Indians, food wastage commits grave economic damage, costing the nation over \$14 billion or INR 92,000 crores in lost crops alone and disseminating environmental damage by squandering water, fuel and deforested land”.

A few years ago, a major news broke out: Retrieved 2 October 2017, from <http://www2.emerson.com/en-in/News/Pages/india-food-waste-and-cold-infrastructure-report.aspx>.

Dehli, Nov. 28, 2013: India, the world’s second largest producer of fruits and vegetables, are throwing away fresh produce worth INR 133 billion every year because of the country’s lack of adequate cold storage facilities and refrigerated transport, according to data compiled in a new report by Emerson Climate Technologies India, a business of the US-based manufacturing and technology company Emerson. In response to India’s cold chain infrastructure needs, many of them outlined in the report, Emerson Climate Technologies have also established its first Cold Chain & Distribution Centre in Chakan to increase awareness of technology solutions and services available to the industry.

These news reports create a trigger for deeper investigation as to how in a country like India these things are allowed. Why the government is not doing much?

As reported in Emerson Climate Technologies, (Climate Technologies for Industrial, Commercial & Residential | Emerson, 2017), India, which is notorious for high rate of food wastage, is expecting an increased interest from private equity investors in the Agri-logistics and cold chain industry. This sector is expecting an annual growth of 20 to 100% per year and hoping to raise anywhere between Rupees 15 crores to Rupees 200 crores. This should make the investors move towards this sector as they find huge investment opportunities.

While the financial investment in cold storage facilities and refrigerated transport is vital, the Climate Technologies for Industrial, Commercial & Residential | Emerson. (2017) also highlights additional challenges faced by India’s cold storage industry today. The three biggest challenges are (1) high life cycle costs for a cold storage facility that typically needs land and buildings to

hold 6,000 metric tons of food; (2) uneven distribution of cold storage facilities with 60 percent of existing facilities located near the point of production in just four states and too little closer to distribution points in the other 24 states; and (3) low awareness of best storage practices amongst industry players.

Other findings cited by the Climate Technologies for Industrial, Commercial & Residential | Emerson. (2017) are as follows:

- A cold storage facility with a capacity of 6,000 metric tons requires an initial investment of INR 50 million, excluding land costs. However, high real estate costs contribute significantly to the high life cycle cost.
- Most cold storage facilities are located near the point of production, with food from the farm, travelling longer distances to reach the facility and end consumer due to uneven distribution.
- Due to limited investment in cold chain technology, there is limited awareness of best practices to operate it efficiently.

Similar observations have been drawn by other researchers for example, Salin and Nayga (2003), Shukla, Deshmukh, and Kanda (2010), Rathore (2013 and 2015).

### **Some basics about supply chains**

Supply chains are today considered as a vital link in ensuring success in any business. The advent of transportation systems, coupled with information technology and electronic commerce, has resulted in the proliferation of the supply chain systems across the globe. Considering the nature of business, it is quite common that supply chains have become the backbone of business and have morphed themselves to suit different requirements based on the nature and quantity of the product that flows through the chain. Three types of flow are common in any supply chain, (Chopra & Meindl, 2015), these include, the flow of the commodity, the flow of money, and the flow of information. It is essential that all the three flows are maintained properly for the success of the chain. It is quite obvious that the flow of the commodity demands its own arrangement for the physical flow to occur, which could be a pipe, or a tanker, or a container in general. Because of the advances in technology, the flow of information and money can be on a real time basis by tracking and monitoring all through the chain. For example, RFID (Radio frequency identification) tag coupled with electronic sensors enabled real-time traceability and cold chain monitoring for food applications, (Abad

et al., 2009). Many attempts have been made to make a supply chain robust and efficient. It is to be noted that quite often a supply chain is expected to be more responsive rather than efficient. This is because, customers traditionally want the supply chain to fulfill their orders or demands, no matter what variety and volume are desired. Hence, whether a supply chain can meet the customers' expectations becomes a vital metric to measure the supply chain performance. Cold chains are no exception as the growers of perishable food items, want full protection as well improved storage facility for the products so as to reach the customers in good shape and form.

