COLLAGE OF DEVELOPMENT STUDIES, CENTER FOR FOOD SECURITY STUDIES

Effect of Postharvest Loss of Fruits and Vegetables on consumers and retailers Food Security during Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia

By:

Kalkidan Fekadu

October, 2023

Addis Ababa, Ethiopia

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EFFECT OF POSTHARVEST LOSS OF FRUITS AND VEGETABLES ON CONSUMERS AND RETAILERS FOOD SECURITY DURING RETAIL AT LAFTO FRUIT AND VEGETABLE MARKET ADDIS ABABA, ETHIOPIA

BY:

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ATHESIS SUBMMITED TO THE CENTER FOR FOOD SECURITY STUDIES COLLEGE OF DEVELOPMENTAL STUDIES ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER IN FOOD SECURITY AND DEVELOPMENT

October, 2023

Declaration

I honestly declare that this thesis title “Effect Postharvest Loss of Fruits and Vegetables on consumer food security during Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia" has been carried out by me under the guidance and supervision of doctor Abebe Haile (PhD). My thesis is original and has not been submitted for the award of any degree and other university or organization.

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Approval Sheet

As supervisors of the thesis, I certify that I have read and evaluated the thesis entitled “Effect of Postharvest Loss of Fruits and Vegetables on Consumers Food Security During Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia” and recommend for Open Defense as fulfilling the requirement for the degree of Master of Science Degree in Food Security and Development Studies.

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Name, Advisor Signature Date

As members of the Examining Board of the Thesis Open Defense, we certify that we have read and evaluated the thesis entitle “Effect of Postharvest Loss of Fruits and Vegetables on Consumers Food Security During Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia” and recommend for Open Defense as fulfilling the requirement for the degree of Master of Science Degree in Food Security and Development Studies.

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Certification

As examiner of the of the thesis, we certify that we have read and evaluated the thesis prepared by Kalkidan Fekadu Entitled 'Effect of Postharvest Loss of Fruits and Vegetables on consumers food security during Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia' for requirement for the degree of Master of Science Degree in Food Security and Development Studies.

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Chairperson of the Centre or Graduate Program Coordinator

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This study was useful as an input for Addis Ababa University College of developmental studies and center of food security.

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Abbreviations and Acronyms

ACP	African, Caribbean and Pacific countries
ETB	Ethiopian birr
FAO	Food and agriculture organization
FDG	Focus group discussion
FS	Food Secured
FLW	Food loss and waste
MiFi	Mild food insecurity
MoFI	Moderate food insecurity
NGO	Non-governmental organization
OCHA	Office for the Coordination of Humanitarian Affairs
PHL	Post harvest loss
PHM	Post harvest management
SFI	Severe food insecurity
SPSS	Statistical package for social science
WFP	World Food Program

Abstract

The study amid to determine effect of postharvest Loss of Fruits and Vegetables during Retail at Lafto Fruit and Vegetable Market Addis Ababa, Ethiopia'. One third of all food produced on the planet and about a half of all fruit and vegetables are lost and not consumed. A cross-sectional study was undertaken among 354 retailers and consumers. Simple random sampling technique was employed for selection of consumers attending the market and retailers were selected by systematic sampling, interviewed to obtain quantitative data on demographic and socioeconomic variables, factors associated with post -harvest and food security behaviors. Both descriptive statistics and econometric analysis were applied using SPSS version 20 software. Furthermore, chi-square was done to explore the association between the predictor factors and post -harvest loss of fruit and vegetables. Also ordered logistic regression was used to determine the significance of food security with variables. The study finding showed that 53.2% retailers were food secured which indicate retailers were more food secure than consumers 47.9%. The finding of ordered logistic regression revealed that those who faced the postharvest lost were 12.355 times more likely to be moderately food in secured as compared to being food secured (AOR=12.355; 95%CI = 2.312 - 66.025, P-value=0.003). In addition to this, both the retailors and customers who had less amount of household income were found to be 1.0001 times more likely to be moderately food in secured as compared to that of food secured study participants. Based on the finding of this study working on reduction of post -harvest loss of fruit and vegetables were very important to enhance the food security status of both consumers and retailers.

***Key words**: Post harvest losses, fruits, vegetables, food security, Addis Ababa*

1. INTRODUCTION

1.1.Background of the study

Food and agricultural organization (FAO) defines Post harvest loss as measurable losses in edible food mass (quantity) or nutritional value (quality) of food intended for human consumption. The post-harvest system comprises a range of interconnected activities, from the time of harvest through processing, marketing, preparation, and finally consumption decisions at the consumer level. Each year, large quantities of food are wasted or lost at each of these stages during their journey to consumers (FAO, 2011).

According to FAO-commissioned study, around one third (1.3 billion tones) of food produced for human consumption is lost or wasted globally each year (Gustavsson, 2011). This inevitably also means that huge amounts of the resources used in food production and marketing are used in worthless. The total postharvest loss of fruit at farmer, wholesale and retail levels were found to be 24% of which the highest proportion of losses (35%) was observed at retail level, while the loss at wholesale and farm levels were 14 and 21%, respectively. Very high losses were observed due to transportation, marketing and postharvest mishandling at market level (Gebeyehu ,2019). 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. A study pointed out the multiple effects of postharvest loss as going beyond the loss of the actual crop to include loss in the environment, resources, and labor needed to produce the crop and livelihood of the individual involved in the production process (Kughur, Daudu, and Yaikyur, 2015).

Food losses and waste are the result of ineffective functioning of food systems. “Post-harvest losses” in the PHL system refer to the quantitative and qualitative loss of food in various post-harvest operations. There is high magnitude of loss in fruits and vegetables crops as compared to other due to the nature of the crops. Many scientific studies were reported that numerous causes and the extent of the loss particularly, in fruits and vegetables. This might be because of financial, managerial and technical knowledge limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems (Muluneh and Bikila, 2019). Usually fruits and vegetables, as well as tubers and roots, have the highest level of losses compared to all food groups.

Global quantitative food losses and wastes during the year are around 40–50% for root crops, fruit and vegetables. The primary role of an effective post-harvest handling system is ensuring that the harvested product reaches the consumer, while fulfilling market/consumer expectations in terms of volume, quality, and other product and transaction attributes, including nutrition, food security, and product safety (Desta, 2021).The major causes of post-harvest losses were due to pest infestation, diseases outbreak, and lack of storage Facilities, poor handling, harsh weather condition, inadequate extension service, improper packaging and marketing system and poor policies. Post-harvest losses of vegetable pose serious threat to farmers because they have serious effect on them. The reduction in quality and quantity produced by the vegetable farmers made farmers to have low income, increase their hunger and malnutrition in farming household (Adeola, 2020). The perception of the retailer is important in considering the reduction of post-harvest loss of fruits and vegetables in marketing chain (Bateno and Buke, 2018).

One of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. According to the FAO, food production will need to grow by 70% to feed world population which will reach 9 billion by 2050. Further trends like increasing urban population, shift of lifestyle and diet patterns of the rising middle class in emerging economies along with climate change put considerable pressure strain on the planet's resources declining freshwater resources and biodiversity, loss of fertile land (Barton and Bennett, 2011). Postharvest losses (PHL) result in direct food and income losses to farmers and consumers globally. PHL reduction strategies offer unique opportunities to contribute to sustainable food systems for increased food security and farm incomes for more than 200 million food insecure people in sub-Saharan Africa (Kikulwe, 2018). According to United Nations Food and Agriculture Organization (FAO, 2016) data; over the 57 million hectares of land, 1.07 billion tons of fresh vegetables were produced all around the world. This value was 865 million tons of fresh fruit for 65 million hectares of land. Post-harvest loss is an important threat to food security, loss in farmer incomes, and inefficiency in the global food system. It is estimated that a one third of food produced worldwide is lost and or wasted.

