

# THE FOOD WASTAGE & COLD STORAGE INFRASTRUCTURE RELATIONSHIP IN INDIA

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DEVELOPING REALISTIC SOLUTIONS



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# THE PROBLEM OF FOOD WASTE IN INDIA

India, the world's largest producer of milk and the second-largest producer of fruits and vegetables, is also one of the biggest food wasters in the world – wasting INR 440 billion<sup>1</sup> worth of fruits, vegetables and grains every year.

The challenge of feeding India's billion plus people is not really about agriculture and food production but getting the food to the people. The biggest contributors to waste are the lack of refrigerated transport and adequate high quality cold storage facilities for both food manufacturers and food sellers (retailers).

What India lacks, and needs, is a well-developed, world-class cold chain infrastructure. Without it, India's problems are vast and likely to grow. As an example, waste is responsible for 50 per cent of the current cost of milk in India.<sup>2</sup> The most susceptible food category to a lack of cold storage is fruits and vegetables where annual wastage is estimated to be 18% of the total production.<sup>3</sup>

Controlling the levels of waste is beyond the capability of individual farmers or consumers. The problem is wider and involves market schemes, availability of power supply, quality of roads and focused government intervention as well as a need for a more pronounced investment in the sector.

This report outlines the extent of food waste in India and highlights where wastage occurs and its ramifications on food cost, production and safety. It focuses on fruits and vegetables since India wastes more of this group than any other food product. Also contained in this report are the challenges faced by the cold chain sector in India and a roadmap for improvements, including greater use of proven technologies.

This report was commissioned by Emerson, a leading global engineering and technology company, which also provides technology solutions and services for the air conditioning and refrigeration industries.

# THE CURRENT STATE OF FOOD PRODUCTION & WASTAGE IN INDIA

"Only 10–11 per cent of the fruits and vegetables produced use cold storage. There is a deficit of 90 per cent. Storage capacity needs to increase 40 per cent to avoid wastage. The wastage of fruits and vegetables occurs more in the southern and western regions of India due to the tropical and humid climate."

Director, National Horticulture Board.

"Milk, meat and poultry products (except eggs) cannot exist without the cold chain. Hence, the cold chain infrastructure for milk, meat and poultry is still good in the country. In the case of fruits and vegetables, there is a market for fresh as well as fruits amongst people of different economic backgrounds. Overall, there are inadequate cold chain facilities for fruits and vegetables."

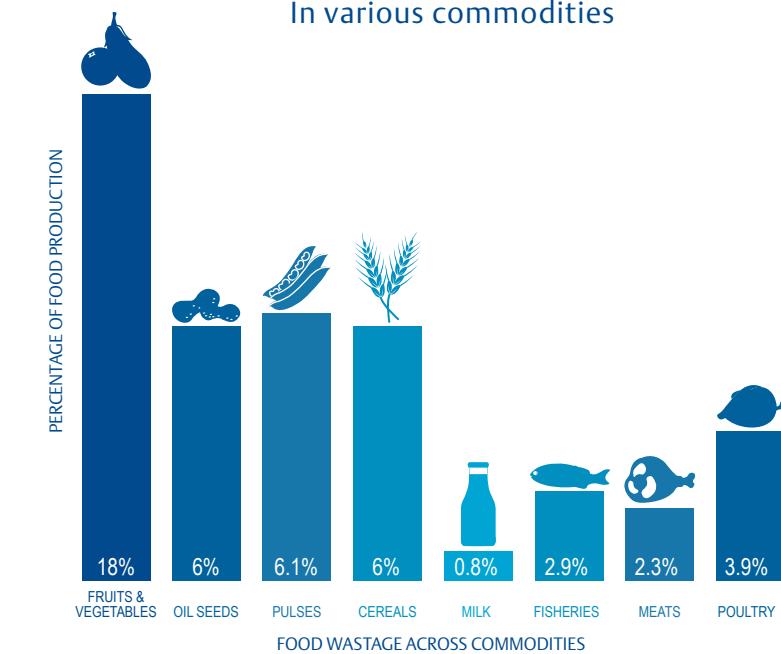
Director, National Horticulture Board

- India produces 250 million tonnes of food every year; 65 per cent of the population is engaged in agriculture.<sup>4</sup>
- About 18 per cent of the country's fruits and vegetables, worth INR 133 billion,<sup>5</sup> go to waste annually because of the lack of cold storage facilities.