### **Concepts and applications of cold chain**

A cold chain is a special supply chain designed and developed for the purpose of transporting or carrying a product from the producer to the consumer, under special conditions, to preserve the properties of the product. The most important factor here is the perishability factor of the product under consideration, which is later processed and packed to enhance the shelf life. The sole objective in the cold chain is that the final consumer gets the product without the loss of the "freshness" which otherwise will render the product less useful to the consumer and in some cases become waste. An estimate puts the post-harvest loss in food sector at 30% around the globe and this is a huge loss. Given the disparity in the economy and thus fighting for "food for all" or eradication of poverty" by many countries, particularly in the developing economies, cold chains seem to be the requirement of the day. As mentioned by Montanari (2008), a cold chain consists of precooling facilities, cold storages, cold carries, temperature and humidity controlled carriers, and information systems. Joshi et al. (2009) have provided an extensive coverage of the literature along with the issues related to the cold chain in India using special models.

### **Brief literature review**

The literature on cold chains is quite diverse and varied. The published work on the cold chains can be classified under three categories, namely, literature pertaining to

- (1) Cold chains of a particular item or product, like cold chain for fish and meat, cold chain for food items, cold chain for pharmaceutical products, and health care related items, like medicines,
- (2) Cold chain logistics, equipment, vehicles, containers, human resource requirement, legal and technology issues, and

- (3) Research related to cold chain and current developments. In addition, considering the strategic importance of cold chains, a number of research reports have been brought out by professional and academic agencies which greatly help the people directly involved in the cold chain network. These people could be the commercial operators, equipment manufacturers, maintenance crew, and other related service providers.

For several years the National Cold Chain Assessment Report brought out under the Ministry of Health and Family Welfare, Government of India, made an assessment of cold chain infrastructure in India along with demand projection and assessment of the current situation. In fact, the Government of India faces the biggest challenge of arranging for vaccine across the entire country so as to inject the same at thousands of places on specified days. The immunization program adopted in India is considered to be one of the biggest mass health care program that covers a large number of women and children. The vaccine administered to children all over the country on a certain day signifies a huge consumption of the vaccines which are distributed across the country using cold chains. The “pulse polio” program, for example, involves millions of children and women, who would receive the vaccine at selected centers all over the country and thus stay immune to possible attacks from virus. The government of India collaborates with World Health Organization and UNICEF in the proper supporting and monitoring of the program for effective immunization against dangerous threats from serious health hazards.

Fernie, Sparks, and McKinnon (2010), comment that cold chain started gaining importance and became subject of interest for research and exploration from 1980's. Though food and non-food items are the major elements to pass through the cold chains, bulk of the developments and growth in cold chains is centered on food related items, only, as stated by Salin and Nayga (2003).

Several reports, for example, National Cold Chain Development (NCCD) and NABARD Consultancy Service (NABCONS), (2015) and International Trade Administration Report (2016), have indicated that the Indian cold chain industry is expected to grow at the rate of 15% to 19% per annum and this includes the entry of new technologies, replacement of outdated technologies, new collaborations, and also new entrants who would introduce new equipment, and automated systems.

Another reason for the surge in demand for cold chain industry is the rapid spread of quick service restaurants or fast food centers, which are largely catering to youngsters who are in a



hurry to get the service. These food service centers have triggered the business to some private logistics providers in the cold chain that include Gati, Kelvin Cold Chain, Snowman logistics, and Crystal Logistics, which have witnessed an annual growth of 15 to 20%, (Kulkarni and Lassar, 2009).

According to India Cold Chain Market Forecast & Opportunities, the cold chain industry is forecast to have a 16-19 % CAGR, which means the cold chain industry is likely to witness a keen competition among the Indian players. This is good news for the service providers as well the product manufacturers in the cold chain sector as the demand is very likely to shoot up. The cold chain market in India is likely to witness 27% CAGR between 2014 and 2019. Anticipating this growth, as mentioned in the report, several private companies have been set up in India and are already providing a variety of services.

Salin and Nyaga (2002) comment that cold chain equipment has to be temperature controllable as different products remain fresh only within a certain temperature range and they suggest the alliance network as a business proposal to meet the challenges of different types of items that pass through the cold chains. They further state that cold chains are also becoming business proposals under make or buy option. It is observed that cold chains on their own do not add value, but depend on volume, and utilization to be more efficient and cost effective.

