



## Original Article

# Post-harvest Losses of Banana in Fresh Produce Marketing Chain in Tangail District of Bangladesh

Chayan Kumer Saha✉, Md. Kowshick Ahamed, Md. Shakil Hosen, Rajesh Nandi, Mahjabin Kabir

Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

ARTICLE INFO	ABSTRACT
<p><b>Article history</b>            Received: 20 Apr 2021            Accepted: 27 Jul 2021            Published: 30 Sep 2021</p> <p><b>Keywords</b>            Banana,            Marketing chain,            Postharvest losses,            Wholesaler,            Retailer</p> <p><b>Correspondence</b>            Chayan Kumer Saha            ✉: <a href="mailto:cksaha@bau.edu.bd">cksaha@bau.edu.bd</a></p> <p> OPEN ACCESS</p>	<p>Post-harvest loss reduction is one of the important criteria to ensure the total amount of bananas available at the consumer's level. This study identified the fresh produce marketing chain and the value chain of bananas along with damages and post-harvest losses in different stages of the marketing chain in Bangladesh through field visits and surveys. The major actors of the marketing chain were producers, local market middlemen/bepari, wholesalers, retailers and consumers. The major value additions in the fresh produce banana marketing were found to be 17.42%, 1.48%, 1.89% and 42.58% for farmers to local market, middlemen, wholesalers and retailers, respectively. The postharvest losses of banana in the marketing chain were obtained as 3.33% at farmer's level, 5.17% at arathdar's level and 16.36% at retailer's level. The gross postharvest losses of banana from harvesting to consumption were obtained as 21.67% of total production. The main causes of the postharvest losses were mechanical and physical damages of banana at the farm and wholesaler's levels, while over-ripening was the main cause at the retailers' level. Therefore, poor postharvest handling practices from the farm to the retailers have primarily caused the losses of banana in the supply chain. The outcomes of this study could be used to adopt measures to reduce the post-harvest losses and improve the socio-economic status of the actors in the fresh produce marketing chain of banana in Bangladesh.</p>
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## Introduction

Banana (*Musa paradisiaca*) is one of the well-known delicious fruits and preferred by people of all ages. It is highly nutritive and also a rich source of energy (89 kcal/100g) (Sidhu and Zafar, 2018). It is one of the cheapest and most nourishing fruits. The origin of banana is considered the southern part of China. In terms of banana production, Bangladesh is ranked 30<sup>th</sup> among the banana-producing countries of the world (FAOSTAT, 2011; ProMusa, 2017).

Banana cultivation is one of the common agricultural practices in Bangladesh all year round. In Bangladesh, banana is mostly cultivated in Narsingdi, Gazipur, Tangail, Rangpur, Bogura, Natore, Pabna, Noakhali, Faridpur, and Khulna and also found per capita consumption of banana is about 4.7 kg in total (Hossain et al., 2016). In Bangladesh, total banana production in the year 2018-2019, was recorded at 8,33,309 metric

tons from the cultivated areas of about 48,849 hectares (BBS, 2020). Among different banana cultivars BARI Kola-1, Champa, Amritsagar, Sabri, Kabri, Mehersagar, Dudsagar, Agniswar, Genasundari, Kanaibanshi, Basrai, Binisuta, etc. are commonly available in Bangladesh (Akter, 2017; Mukul and Rahman, 2013).

Banana is a highly perishable fruit and its postharvest losses range from 25 to 50% during transporting and marketing due to adverse physiological changes, softening of the flesh, and lack of resistance capacity against microbial attack (Akter et al., 2015). High temperature and humidity have been identified as two major environmental drivers involved in 25 to 40% postharvest losses of bananas in Bangladesh compared to 5 to 25% for other developed countries (Kader, 2002; Akter et al., 2015). Hasan (2010) reported that every year 24.62% postharvest loss of banana has been recorded in Bangladesh which accounts for 0.567 billion BDT. Every year a considerable amount of fruits has lost

## Cite This Article

Saha, C.K., Ahamed, M.K., Hosen, M.S., Nandi, R., Kabir, M., 2021. Post-harvest Losses of Banana in Fresh Produce Marketing Chain in Tangail District of Bangladesh. *Journal of Bangladesh Agricultural University*, 19(3): 389–397. <https://doi.org/10.5455/JBAU.74902>

from field to consumer due to improper transportation facilities, rough handling, and inappropriate storage (Uddin et al., 2015).

