

POST HARVEST HANDLING PRACTICES ON SELECTED LOCAL FRUITS AND VEGETABLES AT DIFFERENT LEVELS OF THE DISTRIBUTION CHAIN

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ABSTRACT

Proper post harvest handling practices are important to reduce post harvest losses and improve overall harvest quality. However, inevitable post harvest losses occur during post harvest handling at different levels of the distribution chain. A survey was conducted at different levels of the distribution chain where 634 respondents were surveyed from various zones to identify post harvest handling activities that were practised, the potential post harvest activities that can be carried out, and the factors contributing to post harvest losses. The results showed that 27% of fruits and vegetables were sent directly to the wholesaler without any post harvest handling activities. The remaining was weighed (25%), packed (17%) and washed (10%). Among the post harvest handling activities, packaging (23.8%) had the highest potential of reducing post harvest losses. A majority of the farmers did not perform potential post harvest handling activities mainly because of insufficient knowledge.

As for the four categories (knowledge, attitude, infrastructure and resources) identified contributing to post harvest losses, the results showed that 36.7% was due to insufficient knowledge of good handling practices, 50.3% due to inefficient/improper handling systems, 51.9% due to improper infrastructure and 38.8% due to insufficient funding.

Keywords: Post harvest handling practices, post harvest losses, distribution chains, fruits and vegetables.

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INTRODUCTION

The basic policies and strategic directions for the fruit and vegetable industry in Malaysia had been outlined in the Third National Agricultural Policy (1998-2010) and amplified by the Ministry of Agriculture and Agro-based Industries through its key agencies (Thiran, 2004). The basic recommendations for maintaining post harvest quality and safety of produce are the same regardless of the distribution system (direct marketing, local marketing, export marketing) (Kader and Rolle, 2004). However, the level of technology needed to produce the recommended conditions varies in accordance with distance and time between production and consumption sites, the intended use of the produce (fresh vs processing) and the target market (Kader and Rolle, 2004). Problems associated with post harvest losses are of worldwide concern as world food demand increases. According to the five principles outlined during the World Summit on Food Security, reducing post harvest losses is one of the resolutions endorsed during the assembly (FAO, 2009). Human factors such as handling practices and attitudes, and technological aspects such as improper infrastructure and handling techniques, could contribute to post harvest losses. Therefore, it is essential to determine the extent of the post harvest handling activities performed at the different levels of the distribution chain. In view of the issues highlighted above, this project was carried out to study post harvest handling activities that are practised, potential post harvest handling activities and the factors that contribute to post harvest losses.

LITERATURE REVIEW

Efforts to reduce post harvest losses of high perishable produce such as fruits and vegetables in developing countries are considered crucial not only to avoid wastage but also to reduce the cost of preventing food losses (Booth and Burton, 1983). Booth and Burton, (1983) considered this to be the less costly option compared to producing a similar additional amount of food of the same quality. Hence, cutting the cost of post harvest losses will reduce prices for the consumers and increase the farmers' income (Panhwar, 2006). Abd. Shukor et al. (2003) pointed out that it is pertinent to evaluate the post harvest handling chain of vegetables in a holistic manner in order to identify the causal factors of post harvest losses and thus provide appropriate control measures. This measure is also applicable to fruits.

Appropriate post harvest handling practices are important to minimize post harvest losses and to maintain the quality of fruits and vegetables. Potential post harvest handling activities include packaging, pre-treatment, pre-cooling, washing with water and sorting. The function of packaging is to protect the produce from mechanical injury and contamination during marketing. It also prevents moisture loss, and facilitates in chemical treatment and ethylene absorption (Kader and Rolle, 2004). Pre-treatment of fruits are mostly carried out to protect the produce from decay causing factors such as microorganisms (Fan et al., 2008, Nasrin et al., 2008), chilling injury (McCollum et al., 1993; Paull et al., 2000) and ripening (Paull et al., 2000). Rapid pre-cooling of commodities with short post harvest shelf life will maintain the produce in a condition acceptable to the consumer because

rapid lowering of temperature could help slow down the rate of metabolism and therefore extend the shelf life of the produce (Panhwar, 2006). Immediate post harvest cooling of produce is necessary for produce intended for transport in refrigerated ships, land vehicles and containers which are not designed to handle the full load of field heat but which are capable of maintaining pre-cooled produce at a selected carriage temperature so as to ensure minimal loss of water and quality (Barbosa-Cánovas et al., 2003; Panhwar, 2006). Usually, cleaning and washing are the only preservation treatments applied to minimally processed fresh fruits and vegetables (Yildiz, 1994). Cleaning could also involve removal of foreign materials like twigs, stalks, dirt, sand, soil, insects, pesticides and fertiliser residues from fruits and vegetables, as well as from containers and equipment (Yildiz, 1994). In addition, sorting is carried out to discard decayed or injured produce and therefore to limit the spread of infection to other units, especially if no post harvest pesticides are used (Kitinoja and Kader, 2002).

