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Methods to Rectify post-Harvest Loss of Perishable Agri-Food Produce in India

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ABSTRACT: *Purpose:* to figure out the optimum solution for reducing post-harvest loss of perishable agri-food produce. One third of such produce goes to waste which can be significantly reduced mainly by using pack-houses and efficient refrigerated transportation. This article clearly uncovers the myth about, inadequate cold storage in India being the sole reason to the problem.

Approach: descriptive research approach for determining the significance and approach of pack house within the whole of cold supply chain using qualitative article reviews and put forth our views and thoughts.

Findings: there is a supply gap of 99.6% on pack-houses and supply gap of 85% on refrigerated transportation, if rectified can significantly reduce post-harvest loss and create immense amount of employment in the particular village.

Practical implementations: in Indian market 80% of 37 million MT cold storage capacity is occupied by only Potato storage. Potato and onion have longer shelf life which in turn reduces the price fluctuation of the commodities. Whereas, perishable goods are the ones getting damaged and contributing to major losses of Indian agri-food industry. The implementation of pack house and refrigerated transportation will significantly improve the scenario.

KEYWORDS: pack house, cold supply chain, perishable agri-food products, shelf life.

I. INTRODUCTION TO INDIAN AGRIFOOD INDUSTRY

Indian agri- food industry plays a major role in invigorating the healthy maturation of the Indian agriculture. With the increase in the scope and portion of high valued commodities, the area is likely to affect the agricultural growth in a bigger perspective and also encourage different employment opportunities. Similarly, the income part of agri- food industry has also been set as a profitable sector to leap on and with a wide variety of climatic conditions available in India it has been a well-favoured production house of fruits and vegetables. As published by Indian horticulture database in 2014, India was ranked 2nd in the production of fruits and vegetables with a production figure of 88.97 million metric tonnes in fruits and 162.89 million metric tonnes in vegetables following China. The results can be expected to be more impactful with its growth rate stimulating as the time goes.

Although the increasing numbers present a pleasing view, the industry in reality suffers severely from supply chain inefficiencies. As reported by economic times in 2013, India lost around Rs 2 trillion due to this problem. The problem being so serious that although ranked 2nd in the production of fruits and vegetables, it has listed itself to be the 55th among 120 countries with the highest level of food insecurity. With the perishable nature and short shelf life the backward integration and transportation of these produce requires a well thought and integrated system which certainly is lacking in Indian Market.

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II. OBJECTIVE OF THE STUDY

Argo food industry being the driving force of agricultural economy undoubtedly impacts the Indian economy. With the supply chain in jeopardy the increasing losses in agriculture economy can impact the economy in a negative manner. Considering the study and recognition of the issue would help to decrease the pre harvest losses, the present study brings out the following objectives:

- To identify and evaluate the problems and erroneous conjecture present in the current supply chain.
- To propose effective solutions for the raised problems

III. RELATED WORK

ANALYSIS OF CURRENT SCENARIO AND MYTH IN THE INDIAN MARKET

Source: *The Hindu business line*, November 4, 2018.

According to Pawanesh Kohli, CEO & Chief Advisor, National Centre for Cold-chain Development, there are few important things to clear out:

1. Why do we not have enough cold storage?
India has the world's largest footprint in cold storage, nearly 37 million MT, and it is a false claim that due to lack of cold storage we are facing more than 30% of post-harvest loss.
2. Why is there still so much post-harvest wastage?
The fruits and vegetables production are about 270 million MT, out of which 200 million MT is of perishable produce with 2-4 weeks of life span. Even if we use the most advanced technology and best cold supply chain technology, they will not survive the trip itself. So, we store long shelf life produce like potato in higher quantity (75-80% of total storage) to reduce price fluctuations.
Therefore, we should focus on improving other aspects of the supply chain like: refrigerated transport and Pack-house, than the cold storage, to save our perishable produce.
3. Having enough storage, why does price fluctuate?
It is not just about cold storage capacity alone. Price fluctuate due to excess in supply and demand, which India always produces in excess of potatoes in the season. Also, the climatic condition is a major factor contributing to the same which is out of our hands. Also, insect infestation during bulk storage and, lastly, the storage of onions and potato gets damaged due to the monsoon and usually results to price hike after monsoon season.
4. What is that missing link in the market resulting to such losses?
I would credit it to the acute shortage of back-end management, the "Pack-House". Just like we have 200,000 depots for milk collection, we need similar depot or pack-houses to collect, grade and pack the produce for the market. Currently in 2018, India only has about 450 pack-house where the requirement is about 70,000 which is 10 pack-houses per village.
As in layman understanding of cold supply chain people relate it to the result of only cold storage as such and try to come up with solution on their own without any in depth understanding of the current scenario and actual problem faced by the Indian agri-food industry.

