

Postharvest Losses of Cabbage Along the Market Chain: A Case Study from Sri Lanka

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Abstract—Postharvest losses in fresh fruit and vegetables are higher, especially in developing tropical countries such as Sri Lanka. The production of perishables annually faces significant losses along the supply chain, from the farm gate to the retailer market. This study established the extent of postharvest losses in the cabbage market chain in Sri Lanka's wet zone. Random samples were collected from the total harvest of a selected farmers' field in Nuwara-Eliya district and tracked at various market points. There the postharvest practices were observed, and yield weight and loss were calculated. Results showed that from the farm gate to the retailer market the weight loss that occurred from cabbages was 22.44%. The majority of the total loss, accounting for 58.05%, resulted from the cleaning process carried out at the retail market. Upon further investigation, it was revealed that losses were also caused by improper packaging, poor transportation facilities, and handling. To minimize crop losses, proper pre-harvest practices should be followed. Most importantly, post-harvest practices such as maintaining lower storage temperatures, use of appropriate packing materials, and implementing a safe transportation system can help mitigate these issues.

Keywords—Postharvest losses, perishables, tropical countries

I. INTRODUCTION

Cabbage (*Brassica oleraceae* L.) is a vegetable belonging to the Brassicaceae family, widely grown in Sri Lanka. In upcountry regions with cool climates,

cabbage can be effectively grown while varieties that can withstand heat can be grown in dry areas. Usually grown varieties within the country include Hercules, Exotic, AS Cross, XY Cross, Green Hot, and Grand Moist. In 2022 total cabbage production of the country was 116,662.2 t from a cultivated land extent of 4,546.5 ha. A higher production has been recorded mainly from districts such as Nuwara Eliya, Badulla, Kandy, Matale, and Puttalam. Although cabbage production varies, its consumption is fairly distributed within the country because of the higher demand it gets throughout the year.

Leafy vegetables such as cabbage are typically harvested before reaching full maturity when their metabolism is at its peak. This makes them particularly vulnerable to quick spoiling and deterioration due to both physical and microbiological factors, along with their high moisture content which is around 90% [1]. Due to this reason, quantitative and qualitative losses can be incurred from the farmer fields up to the consumer level along the market chain of cabbage. These losses may be caused by one or more reasons such as high harvesting temperatures, rigorous handling of fresh crops after harvest, inadequate pest control management, improper transportation, and less available nutrients during the cultivation period. This study aimed to evaluate the causes of cabbage postharvest losses in Sri Lanka's Wet Zone region and identify feasible reduction measures.

II. METHODOLOGY

A cabbage farmer's field was chosen in Nuwara-Eliya district, Sri Lanka, where a higher cabbage production can be seen throughout the year. There the cabbage variety – “Hekeels” has been cultivated in red-yellow Podzolic soil. Random samples (mesh bags filled with 30-40 cabbage heads) were selected from the total harvest and tracked at each point of the market chain, including the field, wholesale market, and retail market, to collect data (Fig. 1). Information on postharvest practices such as harvesting, handling, packing, transporting, and sorting was observed visually and obtained through verbal communication with stakeholders. The weight of the yield was measured as the weight per bag at each location in the market chain, and the loss at each location was calculated. The statistical analysis was carried out using ANOVA, and mean separation was performed using Tukey's test in Minitab 19.