India is an agrarian economy and agriculture contributes approximately 14 per cent of the country's GDP.<sup>6</sup> The country is a leading producer of milk and the world's second-largest producer of fruit and vegetables, while also producing a significant amount of meat and poultry. The Government of India spends INR 750 billion a year, about 1 per cent of GDP in 2011, on the food distribution system.<sup>7</sup>

Despite high production and an existing distribution network, India finds it difficult to feed its own people. This is due to considerable wastage. According to the Central Institute of Post Harvest Engineering and Technology (CIPHET), Ludhiana, approximately 18 per cent of the country's fruits and vegetables, worth INR 133 billion,<sup>8</sup> go to waste annually because of the lack of cold storage facilities. India wastes more fruit and vegetables than any other food product in India, mostly due to inadequate cold storages and inefficient handling. The chart below shows the percentage wasted for each product.

Annual cumulative wastage percentage  
In various commodities



Source : Central Institute of Post Harvest Engineering and Technology (CIPHET), Ludhiana



Poor cold storage infrastructure not only affects the freshness and quality of products, but also the price. Waste can contribute to the doubling of fruit and vegetable prices; while milk can cost 50 per cent higher.<sup>9</sup> In India, due to low awareness of food freshness, lower quality fruits and vegetables end up being consumed. This is at considerable risk to their health.

Appropriate food storage plays a critical role in preserving the nutritional value of food. It prevents food borne illnesses caused by harmful bacteria and helps protect vital nutrients. When food is not stored properly the result is under-nutrition affecting large sections of the poor, particularly women and children. Consequently, physical growth and health deteriorates in adults, work capacity and productivity is reduced in children.

### Cold Storage and Milk in India

The supply chain management, including its cold chain component, is better organised for India's milk dairy industry, leading to lesser wastage of milk as compared to fruit and vegetables. A lot of this can be attributed to the success of the Amul dairy cooperative in India. Amul cooperative dairies collect milk from farmers at technologically advanced collection centres after testing it for milkfat content. The milk is transferred to chilling centres or bulk cooling units where it is cooled to 4°C. It is then transported in insulated tankers to processing plants where it is processed and then sent to distribution centres for packaging. This process pioneered in Gujarat and has been so successful that the government replicated the model with the launch of 'Operation Flood' in 1970 in other states of India.

The initiative was aimed at reducing the gap between rural supply and urban demand. Following the program, India emerged as a leading worldwide producer of milk.

"Around 30 per cent of the fruits and vegetables produced in India are wasted in post-harvest handling. The major reason is low use of refrigerated transport services. Farmers are either not aware of reefer trucks or not using them to transport fruits and vegetables because of their high costs."

Associate Consultant, Cold Chain Company.

"We have different restaurants in our hotel, catering to different cuisines. Customers today are more demanding. They are particular about the temperature of wine, smell of food and its taste. We store different types of meat and fish. Some of the ingredients are imported or sourced fresh locally. Cold storage is particularly important in our line of business - we must ensure availability of ingredients for our customers at all times while also meeting the ISO: 22000 food & safety regulations."

Chief Engineer at a leading hotel chain

According to Associated Chambers of Commerce and Industry of India (ASSOCHAM), milk production increased from 17.27 million metric tonnes in 1950–51 to 123.7 million metric tonnes in 2010–11. Milk available per capita has also increased from 112 grams per day in 1968–69 to 281 grams per day in 2010–11, thus addressing the nutritional deficit in specific areas in India.

