

Full Length Research Paper

Assessment of fruit postharvest handling practices and losses in Bahir Dar, Ethiopia

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Received 20 September, 2016; Accepted 25 October, 2016

Demand for fresh fruit is steadily increasing in big cities of Northwestern Ethiopia. As a result, fruits are transported from nearby as well as long distance sources to urban centers such as Bahir Dar. The type of fruit crops available in the market and number of fruit retailers are increasing from time to time. However, the key challenge facing the sector is loss across the supply chain. Therefore, the objectives of this study were to analyze fruit marketing practices, document causes and extent of postharvest losses in Bahir Dar fruit market. The study was conducted in June 2016 using semi structured questionnaire. Thirty-one fruit retailers were randomly selected and interviewed to obtain information on their socio-economic characteristics, fruit marketing practices and postharvest losses. Data analyzed using SPSS statistical software. Results revealed that, 77.4% fruit retailers are less than 31 years old, 67.8% attended above primary school education, and 83.9% have less than six years fruit trading experience. Therefore, fruit retailers are young and educated but have very limited fruit trading experience. Of the seven fruit crops commonly sold in Bahir Dar market; mango, banana and avocado were the most prevalent. The average shelf life of fruits in retailers' hand is only 3 to 4 days and about 20% of the fruits purchased by retailers lost before reaching to consumers mainly due to inappropriate handling and lack of proper storage facility. Therefore, multifaceted interventions such as capacity development, improved fruit production and harvesting practice, and proper storage and transportation facilities establishment are required to reduce postharvest loss and extend fruit shelf-life.

Key words: Postharvest loss, fruits, shelf life, storage, Bahir Dar, nutrition security.

INTRODUCTION

Ethiopia has suitable agro-ecology to grow both temperate and tropical fruit crops. However, fruit production activity is at infant stage in most parts of the country including in Northwestern Ethiopia and both small scale fruit producers and traders have very limited knowledge and skill on fruit production and postharvest handling practices. In this connection high amount of

fruits is expected to be wasted due to several inappropriate production and postharvest handling practices. Kughur et al. (2015) reported 48.5% fruit and vegetable postharvest loss in Nigeria. Similarly, Zenebe et al. (2015) reported 45.9% postharvest loss on banana in Ethiopia, of which about 15.7% was incurred at farm, 22.1% at whole sale and 8.1% at retailer levels. On the

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Table 1. Socio-economic characteristics of the respondents.

Variables	No. of respondents	% of respondents
Sex		
Female	15	48.4
Male	16	51.6
Age (years)		
≤20	4	12.9
21-30	20	64.5
≥31	7	22.6
Fruit trading experience (years)		
≤ 5	26	83.9
≥6	5	16.1
Level of education		
Illiterate	5	16.1
Primary school	5	16.1
Secondary school	15	48.4
College	6	19.4

other hand, Madrid (2011) estimated that post-harvest losses in developed countries are an average of 12% from production to retail warehouse, and an estimated 20% at retail stores and food service sites.

Improper harvesting and postharvest handling practices result in loss due to spoilage of the produce before reaching to consumers along with the loss in quality of the produce such as deterioration in appearance, taste and nutritional value. The high perishable nature of fruit, lack of storage facilities, mechanical injuries due to improper handling, packaging, transportation, and microbial infection are the major reasons for postharvest loss in fruits (Devkota et al., 2014). Zenebe et al. (2015) pointed out market distance, duration of transport, storage condition, storage duration, duration of ripening, ripening room types, means of transport, and experience in banana marketing as important determinants of the postharvest loss of banana in Ethiopia.

Higher postharvest losses not only reduce the availability of fruits but also result in increase in per unit prices of the produce and thus limit the accessibility by the majority of community segments. Kughur et al. (2015) pointed out the multiple effects of postharvest loss as going beyond the loss of the actual crop to include loss in the environment, resources, labor needed to produce the crop and livelihood of the individual involved in the production process. However, it is important to note that much is being invested to production compared to postharvest handling, though 30 to 50% of the produce is wasted in few days after harvest. So far there are very limited reports on the causes and amount of fruit postharvest loss in Ethiopia. However, there is no information on the cause and extent of fruit postharvest loss in Bahir Dar. Therefore, the present study was conducted to assess causes and estimate amount of fruit postharvest losses in Bahir Dar.

MATERIALS AND METHODS

Description of the study site

This study was conducted in Bahir Dar city, Northwestern Ethiopia. Bahir Dar city is found at about 565 km away from Addis Ababa on 11°38' North latitude and 37°15' East longitude. It is one of the leading tourist destination and fastest growing cities in Ethiopia with a population of 221,991 people (CSA, 2007). It is found in one of the high potential areas of Ethiopia for crop production. It is found on an average elevation of 1830 m above sea level and characterized by hot and humid weather with an average temperature of 29°C. It receives 1416 mm annual rainfall in 125 rainy days and has distinct dry and wet seasons. About 100 fruit retailers and juice shops are found in Bahir Dar city.