In developing countries, post harvest losses mostly occur during transportation, handling, storage and processing (Barbosa-Cánovas et al., 2003). According to Barbosa-Cánovas et al., (2003), rough handling during preparation for the market increases bruising and mechanical damage and limits the benefits of cooling. In addition, mechanical damage such as tissue wounds, abrasion, breakage, squeezing and escape of fruits or vegetables is caused by inappropriate methods used during harvesting, packaging and inadequate transportation, and thus increase susceptibility to decay and growth of microorganisms (Barbosa-Cánovas et al., 2003). Abd. Shukor et al. (2003) reported that in ASEAN countries, improper handling and packaging, low-level technology, lack of basic equipment and facilities at the packing houses, and lack of trained personnel, commonly contribute to post harvest losses. They also reported that improper post harvest handling of vegetables often results in quality deterioration and significant economic losses. Moreover, they found that post harvest losses for vegetables vary between 20-50% in different countries depending on the handling and distribution chain. Panhwar (2006) too, reported that an estimated value of 9-16% of produce is lost due to post harvest problems during shipment and handling.

METHODOLOGY

This study was carried out with the aim of determining post harvest handling activities that are practised, potential post harvest handling activities and the factors that contribute to post harvest losses of selected local fruits (starfruit, papaya, mango, guava, *limau madu*, pineapple, watermelon, melon group, pomelo and pitaya) and vegetables (Chinese mustard, *kangkung*, sweet corn, French beans, long beans, chilli, tomato, cucumber, Lady's fingers, eggplant, capsicum, cabbage, cauliflower, pumpkin and *keladi cina*).

A survey was conducted to investigate post handling activities from farm gate to consumers (farm, collecting centers/packing house, wholesalers, retailers, transporters and consumers) at eight zones, namely the North Zone (Perlis and Kedah), the East Zone (Kelantan and Pahang), Cameron Highlands, the Middle Zone (Klang Valley, Negeri

Sembilan and Melaka), Johor, Perak, Sabah and Sarawak. The unit of analysis for this study is the individual who represents the different levels of distribution entity. The method of survey employed was through personal interview.

A questionnaire was designed as the research instrument for the study. Only one standard questionnaire was used to cater for all respondents in the different levels of distribution entity. A sample size of 996 was targeted based on distribution functions. However, only 634 respondents were interviewed. The number of respondents interviewed was lower than the number targeted because some of the respondents were responsible for more than one function. Sample size was chosen based on expert judgment of the researchers. Sample size for Johor, the North Zone (Kedah and Perlis), the East Zone (Kelantan and Pahang), the Middle Zone (Kuala Lumpur, Selangor, Negeri Sembilan and Melaka), Cameron Highlands, Perak, Sabah and Sarawak were 68 (10.73%), 97 (15.30%), 117 (18.45%), 39 (6.15%), 79 (12.46%), 76 (11.99%), 80 (12.62%) and 78 (12.30%) respectively. The number of usable questionnaires obtained was 634 (100%). Data on the determination of the post harvest handling activities being practised, potential post harvest handling activities and the factors that contribute to post harvest losses of selected local fruits and vegetables were analysed descriptively (frequency analysis) using SPSS version 15.0.

RESULTS AND DISCUSSION

The respondents' demographic profile obtained from the survey carried out in the selected zones is shown in Table 1. The data obtained indicates that the average age of respondents is 46 years' old and the majority are Chinese (42.8%), followed by Malays (36.4%), others (17.3%) and Indians (3.6%). This indicates that the Chinese are the major players in the Malaysian fruit and vegetable industry. Most of the respondents had only either primary (69.4%) or secondary (29.3%) education, indicating that most of them did not have tertiary education.