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Table 1: cold supply chain infrastructure of status and gap as of 2015.

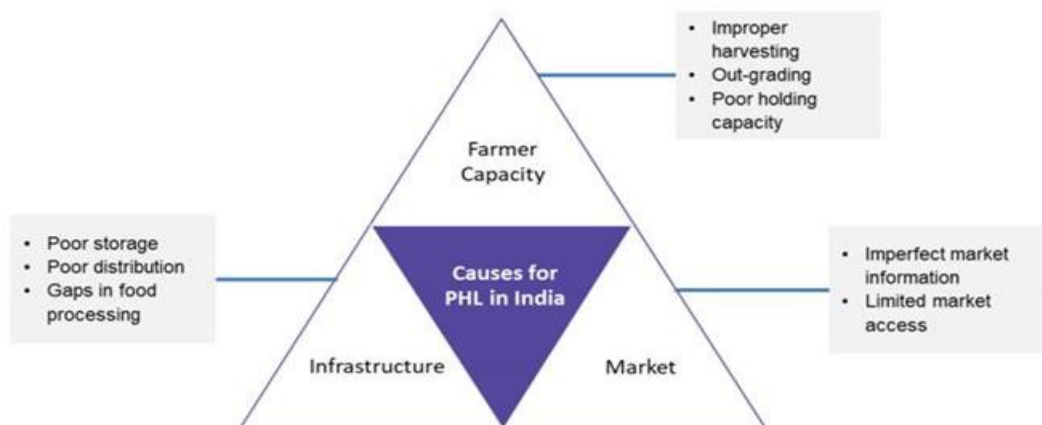
Types of infrastructure	Infrastructure requirement	Infrastructure available	All India gap	Shortfall % share
Integrated pack-house	70,080 nos	249 nos	69,831	99.6
refrigerated transport	61,826 nos	<10,000 nos	52,826	85
cold storage	35,100,662 MT	31,823,700 MT	3,276,962 MT	10

Table 2: total post-harvest loss in percentage in each step of the supply chain as of 2015.

Activity	Harvesting	Collection	Grading/ Sorting	Packaging	Transportation	Farm level storage	Godown/ cold storage	Whole seller level storage	Retailer level storage	Processing unit level storage	Total loss
Tomato	1.7	1.1	3.2	0.8	3.1	0.17	0.01	1.23	0.98	0.11	12.4
Potato	3.2	0.7	2.2	0.1	0.5	0.38	0.78	0.96	0.19	0.01	9
Onion	2.7	0.2	1.6	0.1	0.4	0.54	0.38	0.81	0.56	0.01	7.3

Major contributors to post-harvest loss

Our main concern is the huge Rs 92,651 crore post-harvest loss of farmers which they have already invested to produce. Farmers are unable to sell their produce in the market by the proportion of 34%. Ironically, to overcome these barriers about Rs 89,000 crores is required which is lesser than annual post-harvest loss which is ever increasing and if worked on can create more than 3 million jobs at the same village, *bystate of India's environmental figures 2018*.



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IV. KEY CHALLENGES AND BARRIERS HINDERING THE GROWTH

Post-harvest losses are to be blamed to a basket of factors than a single element. These factors can be condensed and separated out into different issues such as: Cold Chain issues, Integration issues, Infrastructure issues, Packaging issue, Technological issues, Transportation issues and Information gap issues.

i. Cold Chain issues:

Starting with the cold chain issue, India lags behind in numerous cold chain factors. From cold chain capacity to its network, the reform is well needed. Cold chain issues have been a hot topic in Indian news for decades and the lack of proper warehousing facilities and cooling shed certainly is undeniable. Although the hype has certainly been one sided towards cold chain, in reality the effects have been influenced by other issues too.

ii. Integration issues

Interconnection between different bodies in supply chain certainly has been another major issue deteriorating the supply chain. An absence of correlation between government and organizational bodies has created an unavoidable information and technological lag. This is mainly caused due to the inability of initiatives to incorporate the large number of small land farmers which is found to be a majority in India.

iii. Infrastructure issues

The problem of infrastructure has been lying around in Indian supply chain for decades. With a poor warehousing and storage to inadequate equipment's near the farm region the problem has been a major factor distressing the profits and efficient connectivity of the farmers and the organizations, thus affecting the whole supply chain.