In the meantime, while the number of food insecure population remains unacceptably high (FAO, 2012), each year and worldwide, massive quantities of food are lost due to spoilage and infestations on the journey to consumers (FAO, 2011). In some African, Caribbean and

Pacific ACP countries, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can regularly be as high as 40-50% (Masin, 2011). Production of agricultural products such as fruits and vegetables can contribute to increased food security as well as better nutrition intake which could leads to economic development (Weinberger and Lumpkin, 2007). Obviously, one of the major ways of strengthening food security is by reducing these losses.

According to (FAO, 2012), in the developing countries, absence of basic infrastructure and knowhow in post-harvest handling have been identified as significant drivers in the formation of food loss, both currently and foreseeable future. In broad terms, as per (World Bank, 2010), food losses are influenced by production and processing choices, patterns and technologies, internal infrastructure and capacity, supply chains and channels for distribution and consumer food use practices.

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 but high amount of fruit is expected to be wasted due to several inappropriate production and postharvest handling practices (Bateno and Buke, 2018). Most of postharvest losses occur before reaching the market. Inefficient pre and postharvest handling practices, postharvest losses and major issues of food quality are becoming major challenges in food security (Emana, 2017). Ethiopia is one of the sub-Saharan African countries on the verge of severe food insecurity and poverty (FAO, 2019). Agricultural production fails to meet total domestic food needs, and nearly half of the population lives in absolute poverty due to, among others, pre-and postharvest food loss (FAO, 2018).

1.2. Statement of the problem

The subject of PHL prevention recently gained much attention and priority among governments and international organizations, as a major means to achieve global food security and sustainability; this led to the very ambitious UN goal SDG12.3, which aims to halve global food losses by 2030. Studies conducted by various international and national organizations led by the FAO indicated that about one third of all food produced on the planet and about a half of all fruit and vegetables (F&V) are lost and not consumed. FLW occurs during five key stages of the food supply chain: agricultural production, postharvest handling and storage, processing, distribution, and consumption. However, proper implementation of this process will not be achievable without sufficient participation of postharvest researchers and technologists (Amnon, Leon, Roger and Jean, 2018).

One of the main challenges facing Ethiopia today is to ensure food security for its highly increasing population growth. Although the country's production is much lower than the national demand in other hand there are high post-harvest food losses due to different reasons. Mishandling during harvesting, packaging, transportation and storage and unfavorable climatic condition and contamination are causing mechanical, pathological and physiological damage. The support given for the improvement and reduction of post-harvest loss and quality deterioration of horticultural crops from concerned bodies is low and insufficient (Solomon, 2019).

Understanding major causes and critical loss points are important inputs to recommend relevant solutions to minimize losses (Chala, Yetnayet and Gemechu, 2019). Research to quantify the extent and drivers of loss of specific crops in specific contexts is needed to identify the most cost-effective solutions to addressing post-harvest loss; this can accompany practical efforts to mitigate the problem (Carlotta, 2018).

Little information is available regarding postharvest loss during market at Addis Ababa capital city of Ethiopia and the biggest fruit and vegetable market of the city which the crops produced far from the market. Post-harvest practices and losses of fruits and vegetables are considered to be a major problem in the surveyed area. The low attention given to the PHL

issue of the country might be due to lacks of awareness and information generated by in-depth analysis of the challenge in terms of the economic and food security burdens it is posing on the national economy (Tadese, 2022). The paper contributes to the bodies of literature on the impacts of postharvest of fruit and vegetable on food security.

1.3. Objective of the study

1.3.1. General objective

This study carried out to asses Effect of post-harvest losses of fruit and vegetables on consumers and retailers food security during retail at Nifas silk Lafto fruit and vegetable retailers.

1.3.2. Specific objectives

- To determine post-harvest loss of fruit and vegetables at Lafto market on selected commercial crops.
- To identifying determinants of post-harvest loss of fruit and vegetable at Lafto market.
- To evaluate food security status of consumers purchasing and retailers at Lafto market.
- Effect of post-harvest loss fruit and vegetable on food security.

1.4. Research questions

- ✓ How much selected fruit and vegetable loss during retail at the study area?
- ✓ What is the food security status of consumers purchasing and retailers at the market?
- ✓ What is effect of post-harvest loss of fruit and vegetable food security?

1.5. Significance of the study

This study help to identify average loss of fruit and vegetables at retail level and identifies the effect of post-harvest of fruit and vegetables during retail on food security of consumers, because it's one of food chain and the significance of food loss reduction for ensuring food security. It has major environmental, economic, and sociological impacts. Finally this study was used as input for policy maker to make strong legislation for regulation, researchers will use as source and the amount of postharvest loss of fruit and vegetable during market and its effect on consumers food security at study area was quantified.

1.6. Scope of the study

The study was conducted in nifas silk lafto sub-city woreda 11 fruit and vegetable retailers due to time and financial constraints the assessment of postharvest loss of fruits and vegetables analysis was conducted at selected major horticultural crops of the area. Most importantly, the study has a scope of survey using questionnaires to collect quantitative information to better understand the issue under investigation.

1.7. Limitations of the study

The limitation of the study was only focus on quantitative weight loss of fruit and vegetables and loss at retail level only which do not incorporate other value chain. Food security status of consumers and retailers where measured regarding to post harvest loss. In addition it was difficulty in getting similar studies at retailer's level of postharvest loss at urban context. Also scarcity of information to discus and compare with empirical literatures.

1.8. Organization of the study

The paper is organized in to six chapters as follow. The first section focus on introduction, statement of problem, objective, research questions, significance, scope limitation and organization of the study. Chapter two reviews literatures on basic concepts and definition of post-harvest loss of fruit and vegetable, empirical literature, conceptual frame work, theoretical frame work. Chapter three focus on Research methodology that was used in the analysis of this paper. Chapter four shows the result of the study then the next three chapters deal with discussion, conclusion and recommendation of the study.

2. RELATED LETRATURE REVIEW

2.1. Concepts and theories literature reviews

2.1.1. Definition and concept of post-harvest loss

Postharvest loss (PHL) is defined as the measurable quantitative and qualitative loss of products at any point in the postharvest chain, from harvest to consumption (Kikulwe, 2018). Postharvest losses originate from poor pre-harvest and postharvest management including bad handling of produce during transit and storage leading to partial or total loss in produce quality. Food waste which is often referred to in literature as food losses and spoilage is a major concern with regards to postharvest losses. This type of loss relates to products intended for human consumption occurring at the end of the food supply chain as a result of retail and consumer behavior. Reasons for food waste can stem from dislike and taste preference. Although the causes of losses may be readily apparent, the complexity and heterogeneity within vegetable marketing systems makes it difficult to quantify postharvest losses (Prusky, 2011).

2.1.1.1. Post-Harvest Losses of Fruits and Vegetables in Developing Countries

Post-harvest loss of fruits and vegetables occur due to lack of proper technique of harvesting, transportation, storage and distribution. The freshness of fruits and vegetables after harvest is controlled by water content, respiratory rate, ethylene production, endogenous plant hormones and exogenous factors such as microbial growth, temperature, relative humidity and atmospheric compositions. Therefore, post-harvest loss of fruits and vegetables can be considerably reduced and their shelf life increased by careful manipulation of these factors.

2.1.1.2. F**actors that affects postharvest loss of fruits and vegetables**

Several factors contribute to the success of fruit and vegetable storage including temperature, humidity, atmospheric composition, air movement and light. The cold storage temperature should be maintained at the desired level for the fruits and vegetables to be stored. Sensitivity of the crops to physical damage was because of the perish-ability nature of the crop and high water content inside the commodity. The expected reason is exposing fruits and vegetables to high light intensity leads to water loss through vapor-transpiration and finally the commodity drying or rooting. The storage material composition, adeptness to the local environment and suitability. In addition, during storage greater postharvest losses of commodities were

associated with using rough storage materials and commodities were associated with using rough storage materials and commodities were stored longer time in the hands of retailer.