Table 1: Respondents' Demographic Profile

Factors	Description	Percent (%)
Race	Malay	36.4
	Chinese	42.8
	Indian	3.6
	Others	17.3
Age	>65 yr	4.3
	56-65 yr	17.0
	46-55 yr	34.5
	36-45 yr	28.6
	26-35 yr	11.4
	<26 yr	4.3

Table 1(Continued)

Education level	Graduate	0.3
	Diploma Holder	0.6
	Technical Certificate	0.3
	SPM/STPM	29.3
	Others	69.4
Number of workers - Family member	0 person	36.3
	1 person	25.2
	2 person	21.0
	3 person	11.2
	4 person	4.3
	5 person	1.1
	6 person	0.8
	7 person	0.2
- Non-family member	0 person	62.5
	1-2 person	15.3
	3-4 person	10.1
	5-7 person	5.8
	8-10 person	3.0
	11-15 person	1.9
	16-20 person	0.3
>20 person	1.1	
Number of foreign workers	0 person	87.9
	1-2 person	4.9
	3-4 person	3.2
	5-6 person	1.3
	7-8 person	0.8
	9-10 person	0.6
	>10 person	1.4
Average worker's working experience	≤1 yr	26.8
	2 yr	11.8
	3-4 yr	14.5
	5-7 yr	22.4
	8-10 yr	12.5
	11-20 yr	7.9
	>20 yr	4.1

Table 2 shows the breakdown of functions played by the respondents. One respondent may perform more than one function. For the zones that were surveyed, the main respondents were wholesalers (32.1%), followed by retailers (31.5%), and growers (24.5%).

Table 2: Breakdown Of Functions Played By The Respondents

Level of Distribution Chain	Percent (%)
Growers	24.5
Wholesalers (Include Agents, Packers, Exporters)	32.1
Retailers	31.5
Transporters	3.1
Storage	1.4
In Transit	6.7
Others	0.6

Figure 1 shows the post harvest handling activities carried out for fruits and vegetables. From the data gathered, 27% of the respondents sent their products directly to the wholesaler without performing any post harvest handling activities. The rest of the farmers performed activities such as weighing (25%), loading onto lorries (21%), packing (17%) and washing (10%).

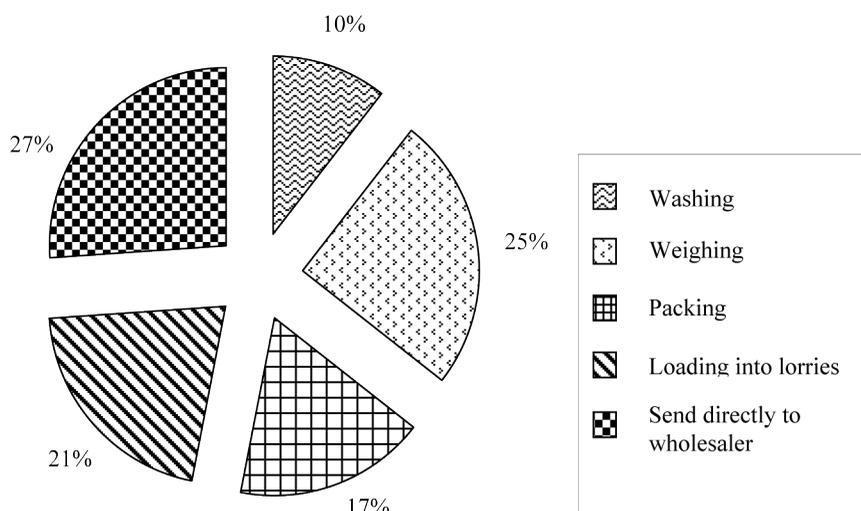


Figure 1: Post Harvest Handling Activities For Fruits And Vegetables

Figure 2 shows the potential post harvest handling activities that can be carried out to reduce post harvest losses. From the responses obtained at the different levels of the distribution chain, packaging (23.8%) of fruits and vegetables has the highest potential in reducing post harvest losses followed by sorting (22.0%), pre-cooling (20.5%), pre-treatment (17.3%) and washing (14.4%).