Banana can be exported by fulfilling the national demand with appropriate post-harvest management of banana production. However, enough attention needs to be paid to post-harvest loss reduction to ensure the total amount of food available at the consumer's level. Therefore, it is necessary to understand present post-harvest management practices along the supply chain and their corresponding losses of Banana. The present study has designed based on three objectives, firstly to identify the fresh produce marketing chain of bananas in Bangladesh, secondly to identify the damage occur in different stages of the marketing chain in Bangladesh, and finally, to determine the post-harvest losses of bananas in different stages of marketing chain in Bangladesh.

*Site selection and preparation of interview schedule*

Jalchatra, Modhupur was selected as the study site for data collection as Modhupur is the highest banana cultivation area in the Tangail district. In the year 2018-2019, the highest banana cultivation in the Tangail region was recorded 1,17,434 metric tons from a cultivated area of 4627 hectares (BBS, 2020). An interview schedule was prepared to collect the data on damages and postharvest losses of bananas within the identified marketing chains of bananas from the key informants of the relevant fields.

*Identification of marketing chain and data collection*

In this study, individual actors of the fresh produce banana marketing chain were identified as shown in Figure 1 and throughout the chain, post-harvest losses were also investigated by using pre-structured questionnaires and written comments provided by the key informants of the marketing chain.

**Materials and Methods**

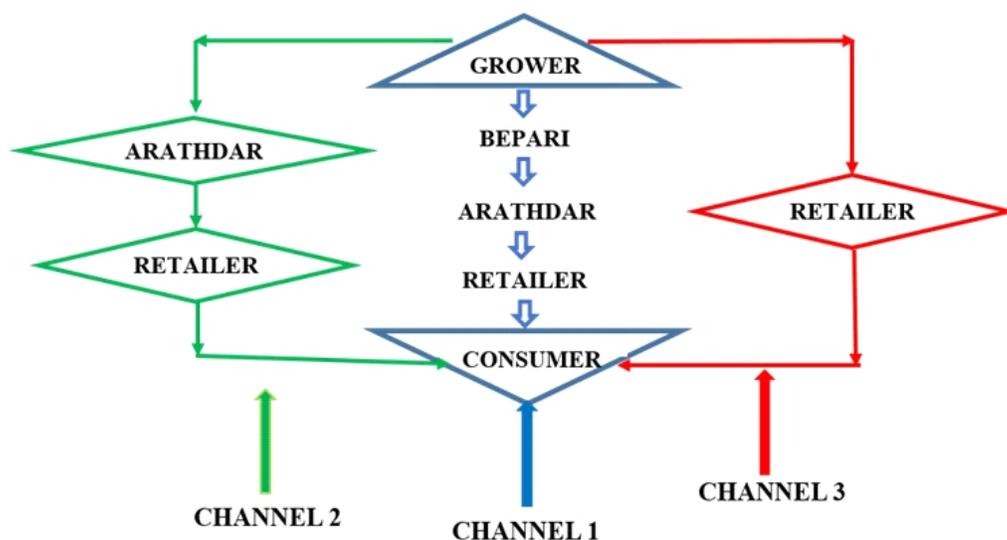


Figure 1. Marketing channels of banana in Bangladesh

Data were collected from eight farmers, five bepari/middlemen, seven arathdars/ wholesalers, and six retailers through a personal interview by semi-structured questionnaires shown in Figure 2.