### Cold storage and marine food exports

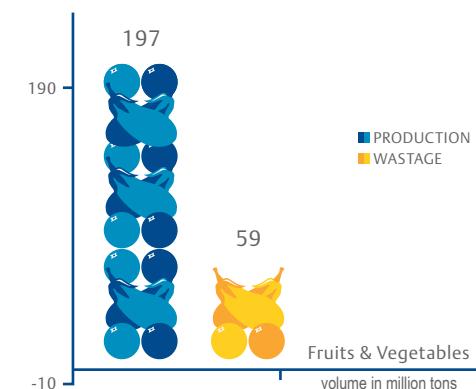
ASSOCHAM estimates that, India's total marine products exports are expected to grow from the current INR 188.56 billion to INR 290.7 billion by 2014. The fisheries sector has witnessed development and progress over the years through various Five Year Plans.

Once caught, marine food products are highly perishable. Marine foods for export typically need to be quickly frozen after initial processing and kept frozen until purchased by the consumer.

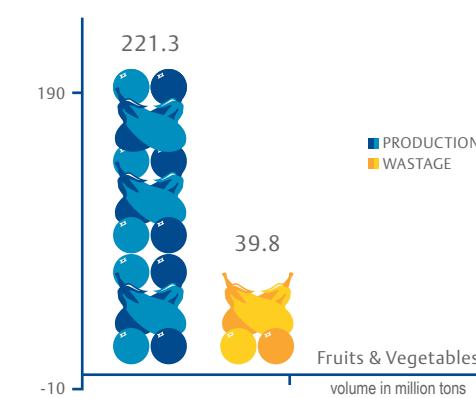
New initiatives have been adopted for developing the sector to increase yields and ensure a sustained livelihood for fishermen. There has also been an amplified effort to increase exports to other countries through improvements in infrastructure facilities like cold storage that better address post-harvest management.

As a result of this concerted effort, marine product exports have grown by 7.68 per cent over the last fiscal year according to the Ministry of Commerce.

Production and Wastage in India (2009)



Production and Wastage in India (2010)



Retail Refrigeration head at one of India's leading food retail chains

# EXISTING COLD STORAGE INFRASTRUCTURE

- There are about 6,300 cold storage facilities in India, with an installed capacity of 30.11 million metric tonnes.<sup>10</sup>
  - It is estimated that cold storage capacity in India needs to double, to a total of 61.13 million metric tonnes of cold storage to minimize food wastage.
  - An investment of INR 550.74 billion in new cold storage capacity by 2015–16 is required to keep up with the fruit and vegetable production increase.<sup>11</sup>