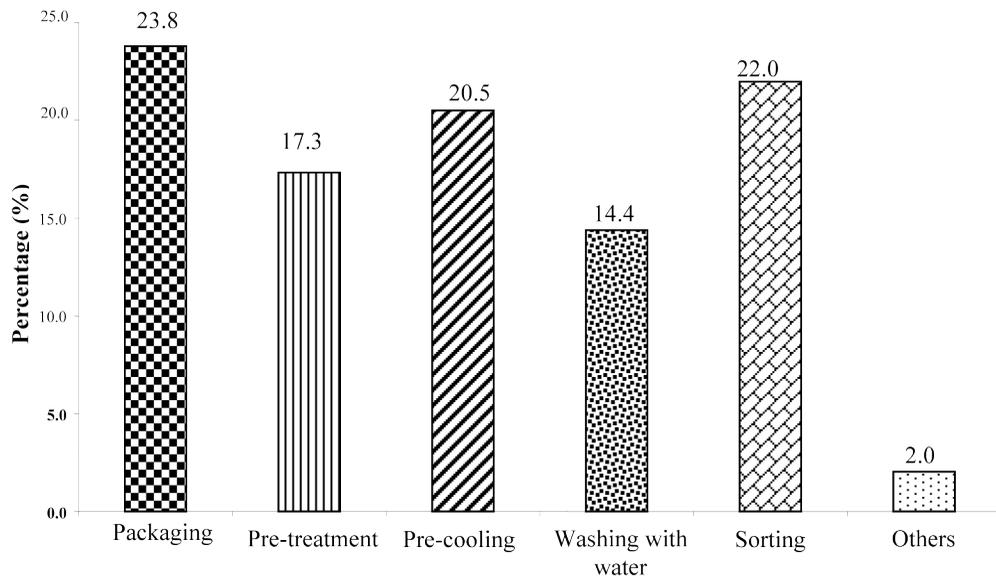


Figure 2: Potential Post Harvest Handling Activities

In the case of packaging, the reason for the respondents not performing it currently was mainly due to insufficient knowledge (25.4%), insufficient funding (22%) and others (22%) (Figure 3), while the reasons for not sorting the fruits and vegetables were due to insufficient knowledge (33.1%), followed by no workers or insufficient number of workers (22%), and insufficient infrastructure (20.5%). As for pre-cooling, the reasons for not performing it were due to insufficient funding (29.4%), followed by insufficient infrastructure (23.5%), and knowledge (22%). It was found that a high percentage of the respondents did not give any pre-treatment to their fruits and vegetables due to insufficient knowledge (32.8%), insufficient funding (19.1%), infrastructure (19.1%) and others (19.7%). Washing of fruits and vegetables was also not carried out. The reasons given by the respondents were insufficient infrastructure (20.4%), insufficient number of workers (19%) and others (35.9%).

Post Harvest Handling Practices on Selected Local Fruits and Vegetables at Different Levels of the Distribution Chain

