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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

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ACKNOWLEDGMENTS

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APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

UNPUBLISHED DISSERTATIONS AND THESES

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

ANALYSIS OF SOURCES OF FRUIT WASTAGES IN COLD STORAGE UNITS IN TAMILNADU

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ABSTRACT

Inspite of being the second largest producer of fruits, nearly 72 % of fruits is wasted in India. With a high percentage of waste of fruits, the value loss could be imagined. By minimizing wastage of fruits, the return to producer, processors and retail vendors could be increased considerably. Cold storage plays major role to rescue these problems. Since fruits wastage in processing stage and retail outlets already been done by the same researcher, he came to know that cold storage also causing wastage at some extent. Hence analysis of sources for wastage of fruits in cold storage is undertaken to suggest ways out to minimize this loss and improve the return to the producer, processors and retail vendors. Data has been collected from 37 cold storage units in Tamilnadu through in-depth interview with top level management executives. It is found that around 34% of fruits are getting waste from entry to exit in cold storages. This study has found major sources of wastages and prioritizes them based on quantity and value loss. This research is confined to the cold storage units in Tamilnadu, which is one of leading producer of fruits in India.

KEYWORDS

Agriculture, Automation, Cold storage, Fruit wastage, Value loss.

INTRODUCTION

The contribution of agriculture to India's GDP at the time of Independence was 70% and it accounted for 85% of total employment[12]. The share of agriculture in the country's GDP has been gradually declining since then. At present, the contribution of agriculture to GDP is about 25%, but it still engages about 70% of the population[12]. The annual average rate of growth of agricultural GDP has also declined from around 3.5% during mid eighties to mere 1.5 % during 2006-07[12]. It is estimated that if the country has to maintain a GDP growth rate of over 8%, the agricultural sector has to grow at the rate of at least 4%[12]. The country has a huge potential for growth in agriculture with about 160 million hectares of arable land and diverse agro climatic conditions, suitable for cultivation of a wide variety of crops[12].

India is the second largest producer of overall fruits. A fresh estimate from the ministry of food processing says a whopping Rs 58,000 crore (Rs 580 billion) worth of agriculture food items get wasted in the country every year[14]. Officials said only 7% of food in India is processed[18]. Out of that the fruits and vegetable processing level in India is estimated to be around 2% as compared to about 80% in Malaysia, 30% in Thailand, and 60-70% in the UK and USA[19]. The production of vegetables in India is next only to China. The vegetable and fruit production contributes more than 30 percent of the agriculture GDP. The crop diversification has led to rise in horticulture production, which has reached 185.2 billion tonnes in 2007[16]. India produces over 46 million tonnes of fruits accounting for around 10% of the world's production[12]. About 72 percent of the fruit and vegetable production in India goes waste[16]. In spite of being a major producer of fruits, a large quantity is wasted in the absence of storage, logistics and processing support. Since fruits wastage in processing stage and retail outlets already been done by the same researcher, he came to know that cold storage also causing wastage at some extent. This research is confined to the cold storage units in Tamilnadu, which is one of leading producer of fruits in India.

REVIEW OF LITERATURE

M. Fehr and D.C. Romão conducted study on modeling the success of fruit and vegetable marketing. This study develops a scoring guide that can assist commercial establishments and households in evaluating and mitigating the loss potential for fruit and vegetables within their operations. The scoring model separately addresses losses related to products and losses related to establishments. Losses by product are presented as a function of the sum total of points attributed to the various handling stages which shown by following equation. PL = f (C+P+T+S). Where, PL product loss %, C classification stage score, P packaging stage score, T transport stage score, S storage stage score. The individual scores for each stage are average scores obtained upon evaluating all occurrences of the respective stages. Losses by establishment are presented as a function of the sum total of points attributed to the various managerial responsibilities as shown by following equation. EL = f (M+H+Q+V+2A) / 6. Where, EL establishment loss %, M maintenance of premises, H qualification of human talents involved, Q quality of products upon purchase, V physical or virtual purchase strategy, A efficiency of the administration with weighing factor 2. The scores determined for each responsibility are averaged to obtain a single value for the establishment loss. This equation is specific for each type of establishment evaluated. Score sheets have been prepared from the experience of this research for wholesalers, retailers and consumers. The score for the products evaluates the activities of sorting, packaging, transport and storage. The model proposed here addresses the waste figure of 18% determined experimentally by the authors. It is the result of research done in all instances of the marketing and consumption chain of fruit and vegetables. The model is primarily a qualitative evaluation of all the handling and administrative procedures that influence the fitness for consumption of the produce at the end of its trajectory when it appears in the kitchen for meal preparation. The model addresses separately the two basic components of good marketing practice: attention to the general characteristics of each item of produce and specific management methods of each establishment. Hence this study has given an idea about fruit wastages during some of the operations like sorting, packaging, transport and storage[1].