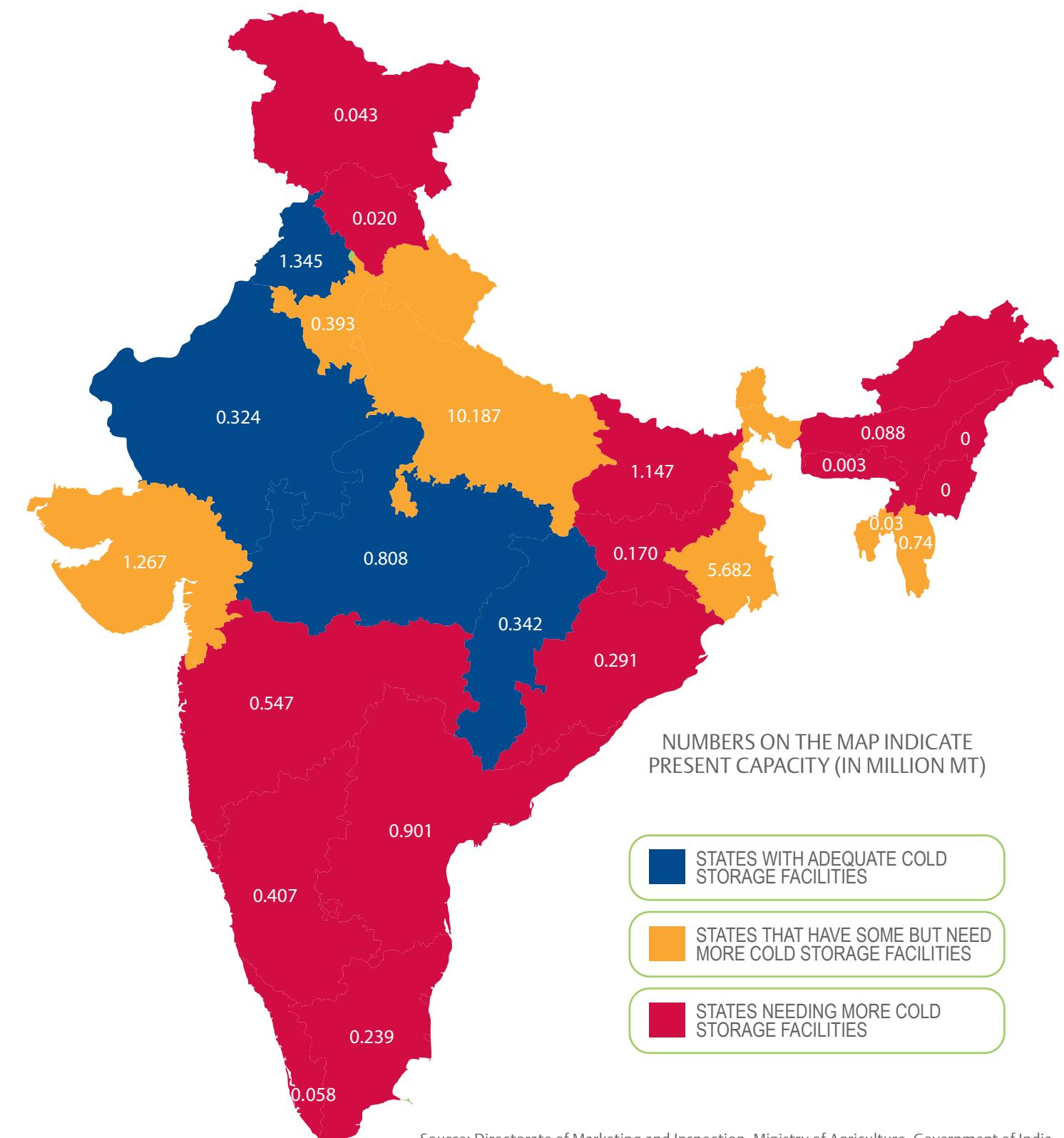
As of 2012, India had approximately 6,300 cold storage facilities, with a capacity of 30.11 million metric tonnes.<sup>12</sup> Of the total number of facilities, about 60 per cent are located in just four states: Uttar Pradesh, Gujarat, West Bengal and Punjab. Uttar Pradesh has the highest present capacity of 10.187 million metric tonnes with a gap of 20 per cent pegged at 2.041 million metric tonnes. The remaining 24 states and the bulk of the country remain underserved. In 2010, Tamil Nadu had only 0.0239 million metric tonnes of actual cold storage capacity but had a need for 7.906 million metric tonnes of capacity, leaving a 97 per cent shortfall.

India's cold storage market has a multitude of players, with over 3,500 companies in the value chain.<sup>13</sup> Cold chain solution provider companies constitute 85 per cent of the market, while transportation services, such as refrigerated trucks (known as reefers), account for the remaining 15 per cent.<sup>14</sup> In 2010, for the transportation of perishable products, there were 250 reefer transport operators running around 25,000 vehicles in India. Of these vehicles, 80 per cent were utilized for the transportation of milk, leaving only 5,000 vehicles for other produce such as fruit and vegetables.<sup>15</sup>

According to ASSOCHAM, during the period of 2009-2017, the cold chain industry in India is expected to grow at a CAGR of around 25.8 per cent to reach INR 64 billion. The National Horticulture Board (NHB) recommends that investments worth INR 550.74 billion in new cold storage capacity are needed by 2015–16 to keep up with the increasing production of fruits and vegetables.<sup>16</sup>

If the projected growth in food production becomes a reality and cold chain industry investments are not made, the current food waste scenario will only become worse. Despite initiatives by the Government of India and investments by private players, the cold storage industry continues to face a lot of challenges.

# STATE-WISE PRESENT CAPACITY OF COLD STORAGE (\*2010)



Source: Directorate of Marketing and Inspection, Ministry of Agriculture, Government of India.