Based on the definition of post-harvest losses associated with the marketing chain (Acharya and

Agarwall, 2004) and from the context of banana marketing (Molla et al., 2012), channels were identified to estimate the post-harvest losses at field level, transit, wholesale and retail marketing level through field visit and interviews. After identifying the marketing chains that existed in Modhupur, post-harvest losses were estimated from each channel.



Figure 2. Data collection from the key informants (a) farmer, and (b) wholesalers of banana marketing chain, Jalchatra, Modhupur

In this study, the major players in the marketing chain are growers, beparies, arathdars, retailers and consumers. Farmers are in growers level produces banana and sell their produce to the arathdars through beparies. On the other hand, beparies, and arathdars belong at the wholesaler's level. Retailers mostly buy banana from beparies through arathdar and sell it to the local or urban market to the ultimate consumers. Different post-harvest operations of bananas such as harvesting, sorting, grading, packing, transportation, and handling were carefully investigated to identify different kinds of damages and losses throughout the marketing chain of bananas. To identify the value addition from producer to retailer level, the selling price of banana at each level was recorded along with production, transport, labour, and holding cost at the individual channel.

#### Loss assessments

The total amount of bananas harvested was recorded first from the field. After that, the amount of discarded and damaged bananas was measured. Simple averages and percentages were used for the estimation of post-harvest losses (Equation 1) at different stages of the marketing chain (Uddin et al., 2015).

$$\text{Losses of Banana (\%)} = \frac{W_{db}}{W_{db} + W_{gb}} \times 100 \quad (1)$$

where,  $W_{db}$ = weight of discarded and damaged bananas, kg

$W_{gb}$ = weight of good quality bananas, kg

Loss assessment in the banana marketing chain was calculated for an average of 120 pieces of banana, proportionate to around 10 kg weight from producers

to retailer level. Losses of bananas were also identified for individual actors according to their channel of interaction.

#### Results and Discussion

##### Fresh produce marketing of banana

Based on field investigations from the producer to retailers, the marketing and the value chain of bananas were identified. In forward linkage, the channels were investigated up to the consumer, and in backward linkage, the investigation was brought down to the farmer's level at Jalchatra, Modhupur. Depending on the size of production, transportation facilities, and consumer demand city markets of Tangail, Mymensingh, and Karwan Bazar, Dhaka are highly dependent on bananas from Modhupur.

Farmers sell locally produced bananas from Jalchatra, Madhupur in the local market through beparis. Sometimes beparis acts as a middleman and supplied the banana from farmers to the arathdars/wholesalers in district and city markets. The wholesalers were used to stock bananas for selling to retailers and finally banana was available at consumer's level through the retailers. There were found three marketing channels of banana shown in Figure 1 in Jalchatra, Modhupur.

Channel 1 is considered as the major channel and the value of banana is added to each actor from growers to consumers within the marketing channel. In Jalchatra, mainly Sagor and Sabri are commercially cultivated varieties and generally sold in the bunch, consist of around 120-130 pieces of bananas shown in Figure 3.



Figure 3. Commercially cultivated varieties of banana (a) Sagor, and (b) Sabri in local market of Jalchatra, Modhupur

Sabri as well Sagor are the two most popular varieties of banana and consumers are usually buy bananas in “hali” (one hali consists of four bananas). Generally at the consumer’s level banana is purchased more than one or two hali at a time. In the case of changing units of selling in different stages of banana, the market price is calculated as per kg, consist around 12 pieces of banana. Figure 4 shows the market prices of each kg banana at the different channels of marketing. In

channel 1 production price of bananas including the cost of transportation and labour at the producer level was shown at 28.97 BDT/kg. Beparis collected the banana from producers at 36.99 BDT/kg and sold it to arathdars at 42.99 BDT/kg. Similarly, the market price of bananas at retailers’ level was recorded 51.9 BDT/kg and finally, consumers purchased from retailers at 75 BDT/kg.