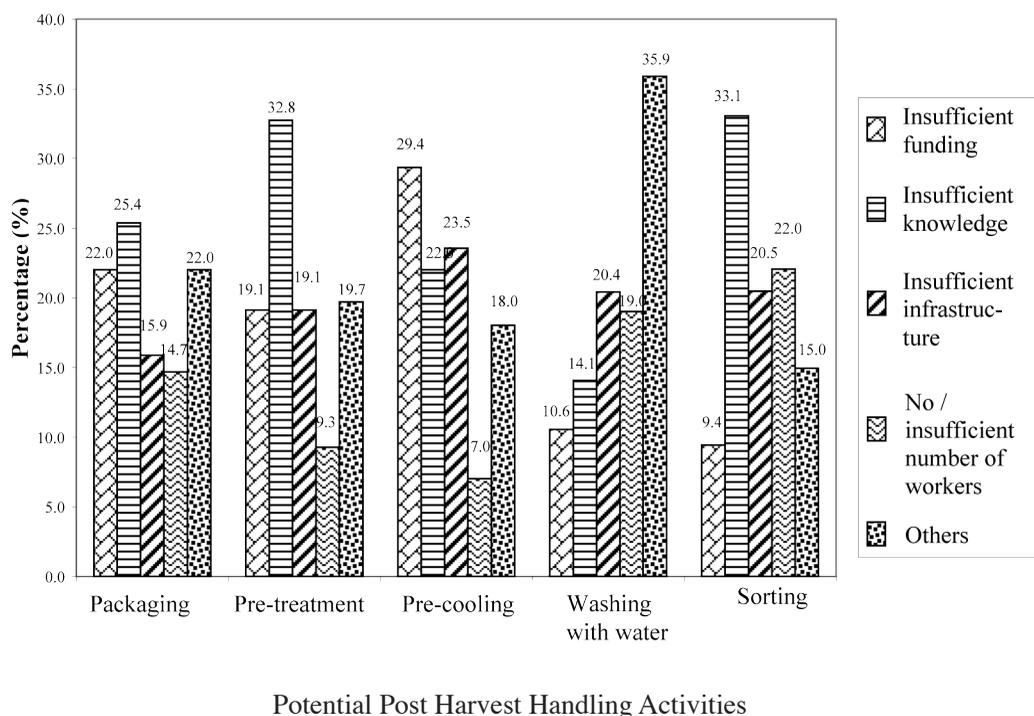


Figure 3: Reasons for Not Performing Potential Post Harvest Handling Activities

* “Others” refer to perceived reasons of the respondents that these activities were not required or there was insufficient time to perform them

In light of the reasons for not performing potential post harvest handling activities, a survey on the level of awareness of usage and availability of government-owned cold rooms, together with availability of post harvest handling technology and facilities provided by government and private agencies, were also carried out (Figure 4). The main reasons for not performing pre-cooling were insufficient funding and infrastructure. However, in many cases, it was necessary to have cold rooms made available in the premises at the different levels of the distribution chain. Data obtained shows that 63% of the respondents at the different levels of the distribution chain were aware of the usage of cold rooms for post harvest handling of fruits and vegetables. However, only 45% of the respondents were aware of the availability of government-owned cold rooms in their areas. It was also observed that 57.3% of the respondents were aware of the availability of post harvest handling technology for fruits and vegetables, and 55.4% of the respondents were aware of facilities, such as financial funding, loans, equipment, courses and adoption programmes that are provided by the government and private agencies. Taken together, the results suggest that insufficient knowledge on potential post harvest activities such as packaging, pre-treatment and sorting, might be the main reason that hinders a wider utilisation of these facilities.

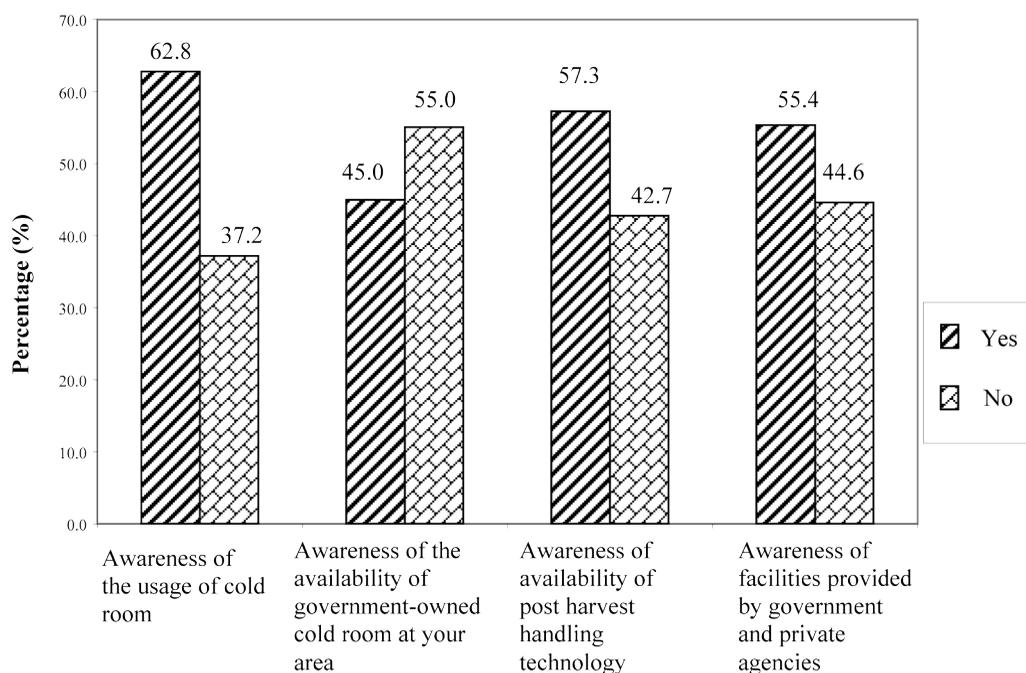


Figure 4: Levels of Awareness at the Different Levels of the Distribution Chain

A response map on the awareness of the availability of cold rooms in the area studied (Figure 5) was constructed and it showed that only 14% of the respondents utilised the facilities. Nevertheless, it was found that only 13% who utilised the cold room facilities were satisfied with the services provided and the remaining 87% were not satisfied. The reasons given by them were high cost (28%), small capacity (25%), insufficient facilities (19%), management bureaucracy (19%) and unsatisfactory management of cold rooms (9%). Among the reasons given by 86% of the respondents who did not utilise the cold room facilities were that there was no requirement for the utilisation of cold rooms (68%) since they sold their fruits and vegetables directly to the wholesaler and retailer; that the location of cold rooms was far from their premises (22%) and also unreasonable rental rates (10%).