Katinka Weinberger, Christian Genova II, Antonio Acedo studied Quantifying postharvest loss in fruits and vegetables along the supply chain in Vietnam, Cambodia and Laos. This study finds that the average loss of the selected vegetables is about 17%, and that farmers are the most vulnerable group compared to middlemen and retailers who both have more control on product prices. It recommends developing measures to contain disease problems for farmers, and improving marketing efficiency through standardization of product quality for middlemen and retailers. This study investigates the volume and value of vegetable losses upstream along the supply chain, and identifies the main reasons and the preventive measures undertaken at each stage in the supply chain to abate postharvest losses[2].

Pramila Tripath and A.K. Shukla conducted study for the application of essential oils for postharvest control of stem end rot of mango fruits during storage. From this study we could understand that there is a loss due to rot during the storage of mangos. Hence this study facilitates to control the loss through

technically by using essential oils. But this study has not given any empirical data about loss of mangoes due to rot during the storage, but we could conclude that there may be a loss due to rot during the storage[3].

Rory C. Flemmer and Claire L. Flemmer was made study on Innovations in fruit packing for both kiwi fruit and apples. They were discovered two innovative packing methods. Firstly, a novel packing line for kiwifruit and secondly, an automated apple packing system. Through which they were minimized wastage during packing and transportation. Hence, from this study we could find out that fruit wastages can happen due to packing methods[4].

Bundit Jarimopas, Dolhathai Rachanukroa and Sher Paul Singh conducted study for the development of a new retail packaging for sweet tamarind. From this study, authors were trying to determining post-harvest damage to sweet tamarind that has been packaged for sale and making comparisons in performance between current and new forms of packaging for sweet tamarind. Finally they were developed new packaging system for tamarind which provides additional protection and its cost is equivalent to the cost of plastic bags and about half that of paperboard boxes. This study is also giving idea about importance of packaging system for the fruits for reducing wastage[5].

S.F. AL-Zenki, H.M. AL-Mazeedi, S.N. AL-Hooti, T. AL-Ati, Q. AL-Matawah, H.F. Alomirah and Jiwan S. Sidhu conducted study on Characterization of quality and safety of tomatoes sold in the state of Kuwait. This study determined the microbiological quality and safety of locally produced and imported tomatoes at selected points of the food chain. To accomplish this objective, a survey was conducted to obtain necessary information on the various links in the food chain for tomatoes. The food chain operational links for local and imported tomatoes were then prepared. Microbiological assessment of tomatoes was then carried out by collecting samples from local farms, retail and wholesale outlets. Authors were conducted different micro biological studies and found that there were lots of microorganisms in the tomato samples during supply chain transportation. Hence we could understand that there will be chances of fruit wastages during the supply chain activities and transportation[6].

Suresh Tiwari, D.K. Tandon and Elda B. Esguerra studied Chilling injury as an indicator of critical temperature for cold storage of guava. The critical temperature for cold storage of guava and the changes in physico-chemical attributes during its storage were studied. Fruits were stored at 5, 8 and 15° C with 85–90% relative humidity and withdrawn weekly from cold storage and kept at ambient condition (18–20° C and 65–70% RH) for analysis. Chilling Injury (CI) symptoms, characterized by browning of peel, development of pitting on fruit surface and desiccation of fruit, appeared after 2 weeks in the fruits stored at 5° C. These symptoms became more aggravated when the storage at ambient condition prolonged upto 6 days and when the fruits did not ripen uniformly. The CI symptoms in the fruits stored at 5° C showed membrane damage, i.e. higher electrolyte leakage values and low ethylene levels. However, the fruits stored at 8 and 15° C did not exhibit any symptoms of CI and ripened well until 3 weeks of cold storage. From this study we could identified that, temperature variations can cause the fruits damage and wastage. Hence we can take temperature variations is one of the factor for our study[7].