Sampling, data collection and analysis

Thirty-one respondents were randomly selected among 100 fruit retailers operating in Bahir Dar city. The survey was conducted in June 2016 using semi-structured questionnaire following individual interview method. Both qualitative and quantitative data including sex, age, education level and length of fruit marketing experience of respondents, type of fruit they are selling, type of packaging material, transportation method, storage facility, source of fruit, percentage of fruit loss, causes of fruit losses, percentage fruit loss in different seasons, possible uses of over-ripen fruits, and measures taken by respondents to reduce postharvest losses were collected using the questionnaire and analyzed using SPSS statistical software.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Results of this study revealed equal participation of women and men in fruit retailing business in Bahir Dar market (Table 1). Therefore, men and women are equally

Table 2. Types and major sources of fruit crops sold by respondents.

Fruit crop	Number of respondents	Percentage of respondents	Major sources	Distance (km)
Mango	29	93.5	Andassa, Deke, Arjo, Arbaminch & Assosa	22-1236
Banana	27	87.1	Arbaminch	1052
Avocado	24	77.4	Mecha, Wondogent & Arbaminch	35-1052
Papaya	17	54.8	Andassa	22
Orange	13	41.9	Markos, Mersa & Awash	263-804
Pineapple	7	22.6	Awassa	865
Guava	4	12.9	Andassa	22

benefiting from fruit retailing business. In contrast to this finding, researchers in other African countries reported fruit marketing as women dominated business (Mashau et al., 2012; Kughur et al., 2015). This disagreement could be attributed to fruit marketing system and cultural differences.

Results in Table 1 show that 77.4% of respondents were less than 31 years old. Therefore, fruit retailing business in Bahir Dar city is dominated by youth and creating employment opportunity for the youth. According to the current situation, fruit retailing business can be started with limited capital or even by borrowing fruits from wholesalers. It can be run even on roadsides without requiring land or shop ownership. It is also less labor demanding activity compared to crop production. All these factors might contribute for the more engagement of youth in fruit retailing business. Youths are usually said to be open-minded compared to elders. Therefore, this is an opportunity to modernize the existing fruit marketing practice in the city through proper guidance or training.

Results indicated that 67.8% of respondents attended above primary school education (Table 1). Therefore, most fruit retailers in Bahir Dar city are educated. However, all respondents did not receive any training on fruit postharvest handling practices. Education is generally considered as an important variable that enhances adoption of new technologies (Sabo, 2006). Hence, there is an opportunity to reduce fruit postharvest loss in Bahir Dar city through training and demonstrating various postharvest technologies to fruit retailers.

Results revealed that 83.9% of respondents have been in fruit retailing business for less than six years (Table 1). Therefore, most fruit retailers have very limited practical experience on different fruit crops postharvest physiology and handling practices. Zenebe et al. (2015) identified experience in banana marketing as one of the important determinants of the postharvest loss of banana in Ethiopia.

Types and major sources of fruits sold in Bahir Dar market

During this assessment period, about seven fruit crops

were available in Bahir Dar market and retailers were selling more than one fruit crops in their shop (Table 2). Mango (*Mangifera indica* L.), banana (*Musa cavendishii* L.) and avocado (*Persea americana* Mill.) were available in more than 75% of the total respondents shop. On the other hand, guava (*Psidium guajava* L.) and pineapple (*Ananas comosus* L. Merr) were available only in less than 25% of the respondents shop. Retailers select the type of fruit crops they are selling primarily based on consumers demand and harvesting season of the crop. The number of fruit crops sold by a retailer ranged from one to six. About 87.1% of respondents sell more than two fruit crops. Only banana and mango has few specialized retailers. Therefore, storing and selling of different fruit crops in a very small shop will increase postharvest losses.

The sources of fruit crops sold in Bahir Dar market were diverse (Table 2). This could be since most fruit crops have seasonal fruit bearing characteristics. Of all the fruit crops, mango, avocado and sweet orange were supplied from diverse and distant areas. Similarly, banana and pineapple were supplied throughout the year from very far places such as Arbaminch and Awassa, respectively. Only papaya and guava were supplied from nearby areas. Therefore, transporting fruits from distant areas as far as 1236 km might contribute for the prevailing high postharvest loss.