Disclaimer: The frontiers depicted on this map are from a neutral point of view and are not intended to make any political statements. All efforts have been made to make this map accurate. However the authors of this report do not own any responsibility for the correctness or authenticity of it.

# FROM FARM TO FORK

India is the world's third-largest producers of apples with most of its production coming from Jammu & Kashmir, Himachal Pradesh and Uttarakhand. This infographic examines the apple supply chain from farm to consumer.



## 1 HARVESTING

Apples have a short harvesting period from August to October. Quality deterioration of domestic apples happens due to paucity of good storage facilities as most orchards have limited storage facilities.

## retailers

## 6 CONSUMERS

Apples are typically not kept in cold storage in the producing area. Apples not sold immediately by growers or held for later sale by wholesale merchants are typically held in cold storage in major markets or cities. These are then sold in Indian cities, both small and large though in small towns the quality and appearance are likely to be poor and prices relatively lower.

## retailers

## cold storages

## wholesalers

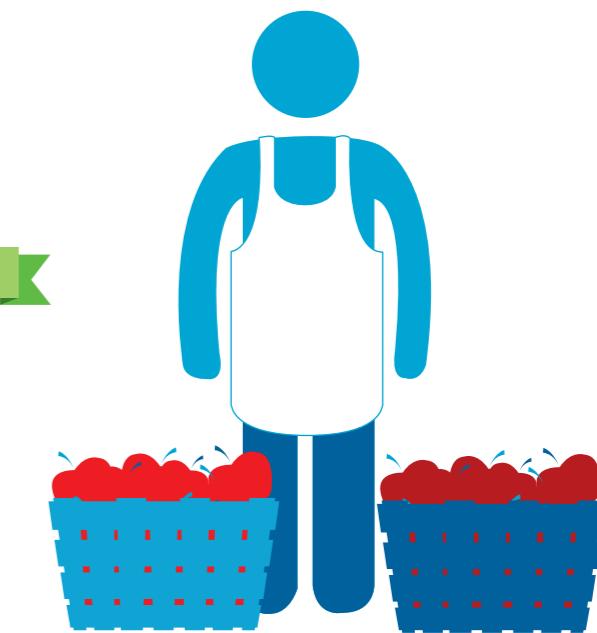


## 2 RIPENING



There is no set timeline for ripening; the fruit appears as base shade and then deepens in colour.

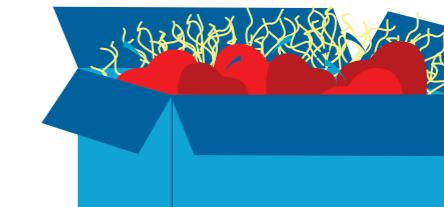
## 3 HANDLING



Apples are assembled, sorted, and graded on the basis of quality, color and size. The high and low graded fruits are sorted before sale with pricing based on visual properties.

## 4 PACKAGING

Over packing apples in thin wooden crates or corrugated cardboard boxes with straw leads to bruised fruits. High quality boxes with superior rigidity greatly reduces this problem.



Post-harvest losses amount to 25-30%

## 5 TRANSPORT

Apples are transported through the country in unrefrigerated trucks over poor roads. There is a shortage of trucks during peak season leading to extended periods of unrefrigerated storage. This further leads to heavy damage to the fruit during transportation.

"The distance between the farmer and the producer/manufacturer and the manufacturer to the end-consumer is widened by the involvement of multiple delivery intermediaries in India. This impacts the quality and timely deliveries to the end consumers. The long chain can be shortened by the involvement of private-public partnership (PPP) and huge investment in infrastructure like electricity projects, road linkages, skilled labour and apt raw materials availability. Both these processes can be further facilitated by Government intervention in the supply chain." -

President, Emerson India

Most so-called cold storages in India are for potatoes and they are not essentially cold storages. They are only warehouses with air-conditioners without any cooling technology and technically, should not be considered as cold storages. The problem is that cold storages are not defined in India. Technically, warehouses with air-conditioners should not be considered cold storages. The other major challenge is the lack of technical knowledge. The technical people at cold storages do not have the basic knowledge of operating the facility efficiently."