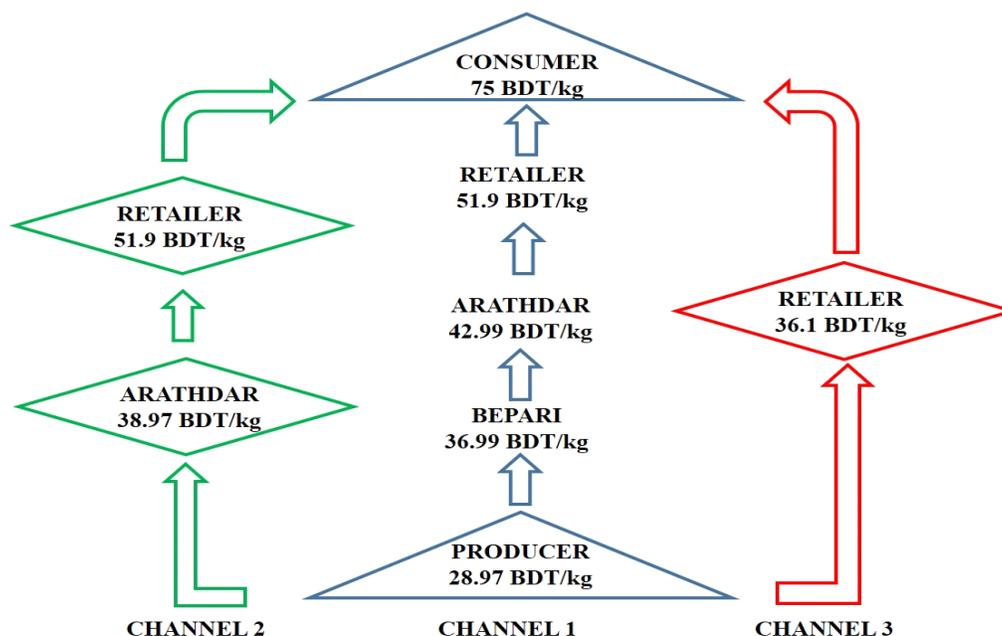


Figure 4. Fresh produces marketing channel of banana representing market prices of banana from producer to consumer level in Jalchatra, Modhupur, Tangail

In the case of channel 2, as shown in Figure 4, arathdars directly purchased bananas from farmers at 38.97 BDT/kg and retailers collected bananas from arathdars at 51.9 BDT/kg for final consumption at the consumer level. On the other hand, in channel 3, the retailer was the only middleman from producer to consumer level and the market price at the retailer and consumer level were 36.1 and 75 BDT/kg respectively. As channel 1 is

the longest chain, profit level was decreased for each actor than other channels because of losses due to transportation and long holding time.

In channels 2 and 3 profit margin increases as the number of middlemen reduced and the holding time decreases. Reduction of transportation channels also decreases the damages of bananas due to

transportation. At the consumer level comparatively fresh and less damaged bananas were reached for consumption.

#### Value chain analysis of banana

The value chain is an important marketing chain to analyses cost and profit within a path that a product follows from producer to consumer level (Porter, 1985). As the product progresses along the value chain, value is added and allowing the business personnel to earn a profit over time and finally, the product is conveyed to the consumer (Kabir, 2014).

In Figure 5, value chain analysis of bananas for three individual marketing channels was shown. In channel 1 at the producer's level considering production, labor, and transportation cost of 28.9 BDT/kg of banana, the farmer earned 17.42% of profit with 8.09 BDT/kg value additions after selling to bepari. Similarly, from bepari to retailer value addition at bepari, wholesalers, and retailer's level were calculated as 0.68, 0.87, and 19.6 BDT/kg, respectively along with profit margin of 1.48%, 1.89%, and 42.58% with the consideration of transportation, labour and holding cost shown in Figure 5.