Based on a study of cold chains in the state of West Bengal by Kumar (2014), the cold chain infrastructure in India is poor, inadequate, and requires benchmarking against the international standards. The network of cold chains is capable of meeting only about one fourth of the demands related to agricultural production and food sector.

A research paper by Rathore (2013) has explored the cold chain pertaining to the food sector in India and comments that India has a long way to go in building the cold chain infrastructure more so because of minimizing the food waste. Kulkarni and Lassar (2009) lucidly explained how the multinational company McDonalds faced the challenges because of a high quality cold supply chain and later overcame the obstacles in growth. Sager, Yadav, and Deshmukh (2009) have explored the agri-food supply chain along with the cold chains and have developed a framework under the two perspectives of the value chain and strategic competitiveness. They have also considered the human and non-human elements and indicate that their framework can be used to assess the efficiency of supply chains.

It is clear from the brief overview of the literature that the cold chain industry in India is still not yet ready to meet the demands of the farmers and corporate. Thus, it offers a lot of scope

for starting and expanding cold chain infrastructure. Considering the prospects of the cold chain industry, as suggested by several surveys, it is quite likely to be the promising industry and thus also boosts employment opportunities besides serving a national objective of saving food.

### **CII national cold chain task force**

The CII National Cold Chain Task Force, aims to create awareness of global developments in the area of the cold chain sector as practiced by the major players and policy makers. During 2013-14, the Task Force concentrated on the following thrust areas which focused on crops, fruits, or vegetables in different states of India. Develop roadmaps and feasibility reports in consultation with state and central governments. Identified pomegranate in Karnataka, pineapples in Kerala, and mangoes in Tamil Nadu.

- a) Collaborating with NCCD (National Center for Cold Chain Development) at a macro level and developing technical standards for cold chain equipment and warehouses.
- b) International outreach and collaboration in the area of agro logistics
- c) Holding conferences and enlarging the scope of crop related festivals.

### **Prospects and growth of cold chain in India**

In the recent times several private players have set up cold chains and offering a variety of services. It is expected that the cold chain industry continues to be a favorite field to start new enterprises. Given the huge loss due to food waste and spoilage due to non-availability of the cold chain facilities, it is imperative that the cold chain industry has to set up and manage cold chains on a large scale. As quoted by Rathore (2013), the Indian cold chain industry is poised to grow to 2 to 2.4 billion USD in the near future. However, the authors have noted that the cold chain industry is yet to evolve to the required level and as a result losses and wastage are not fully controlled. Rao et al. (2013) have studied the cold supply chain in India with respect to dairy products and comment that the milk production industry faces a number of problems because of the lack of cold chain facilities.

Negi and Neeraj (2015) have explored the fruits and vegetable cold chain in a state in India and have suggested that in those states in India which are predominantly relying on agriculture, lack of cold supply chains is causing a loss to the entire community and more so

for the farmers. They strongly urge for the development of cold chains and related infrastructure.

Rathore (2015) who has studied the cold chain logistics feels that the logistics support is essential for the success of cold chains. Further, the author says that India, the world's second largest producer of fruits and vegetables, is losing fresh produce only because the cold chain facilities are poor and inadequate. The author also laments that the technology used is old and training the workers along the supply chain is insufficient.

### **Cold chain - issues and challenges in India**

The literature review indicates that the cold chain sector is yet to emerge as a major strength in India and compared to the global standards, the existing cold chain suffers from the following weaknesses:

- Insufficient capacity
- Outdated technology being used
- Lack of support from all the stakeholders.
- Very little use of standards, national or international.

In a recent article, Bag (2016) echoes similar views and states that a little support from the Government, using non-recyclable packaging materials, high capital costs, and lack of reverse logistics also have hindered the growth of cold supply chains in India. Balraj (2016) while commenting on the food production in India says that fruits and vegetables constitute 92% of the horticultural produce and suffer from poor cold chain facilities. The cold chains currently in use are not able to give the necessary support to the growers and middlemen. Thus the development of the cold chain is a matter of concern and urgency.