A similar study show that the major constraints of post-harvest deterioration market were transportation from long distance to market place (18% lettuce and 14.8% tomato were damaged), traditional storage material (22% banana and 21% tomato were physically damaged), high temperature (high light intensity) in the market (34.4% lettuce and 33.6% mango were damaged) (Bateno and Buke, 2018).

2.1.1.3. Post-harvest losses of Fruit and vegetables during marketing

A perfect and efficient marketing system is essential to avoid the losses of fruits and vegetables, and it is possible and at a time when the market needs the produce most and also to get a good return for the effort and money spend. However, marketing of fresh perishables presents more problems compared to other durable agricultural products (MOARD, 2005). In most of the developing countries like Nigeria, the interests of producers as well as consumers are very poorly served, the famers' gets less return for their effort and money spend while the consumer pays more than what is necessary. However, during the peak of the season when the market is in glut with a particular vegetable or fruit a lot of wastage or loss is experienced. Also, prices are considerably very low, and farmers get discourage and dejected. Therefore, effort should be made to avoid glutting and the loss should be reduced to the barest minimum (Emana B, Gebremedhin, 2007).

2.1.2. Definition and concept of Food security and insecurity

2.1.2.1. Food security

Food security/insecurity, as a concept, has been reformulated many times since mid-1970s when the term began to be used on a regular basis. The earliest definition of the concept of food security considers it as the availability of sufficient food supply at the global, national and regional levels. The focus was, therefore, on the aggregate supply of food in the world market to meet the demand for it (Maxwell and Smith, 1992).However, the availability of food at larger scale alone never guarantees food security at household or individual level.

Unlike the case in 1970s, the focus of the concept of food security shifted to questions of access to food at household and individual levels in 1980s. In 1983 FAO conceptualized food security as: 'Ensuring that all people at all times have both physical and economic access to

the basic food that they need', implying that a balance should be struck between the demand and supply side of the food security equation.

In the 1986 Poverty and Hunger report of the World Bank, this concept of food security has been further elaborated in terms of: 'access of all people at all times to enough food for an active and healthy life.' It introduced the widely accepted distinction between chronic food insecurity, associated with problems of continuing or structural poverty and low income, and transitory food insecurity, which involved periods of intensified pressure caused by natural disasters, economic collapse or conflict (FAO, 2003).

The World Food Summit adopted even a more comprehensive definition: 'Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life' (FAO, 1996). In this definition the phrase 'safe and nutritious' emphasizes food safety and nutritional composition while 'food preferences' indicates the change of the concept from mere access to access to the food preferred.

This implies that people with equal access to food, but different food preferences, could show different levels of food security. This definition is again refined in the State of Food Insecurity (WFS, 2001) as: 'a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary food preferences for an active and healthy life'. (Degefa, 2007), based on the aforementioned series of definitions, conceptualized food security to Ethiopian context as: 'Household can be described as food secure when its livelihood activities allow to meet its food requirements and other basic needs, either through its own productions i.e. crop cultivation and/or livestock rearing, through having opportunities to run own non-farm ventures or to work with somebody else, or getting access to food through transfers.

The analysis of food security status at different societal levels requires investigation of four core components: physical availability of food, economic and physical access to food, utilization, and stability (sustainability) of the other three dimensions over time. The first component, food availability, refers to the supply-side indicator of food security referring to the capacity of the households or individuals to obtain food. It is achieved when sufficient quantities of food are consistently available to all individuals within a country or region. It

can be supplied through household production, food imports, or food assistance. Physical food availability is determined by the level of food production, stock levels and net food trade. The other dimension, economic and physical access to food, is determined by the income and expenditure condition of a household as well as food market and food price (FAO, 2008).

2.1.2.2. Food insecurity

Food insecurity is a complex concept mainly referring to lack of access to enough food for all people at all times for an active and healthy life. Food insecurity can be permanent or temporary. Temporary food insecurity is caused by a temporary reduction in house hold access to food which is primarily caused by fluctuations in food prices, production, household income or combination of these factors (Reutlinger and Holst, 1986).Chronic food insecurity is characterized by lack of adequate diet and nutrition due to the households inability to obtain food .chronic food insecurity affects households that cannot buy food or produce there food regularly (Sen, 1981).

2.1.2.3. Pillars of food security

2.1.2.3.1. Food availability

Food availability refers to the supply-side indicator of food security referring to the capacity of the households or individuals to obtain food. It is achieved when sufficient quantities of food are consistently available to all individuals within a country or region. It can be supplied through household production, food imports, or food assistance. Physical food availability is determined by the level of food production, stock levels and net food trade (Jrad, 2010).

2.1.2.3.2. Access to food

Access to food is determined by the income and expenditure condition of a household as well as food market and food price issues. Food access is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet (FAO, 2013).

2.1.2.3.3. Utilization

Utilization refers to the way the food ought to be consumed. Food utilization refers to the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients, potable water, and adequate sanitation. Effective food utilization depends in large measure on knowledge within the household of food storage and processing techniques, basic principles of nutrition and proper household care, and illness management (USAID, 1992).

2.1.2.3.4. Sustainability

Sustainability considers the other three components on a periodic basis. It addresses whether the nutritional status is improving or deteriorating. It includes such aspects of food consumption as nutritional balance, hygienic preparation and preservation of food, as well as access to potable water. The fourth component of food security as asset creation referring to the position of a household in valuable farming household assets, such as livestock, farming tools and utensils that could be sold into cash or food items in times of food shortfalls to counter balance the possible crises (FAO, 2008).

2.1.2.3.5. Food sovereignty

Food sovereignty tries to fill two crucial elements that the term food security misses in many documents i.e. source of food and the right to food which was stated in Universal Declaration of Human Rights. The proponents of food sovereignty underlined that 'long term food security depends on those who produce food and care for the natural environment. It was re-defined in 2007 in what is known as The La via Campesina Declaration on Food Sovereignty or Declaration of Nyéléni. The proponents of food sovereignty underlined that 'long term food security depends on those who produce food and care for the natural environment'. As the driving forces of food producing resources, they acclaimed seven principles that are of central importance to produce adequate food (both in quality and quantity) locally which are ecologically, socially, economically and culturally appropriate to their unique circumstances (WFS, 2007).

2.1.3. Theoretical framework

The theoretical framework for this study was selected on the bases of Trienekens value chain analysis for developing countries (Kikulwe, 2018) . It consists of three theoretical approaches within the value chain framework such as value chain constraints, value chain analysis and value chain improvements. Value chain constraint approach was used to identity what constraints exist in the supply chain concerning market access, infrastructure and resources.

Value chain analysis approach was used in the framework to examine the network structures, governance structure and value adding activities in the supply chain. The last approach deals with options for improvement within the value chains. The theoretical framework was used to analyze the supply chain channels for selected 11 fruits and vegetables in Ethiopia. The selection of framework was based on the appropriateness of value chains for the developing country. (Trienekens 2011) framework comprises global value chains, which was not included in this exploration as it mostly focuses the domestic market in Addis Ababa, Ethiopia.

2. 2. Empirical literature

Poor postharvest handling practices in the market chain accounts for great losses in the market. For example, rough handling, rough stronger materials/traditional, poor shading material to protect from high light intensity, and duration of the produce in the market. Mechanical injuries are major causes of losses in quality and quantity of fresh vegetables and traits in the study area (during transportation loading and unloading). The perception retailers about postharvest handing practices during storage and postharvest losses factors and their consequences are low in Sodo market. Furthermore, some of retailers have no detail knowledge about unique characteristics of fruits and vegetables and they sell without giving attention about their commodities (Temesgen, 2018).