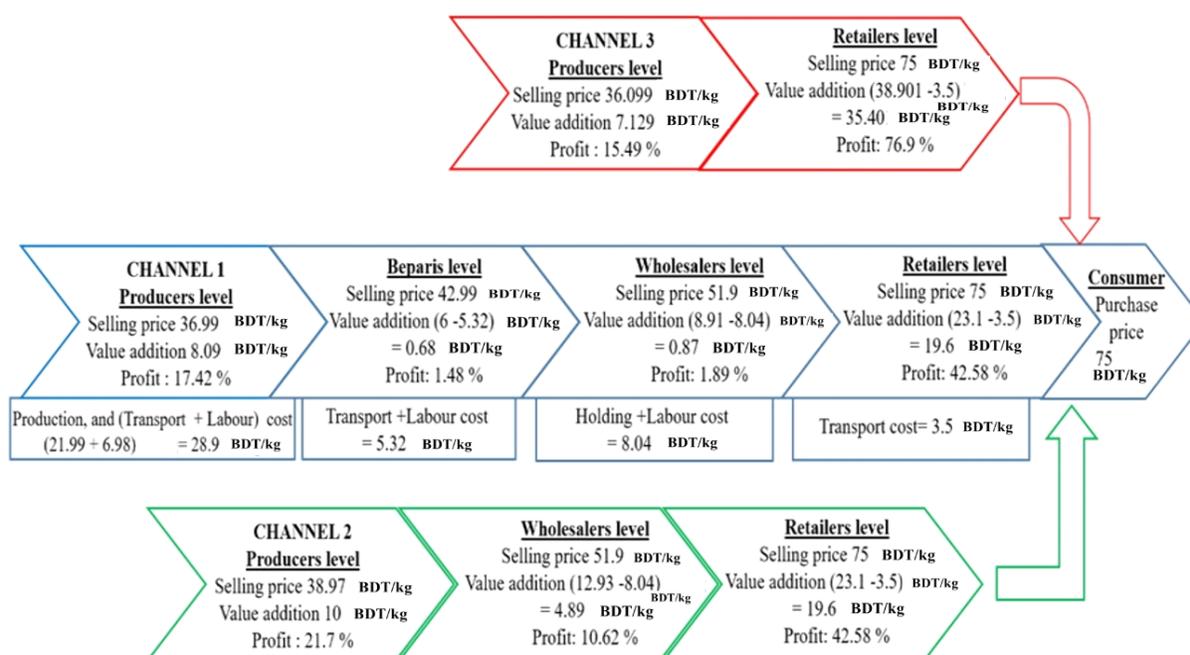


Figure 5. Value chain analysis of banana in fresh produce marketing chain at Jalchatra, Modhupur, Tangail

In the case of channel 2 profit margins were found 21.7%, 10.62%, and 42.58% at producers, wholesalers, and retailer's levels with value additions of 10, 4.89 and 19.6 BDT/kg, respectively. The profit margin for channel 3 was found 15.49% and 76.9% at producers and retailers' level with value addition of 7.12 and 35.40 BDT/kg, respectively taking into account the transportation, labor and holding cost.

Channel 2 was found more profitable for producers. In comparison to channel 1 the profit margin in channel 2 was found 4.28% and 8.73% higher at the producer, and wholesaler's level and 34.32% higher at retailer level in channel 3. From Figure 5, channel 3 was the shortest path from producer to consumer level via retailer and showed higher profit margins compared to channels 1 & 2 due to loss minimization with the shortest transportation and holding time. For being the shortest channel, channel 3 was also considered most

comfortable for consumers as they could buy fresh and damage-free bananas.

#### Damages of bananas

Among the common causes reported for post-harvest losses of bananas, lack of sanitation, temperature control, inadequate packaging and transportation problems are main contributing factors (Vursavus and Ozguven, 2004). According to survey findings at Jalchatra, Modhupur, major damaging factors were spoilage, physical, and mechanical injuries mentioned by all fruit vendors.

#### Physical damage

Poor appearance, dark stains on fruit peel, weight loss, electrolytic leakage, and flesh browning were mainly considered as physical damages (Opara and Pathare, 2014) at different stages of handling, storage and transportation. Over matured damages, and chilling

injury (Figure 6) of storage banana featured by peel browning was found once stored at a temperature below 13°C (Liu et al., 2019). As the data was collected in winter days of January, the lowest temperature and average relative humidity were recorded below 8°C and 69% at Modhupur. Over matured damage (Figure 6a),

and chilling injuries (Figure 6b) due to climate issues results from exposing bananas to a temperature below 13°C for a few hours to a day, depending on cultivar and maturity are mainly responsible for physical damages of banana in Modhupur region.