One of international benchmarks used in supply chain performance is the logistics performance index (LPI) released by the World Bank. As quoted in <https://lpi.worldbank.org/international/scorecard> LPI is the weighted average of the country scores on the six key dimensions which are as follows:

- 1) Efficiency of the clearance process (i.e., speed, simplicity and predictability of formalities) by border control agencies, including customs;

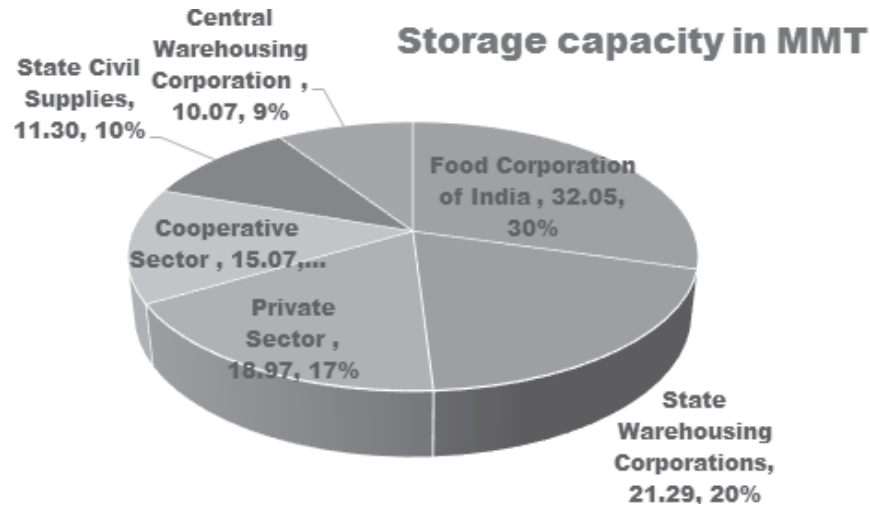
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- 2) Quality of trade and transport related infrastructure (e.g., ports, railroads, roads, information technology);
- 3) Ease of arranging competitively priced shipments;
- 4) Competence and quality of logistics services (e.g., transport operators, customs brokers);
- 5) Ability to track and trace consignments;
- 6) Timeliness of shipments in reaching destination within the scheduled or expected delivery time.

India's scores on a scale of 1 to 5, least to most, along the different criteria are as follows:

Country	Year	LPI Rank	LPI Score	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Time liness
India	2016	35	3.42	3.17	3.34	3.36	3.39	3.52	3.74

India's rank of 36 shows the country's improvement over a span of around 10 years and doesn't show any great improvement over this period. Compared to the top scorer Germany, India needs to improve on all parameters before the country can be called as a quality performer. According to Joshi (2009), India's average cost of logistics is higher than the global average. It is indeed surprising to note the points raised in this report. It is suggested that developing an integrated supply chain, including cold chain can save up to 300 billion annually and at the same time reduce the wastage of perishable horticulture produce. The price of vegetables, fruits, milks and eggs, meat and fish have been rising faster in spite of the fact that India is the second highest producer of fruits and vegetables. Main reasons for this paradoxical thing are inadequate supply chain and logistics infrastructure and management. Hence the country shows a big potential to improve the cold chains and the industry is expected to reach Rupees 624 billion by 2017. Currently in India there are around 6500 cold storages and cold chain units, of which two thirds are set up in two states namely Uttar Pradesh and West Bengal. This skewed distribution has resulted in arbitrary price hikes and artificial shortages. Figure 1 shows the cold chain capacities set up by different organizations, as observed in the Cold Chain Grid in India. (2016).



**Figure 2 : Storage capacity of organizations under different category <<https://lpi.worldbank.org/international/scorecard/radar/254/C/IND/2016>>**

Further, the Cold Chain Grid in India. (2016), has identified the three major challenges for the cold chain industry in India as

- 1) High energy cost
- 2) Rising cost of real estate
- 3) Uneven distribution of capacity

This is where, the researchers and practitioners expect the government to offer a liberal support.