Head of Business Development Manager, cold chain logistics company

# CHALLENGES FACED BY THE COLD STORAGE INDUSTRY IN INDIA

- The cost of real estate in India is increasing.
- High energy costs in India, along with frequent power cuts, leads to a higher cost of investment and operating expenses in the cold chain.
- Cold storage facilities are unevenly distributed across the country.

While additional financial investment is vital, the three biggest challenges India's cold storage industry faces are high lifecycle costs, uneven distribution and low awareness.

## High lifecycle costs

Typically, a cold storage facility with a capacity of 6,000 metric tonnes requires an initial investment of around INR 50 million, excluding land.<sup>17</sup> The high real estate cost also contributes significantly to the high lifecycle cost. In a country like the USA, a similar cold storage facility requires half the investment.

The primary challenge facing the cold chain industry is rising property prices; with increases of more than 280 per cent over the last decade.<sup>18</sup> To build a cold storage facility with 1 million cubic feet of space requires an acre of land.

Electric power is an equally expensive challenge. India faces a 9 per cent peak power deficit.<sup>19</sup> This forces the majority of cold storage operators to run on backup power which leads to a marked increase in operating costs.

Adding to increased costs and also unique to India, are the lack of two-way cargo movement and back haulage of reefer trucks. Other cost contributors include interstate barriers, intercity and state taxes, and bad roads.

## Types of cold storage facilities and uneven distribution

Most of the cold storage facilities in India are for single commodity use. Three quarters of the cold storage facilities are used to store potatoes alone, an important food staple that requires careful handling.<sup>20</sup> As multi-commodity cold storage facilities require different temperature conditions, they are not well-utilized in terms of capacity; therefore, they are neither efficient nor cost effective. As a result, smaller companies prefer to set up single commodity storage facilities.

"Cold storages should be close to the production site. In Agra, there are over 300 cold storages for potatoes. Hence, the market is highly saturated. There is still scope for setting up cold storages in other potato-production sites, which are Kanpur, Lucknow and Varanasi."

Associate Consultant, Cold Chain Company

The uneven distribution of cold storage facilities throughout the supply chain is another major challenge. Most of the cold storage facilities are located near the point of production. However, there are not enough of them downstream. Also, food from the farm has to travel longer distances to reach the facility and the end consumer because of uneven distribution across the country. It is essential that cold storage facilities are available for fruits and vegetables at every point of their journey from farm to fork.

## Low awareness

The cold chain industry consists of multiple-players, both organized and unorganized. However, some of these players are unable to invest much in the technology required to build high-quality cold storage facilities or to acquire reefer trucks. A major chunk of these players are generally unaware of best practices for operating a cold chain efficiently. Inefficiency in handling multiple products in the distribution stage hampers product quality at the retailers' end.

Overall, cold storage facilities are viewed as investments with a long payback period and low return. Considering these challenges faced by the industry, the Indian government has taken several initiatives to promote investment in cold storage infrastructure.

"Bihar and Rajasthan are offering extra incentives, apart from central government incentives, for investing in cold storages. Bihar is offering 50 percent extra subsidy, compared to other states, to companies that want to open cold storages in the state."

Director, National Horticulture Board

## MEASURES TAKEN BY THE GOVERNMENT OF INDIA

- Cold chain recognized as a sub-sector of infrastructure in the Union Budget 2012–13.<sup>21</sup>
- Indian government has offered INR 3.2591 billion to set up 451 cold storages.<sup>22</sup>
- Government collaborates with the Confederation of Indian Industry (CII) and Federation of Indian Chambers of Commerce and Industry (FICCI), growers, and cold chain equipment manufacturers, to set up the National Centre for Cold Chain Development (NCCD).<sup>23</sup>
- The government's approval of 51 per cent<sup>24</sup> foreign direct investment (FDI) in multi-brand retail is a welcome step to facilitate investment in the cold storage market.