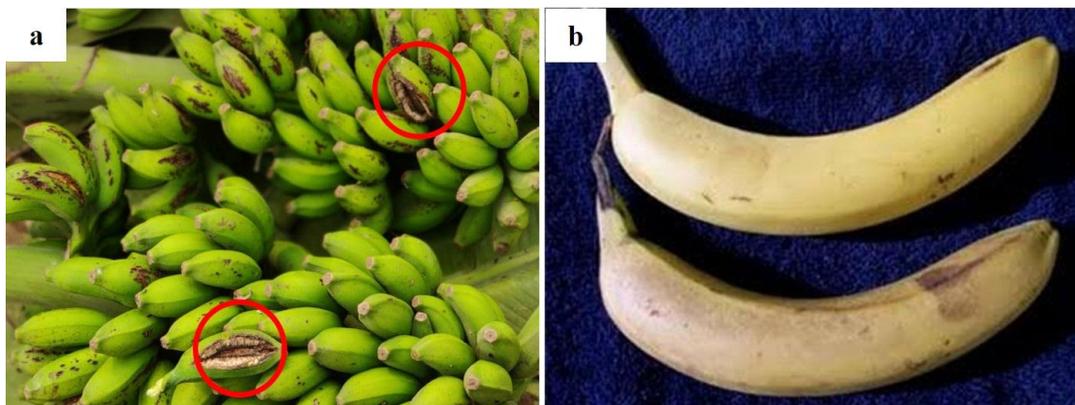


Figure 6. Physical damages of banana, where (a) over matured damages, and (b) chilling injury identified at Jalchatra, Modhupur

#### Mechanical damage

Bananas respond to the physical and physiological level to mechanical damage and cause alteration in color and flavor, tissue damage, softening, faster ripening, weight loss, invasion of microorganisms, and higher enzyme activity in the affected area (Kader, 2002; Li and Thomas, 2014). Quality deterioration of bananas at the time of transportation causes mechanical injuries due to simulated vibration, top-load compression, and drop impact (Fernando et al., 2019a).

improper handling, and abrasion (Figure 7c) of banana peel due to over-ripening were highly noticeable. Hailu et al. (2013); Ilyas et al. (2007); Wasala et al. (2014) reported that damages and deteriorations of bananas were mainly due to physical, and mechanical injuries, enzymatic action, attacked by microorganisms (fungi, bacteria) and become diseased were responsible for post-harvest losses and supports this study outcome.

From the study areas of Jalchatra different mechanical injuries of bananas were observed as shown in Figure 7. Among them damages by cutting (Figure 7a), impact bruising (Figure 7b) by sudden dropping due to

Mechanical and physical damages of bananas mainly occurred during the post-harvest supply chain and damage assessment of packaged bananas was successfully observed to avoid post-harvest losses during transportation (Fernando et al., 2019b).



Figure 7. Mechanical damages of banana, where (a) damages of banana by cutting, (b) impact bruising, and (c) abrasion identified at Jalchatra, Modhupur

### Post-harvest losses of bananas

Every year huge amount of bananas are being lost in different post-harvest operations such as handling, storage, and transportation (Hassan et al., 2010; Molla et al., 2012). Trembling, bulk pressure and improper packaging of bananas are the common reasons for losses in elongated transport between local to city/district markets by vehicles.

In the case of the major channel shown in Figure 8, loss estimation at farmer's level was noted for 10 kg of banana and found 0.33 kg of banana was lost which accounts for 3.33 % of total weight. Losses mainly occurred due to disease and pest infestation, adverse

climate, and poor handling at the time of transportation. A negligible amount of bananas were lost in short-distance transportation at the beparis level as they bought directly from the farmer's field or act as a middle man between farmer and wholesalers/arathdars.