Fruit transportation method

Retailers purchase fruits both from wholesalers and producers, and transport both from distant and nearby areas. Therefore, they are using different transportation methods (Table 3). About 77.4% of respondents reported that fruits are transported by trucks usually from distant areas but these vehicles do not have ventilation facility to transport highly perishable commodities like fruit. Cart and laborers are also used for short distance fruit transportation. All transportation methods predispose fruits to heat buildup and mechanical damage. Therefore, the present fruit transportation method contributes for fruit postharvest loss in Bahir Dar market. Seid et al. (2013) reported pack animals as major transportation system of

Table 3. Fruit transportation methods and packaging materials.

Transportation method	Number of respondents	Percentage	Packaging material	Number of respondents	Percentage
Truck	24	77.4	Wooden box	29	93.5
Manual labor	9	29.0	Sack	5	16.1
Cart	7	22.6	Plastic box	1	3.2
Boat	1	3.2	On truck	3	9.7

Table 4. Causes of fruit postharvest losses at retailing shops.

Rank	Poor storage condition		Mechanical damage (rough handling)		Poor quality produce (disease, pest, premature)	
	No. of respondents	Percentage	No. of respondents	Percentage	No. of respondents	Percentage
Ranked 1 st	17	54.8	14	45.2	0	0
Ranked 2 nd	10	32.3	14	45.2	7	22.6
Ranked 3 rd	4	12.9	3	9.6	24	77.4
Total	31	100.0	31	100.0	31	100.0

fruit from production site to the local market in South Wollo zone, Ethiopia.

Fruit packaging materials

Fruit packaging has significant importance in reducing postharvest losses through protecting fruits from mechanical damage, undesirable physiological changes and pathological deterioration during storage, transportation and marketing. In the study area, retailers use different packaging materials to transport and store fruit crops. About 93.5, 16.1 and 3.2% respondents reported wooden box, sack and plastic box as their fruit packaging materials, respectively. Retailers reported that, among different fruit crops mango and sweet orange are transported and stored using sack as packaging material. Likewise, Seid et al. (2013) reported sack as the major fruit packaging material in South Wollo zone, Ethiopia. Mango and banana are also transported without any packaging material just by spreading on the truck. Transporting fruits without packaging material will increase fruit spoilage by predisposing the fruit to mechanical damage during loading and unloading as well as during driving on rough road.

The most commonly used packaging material, wooden box, has 30 to 50 kg capacity and did not have cushioning material to absorb shocks during transportation. Therefore, it wounds fruits packed with it and contributing to postharvest loss. They also tightly pack fruit in a packaging material or in the truck without grading fruits based on ripening stage. This practice facilitates ripening process and contributes in shortening

fruit shelf-life. Hence, the existing packaging material and practice need to be improved to reduce fruit postharvest losses (Table 3).

Causes of fruit postharvest loss

Causes of fruit postharvest losses are usually interrelated. Therefore, respondents requested to rank causes of fruit postharvest losses in terms of their contribution on fruit spoilage. These responses are given in Table 4. About 54.8% of the respondents ranked lack of appropriate storage facility as the primary cause for fruit postharvest losses. Fruit retailers' sale and store fruits in a very small shop with an average area of 6 to 12 m². Its wall and roof are made of metal and corrugated iron sheet, respectively. Therefore, its temperature rapidly rises during day time and rapidly cools during night time. Temperature fluctuations in the store affect the physiological process of fruits and enhance its rotting. In addition, it does not have ventilation or cooling facility and enough space to store different fruit crops separately. These situations contributed for the high postharvest losses.

In addition, 45.2% of respondents ranked mechanical injury due to rough handling during harvesting, transportation and storage as a primary cause for high postharvest losses in Bahir Dar market. From these observations, it is evident that the major factor causing the loss of the produce was the lack of storage facility followed by inappropriate packaging and poor handling of the produce, and finally poor quality of the produce. Our findings substantiate the report by Devkota et al. (2014)

Table 5. Shelf-life and postharvest losses of different fruit crops.

Fruit crop	Shelf-life (days)			Postharvest losses (%)
	Wet season	Dry season	Mean	
Avocado	4.2±2.7	3.3±1.5	3.8±2.1	23.1±14.9
Banana	3.8±1.3	2.6±1.3	3.2±1.3	20.7±12.9
Guava	2.8±1.7	3.5±3.3	3.2±2.5	16.8±9.7
Mango	4.4±2.7	3.9±1.8	4.2±2.3	23.7±12.7
Papaya	3.0±1.7	2.2±0.8	2.6±1.3	29.2±18.0
Pineapple	3.9±1.8	3.4±1.1	3.7±1.5	10.1±7.8
Sweet orange	5.3±2.2	3.7±2.0	4.5±2.1	16.4±13.4
Mean	3.9	3.2	3.6	20.0±12.8

who reported that lack of cold store and inappropriate packaging facility had significant effect on postharvest losses of fruit in Nepal. Similarly, Zenebe et al. (2015) identified storage condition and transportation practice as important determinants for the postharvest loss of banana in Ethiopia.