The cold chain segment has huge opportunities for growth, given the market potential in the country. However, developing an efficient cold chain logistics system with the latest technologies and capacity is highly capital intensive. To address the need gap of 31 million metric tonne,<sup>25</sup> government intervention is required to build additional capacity. Sensing this need, the recognition of the cold chain as an infrastructure sub-sector in the 2012-13 Union Budget<sup>26</sup> has led to the sector receiving substantial government aid. In a significant move, the Government of India permitted 100 per cent FDI in the cold chain sector through the automatic route in the budget of 2011-12. In the 2010-11 Union Budget, the government exempted air-conditioning equipment and refrigeration panels used in cold chain from excise duty and allowed duty-free import of refrigerated units used in reefer trucks. This is a step in the right direction to enhance and attract investment.

The government's approval of 51 per cent<sup>27</sup> foreign direct investment (FDI) in multi-brand retail also comes as a welcome step that could facilitate investment in the cold storage market. Multi-brand retail channels in India are expected to strengthen the cold chain infrastructure with the introduction of advanced technologies and robust distribution channels that multinational companies follow in other parts of the world.

Government agencies such as the Agricultural and Processed Food Products Export Development Authority (APEDA), National Horticulture Board (NHB) were set up to help provide financial assistance and drive exports for this space.

APEDA, which achieved 29,929 metric tonnes of capacity by March 31, 2012 (as part of the XIth Five Year Plan) had targeted an increase of 6,600 metric tonnes<sup>28</sup> in 2012-13. Also, APEDA has specific schemes to set-up re-cooling facilities and specialised storage facilities such as high humidity cold storage deep freezers, controlled atmosphere or modified atmosphere storage.

The Marine Products Exports Development Authority (MPEDA), established to increase exports and specify standards, provides ongoing subsidies for financial assistance to build large cold storages for surplus seafood. This is part of its vision to achieve exports of INR 358 billion by 2017.<sup>29</sup>

The NHB provides financial assistance for the construction and modernisation of cold storages for horticultural products. It has developed technical standards for companies to follow. These standards are based on three types of cold storages.

- Cold storages for fresh horticulture products, which do not require pre-cooling
- Multi-commodity cold storages for the short- and long-term storage of fresh horticulture products that require pre-cooling and varying storage requirements
- Control atmosphere (CA) storages providing active, modified atmosphere systems, which control one or more gases within an enclosed space.

The establishment of the National Centre for Cold Chain Development (NCCD) in 2012 gives a much needed impetus to the sector by focusing on promotion and development of an integrated cold chain for perishable products.

Equally important is cold storage at the transport stage of the supply chain. The union agriculture ministry is working in coordination with Fresh and Healthy Enterprises, a fully owned subsidiary of the government-owned Container Corporation of India, to launch a special purpose vehicle (SPV), a body to fund projects. In its initial phase, the SPV will provide complete cooling logistics for fruits such as kinnows, oranges, bananas, and mangoes.

This report covers only the key initiatives undertaken by the government of India. Additional work by the Government has also been undertaken which is not mentioned in this report.

# EMERGING SOLUTIONS

The adoption of proven technology solutions can help bring down operating costs, improve quality of produce and help the environment. Multiple, innovative solutions are emerging in India to help meet these goals.

## Multi-commodity Cold Storages

Multipurpose cold storage facilities are designed to store a range of commodities such as fruit, vegetables, dry fruits, spices, pulses and milk throughout the year. These facilities have separate chambers that operate at various temperatures and are simultaneously maintained. This makes them more cost and space efficient and delivers higher profitability.

## Controlled Atmosphere Storage

Controlled atmosphere cold storage facilities are mainly used for long-term storage of highly perishable items such as fruit. This method regulates the temperature along with the concentration levels of oxygen, carbon dioxide, ethylene and nitrogen to maintain a specific atmosphere for that particular product or fruit.

This method helps increase shelf life while ensuring the quality and freshness of the produce.

## Ripening Chamber

Fruit such as mangoes, bananas and papayas are often harvested in a mature but unripe condition, and are subsequently allowed to ripen off the tree. In natural conditions they ripen slowly, leading to high fruit weight loss, desiccation and uneven ripening.