Around 0.5 kg of banana which is 5.17% of the total, was lost at arathdars level due to lack of marketing, storage and transportation facilities. At the retailer level around 1.5 kg of banana which covers 16.33% of the total amount were lost due to broken and rotten problems during handling, heating and marketing. Total loss estimated through the major channel was 21.67%.

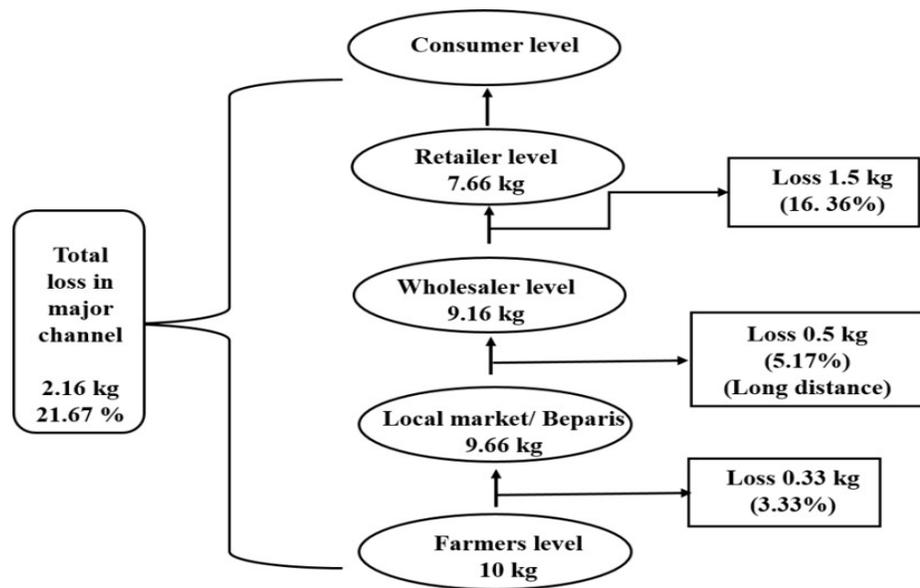


Figure 8. Loss assessment in fresh produce major marketing channel of banana from farmer's level to consumers

Losses in fresh produce marketing channel-2 of banana were shown in Figure 9 for the same volume of banana and the total loss was identified 18.85% through the channel. In this channel losses from farmer to wholesaler were found 3.33% and wholesaler to retailer level was found 15.52% of total banana. On the other hand, Figure 10 shows the losses in marketing channel 3 and the total loss was found 16.66%, which is the lowest among the three channels.

The gross post-harvest losses from harvesting to consumption of banana were calculated as 21.67% at major channel (long channel) as shown in Figure 8, where in channel 2 (short channel, Figure 9) and channel 3 (short channel, Figure 10) losses were found to be 13.01% and 23.12% less in comparison to a major channel.

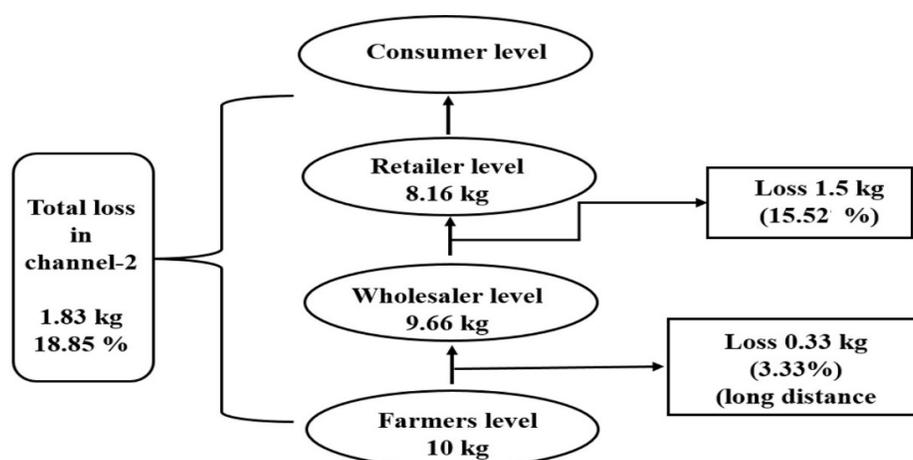


Figure 9. Loss assessment in fresh produce major marketing channel of banana from farmer's level to consumer through Channel 2