A. Frank Bollen conducted a study on technological innovations in sensors for assessment of postharvest mechanical handling systems. Produce damage is a major cause of large postharvest losses internationally. The current level of technology that can enable researchers and industry to understand the mechanical reasons for these levels of damage is discussed in this study. A probabilistic description for damage likelihood is introduced that describes the damage in terms of the proportion of a product's population that will sustain some commercially significant bruise size. These two relationships can then be combined to provide an estimate of the level of damage that can be expected from any handling event. Hence we could understand that, there will be chances for fruit wastages due to poor handling systems[8].

Errol W. Hewett had studied pre-harvest factors influencing post-harvest quality of horticultural products. This study concluded that farmers, scientists, extension specialists and market personnel must work together to provide knowledge, best practices and enabling tools for growers to ensure pre-harvest conditions are optimized for production of high quality horticultural crops like fruits and vegetables that titillate, satisfy and reward discerning consumers. From this study we could find out that pre-harvest practices can cause the fruit wastages at farm level itself[9].

Veena A, K. Nagendra Babu and H.R. Venkatesha studied the supply chain in marketing fresh produce. As per the survey conducted for this study, important drawbacks of the current Supply Chain (SC) are number of intermediaries, high level of wastage, quality degradation, poor infrastructural facilities and high cost. Fresh produce market has immense influence on the socioeconomic and even political conditions. Close to 30% of the F&V grown is going waste. All the stakeholders have to join hands to improve SC mechanism to take produce from the farmers to the consumers. This would facilitate the consumers to get quality produce at economical rates. The middlemen and all the stakeholders in the SC benefit from the improved SC infrastructure. Government and private operators have to join hands to improve the physical infrastructure, information sharing, and the service required for quality improvement of the SC. Hence this study clearly gives the views on fruit wastages due to poor supply chain mechanism[10].

Saurabh Singh studied on sustainable supply chain model for strawberry in uttarakhand. The study found a need for sustainable supply chain model to promote distribution of locally grown strawberry in nearby markets. Once the market is developed, the acreage under strawberry can be increased considerably, which is a good alternative source of income, providing net income of about Rs 70,000-80,000/acre/season to the growers. This study is not directly giving any details about fruit wastage, but this study help us to understand about importance of supply chain to increase farmers' income. Objective of our study is also the same concept like; we could increase the farmers' income by minimizing fruit wastages[11].

A study focusing on major issues that exist in the supply chain of fruits and vegetables include the losses during post harvest handling, processing, packaging and transportation was undertaken. The loss of fruits and vegetables during transportation is said to be in the range of 20 - 30% in countries like China and India. In many countries including China and India - two largest producers of fresh fruits and vegetables in the world - the existing cold storage facilities, reefer vehicles, product traceability solutions and other infrastructural facilities are insufficient to counter the problem of high supply chain losses[13].

Ministry of Food Processing Industry (MFPI), Government of India says that inadequate infrastructure has been identified as a major constraint in the growth of fruit and vegetable processing industries. Without a strong and dependable cold chain, a vital sector like F&V processing industry, which is based mostly on perishable products, cannot survive and grow. Even at currents level of production, wastage in F&V is estimated at 35%, major reasons being inadequate storage, transportation, cold chain facilities and other infrastructure support facilities. Government of India has been implementing several schemes for facilitating creation of infrastructure for food processing including the following components relevant for F&V processing sector: Food Parks, Packaging Centers, Integrated Cold Chain Facility, Value Added Centers and Irradiation Facilities[17].