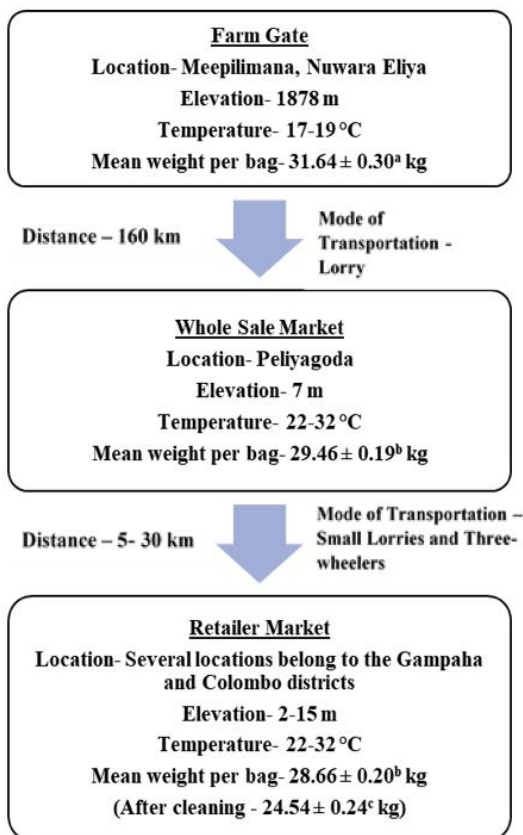


Fig. 1. Each stage's location details, distances, and cabbage weight per bag (mean ± SE of 14 replicates) along the market chain.

III. RESULTS AND DISCUSSION

To identify potential causes and enhance the most effective postharvest techniques, it is critical to understand where losses occur in the food supply chain [2]. According to the current experiment, it can be observed that the weight of cabbages per bag was gradually and significantly reduced along the market chain (Fig. 1.). The percentage loss of cabbages from the farmer field to the retailer market was 22.44%. Several factors may have caused this observation.

The highest percentage of cabbage loss occurred during cleaning at the retailer market (Fig. 2). Before being sold, cabbage heads go through pruning of any damaged and senescent exterior leaves during the postharvest period. This improves the external appearance of the commodity resulting in a high market demand with a high price (Fig. 3C) Although required, trimming cabbages for aesthetic presentation causes the product's overall weight to decrease, which is not what is desired. However, trimming the cabbage leaves during postharvest storage is unavoidable [1]. Therefore, to minimize the losses at this level damages that happen due to transportation, poor handling, improper packaging and insect damage along with microbial spoilages have to be reduced which can appear in the earlier stages of the market chain.

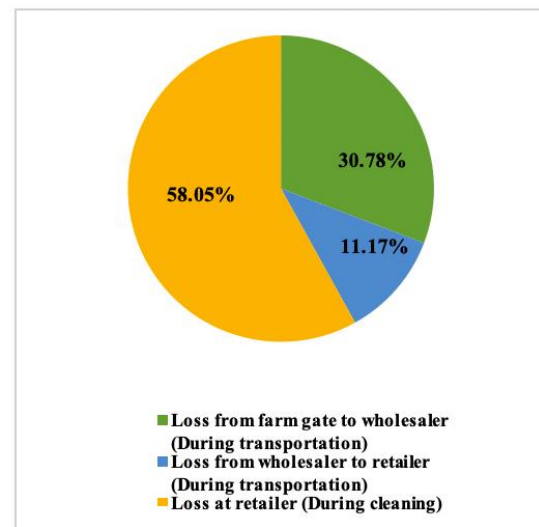


Fig. 2. Percentage weight loss of cabbage at all stages of the postharvest chain (From farm gate to retailer).



Fig. 3. A poly sack bag filled with cabbages in the field (A), A lorry loaded with cabbage-filled poly sack bags to be transported from the field to the wholesale market (B), Cabbage- filled bags heaped at the whole sale market (C), Cleared cabbages for sale at retail shop (D).

During transportation from farm to wholesaler, proportionately a higher loss occurred as shown in Fig. 2. Several differences can be highlighted in these two locations such as the distance, temperature, and elevation (Fig. 1). Longer distances coupled with poor transportation facilities may have resulted in this particular loss. In most cases, wholesalers prefer to ship the maximum quantity possible to minimize the shipping costs per unit [4]. On the other hand, poor roads, a lack of suitable transportation, and ineffective logistics management make it difficult for underdeveloped nations to effectively preserve perishable crops. Additionally, in these nations, untrained, uneducated employees who typically handle goods carelessly do loading and unloading activities. Agricultural products are mechanically damaged as a result [2]. The types of packaging that traders employ is not designed to account for potential harm caused by erratic road conditions, high ambient temperatures, and humid conditions that occur during the lengthy duration of transportation; in this case, it is 160 km from the farm to the wholesaler market. All of these factors hasten the decline in quality. As time in the vehicle increases, the degree of damage also increases including vibration injury during transportation (roller bruising), impact injury, puncturing injury, and subsequent water loss and microbial entrance. Thus, when produce reaches distribution points, it is frequently bruised, infected with post-harvest diseases, and of subpar quality [3,4]. Poorly made packaging materials are unable to fully safeguard fresh goods against harm and may even