Postharvest losses of fruits

Table 5 shows the shelf-life and percentage of fruits lost from retailers in Bahir Dar market. On average, 20% of the fruit purchased by retailers were lost. Kughur et al. (2015) reported 35 to 45% postharvest loss on fruit and vegetable in Nigeria. About 20% postharvest loss is not affordable for a country with large number of food insecure population, particularly at a time when nutritional security is one of the top agenda, both locally and globally.

Among different fruit crops sold by retailers the postharvest loss of papaya, mango, and banana were above the overall average loss. On the other hand, the postharvest loss of pineapple, sweet orange, and guava were below the overall average loss. This variability is primarily attributed to their natural differences in perishability, quantity supplied to the market, and consumers demand to the crop.

The shelf-life of different fruit crops was assessed in dry and wet seasons by interviewing fruit retailers. Respondents reported that, the shelf-life of most fruit crops is short in the dry season compared in the wet season. This could be attributed to the high temperature prevailing during the dry season. High temperature enhance the ripening process subsequently shorten the shelf-life of fruits. Unlike other fruit crops the shelf-life of guava was longer in the dry season compared to in the wet season. Respondents observed relatively short shelf-life and high postharvest losses in January, February, March and April. On the other hand, they have observed relatively long shelf-life and low postharvest losses in June, July, August and September. Among all fruit crops, papaya had very short shelf-life while sweet orange had

relatively long shelf-life (Table 5). Overall, the shelf-life of fruits in Bahir Dar market is very short compared to in other countries. For example, in India traders store banana, sweet orange, guava, mango and papaya up to 3 weeks, 16 weeks, 3 weeks, 4 to 7 weeks, and 1 to 2 weeks by regulating the store relative humidity and temperature at 85-90% and 5 to 13°C, respectively (Singh, 1996). This could be attributed to the hot weather prevailing in the area coupled to the poor storage condition. Traders did not have refrigerator or cold store to extend fruit shelf-life. Instead, they extend fruit shelf-life by cooling the room by spraying water on the floor, and separating ripen and non-ripen fruits and keeping in different boxes.

Postharvest loss minimizing strategies of retailers

In the study area, fruit retailers minimize fruit postharvest losses through the following strategies: they buy small quantity, clean mango and orange fruits, sort fruits according to their ripening stage, select and discard rotten or over ripen fruits every day, avoid frequent touching of fruits by hand, pack and store different fruit crops separately, spray water on the floor to cool the room through evaporation, protect fruits from dry wind by covering with news paper, raise fruit handling wooden box from the floor to enhance air circulation and keep fruits in the shaded part of the shop.

They have also forwarded the following suggestions to reduce postharvest losses: improve fruit quality through improving fruit production and harvesting practices, reduce mechanical damage of fruits through improving packaging material, transportation facility and loading and unloading practice, improve banana ripening practice through training ripeners and standardizing the ripening process, establish better fruit storage and marketing facility, promote the food value of fruits for consumers to create demand, and regulate fruit marketing through creating better linkage among producers, traders and consumers. On the other hand, traders in developed countries reduce fruit postharvest losses primarily by

regulating the storage climatic condition (Singh, 1996).

Over ripen fruit management

Most fruit retailers dispose over ripen fruits as waste. However, few respondents (35.5%) reported the use of over ripen fruit as animal feed. They use over ripen banana, guava, mango, avocado and papaya to feed pigs. Fruit traders provide over ripen fruits to livestock owners free of charge, sometimes even by providing transport service. Over ripen fruits are also used to extract seed. About 22.6% of the respondents sell over ripen avocado, mango and papaya fruits to farmers at lower price (3 to 5 birr/kg) for seed extraction. Therefore, effort required to recycle over ripen fruits either by using as animal feed or preparing organic fertilizer through composting.

Conclusion

The result of this study revealed that, fruit trading is mainly handled by young and relatively educated individuals compared to fruit producers. However, their experience on fruit marketing is very limited and resulted in inappropriate postharvest handling. Inappropriate storage, packaging and transportation practices are identified as principal causes for the 20% fruit postharvest loss and very short fruit shelf-life (3 to 4 days) in the study area. About 20% postharvest loss is not affordable for a country with large number (40%) of food insecure population. Therefore, efforts required on fruit storage and transportation infrastructures establishment, fruit processing, and capacity

development to reduce the recorded high fruit postharvest loss and make available for consumers throughout the year.

Conflict of Interests

The authors have not declared any conflict of interests.

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