The Hindu News paper dated, Jun 25, 2010, Friday stated that Around 5 to 10 per cent of vegetables and fruits that arrive at the Koyambedu wholesale market in the city are wasted daily for want of proper temperature-controlled storage facilities, according to the traders. The market receives around 3,000 tonnes of vegetables every day. The arrival at the fruits market is anywhere between 1,500 and 2,000 tonnes daily. A government-run cold storage facility is available near the market. But its patronage is low as traders say that maintenance of the facility is inadequate. Wholesale trader K. Ponraj said if maintained properly the facility would help in storing at least some amount of the excess produce that arrives in the market. V. R. Soundararajan, one of the members of the Koyambedu Market Management Committee, said different vegetables and fruits have to be stored at different temperatures. But, it is not being followed properly at the cold storage facility. The cold storage, belonging to the Tamil Nadu Co-operative Marketing Federation Ltd (TANFED), has a capacity to store 2,500 tonnes. Officials of the Federation said only 60 per cent of the facility is being used and about 300 customers patronize it. The produce is stored between two degree Celsius and four degree Celsius according to the requirements of the customers. The officials complained that private cold storage plants are operated by some of the traders in the market, resulting in low patronage for the government-run facility. Traders said that two or three such private facilities were available to store mushrooms[15].

NEED FOR THE STUDY

Though India is the second largest producer of fruits, nearly 72 % of fruits is wasted in India. With a high percentage of waste of fruits, the value loss could be imagined. By minimizing wastage of fruits, the return to producer, processors and retail vendors could be increased considerably. Cold storage plays major role to rescue the wastage problems. Since fruits wastage in processing stage and retail outlets already been done by the same researcher, he came to know that cold storage also causing wastage at some extent. Hence analysis of sources for wastage of fruits in cold storage is undertaken to suggest ways out to minimize this loss and improve the return to the producer, processors and retail vendors.

STATEMENT OF THE PROBLEM

Since the gap between total fruits production (46 million tonnes)[12] and processing (2%)[14] is very high, Indian government is taking lot of measures and schemes towards increase of cold storage and processing industry in order to minimize the fruit wastages. Hence, this study is focusing to find out whether the cold storages are really minimizing the fruit wastages or not. This could be accomplished by finding out various causes and resources of fruit wastages in cold storages. Moreover this study offers solutions to minimize the fruit wastages in cold storages in order to make them as ultimate destinations for utilization of maximum fruits with minimum wastages.

OBJECTIVES

- To identify different factors determining the fruit wastages in cold storages
- To prioritize the causes of wastages (based on quantity of wastages) so as to indicate their relative importance and also to develop suggestive preventive measures and solutions to minimize the wastages

RESEARCH METHODOLOGY

This study has been designed in descriptive in nature. This study included owners and top management executives of cold storages. Population details were collected from MSME office at Chennai and Tamilnadu. Details about 43 cold storage units in Tamilnadu were collected which constituted the population database for this study. From the population database, a sample of 37 cold storage units, were selected for collecting the data based on their validity of contact information. After a week of pilot study with few executives and experts, and with the help of review of literature, researcher has found different sources of wastages of fruits in cold storage units. Based on this information and researcher's expertise in the food processing field, data was collected through in-depth interview with respondents. After collecting the data, they were edited based on validity and reliability and then tabulated for analysis purpose. Frequency tests, weighted average and factor analysis were utilized for analyzing the data.

DATA ANALYSIS

Following 12 variables were identified with the help of the articles reviewed above and also based on the researcher's experience in the field of food processing industries and pilot study feedback.

TABLE – 1: VARIABLES AS DIFFERENT TYPES OF FRUIT WASTAGES

Sl. No	Variables (Different types of fruit wastages)
1	Wastage due to Improper storage conditions and poor maintenance of cold storages
2	Wastage during handling (Due to Manual handling, bulk handling, labor laziness etc)
3	Wastage during ripening through natural ripening (Due to beaten spots, microbes etc)
4	Wastage due to packaging (Due to Improper packaging, poor packaging materials etc
5	Wastage during transportation (Due to Over load, long drive, poor containers etc)
6	Wastage due to temperature variations (Due to internal temperature of fruits, external temperature of cold storage etc)
7	Pre harvest wastage (Immature harvesting, poor harvesting methods and equipments etc
8	Post harvest wastage (handling, transportation, ripening, storage etc)
9	Wastage due to un sold stock

TOTAL WASTAGES IN COLD STORAGE UNITS

Following table shows the wastages in cold storage units.