Pre- and PHM practices are essential for fruits and vegetables to supply a quality yield to the market. However, there was a great deal on post-harvest loss of potato (reaches up to 50 quintal/production cycle), in the study area mainly due to lack of market access and linkage and lack of awareness, and it which was mostly happed on small group of producers in association with local seed production and multiplication of potato. Indeed, this was regressive that other individual stakeholders not to produce fruits and vegetables for long-term return. Generally, it could be concluding that horticulture crop producers in northern part of Ethiopia, particularly in Tigray region, are used different cultural practices adopted from innovative technologies and their own tradition cultural practice, and hence they had been increasing the potential for production of fruits and vegetables. However, there are many production constraints during cultivation, harvesting, transportation, marketing and consumption of fruits and vegetables, and hence postharvest loss was listed as a main challenge to perishable crop producers in the study area set that Minimizing postharvest losses of fruit and vegetable is a very effective way of fighting poverty, ensuring food

security and maintaining the quality of produce. In many developing countries, major causes of fresh fruit and vegetable loss are the lack of infrastructure (poor harvesting, transportation, storage and processing technologies) while fruit and vegetable losses in developed countries occur largely at consumer stage. Use of the appropriate post-harvest innovations and technologies is necessary to reduce post-harvest losses. Along with post-harvest technologies, coordination and management of post-harvest stages successfully have an important role in reduction of post-harvest losses (Hagos, 2018).

The study of (Egwuonwu, 2020) analyzed Post-harvest losses among vegetable farmers, and finds that the farmers in the study area experienced post-harvest losses. The major causes of post-harvest losses were due to pest infestation, diseases outbreak, lack of storage facilities, poor handling, harsh weather condition, inadequate extension service, improper packaging and marketing system and poor policies. Post-harvest losses of vegetable pose serious threat to farmers because they have serious effect on them. The reduction in quality and quantity produced by the vegetable farmers made farmers to have low income, increase their hunger and malnutrition in farming household, all these thereby threaten their food security. Postharvest Management is handling of produces from farm to fork/ table i.e. harvesting, transporting, and handling, storing, processing and value addition. Minimizing postharvest losses of crops are a very effective way of reducing the area needed for production and/or increasing food availability. Postharvest technologies can contribute to food security in multiple ways. They can reduce PHL, thereby increasing the amount of food available for consumption by farmers and poor rural and urban consumers. Food availability and accessibility can be increased by increasing production, improving distribution, and reducing the losses. Thus, reduction of post-harvest food losses is a critical component of ensuring future global food security. Generally, significant role food loss reductions could have toward sustainably contributing to global food security (Desta, 2021).

The extent of PHL in Ethiopia is high that greatly impacts the food security of a significant proportion of the population. Considering only the staple crops (cereals and pulses), a great deal of food security potential and opportunities are missed due to the high rates of PHL in the country. To estimate the number of people who could be fed if only 50% of the PHL of grains could have been saved. Taking the total volume of PHL in grains (cereals and pulses), which was 39,123,386 tones or 39,123,385,440 kg of grains, which is about 3,912,338,544 kg every year between 2009 and 2019. A five years (2015-2019) average number of severely

and moderately food insecure persons in Ethiopia is estimated to be 61 million. It is recalled that the Ethiopian per capita consumption of grains is 168 kg/person/year. By dividing the total estimated average annual PHL of grains over the ten years by the per capital grains consumption, we obtain the potential food security impact of the losses after harvest, which is feeding 23,458,502 persons every year between the specified study period. This means that Ethiopia could reduce the number of severely and moderately food insecure persons from 61.36 to 37,901,498 persons, which is a 38.23% improvement in food security. To be very practical, 100% PHL management may not be realistic and if only 50% of the PHL in grains in Ethiopia could be saved, 11,729,251 persons could be fed up to the national grain per capita consumption, which is almost 20% improvement in national food security. Taking the experiences of other countries, it is estimated that grain postharvest losses could be reduced to 2%, which could greatly contribute to national, regional and global food security. It is important to consider that the analysis of the food security potential of the lost food crops in Ethiopia is less than the actual figures as fruits, vegetables and animal products are excluded due mainly to lack of reliable data on the production, consumption and market values of the left-out commodities for the selected study periods. This is to imply that the actually missed opportunity in terms of food security with respect to the lost crops, is higher than the estimations made in this report. This is also exacerbated by the even higher PHL rates of the fruits, vegetables and animal source foods due to their high perishability (Tadesse, 2022).

2.3. Conceptual frame work

The conceptual framework is interconnected/or correlated components/ or sets of concepts addressing the given event and demonstrates how parts are working (Svinicki, 2010). It provides the essential components, constructions, or variables and their connections. Conceptual framework aids to improved research and allows researchers to explain their thinking (Miles and Huberman, 1994). Therefore, the conceptual framework for this investigation was produced based on the evaluation of linked literature and previous research outputs with the present study.

In many developing countries, this are factors affecting postharvest loss of fruit and vegetable during retail and factors affecting food security status of consumers and retailers. The factors associated with high levels of PHL of perishable crops were socio-demographic characters of the farming community, and the handling practices of the products (Yeshiwas, 2021), where income, education level and gender of the farming community, as well as limited private

investment in the sector, are contributing factors. Poor postharvest handling practices in the market chain accounts for great losses in the market. For example, rough handling, rough stronger materials/traditional, poor shading material to protect from high light intensity, and duration of the produce in the market. Mechanical injuries are major causes of losses in quality and quantity of fresh vegetables and traits in the study area (during transportation loading and unloading) (Bateno and Buke, 2018).

According to recent studies, the estimated average magnitudes of postharvest loss in Ethiopia ranges from 15.5 to 27.2% for major grain crops and 23% average loss for all crops (FAO, 2017). A post-harvest loss contributes to the reduction of food supply and, hence, leads to high food prices in the market and thereby aggravating the food insecurity situation in the country. The main reasons of post-harvest loss among others is inherent weaknesses in post-harvest handling techniques due to the poor management practices, lack of infrastructure and appropriate equipment and limited access to market (Teferra, 2021).

The diagram below will represent factors and relationship with post-harvest loss of vegetables.