Using a ripening chamber helps maintain precise conditions specific to the product's requirement. The ripening is more uniform and the fruit has a firmer pulp texture and a better flavor. Farmers can also choose to pause or hasten the ripening process based on market demand. This usually results in less food wastage and higher price realization.

## Distributed Refrigeration Architecture

A centralized refrigeration system consists of one or more large capacity refrigeration racks, housed in a mechanical room, located in the back of a supermarket. It is specifically designed for the store's entire refrigeration needs.

Distributed systems, on the other hand, are one of the newer commercially adopted refrigeration technologies. A distributed system consists of several miniature parallel compressor racks, distributed throughout the store, located next to, or in close proximity to, their display case or walk-in cooler refrigeration loads.

Distributed refrigeration architecture reduces piping by 50-75 per cent over centralized systems and requires 60-80 per cent less refrigerant to operate efficiently. This can reduce installation costs by over 17 per cent.<sup>30</sup>

This system further minimises the risk of shutting down large sections of the store's refrigerated merchandise in the event of a major failure, remodel, or service situation. It also consumes less energy with potential savings of up to 15 per cent in energy costs<sup>31</sup> resulting in significant savings for retailers and easy maintenance.

## Increased Usage of Electronic Controllers

Different products require different temperatures and humidity level maintenance. For instance, fruit requires low temperature and high humidity ranges; pulses and potatoes require low humidity levels. To maintain quality, improve shelf life and extend the sale period of fruits and vegetables, it is critical to control environmental conditions during storage and transportation.

Potatoes are ideally stored within a temperature range of 0-2 degrees Celsius. Temperatures below 0 degrees Celsius blackens potatoes and exposure to temperatures above 2 degrees Celsius increases starch production resulting in the depreciation of the stored produce's net worth.

The conventional monitoring system is expensive and inefficient. In conventional cold storages, the temperature adjustment and storage method depends upon the experience of the operator. This requires the operator to be physically present at the cold storages to adjust the temperature and manage the system by periodic measurement. However, negligence and inaccuracy due to human intervention can result in product spoilage.

The use of electronic management systems and controllers assist by controlling the storage environment automatically, with the preset values which help in precise control, food safety and compliance. Electronic sensors help maintain precise conditions. A remote monitoring capability provides the user with the ability to control the system from any place, instead of remaining at the site all the time, while also maintaining a log of data for easy analysis. Remote monitoring and preventive maintenance can further help reduce operating costs.

## Training and Skill Levels of Handlers and Workers

Lack of skilled manpower and inadequate training is also partially responsible for food wastage. The storage facilities are sometimes managed by inexperienced staff unaware of the latest technology and techniques in handling and storing fresh perishable produce.

To address this, government agencies like NHB and NCCD are investing in training for both private and government operators. Additionally, NHB has infrastructure in place to provide training and education to farmers and processing industry personnel for improving agronomic practices and refrigeration technologies.

There is a need to make training and certification mandatory while also emphasizing the setting of benchmarks and standards.

## CONCLUSION

The cold chain industry is seen as an emerging and fast growing business sector in India. With the present food shortage, food security and safety are issues taking on growing prominence in India. Considering the current levels of food wasted, cold chain facilities will play an important role in feeding the country. Understanding the increasing demand for an effective cold chain, the government has established a separate department, National Centre for Cold-chain Development (NCCD), and this development points to the importance of cold chain facilities.

On an economic level, recent history in other countries shows that as income levels rise, food production and consumption patterns change and often lead to an increase in demand for easier to obtain, processed food. Along with the growth of the processed food market, will come the need for a better cold chain industry.

Developments in the food processing sector, organized retail, and government initiatives will drive overall growth for the industry. The industry's progress will also fuel the flow of investment by multi-brand companies and sustain their interest in the retail sector.

To develop a world-class cold chain infrastructure, the government and industry bodies need to join hands to adopt better and more efficient technologies to prolong the shelf life of food products and to bring commensurate economic returns to the farmers. This will not only ensure year-round availability of perishable food products and reasonable prices to the consumers but also equitable distribution to other parts of the country.

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