TABLE – 2: TOTAL WASTAGE IN COLD STORAGE UNITS

Sl. No	Sources of Wastages	% of Wastages
1	Wastage due to Improper storage conditions and poor maintenance of cold storages	2.7
2	Wastage during handling (Due to Manual handling, bulk handling, labor laziness etc)	3.3
3	Wastage during ripening through natural ripening (Due to beaten spots, microbes etc)	5.78
4	Wastage due to packaging (Due to Improper packaging, poor packaging materials etc	7.4
5	Wastage during transportation (Due to Over load, long drive, poor containers etc)	7.23
6	Wastage due to temperature variations (Due to internal temperature of fruits, external temperature of cold storage etc)	5.78
7	Wastage due to un sold	1.75
	Total Wastages	**33.94**

(Source: Primary data)

(Note: Two variables i.e Pre harvest and post harvest wastage are not taken to the count since they are not belongs to the cold storage units. They have included in variables, since they are creating impact for wastage of fruits in cold storage which is suggested by industry experts)

PRIORITIZING THE WASTAGES RESOURCES IN COLD STORAGE UNITS

Weighted score has been calculated for prioritizing the wastage resources in cold storage units. Following procedure was followed for calculating weighted score.

WEIGHTED SCORE CALCULATION PROCEDURE

- Each variable had 5 different options as frequencies. Each respondent have responded one option among 5 options. [Ex: (1) 1 – 2; (2) 3 – 5; (3) 6 – 10; (4) 11 – 15; (5) 16 – 20]
- All the options were given as range. Hence mean value of range has taken for calculating weighted score. [Ex: (1) 1 to 2; (2) 3 to 5; (3) 6 to 10; (4) 11 to 15; (5) 16 to 20]
- Now median value of each option was multiplied by number of respondents responded for the same option and calculated the summation of values of each option. This value considered as weighted score for the respective variable. [Ex: (1.5 X 5) + (4 X 7) + (8 X 1) + (13 X 1)] = 56.50
- Similarly weighted score was calculated for all the variables.
- Weighted score of all the variables were sorted based on descending order to prioritize the variables.

TABLE – 3: PRIORITIZING THE WASTAGES RESOURCES FOR COLD STORAGE UNITS

Variables	Frequency					Weighted score	Descending order of weighted score	Respective variable code	Respective variable name (Priority)
1	13	4	3	0	0	59.50	347.00	10	Post harvest wastage (1)
2	10	8	2	0	0	63.00	232.00	9	Pre harvest wastage (2)
3	16	2	0	0	0	106.00	131.00	7	Wastage during transportation (3)
4	9	9	2	0	0	120.50	120.50	6	Wastage due to packaging (4)
5	0	11	6	3	0	131.00	106.00	4	Wastage during ripening through natural ripening (5)
6	2	11	7	0	0	103.00	103.00	8	Wastage due to temperature variations (6)
7	4	8	6	0	0	232.00	63.00	2	Wastage during handling (7)
8	3	5	6	3	3	347.00	59.50	1	Wastage due to poor storage conditions (8)
9	17	1	2	0	0	45.50	45.50	11	Wastage due to un sold (9)

(Source: Primary data weighted score analysis)

FACTOR ANALYSIS

KMO AND BARTLETT'S TEST

TABLE – 4: KMO AND BARTLETT'S TEST

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.329
Bartlett's Test of Sphericity	Approx. Chi-Square	55.773
	df	36
	Sig.	.019

(Source: Primary data SPSS analysis)

EIGEN VALUES AND LOADINGS

TABLE – 5: FACTOR ANALYSIS FOR COLD STORAGE WASTAGE

Total Variance Explained									
Factor Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.839	31.545	31.545	2.839	31.545	31.545	2.306	25.627	25.627
2	2.068	22.976	54.522	2.068	22.976	54.522	2.266	25.172	50.799
3	1.240	13.774	68.295	1.240	13.774	68.295	1.575	17.496	68.295
4	.790	8.780	77.075						
5	.712	7.917	84.992						
6	.615	6.831	91.823						
7	.400	4.439	96.263						
8	.286	3.179	99.442						
9	.050	.558	100.000						
Extraction Method: Principal Component Analysis.									