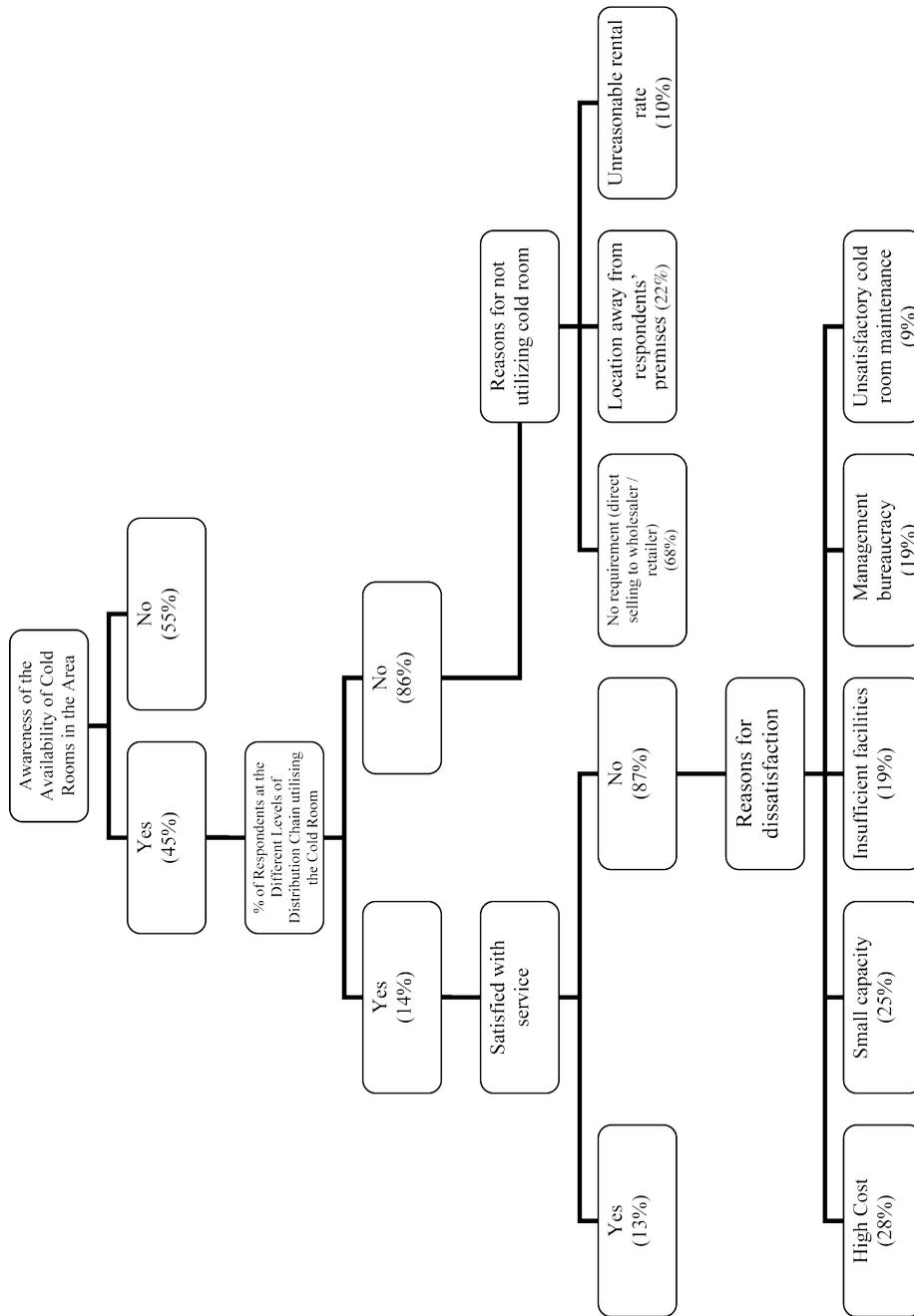


Figure 5 : Response Map of the Awareness of the Availability of Cold Rooms in the Area Studied