iv. Packaging issues

This issue mostly pertains in agri- food industry as they are highly perishable and hold a short shelf life. Already being an issue concerned with health, the freshness certainly is unavoidable and packaging plays a vital role in that. While this being said, the Indian market lacks in the availability of packaging materials making it a luxury to afford for the farmers. Thus, affecting the whole supply chain process.

v. Technological issues

The lack of technology is clearly visible in Indian farmers and institutions. This slow and constricted use of technologies has slowed and resisted the movement of the fruits and vegetables thus creating an inability to satisfy the demands even if the supply is adequate. Some of the technological issues pertaining in India includes lack of processing plants and packaging technologies.

vi. Transportation issues

Transportation becomes a more pressing concern when talking about the perishable goods like fruits and vegetables. The transportation related problems are relatively high in India with factors like inadequate transportation mode, the high cost involved in it and the unavailability of temperature controlled vehicles for the transport of the goods. This not only slows down the process but also creates possibility for the increase in the post-harvest losses

vii. Information gap issue

India indisputably lacks in the efficient flow of information between the bodies in a supply chain. This lack of information is mainly experienced on the farmers side. Farmers lack the information on the actual prices, demand and processing units prevailing in the markets. The lack of information not only affects the realization of actual prices but also affects its distribution.

Conjecture: Elucidating in a condensed form the Indian supply chain is distressed with factors like lack of cold chain infrastructure, inappropriate supply chain management and lack of packaging and processing units which altogether has weighed down against increasing post-harvest losses.

V. PROPOSED SOLUTIONS TO OVERCOME POST-HARVEST LOSSES

As we know, pack-house and refrigerated transport is the major contributing factor to post-harvest loss and thus have immense supply-demand gap, we will further elaborate on these two factors:

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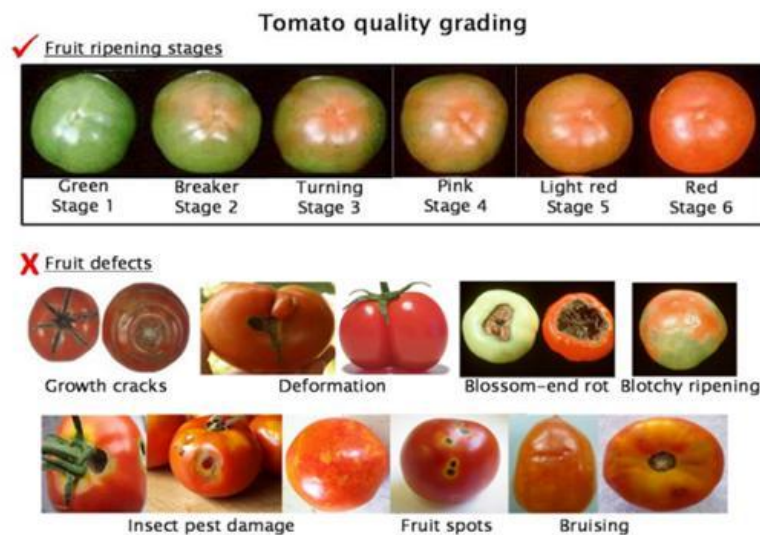
Pack-house for perishable goods.

Since there is an acute shortage of pack-house (99.6% gap to the demand) and is singly responsible for huge post-harvest losses we will focus on this most.

Pack-house is the hub for coordination between the farmer and the market. The main function of the pack-house is packing using scientific arrangement which adds value to the produce and help farmers realise higher profit and less post-harvest loss over all.

The work flow of a pack-house is:

- i. Receiving
Record keeping (source and weightage) is done and sample is taken for analysing pesticide residues. The process is operated in controlled environment.
- ii. Sorting and grading
This process alone can add 40-60% value to the produce. It does so by removing damaged and diseased produce hence increasing quality. Then, grading is done according to its size, weight and maturity stage. Below is the attached picture of grading standards:



- iii. Cleaning
Will result to higher market appeal and increased price. It reduces physical damage, transport cost and microbial contamination. eg: trimming fruit stems and unnecessary parts of the vegetables.
- iv. Treatment before packing
Washing in 100-200ppm of chlorine or calcinated calcium can result to reduction in Phomopsis rot in eggplant and other vegetables, increasing shelf life and quality of the produce.

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v. Packaging

Greatly reduces the post-harvest loss by packaging according to the produce requirement, distance and mode of transportation. Use clean and rigid container, not to over fill it, and only pack single maturity stage produce per container.

Modified Atmospheric Packaging (MAP) is the process of sealing the produce with commercial low density polyethylene (LDPE), which will create humid condition and slows metabolic processes and water loss.

Refrigerated transportation for perishable produce.