(Source: Primary data SPSS analysis)

ROTATED COMPONENT MATRIX

TABLE – 6: FACTOR ANALYSIS FOR STORAGE WASTAGE – ROTATED COMPONENT MATRIX

	Component		
	1	2	3
Wastage during Storage	.715	.176	.085
Wastage during Handling	.624	-.244	.455
Wastage during natural ripening	.742	.157	.067
Wastage during Packaging	.198	.839	.224
Wastage during Transportation	.176	.846	.193
Wastage due to temperature variations	.866	-.069	-.073
Pre harvest wastages	.074	.107	.844
Post harvest wastages	-.168	.831	-.074
Wastage due to unsold	-.027	-.149	-.738
Extraction Method: Principal Component Analysis. ***Rotation Method:*** Varimax with Kaiser Normalization. Rotation converged in 5 iterations.			

(Source: Primary data SPSS analysis)

RESULTS AND DISCUSSIONS

As we stated in table-2, 33.94% of fruit wastages occur in cold storages. Cold storage respondents are expressing that most of the fruit wastages are happening at farm level in both post harvest and pre harvest stages. These factors are ranked first and second respectively in fruit wastages as per analysis given above. These respondents are quoting poor harvesting methodologies and techniques, post harvest handling, packing and transportation for post harvest wastages. Immature fruit harvesting, loss of flowers, natural calamities like heavy rain and wind, pesticide penetration, ants, birds and rodents are the reasons for pre-harvest wastages. Immature fruit harvesting and penetration of pesticide, ants and rodents are leading to post-harvest spoilages during ripening. Cold storage respondents are suggesting that to avoid all these types of wastes is to educate and create awareness among the farmers.

The third reason for wastage in cold storages is due to transportation. As discussed earlier, Lack of road facilities, poor road conditions and bulk volume (overload) of transportation are considered as major reasons for this wastage. Cold storage units and fruit processors are expecting government to provide good road facilities and concessional rate for transportation of fruits in order to transporting optimal quantity of fruits per load.

Fourth major reason for fruit wastage in cold storages is packing. Poor packing method and packing materials result in more spoilage of fruits. Cold storage respondents are complaining on domestic packing. They reported that import packages are far better than the domestic packages that wastage in domestic packing is higher than the international packing. Though there are some packing standards (Specified by the government) for fruits, suppliers are not followed due to non-monitoring and absence of severe actions to penalize if deviation from the standards. This could be overcome by continuous monitoring of fruit packing by concerned authority and implementation of penalty whenever deviation is noticed from the standards.

The fifth reason for wastages of fruits in cold storage is natural ripening process. Most of the cold storage units are not undertaking ripening process. Very few units undertake ripening process in a limited way. Since it is occasional process, no cold storage units are interested to adapt ripening chamber technique to

ripen the fruits. Hence, wastage is increasing during natural ripening process. Some of the cold storage units are reduced this type of wastage by sorting and selecting good fruits for ripening and storage process.

Temperature variation in internal fruit pulp and external refrigeration temperature is the sixth source for fruit wastages in cold storages. Cold storage units are purchasing fruits from different regions with different climatic conditions. Hence internal pulp temperature of fruits is varying from fruit to fruit. Moreover, cold storage units are purchasing different types and varieties of fruits. Each and every type or variety of fruit needs different ripening and storage conditions in terms of temperature. These lead to waste of fruits. These kinds of wastages can be overcome by limiting to few varieties of fruits and purchasing from specified regions. Otherwise, fruit processors can segregate their ripening and storage area based on type and variety of fruits.

Wastage during handling is the seventh source for fruits wastage in cold storage units. Reasons and justifications are same as fruit processing industry handling, which has been already discussed.

The eighth reason for fruit wastage in cold storage units is during storage. It is very negligible in case of cold storage units, because most of the cold storage units are storing fruits after the sorting and selecting of good fruits. Hence, wastage during storage in cold storage units is minimized.