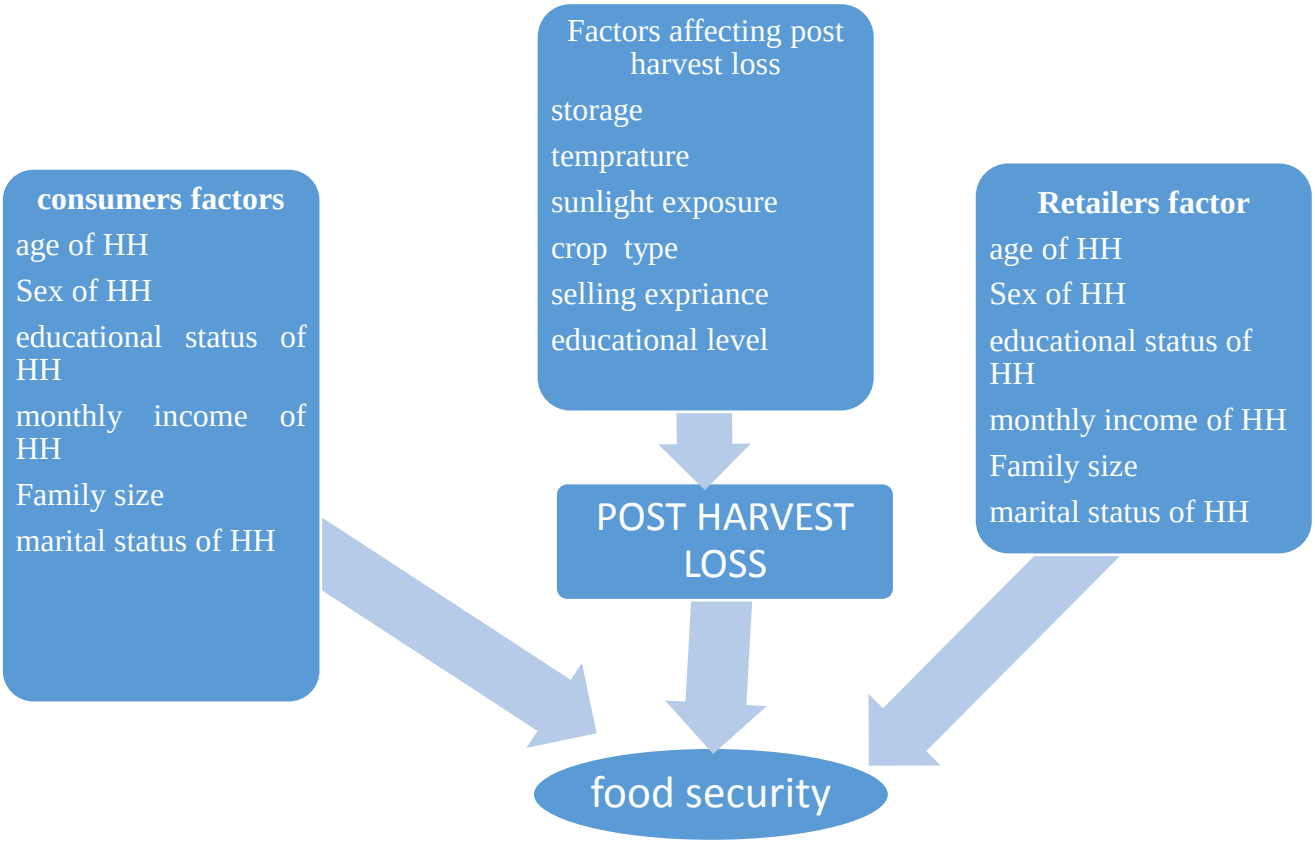


Figure 2.1 Conceptual frame work for post-harvest losses of fruits and vegetable and consumers' food insecurity.

Source; Own elaboration and adapted from literatures by assessing factors affecting Post harvest loss and food security.

3. DESCRIPTION OF STUDY AREA AND RESEARCH METHODOLOGY

3.1. Description of the study area

Nifas silk Lafto is one of the 11 sub cities of Addis Ababa, the capital of Ethiopia. As of 2016 population projection, its population was of 387017 and total area 68.30 km3 (26.37 sq. mi). The district is located in the south-western suburb of the city. It borders with districts of Kolfe Keranio, Lideta, Kirkos and Bole and Akaky Kaliti sub-cities of Addis Ababa and Sebeta and Alemegena woredas of oromia regional state. The study will under taken in Lafto fruit and vegetable market which is found in Nifas silk Lafto sub city Woreda 11. Following the onset of the Novel Coronavirus (covid-19) pandemic, Atikilt Tera, a vast open vegetable and fruit market originally based in Piassa, temporarily moved to the fields of Jan Meda, a sports ground, to curb the spread of the virus. The market stayed in Jan Meda for over five months. Ultimately, it was given its new home at the Lafto Vegetable & Fruit Market Centre in the Haile Garment neighborhood of southwestern Addis Ababa. The location seemed to surprise both customers and vendors. The location is relatively well-suited for a fruit and

vegetable market. The market contains 780 compartmentalized shops accommodating 316 small-scale vendors, 46 distributors and 24 farmers. The stands lie in rows with wide spaces dividing the sections. It has a large parking area and is well-secured with constables guarding the compartment rows. The market opens at 6:00am and closes around 7:00pm. The construction of this vegetable market has created jobs for more than 2,000 people. This includes caretakers and those who worked loading and unloading produce at the previous market in Jan Meda, as well as 100 waste collectors hired to keep the area clean.

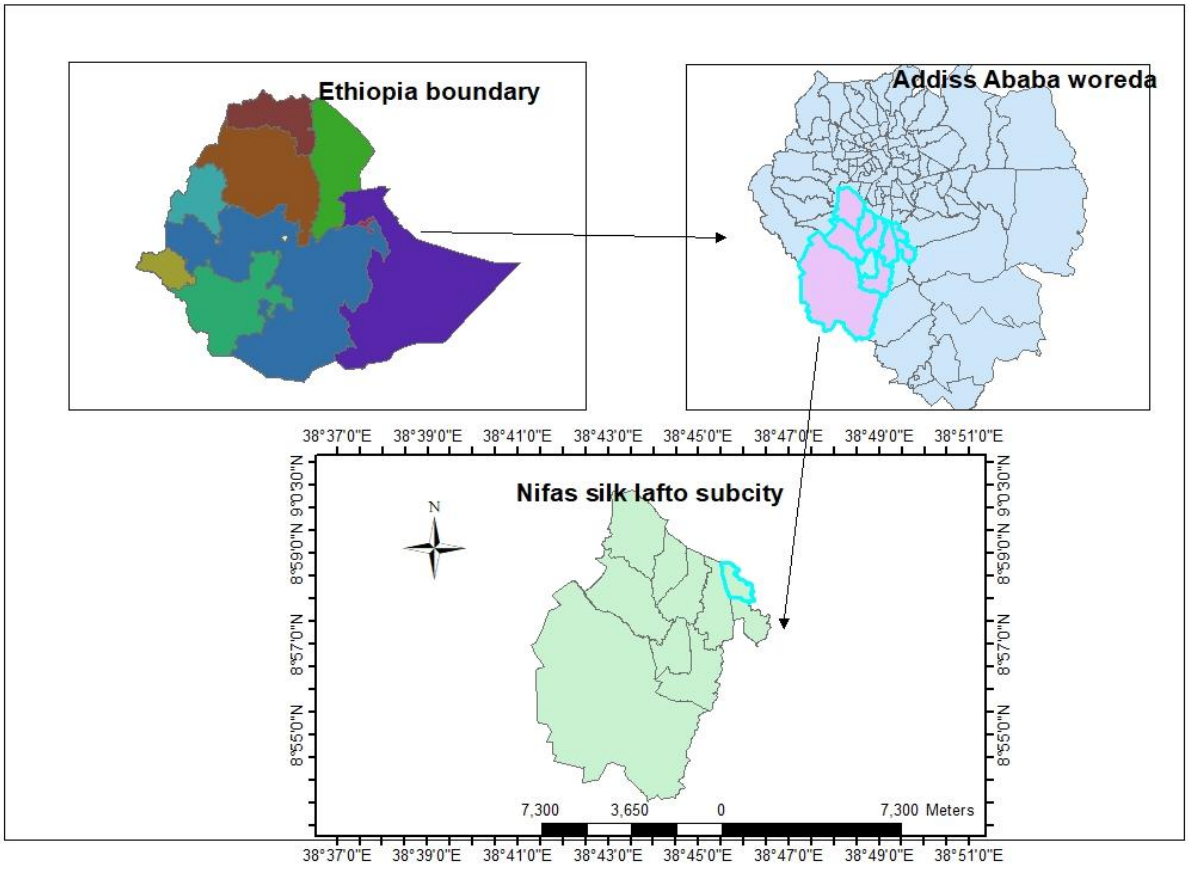


Figure 3.1 Map showing Nifas Silk Lafto Sub city

Source: developed by Arc GIS, 2021

3.2. Study design

The study was use mixed research design and use both quantitative and qualitative research approaches. A survey strategy collect data acquired through structured questioners, interviews, and a focus group discussion checklist. Secondary data was used gathered from

books, journal articles, government offices, and published and unpublished scholarly publications, which utilize multiple methodologies to gather and analyze data to assess effect of post-harvest loss on food security. Mixed methods research is a good design to use to build on the strengths of both quantitative and qualitative data.

3.3. Source population and study population

The source population of this study was obtained from lafto fruit and vegetable market and who only retail fruit and vegetables and consumers who presented for purchasing fruit and vegetables from the market, study population for this study were all fruit and vegetable retailers at Addis Ababa city.