India has only 10,000 to 12,000 refrigerated trucks on road out of 61,000 estimate requirements for perishable produce. And refrigerated transport only makes sense for the transportation of perishable produce, which actually occupies only 1000 to 2000 trucks. So, a dire need of transportation is needed for smooth transportation of agri-food produce overall.

In India, about 104 million MT of perishable produce are transported between cities and only 4 million MT uses the refrigerated trucks. Mainly because, >80% of the refrigerated trucks available are used for transportation of dairy produce which results in higher profit.

For particularly perishable produce, after the pack-house the it should be handled with care and loaded to the refrigerated trucks. The price of the transportation increases 3 to 4 times than without refer trucks. So, the refrigerated truck must be used strategically according to distance and the produce requirement.

This issue of refrigerated truck can again be eliminated using proper pack-house placement which increases the shelf-life. It will be an attractive alternative to the expensive refrigerated transport. However, USA transports about 80-85% of its perishable agri-food produce within cities using refrigerated transport system.

“Driver relay model” can be opted to make this chain efficient. Where, each driver drives for around 300km and another driver replaces him and so on. After, reaching the destination, while returning the same driver would be waiting at the left-over point to finally return in the original destination. These results in efficient commute i.e.: reduction of transit time by 50% with consideration to driver efficiency, as currently practiced by Rivigo, 2017.

VI. GOVERNMENT INITIATIVES

- i. ICAR-Directorate on Onion and Garlic Research, Pune under public private partnership mode have performed various R&D and came up with DOGR Cold Storage.

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DOGR cold storage maintains the threshold requirement to increase shelf-life of the produces like onion, potato, banana ripening.

DOGR as compared to other form of storage is much more economical and farmers can make it in their own farm for value addition. DOGR storage maintains temperature of 27 ± 2 °C and relative humidity of 60-65% including air circulation system.

Hence, after 120 days of storage in DOGR only 7.14% of produce was accounted for storage losses as compared to 54.89% in ventilated traditional storage. *Source: ICAR-Directorate on Onion and Garlic Research, Pune*

- ii. Agricultural and Processed food Products Export Development Authority (APEDA). One of the main responsibilities is to develop and promote the export of the specified product.
APEDA is a government body which aims to increase the export of the particular product by increasing the efficiency and distribution of Pack-houses and Cold chain logistic chain.
Some of the Functions of APEDA:
 - Providing monetary backup or financial assistance for the development of Industries concerning the particular product.
 - Foreseeing the improvement in marketing and packaging of the product.
 - Inspecting the processing plants, slaughter houses, storage premises on a regular basis.
- iii. The Government of West Bengal has come up with the initiative of providing free cold storage to one of the state's major produce, Potato. It can be kept free of cost only until December 15, 2018 to reduce price fluctuations and It is estimated that the state produces over 100 lakh tonnes in 2018.
- iv. Haryana government has funded around 510.54 crore in the horticulture project which aims to establish 140 pack-houses associating more than 20,000 farmers.
- v. Government with the aid of Indian Institute of packaging has set out standards for packaging for fruits and vegetables like grapes, mango, tindola, custard apple, onion, potato, banana, oranges, green chilly etc
- vi. Government has come out with transverse initiatives like Goods and Services Tax (GST) which aims to broaden market for the small holder farmers, improve price realization, decrease price fluctuations and decrease the lead time for perishable goods.
- vii. Government also has facilitated warehouse receipt financing which aims to ease the process involve in supply chain.
- viii. Private institutions such as BigBasket, Haldiram's and Amul have got the approval from the Government to set up 101 cold chain projects. This is mainly aimed at increasing the cold storage by 2.76 lakh tonnes capacity, apart from creating huge employment opportunities. Big Basket generally use the cold storage for Fruits and Vegetables.

VII. CONCLUSION

The problem of post-harvest loss is immense and if untreated will only result in more loss and dampening of our natural resources. As per the articles (in reference) the post-harvest loss per year amounting to 90,000 crores can be used to feed 5 crore people for a year, and that same amount 90,000 crore is enough to resolve the whole issue by keeping enough pack-houses and refrigerated transportation.

The introduction of innovative techniques such as improving the pack-house technology and introducing refrigerated vehicles should be the main focus as it will not only minimize the losses but also will raise probability for India to transform agri-food produce as its competitive advantage.

Similarly, the study declares the presence of government and private sectors involvement, which has provided a lot of incentives and encouragement to further improve the scenario, but there is certainly an undeniable gap between the available and the needed resources.

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Hence, all in all looking at international level how the developed countries have utilized its resources efficiently and come up with solution for their problems, we believe even India can overcome this problem in the upcoming years.

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