Figure 6 shows that with respect to knowledge, it was found that 36.7% of the respondents have insufficient knowledge for good handling practices followed by insufficient knowledge on supply and demand (35.7%), and insufficient knowledge regarding off-season/off-grade product diversification (27.6%). When the attitude of the respondents was surveyed, it was found that inefficient/improper handling systems (50.3%) and workers' apathy (49.7%) were the contributing factors to post harvest losses for fruits and vegetables. Infrastructure was also a contributing factor to the post harvest losses of fruits and vegetables at the different levels of the distribution chain, where 51.9% was due to improper infrastructure and 48.1% was due to insufficient infrastructure. Availability of resources had also influenced post harvest losses. The highest factor was insufficient funding (38.8%), followed by improper equipment (31.6%), and insufficient equipment (29.6%) for good handling practices.

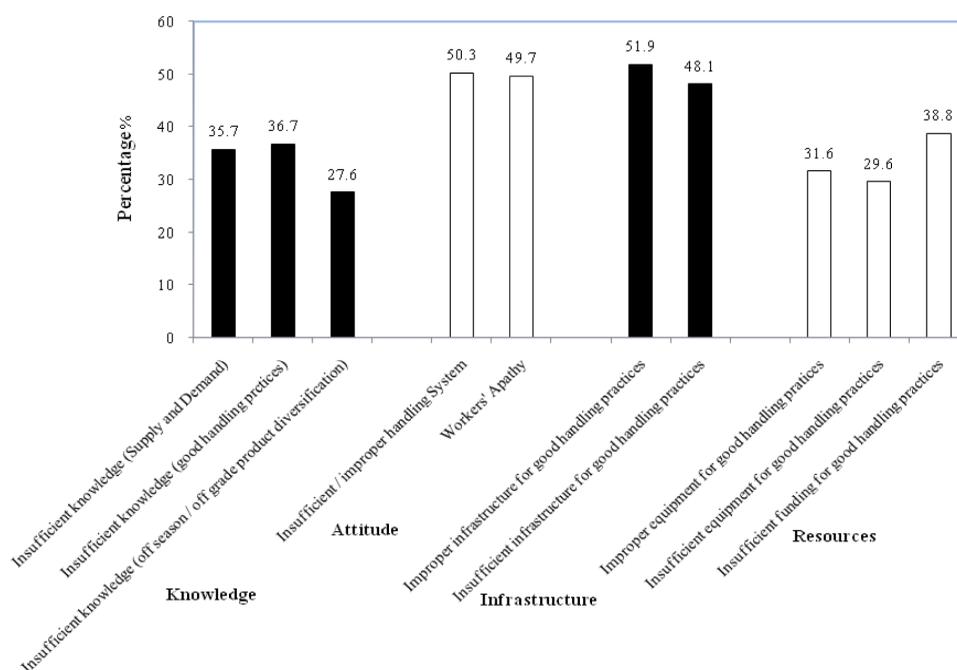


Figure 6: Breakdown Of Factors Contributing To Post Harvest Losses Of Fruits And Vegetables

CONCLUSION AND RECOMMENDATIONS

The results of this study indicate that 27% of respondents send their products straight to the wholesaler without performing any post harvest handling activities. Packaging of fruits and vegetables is the post harvest handling activity with the highest potential in reducing post harvest losses. However, insufficient knowledge is the major cause for respondents not carrying out packaging, sorting and pre-treatment in post harvest handling of fruits and vegetables. Therefore, sufficient knowledge of the above should be disseminated to all players at the different levels of the distribution chain. As such, training programmes, extension services and other forms of exposure by the relevant authorities should be given priority. It is also recommended that those who have successfully attended training programmes should be given special incentives. Successful attendance here refers to those who have attended, practised and have shown a good track record in reducing post harvest losses.

It was also found that 63% of the respondents were aware of the usage of cold rooms, while 45% of them were aware of the availability of government-owned cold room facilities in their area. However, a large percentage (86%) did not use these facilities because they felt that there is no necessity to do so since they sell their products directly to the wholesalers and retailers. In addition, the location of the cold rooms was far from their premises and the rental rate was said to be unreasonable. Hence, the relevant agencies should take into consideration the above mentioned factors before providing the facilities. It was observed that only 57.3% of the respondents at the different levels of the distribution chain were aware of the availability of post harvest handling technology for fruits and vegetables. The study also found that 55.4% of the respondents were aware of the facilities that are provided by the government and private agencies. However, insufficient knowledge in carrying out packaging, sorting and pre-treatment in post harvest handling of the fruits and vegetables might prevent these facilities from being more widely utilised.