The ninth reason for fruit wastage in cold storage is unsold stock. This reason would not be applicable for all cold storages because all cold storages are not dealing with retail sale. Most of the cold storage units are operating based on space rental basis. Whatever the fruits keeping inside the cold storage by the clients, same will be taken again by the client. i.e. input and output quantity of fruits is the same in cold storages for clients. Hence, unsold fruits are at the risk of clients. In this study researcher has collected data with two cold storages, which deals with retail sales. Other cold storages are not dealing with retail market, but wastage is higher for those two cold storages, which deal with retail sales. A more detailed study involving a large number of cold storage units with provision for retail sales, might give a more comprehensive picture, thereby affecting the ranking of the reasons for wastages.

DISCUSSIONS ON FACTOR ANALYSIS

From the table 9, it is clear that first three components are contributed 68% of wastage in cold storage units since eigen values are greater than 1 for all these three components. From the table 10, it is discovered that, out of these three components, first component contains 4 factors with heavy loading viz. Wastage during storage, wastage during handling, wastage during natural ripening and wastage due to temperature variations. Second component contains 3 factors with heavy loading viz. Wastage during packaging, wastage during transportation and wastage due to post harvest activities. Third component contains only one factor with heavy loading i.e. wastage due to pre harvest activities.

By considering all these factors, we could understand that cold storage units are realizing wastage of fruits at two different levels such as in side of the cold storage units and outside of the units. Inside wastage is happening due to poor infrastructure facilities and manual handling. Not all the cold storage units are having infrastructure problems. Most of the private cold storage units are having good infrastructure facilities and maintain the same quality throw out the year, but some of the government running cold storage units and co-operative cold storage units having maintenance problem. Moreover, they are handling the fruits by manual. Hence, they are realizing more wastage during storage. Both private and government cold storage units are facing common technical problem due to internal pulp temperature. They could not maintain separate temperature for separate variety of fruits. This also leads the wastage of fruits in cold storage units. Except these types wastage, cold storage units are blaming all other wastages on the farmers such as pre harvest, post harvest activities, natural ripening, poor packing and poor transportation. Hence, researcher has suggested that, cold storage units are having good infrastructure, but they have to maintain properly and follow the handling procedure as per system in order to minimize fruits wastages. Instead of maintaining separate cold storage units for separate fruits due to temperature variations, they can allocate different zones in same cold storage unit for same temperature fruits groups and they can maintain separate temperature by using temperature regulator for each zone. For minimizing farm level, packaging and supply chain wastages, cold chain units can educate and give training to the farmers about pre harvest, post harvest, ripening and packaging methodologies for minimizing wastages by making them to realize quantity and value loss due to their unawareness and careless.

FINDINGS

Through the data analysis, it is found that around 34% of fruits are going waste in cold storage for various reasons. From the weighted score analysis it is found that, post harvest and pre harvest activities create more impact on wastages which are plays first and second rank respectively for sources of wastages. Transportation and Packaging follows the next third and fourth respectively. Wastage due to unsold stock and poor storage conditions are playing the least role for wastage of fruits in cold storage. From the factor analysis, except unsold stock wastage, all other wastage variables are found to be important.

CONCLUSION

This study discovers the total quantity of wastages in cold storage units is around 34%. It means that, if a cold storage unit purchases the fruits with the cost of Rs. 100, then they realize Rs.34 as wastage. Apart from this wastage quantity, they have to fix up some margin as a profit. For example, if we consider just 10% profit for the cold storage units, around Rs. 44 increasing (Purchasing price Rs.100 and selling price Rs.144) just for storage without any value addition. If they reduce percentage of wastage, then they could sell more due to decreased selling price so as to they could realize more profit and they can create opportunities for producers, processors and retail vendors for more profit making. Moreover, this study reveals the different reasons and causes for fruit wastages in cold storages through weighted score and factor analysis. If they concentrate on those reasons, they could reduce their fruit wastage as well as value loss for all the people those who rely on fruits tremendously.

SCOPE FOR FUTURE RESEARCH

Indian government is providing various schemes and funds to set up cold storage units. Hence, it is worthwhile to explore whether government schemes could be utilized by the cold storages effectively. Cold storage respondents are revealing that farm level wastages are high as pre-harvest and post-harvest losses due to lack of awareness about harvesting stages and methods among farmers and poor logistics and supply chain management links etc. This study has brought to light the need to undertake more research in the area of wastage of fruits so as to enable the producers to realize better returns from their business.

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