3.4. Eligibility criteria

3.4.1. Inclusion criteria and Exclusion criteria

Inclusion criteria for this study was only consumers and Retailers at lafto fruit and vegetable market, who only retail fruit and vegetables, volunteers and presented at the time of data collection. Exclusion criteria were consumers and retailers who are not volunteers, Fruit and vegetable Retailers out of lafto market and Consumers who purchase other than lafto market at the time of data collection.

3.5. Data source

The research used all relevant primary and secondary data sources. Primary data was obtain Information to assess effect of post-harvest losses of fruit and vegetables on consumers food security during retail, close and open-ended questionnaires, FGD ,field observation and standard HIFIAS question was used to collect primary information . The questionnaire was pre tested and then improved before data collecting. This was done to avoid ambiguity, and redundancy of words, in turn, to improve clarity and understanding. Secondary data were gathered through a study of different published and unpublished publications on the post-harvest loss of fruit and vegetables during retail and food security status of consumers.

3.6. Sample size determination and sampling techniques and procedure

3.6.1. Sample size determination

Using Taro Yamane (1967) sample size determination formulas it was given the formula as, $n = N/ 1+N (e)^2$ Where,

n- Is the required Sample size from the stores under study

N-is the whole stores under study

e- Is the precision or sampling error which is 0.05

Similarly, the marginal error (e) of this study was 5%, which is equal to 0.05.

Means that N=316

e= 0.05

$n = N/ 1+N (e)^2 = 316/ 1+316(0.05)^2$

= 316/1.79

= **177** sample size from the fruit and vegetable store and 10 % non-respondent rate

The study obtain similar sample size for consumer to get parallel information so that, 177 consumers were interviewed, In general, the total sample was sought to be equally distributed along study group (Tesfaye, 2015).

There for, total sample size were 354 consumers and retailers are participated.

3.7. Sampling techniques

In this study three stage sampling technique was used in the first stage the biggest fruit and vegetable market in Addis Ababa city was selected to get adequate information, at the second stage among 316 retailers by using Taro Yamane formula 194 retailers was selected, For the purpose of this study a sample size of 177 retailers was selected from Lafto fruit and vegetable market and all are retailers in the market chain. A systematic sampling technique was adopted

to obtain postharvest loss of fruit and vegetable who have the knowledge and experience in the market. The 177 retailers was selected by systematic sampling technique and interviewed at the last similar number 177 consumers attending the market was selected and interviewed by using simple random sampling.

3.8. Data collection instrument

Data was generated by preparing questionnaire and interview the targeted consumers and retailers through open questions. The data was collected both in terms of quantitative expiration. Therefore the data collection was carried out with the aim of food security status of consumers in Lafto vegetable and fruit market, the factors that contribute to postharvest losses of selected fruits (mango, Avocado, Banana, Orange and Papaya) and vegetables (pepper, potato, cabbage, tomato carrot and onion). The questions are specifically focus on information of the market changes on fruit and vegetables postharvest handling practices and associated losses of selected crops. In addition to individual respondents the questionnaires are supplemented by group discussion.

3.8.1. Questionnaire survey

Questioner survey was applied to generate quantitative and qualitative information about the food security status of both consumers and retailers and postharvest loss of fruit and vegetables during retail from a data collection 354 sample size was surveyed. To Surveys was undertaken by developing questionnaires. A questionnaire was chosen as the data collection instrument. Questionnaire survey was conducted using a Kobo Toolbox which is a free open-source tool for mobile data collection. It allows to collect data in the field using mobile devices such as mobile phones or tablets, as well as with paper or computers. It is being continuously improved and optimized particularly for use in emergencies and difficult field environments to support data collection (OCHA).

3.8.2. Focus group discussion (FGD)

The purpose of the FGD was to gather information related to causes of postharvest losses of fruit and vegetables during retail of selected crops. Using the same method of estimation of saturation, it was found that saturation was reached after conducting eight FGDs (Kirchberger, 2009). Therefore, five FGDs was conducted to gather some qualitative information from the respondents who are not involved at the questioner survey. The FGD was conducted for a retailers groups of 8-12 persons per each FGDs. The participant for FGD

were those who are not participated on questionnaire interview.4 FGD was done and 42 total retailers was participated and there were age 18-55.

3.8.3. Field observation

Field observations were conducted to confirm the information obtained through primary and secondary data gathering instruments. Field observation was employed to truly cover the ground and improve data collecting from other sources. Observation is a qualitative strategy that helps researchers understand about the viewpoints held by study area. Observational data serve as a check on participants' subjective reporting of what they think and do (Mitchell and Fraser, 2015).

3.8.4. Secondary Data Review

A review of related literature was collected to understand previous works in post-harvest loss and food security of customers. Different books, journal articles, reports, reviews, working papers, guidelines, dissertations, and internet sources were reviewed. Resources from UNHCR, CARE, World Food Program (WFP), and Food and Agriculture Organization (FAO) were included in the desk review process.

3.9. Data processing and analysis

The data analysis included both qualitative and quantitative methodologies. The quantitative data analysis included descriptive statistics such as mean, standard deviation, percentage and frequency distribution. Inferential statistics such as chi-square test were utilized to examine the significant link. In addition to this, econometrics models were applied for the study. In this respect, logistic regression model, multiple linear regression and multi-nominal regression were utilized for this investigation. The model assisted to define the link between the dependent variables and a collection of explanatory variables. Quantitative data were maintained and analyzed using SPSS Version 20 software. The material acquired through, FGD and field observations were qualitatively examined.

3.9.1. Analysis of postharvest loss fruit and vegetable during retail

Mean and percentage were used to calculate the PHLs of fruits and vegetables at retail level loss estimate was quantified and calculated as the difference between volume purchased and volume sold in relation to total volume sourced (Tesfaye, 2015).

PHL=PV-SV

Whereas PHL refers to one crop that which loss is calculated

PV purchased volume

SV sold volume

NI number of item

PHL of banana= PV banana – SV banana (this is used to calculate loss for each crops).

The loss is defined and analyzed by loss and no loss (if loss =yes, no loss=no)

3.9.2. Analysis of Food Security

Data for this study was generated through quantitative and qualitative methods and HFIAS questions was used to assess food security status of retailers and consumers. Food security is designed to assess the availability, accessibility, consumption or utilization and stability of food at the global, national household and individual levels. A situation of food insecurity also stated when the population lack access to enough and secure supply of food on consistent basis. Internationally food security is defined as the capacity of individuals to obtain enough food. To evaluate the food security status, there are a variety of measuring instruments accessible of household and it very dependent on the scope and goal of the evaluation.

3.9.2.1. Household Food Insecurity Access Scale (HFIAS)

HFIAS indicator offers information on food insecurity, this indicator measures the severity of household food insecurity. It focuses on the “access” aspect of food insecurity (i.e. not on food utilization). It is based on respondents’ perceptions of their households’ food

vulnerability and on their behavioral responses to food insecurity. Conducting individual interviews with a representative sample of target households, asking them nine occurrence questions representing a generally increasing level of severity of food insecurity. Nine frequency of occurrence questions that are asked as a follow-up to each occurrence question to determine how often the situation occurred ,a 4-item Likert scale as frequently; sometimes; rarely and never. The mentioned responses were scored as 3, 2, 1, and 0, respectively. The maximum score for a household was 27. When the household response to all nine questions was "often", the response score was 3, but the minimum score was 0 when the household responded 'no' to all questions. Higher scores in the HFIAS meant the worse status of food insecurity for household. In this scale, food insecurity was divided into four groups including: food secure (0–1 point), mildly food insecure (2–7 points), moderately food insecure (8–14 points) and severely food insecure (15–27 points).