Insufficient knowledge, with respect to good handling practices is the major contributing factor to post harvest losses of fruits and vegetables. Post harvest losses were highest for wholesalers and retailers of fruits and vegetables. Therefore, any preventive measures that need to be implemented to reduce post harvest losses of fruits and vegetables should focus more on these two levels of the distribution chains.

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References

- Abd. Shukor, A. R., Mohs Salleh, P., Ahmad Tarmizi, S. and Pauziah, M. (2003). Development of Appropriate Postharvest Technologies for Major Vegetable Crops of ASEAN, Perspectives of ASEAN Cooperation in Vegetable Research and Development, *Proceedings of the Forum on the ASEAN-AVRDC Regional Network on Vegetable Research and Development (AARNET) in Kuo G. (Ed), http://www.avrdc.org/pdf/aarnet_proc/008.pdf*
- Barbosa-Cánovas, G.V., Fernández-Molina, J.J., Alzamora, S.M., Tapia, M.S., López-Malo, A. and Chanes, J.W. (2003). Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas, Technical Manual FAO Agricultural Services Bulletin 149, Food and Agriculture Organization of the United Nations.
- Booth, R.H. and Burton, W.G. (1983). Future Needs in Potato Post-harvest Technology in Developing Countries, *Agriculture, Ecosystem and Environment*, 9, 269-280.
- Fan, L., Forney, C.F., Song, J., Doucette, C., Jordan, M.A., McRae, K.B., and Walker, B.A. (2008). Effect of Hot Water Treatments on Quality of Highbush Blueberries, *Journal of Food Science*, 73, M292 – M297.
- FAO. (2009) Declaration of the World Summit on Food Security, World Summit on Food Security, Rome, 16 – 18 November 2009, http://www.fao.org/fileadmin/templates/wfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf
- Kader, A. A. and Rolle, R. S. (2004). Chapter 3: Post-harvest Management Procedures that are Critical to Maintaining the Quality and Safety of Horticultural Crops, In: *The Role of Post-Harvest Management in Assuring The Quality and Safety of Horticultural Produce*. FAO Agricultural Services Bulletin 152, 13 -24.
- Kader, A. A. and Rolle, R. S. (2004). Chapter 6: Criteria for the Selection of Appropriate Post-harvest Technologies, In: *The Role of Post-Harvest Management in Assuring The Quality and Safety of Horticultural Produce*. FAO Agricultural Services Bulletin 152, 43 - 45.
- Kitinoja and Kader (2002). Chapter 3: Packinghouse Operations. In: *Small-Scale Postharvest Handling Practices: A Manual for Horticultural Crops (4th Ed)*, Post-harvest Horticulture Series No. 8E, University of California Postharvest Research & Information Center, UC Davis, 35 – 58.
- Mccollum T. G., D’aquino S., and Mcdonald R. E. (1993). Heat treatment inhibits mango chilling injury, *HortScience*, 28, 197 – 198.
- Nasrin, T. A. A., Molla, M. M., Alamgir Hossaen, M., Alam, and M. S., Yasmin, L. (2008).

Effect of Postharvest Treatments on Shelf Life and Quality of Tomato, *Bangladesh Journal of Agricultural Research*, 33, 579 – 585.

Paull, R. E. and Chen, N. J. (2000). Heat Treatment and Fruit Ripening, *Postharvest Biology and Technology*, 21, 21–37.

Panhwar, F. (2006). Post Harvest Technology of Fruits and Vegetables, www.eco-web.com/editorial/060529.html

Thiran, J.N. (2004). Competitiveness of the Malaysia Fruit and Vegetable Industry in the ASEAN Context, Paper presented at 'Seminar ke Arah Penjenamaan Malaysia's Best', Renaissance Hotel Kuala Lumpur, May 17th, 2004.

Yildiz, F. (1994). Initial Preparation Handling and Distribution of Minimally Processed Refrigerated Fruits and Vegetables, In Wiley, R. C. (Ed), *Minimally Processed Refrigerated Fruits and Vegetables*, Chapman & Hall, NY London.