enhance their deterioration. During the current study, it could be observed that the farmers and other stakeholders preferred to use poly sack bags which were very harmful to the cabbages. This inappropriate packing material also can be emphasized as one of the major causes of these losses (Fig. 3A). Unfortunately, because they are inexpensive, low-quality packaging materials are frequently used in many regions of the world. Particularly, the usage of subpar packaging containers is more widespread in emerging and underdeveloped nations [2].

In order to ensure the efficient functioning of the cabbage market chain within the country, it is essential to conduct a thorough analysis to identify any existing deficiencies and take action to overcome them.

Usually, vegetable supply chains experience losses at the stages of harvest, handling, storage, processing, distribution, and consumption. If these conditions are not appropriately regulated, large-scale postharvest losses will result. While the changes that happen to fresh produce cannot be halted, they can be minimized with moderate care, including low storage temperatures, relative humidity management, appropriate packing, safe transportation, etc. [2]. In the case of cabbages, the losses that occur in the market chain in Sri Lanka could be observed as discussed above. To minimize the loss due to the excessive trimming at the field level proper pre-harvesting practices should be implemented during the cultivation. Especially, proper attention should be given to nutrient management and insect pest

management. Also, harvesting at the correct maturity level can improve the quality of the final product.

Since Sri Lanka is a humid tropical country with a relatively higher environmental temperature, perishables after harvest tend to decline their quality and quantity rapidly. To avoid that management of the cold chain is really important with proper temperature and relative humidity controls. However, there are currently no services offered for suitably large-scale temperature and humidity-controlled storage facilities within the country [4], therefore government intervention in this matter is suggested.

It is crucial to develop packaging materials that can withstand any potential impacts or mishandling that may occur during the shipping process. Since the stakeholders involved in this process were often economically unstable, they tended to use these sacks. Although the government recommended using plastic crates for transporting perishables, stakeholders did not adopt them due to their high cost and difficult handling. Therefore, to produce a cost-effective and user-friendly packaging system for cabbages, further research and involvement in new technological aspects is necessary. However, reference [5] has shown that using CFB boxes for cabbage transportation was relatively preferable when wrapped in perforated LDPE films [5]. With that, it can be recommended to explore innovative practices implemented by other countries.

Proper government intervention through policies and regulations is necessary to overcome losses, particularly in rural areas. This includes improving infrastructure such as roads, electricity, markets, and communications [3]. Further, advanced knowledge should be disseminated throughout the market chain, highlighting the benefits of its use. To ensure uninterrupted service and the effective transfer of new data, advanced technologies like e-marketing and mobile decision support systems, which include crop forecasting, price forecasting, land use, allocation of resources, and assistance in marketing, should be used and widely adopted by all stakeholders in supply chains.

IV. CONCLUSION

As a developing country located in the tropical region of the world, Sri Lanka faces the challenge of minimizing the quantitative and qualitative losses of perishable fruits and vegetables during their postharvest life. The current study has shown that the postharvest weight loss of cabbage from the farm gate to the retailer market was 22.44%. This loss was mainly due to excessive trimming and cleaning at the retail market, along with poor transportation and

packaging facilities. While it may not be possible to completely eliminate these losses, they can be minimized by facilitating proper transportation modes, maintaining a cold chain along the market chain, and using cost-effective and user-friendly packing materials. For this purpose, further research in the relevant subject area and government intervention are highly recommended.

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