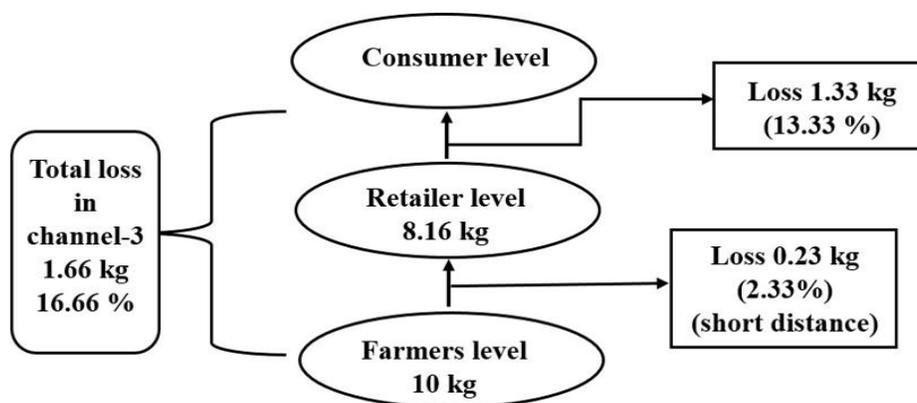


Figure 10. Loss assessment in fresh produce marketing channel of banana from farmer's level to consumers through Channel 3

The longer channel of transportation including storage and handling increases the post-harvest losses than the shorter channel as it reduces the time of storage and handling. A study on post-harvest losses assessment of banana grown in Gujarat was also found 5.86% transportation and handling losses at trader's level (Davara and Patel, 2009). Molla et al. (2012) found that on an average 2.13%, 9.0%, 7.25%, and 2.5% to 3% postharvest losses were estimated at grower's, beparis (long channel), arathdars, and consumer to retailer's level respectively.

To loss reduction, some locally adapted postharvest practices are followed by various points in the supply chain for bananas. The usual post-harvest practices followed by farmers and/or beparis were covered bananas with banana leaves before they were shipped to various locations. Most of the time farmers/ beparis were not concerned with banana sorting and grading. Sorting and grading practices were followed by arathdars at the primary level based on upper and

lower banana bunches. Under unavoidable circumstances, both short and long-distance losses occurred at the beparis level due to rough handling, overloading tendency and delayed transport. The post-harvest banana losses at the level of the arathdars were due to overheating, insufficient marketing and storage facilities. The loss at the retailer level occurred during transportation at unfavorable road conditions from arath or collection point to the selling point.

### Conclusion

The fresh produce marketing chain of banana was identified at Jalchatra in Tangail district. Different post-harvest practices and losses of banana were also identified to monitor the value chain of banana in the fresh produce marketing chain. The postharvest losses of banana were recorded in a long channel transportation as 3.33%, 5.17% and 16.36% at the level of the producers, arathdars and retailers, respectively. The gross post-harvest losses of banana in the longest

marketing channel, from harvesting to consumption, were obtained as 21.67%, which was higher than that in the short marketing channels with 18.85% and 16.66% losses. The value chain analysis from the three major channels also revealed that the shortest the transportation channel, the highest was the profit margin as the losses are well-monitored and less in short channels. The main causes of the post-harvest losses at the farm and wholesaler's levels were the mechanical and physical damages of banana, while over-ripening was the main cause at the retail level. The selection of appropriate post-harvest practices is therefore crucial to reduce postharvest losses of bananas in Bangladesh.

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