The HFIAS score is a continuous measure of the degree of food insecurity (access) in the household in the past four weeks (30 days). Four types of indicators can be calculated to help understand the characteristics of and changes in household food insecurity (access) in the surveyed population, it is calculated for each household by summing the codes for each frequency of occurrence question. The lower the score (0-27), the less food insecurity (access) a household experienced. Determine the indicator's value by summing up the scores of all households and then dividing the result by the number of interviewed households.

There are two terms used throughout the questionnaire that are highly context specific: "household" and "lack of resources." By "household" we mean those of you that sleep under the same roof and take meals together at least four days a week. It is not recommended that an average increase from 12 to 24 be reported as a "doubling of food insecurity", but rather as a "doubling of the food insecurity score. HFIAS is expected to be used both in contexts with rapidly changing situations, where the primary interest is in detecting acute/ transitory insecurity, as well as in relatively stable situations, where the problem is one of chronic food insecurity. First, a HFIAS category variable is calculated for each household by assigning a code for the food insecurity (access) category in which it falls. The data was coded frequency-of-occurrence as 0 for all cases where the answer to the corresponding occurrence question was "no" (i.e., if Q1=0 then Q1a=0, if Q2=0 then Q2a =0, etc.) prior to assigning the food insecurity (access) category codes. The four food security was created sequentially, to ensure that households are classified according to their most severe response.

Calculate the Household Food Insecurity Access category for each household. 1 = Food Secure, 2=Mildly Food Insecure Access, 3=Moderately Food Insecure Access, 4=Severely Food Insecure Access

HFIA category = 1 if [(Q1a=0 or Q1a=1) and Q2=0 and Q3=0 and Q4=0 and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]

HFIA category = 2 if [(Q1a=2 or Q1a=3 or Q2a=1 or Q2a=2 or Q2a=3 or Q3a=1 or Q4a=1) and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]

HFIA category = 3 if [(Q3a=2 or Q3a=3 or Q4a=2 or Q4a=3 or Q5a=1 or Q5a=2 or Q6a=1 or Q6a=2) and Q7=0 and Q8=0 and Q9=0]

HFIA category = 4 if [Q5a=3 or Q6a=3 or Q7a=1 or Q7a=2 or Q7a=3 or Q8a=1 or Q8a=2 or Q8a=3 or Q9a=1 or Q9a=2 or Q9a=3]

3.10. Quantitative Data Analysis

3.10.1. Descriptive Statics

Descriptive statistics are described in terms of percentages, ratio, and average (mean) as measurements of central trends. Results are sometimes given in the form of tables (Meron, 2014). Dispersions specifically standard deviation were also employed in this investigation. If appropriate, partition values like quartiles and percentiles was also employed. Results are also offered in the form of tables.

Descriptive statistics offer absolute numbers. However, they do not explain the logic or reasoning behind such statistics. Before employing descriptive statistics, it's crucial to think about which one is most suited for the study issue and what the researcher wish to reveal. In addition, descriptive statistics are most useful when the study is confined to the sample and does not need to be expanded to a wider population (Atlan, 2018).

The acquired data was recorded, organized cleaned, and summarized for analysis. The two kinds of parametric statistical tests such as descriptive and inferential statistics were applied to examine the data using the SPSS version 20 software. According to (Walliman, 2011), descriptive tests disclose the 'shape' of the data in the sense of how the values of a variable are distributed. Inferential tests propose (i.e. infer) findings from a sample about a population. Thus, the food security level of the selected households was analyzed using descriptive

analysis. Descriptive statistics such as frequencies, percentages, mean and standard deviations were used to examine socio-economic characteristics of study participants and to characterize the factors of food security. Finally, the results were presented as found appropriate in histograms, tables, and charts.

3.10.2. Inferential Statics

Inferential Statistics is the mathematics and logic of how generalization from sample to population may be formed (Klotz, 2006). The underlying issue is: can researchers predict the population's characteristics from the sample's features? If a difference in the dependent variable between the two groups is statistically significant, it suggests that the findings were not likely to have occurred by luck. Statistical significance shows a high chance that the independent variable caused the change in the dependent variable. Inferential statistics, as the name indicates, requires drawing the proper inferences from the statistical analysis that has been completed using descriptive statistics (Saunders, 2009).Them enhances descriptive statistics by putting it beyond description.

Therefore, the researcher were utilize inferential analysis to infer the cause and effect connection between independent and dependent variables. There are varieties of inferential statistics to determine statistical significance, however in this research regression analysis was conducted because this research is intended to assess the relationship between the independent variable i.e. food security status and their effects on the dependent variable.

3.10.3. Model Specification

Model specification may be described as the practice of officially declaring a model i.e. the explicit translation of theory into mathematical equations and involve utilizing all the available relevant theory research and information and producing a theoretical model. (Saunders, 2009). significance level of the explanatory variables such as the age of the household head, family size, and dependency ratio of the households, monthly income of the household, remittances earned, and saving amount gender and social connection on dependent variable which is food security status of the customers .

3.10.3.1. Ordered logit Regression

Ordinal regression was allowing us identify, which of our independent variables (if any) had

a statistically significant influence on the dependent variable. The dependent variable is assessed on an ordinal level. The four independent variables are categorical or ordinal. The independent variables are strongly correlated with each other, proportionate odds i.e. that each independent variable has a similar influence at each cumulative split of the ordinal dependent variable (Gujarati, 2004). The ordered logit model examined relationships between food insecurity and household demographic and socioeconomic factors. Ordered logit is a generalization of the analysis to the case of more than two categorical outcomes of an ordinal dependent variable. The dependent variable, Food secure, was ranked from the following list: Food Secure, Low Food Insecure, and High Food Insecure. Suppose the underlying relationship to be characterized is,

$$y_i = X_i \beta + \varepsilon_i \text{---------- (1)}$$

Where y_i is the exact but unobserved dependent variable; Xi is the vector of independent variables, β is the vector of regression coefficients which we wish to estimate and ε_i is the error term such that ε_i is identically and independently distributed as N (0; 1). Further suppose that while we cannot observe y^*, we instead can only observe the categories of response:

$$y = \begin{cases} 1 \text{ if } yi* \leq \mu 1 \text{ (food secure)} \\ 2 \text{ if } \mu 1 \leq yi* \leq \mu 2 \text{ (mildly food insecure)} \\ 3 \text{ if } \mu 2 \leq yi* \leq \mu 3 \text{ (moderately food insecure)} \\ 4 \text{ if } yi* > \mu 3 \text{ (severely food insecure)} \end{cases} \text{----------(2)}$$

Here, 1, 2, 3, and 4 are the levels (FS, MiFI, MoFI, and SFI), $\mu 1$ to $\mu 3$ are threshold values (cut-off points) to be predicted for any of the consumers food insecurity levels.

The variance inflation factor provides a measure of the degree of collinearity, such that a variance inflation factor of 1 or 2 shows essentially no collinearity and a measure of 10 or higher shows

extreme collinearity. Following (Gujarati, 1995), VIF is defined as:

$$1(Xj) = [2] - (1)$$

$1 - Rj$ Where:

Xj = the j^{th} quantitative explanatory variable regressed on the other quantitative explanatory v variables.

R2j = the coefficient of determination when the variable Xj regressed on the remaining explanatory factors. As a rule of thumb, if the VIF of a variable exceeds 10 that variable is considered to be extremely collinear and it may be assumed that multi-collinearity is an issue (Gujarati, 1995). It is also obvious that there can be interaction among qualitative factors, which might lead to the issue of multi-collinearity. To discover this issue, contingency coefficients were calculated for each pair of qualitative variables.