### **Will the local and international players get into a conflict or cooperation?**

The strong Indian market has attracted many foreign players in the fast food market that are currently the favorite of many caterers. McDonalds, Starbucks, Pizza Hut, Dominos, and Dunkin Donuts, among others have ventured into India and now trying to replicate their success model in their home country. But the roadblocks have been the inconsistent supplies, unreliable quality and poor scheduled deliveries. All these proved costly for the global players who have set foot on many countries. In India there is no one food chain that has a presence all over the country, though names like Nirulas, and Haldiram are often quoted. (Mor, Singh, Bhardwaj and Singh, 2015). The foreign players had to approach the same suppliers and had to

convince and convert them to suit their requirements. Jauhari (2004) describes how McDonalds was able to slowly understand the cold supply chains, their way of operations, the difficulties they have, and also the poor logistics support. Thus, they had to build their business models focusing both on the front and the rear sides of the entire business to maintain their brand value. These joint exercises enable the Indian suppliers also to raise their standards and meet not only McDonalds but other international players also. For example, the following were new challenges, (Jauhari, 2004):

- a) Separate processing lines for chicken and vegetable foods.
- b) Capability to produce frozen foods at temperatures as low as -35 degree Celsius to retain freshness.
- c) International standards, procedures and support services.

Given the wide spread of agricultural and horticultural activities in India, one suggestion is to develop cold chain grid or network. Because different states and different private agencies have different components of the cold supply chain and the facilities are not uniformly distributed to meet the requirements of all the stakeholders, (D&B Tangram Advisory Services, 2016). Hence a network may be more useful to all the players in the supply chain. Further, it is interesting to note more than fifty percent of the produce from agriculture and horticulture is concentrated in five states of India.

As stated in National Cold Chain Development (NCCD) and NABARD Consultancy Service (NABCONS) (2015), for instance, in 2013-14, Maharashtra (15 per cent), Andhra Pradesh (12 per cent), Gujarat (9 per cent), Tamil Nadu (8 per cent) and Uttar Pradesh (8 per cent) were the major producers of fruits. In the same year, West Bengal (14 per cent), Uttar Pradesh (12 per cent), Bihar (9 per cent), Madhya Pradesh (8 per cent) and Gujarat (7 per cent) were the major producers of vegetables. Hence a cold chain grid would benefit all the players from end to end, and boosts investment and employment opportunities. It is possible to attract Foreign Direct Investment in this field and at the same time minimizes loss and wastage. The state and central governments have all the necessary infrastructure to create a hub and spoke model and the private players can provide all the peripheral support and integrate the currently fragmented cold chain network. Hence it is better for the country to go in for a cold chain grid and ensure better yields to all the participating industries.

Richard Tracy, Global Cold Chain Alliance, has stated that (International Trade

Administration Report, 2016), “India is a huge market that is being eyed, from a distance, by major logistics players. Equipment suppliers are already there in full force; however, they are facing issues of price sensitivity. Many customers make major purchasing decisions based solely on price as opposed to quality. Finally, the vast majority of consumers in India are still not demanding the use of cold chain”.

Shabani et al. (2012) have developed a benchmarking model for selecting the best sales agents as a “Benchmark” in the presence of non-discretionary factors and imprecise data under the Free Disposability assumption. These models, though still not adopted by all, can serve a useful purpose when the cold chains freshly been created.

The Birmingham Energy Institute (2014), has come out with the following observations:

“The prospects for developing liquid air cold chains in India appear promising: the need is vast; investment in the sector is booming; much of the necessary infrastructure already exists; government policy is supportive; investment funds are available; and liquid air technologies would be economically competitive against diesel, and are zero-emission and environmentally sustainable”.

### **The road ahead**

Cold chain has to be improved and expanded in volume to meet the growing industry in India. There is no second thought about the prospects of cold chain. While this move will greatly help the business to scale up, the paradox of being a top producer yet not able to meet the demand at a reasonable price to the customers, can be eliminated. But a more compelling reason is India, being known for poverty, hunger, and malnutrition of children (India is ranked number one in milk production), has to put in a serious effort to improve the cold chain which greatly helps the society. Dr. Shamantak no doubt will be playing a key role in this high priority requirement by further research in the area of cold supply chains.

### **End of case questions**

1. Will improving the cold chain infrastructure enable better food management in India?
2. Are governments (State and Central) providing enough support to the cold chain infrastructure?
3. Who are the beneficiaries of cold chain and how do they benefit?

4. Should India's cold chain be benchmarked against international plays and improved and should an indigenous model be developed to suit Indian conditions?

**Disclaimer**

Dr. Shamantak is a fictional character created for the purpose of narration only.

The case here only discusses an important national issue, related to a particular sector namely cold chain, a subset of supply chains. The facts and figures quoted are all collected from various secondary sources and hence the accuracy or completeness is not guaranteed. The author doesn't confirm or contradict the opinions expressed by various authors.