3.10.3.2. The Chi-square test

The Chi-square test informs whether there is a significant association between two categorical variables. Suppose the calculated Chi-square value is above the critical value from the Chi-square distribution. Inferential statistics (using Chi-square test) were implemented to explore the significant association between the socio demographic aspects and fruits and vegetables

Postharvest losses. Chi-square test indicated that if there is a significant difference among educational status, selling experience, storage material, age, sex of retailer, demand price variation and postharvest loss. Chi-square statistics are calculated as stated below.

$$\chi^2 = \sum (O_i - E_i)^2/E_i$$

Where,

χ^2 = Chi-square

O_i = observed value (actual value)

E_i = expected value

3.10.3.3. Simple linear regression

Simple linear regression model was used to examine the relationship between postharvest loss fruit and vegetables and explanatory food security status of respondents. The general form of multiple linear regressions is:

$$y = \beta_0 + \beta_1 X + \epsilon$$

- **y** is the predicted value of the dependent variable(food security status of consumers) (**y**) for any given value of the independent variable (post-harvest loss of fruit and vegetables during retail(**x**).
- $\mathbf{B_0}$ is the **intercept**, the predicted value of **y** when the **x** is 0.
- $\mathbf{B_1}$ is the regression coefficient – how much we expect **y** to change as **x** increases.
- **x** is the independent variable (post-harvest loss of fruit and vegetables).
- **e** is the **error** of the estimate, or how much variation there is in our estimate of the regression coefficient.

Linear regression finds the line of best fit line through data by searching for the regression coefficient (B_1) that minimizes the total error (e) of the model.

3.11. Qualitative Data analysis

Qualitative data was obtained via interviews, observations, and secondary data. In this research, therefore, quotes analysis was the best way to examine information obtained from consumers and retailers, FGD facilitation and information from direct observations. The information was summarized and analyzed and cross triangulated with quantitative data and narration.

3.12. Description of Study Variable

The data included the details required to assess the demographic, and socioeconomic factors

that affect food security status of consumers and post-harvest loss of fruit and vegetables. The following variables were identified and taken into consideration in the study because they were continuous and discrete variables that could be used to answer the study's research questions.

3.12.1. Dependent variables

The dependent variable is determinant of food security status of consumers and retailers. The measurements used to determine the factors determining food security status were observed from ordered logit regression models and Chi-square test. The Household Food Security is categorized dependent variable in the model, with 1 representing Food Security, 2 mild food insecurity, 3 moderate food insecurity, and 4 severe food insecurity.

3.12.2. Independent Variables for food security

The following independent variables were identified as being associated to food security: age of the household head, gender of the household head, family size of the household, educational level of the household head, marital status of the household head, number of dependents in the household, and monthly income.

3.12.2.1. Sex of the household head (shh)

Is dummy variable indicating the sex of the head of the family, where, male take 0 female 1. As (Baten and Khan, 2010) stated female-headed households might find tougher than males to acquire access to valuable resource. In Ethiopia, gender differences in economic output remain an issue with the majority of women still encountering discrimination, which in turn, raises their risk of being food insecure (Brauw, 2008). Therefore, it is anticipated that female-headed families are less likely to become food secure compared to male headed households.

3.12.2.2. Age of household head (Ahh)

Age is a continuous explanatory variable measured in years. Older people have relatively richer experiences of the social and physical environments and knowledge in searching for different jobs and accumulates wealth over time, making them more food secure than elder household heads. According to previous research, age has a substantial influence on household food security, and the age of the household head may affect the activities of a family (Walker, 2003). Their age is defined as the period from his or her birth to the time of

his or her interview and is measured in years. As a result, the likelihood of such a home being food secure is high.

3.12.2.3. Family size of household head (Fsz)

It refers to the total number of household members who lived and eat with household at least for six months. It is an important variable which determines the state of household food security and expected to have negative effect on household food security (Beyene and Muche, 2010; Mequanent, 2009).According to reviewed literatures, increasing family size tends to exert more pressure on consumption than contribution to production (Tsegay, 2009).

3.12.2.4. Marital status of household head (Ms)

A household with a head and a spouse has a better chance of avoiding food insecurity because the spouse is more likely to contribute to the means of obtaining food. It is claimed that single household heads bear a disproportionate burden in terms of food acquisition because they typically have a limited support structure (Kaloi 2005:70). This variable was necessary because little is known about the relationship between marital status and food security (Hanson 2007). In this study Participants had four options for this question: married, unmarried, divorced, or widowed.

3.12.2.5. Educational level (El)

It is a continuous variable measured in number of years in education. Education is one of the major characteristics, which boost an individual's capacity to acquire process and apply agricultural knowledge (Namara, 2003). A large body of literature noted that household heads with better education status are believed to have a chance to diversify household's income sources and adopt better production technologies, as compared to the illiterate ones (Bogale, 2009). Likewise educated household head has the capacity to innovate and to adopt timely technology and has better understanding of the cash crops that can help them to have a better income than the non-educated households (Fekadu, 2008 and Amaza, 2009). Thus, education status is hypothesized to have a positive effect on household food security.

3.12.2.6. Monthly income (Mi)

The higher the monthly income per adult equivalent, the lower the likelihood of household food insecurity; higher income means better access to food resources for urban households (Birhane, 2014). Thus, higher income could be hypothesized to be positively related to households' food security status. A different source was used to calculate the total monthly income per adult equivalent in Birr.

3.12.2.7. Dependency ratio (Dr)

Dependency ratio measured as total household size divided by the number of individuals working to support the household. Due to the scarcity of resources, an increase in household size especially the non-working members put pressure on consumption than production (Beyene and Muche, 2010). An increase in the number of non-working member of household or dependency ratio increases the food insecurity level of household (Feleke, 2005).

3.12.3. Independent Variables for postharvest loss of fruit and vegetable during retail

The following independent variables were identified as being associated to post-harvest loss of fruit and vegetables during retail: sunlight exposure, educational level, selling experience of retailer, storage material, price variation, and demand.

3.12.3.1. Sunlight exposure (To)

The expected reason is exposing fruits and vegetables to high light intensity leads to water loss through vapor-transpiration and finally the commodity drying or rooting. Moisture migration and rotting are the two major factors contributed for storage related losses due to lack of recommended low temperature-high relative humidity storage condition. This finding is in line with the work of (Tigist, 2013) who reported that, moisture is lost during storage due to respiration and transpiration and resulted in physiological weight loss. The deteriorate rate of harvested fresh commodities increases as they stay for a long time in the market, as their exposure to sunlight and fluctuated environmental conditions ultimately changes their aroma, texture, and flavor (Kereth, 2013).

3.12.3.2. Crop type (Ct)

Sensitivity of the crops to physical damage was because of the perish-ability nature of the

crop and high water content inside the commodity**.** Relatively, the highest percentage of loss was observed from fruit crops compared with vegetable crops. The more delicate and highly perishable types of produce (tomatoes) were exposed to higher losses than the less perishable commodities (carrot, cabbage) (Yebirzaf and Esubalew, 2020).

3.12.3.3. Storage (St)

The storage material composition, adeptness to the local environment and suitability. In addition, during storage greater postharvest losses of commodities were associated with using rough storage materials and commodities were associated with using rough storage materials and commodities were stored longer time in the hands of retailer. The work in Kenya reported similar observation storage related losses. Storage at retailers' level can also be considered as one of the hot spots for high postharvest loss of the tubers, Therefore construction and use of recommended tuber storage structures with efficient marketing strategies can be alternative recommendations to minimize storage associated losses (Kaguongo, 2014).

3.12.3.4. Educational level (Ei)

When the educational status and selling experience of the retailers increase, the loss of fruits and vegetables decreases. (Masood, 2011) and (Alemayehu, 2018) reported similar results as formal education has a significant contribution to the postharvest loss.

3.12.3.5. Selling experience (Se)

Selling experience of the retailers increase, the loss of fruits and vegetables decreases. Similar study result also indicated that selling experience has a significant relationship with postharvest loss. The reason could be due to the experience they had which improved their awareness about handling methods of harvested fruits and vegetables (Yebirzaf and Esubalew, 2020).

3.12.3. 6.Seasonality demand and variation (Sd)

The primary causes of seasonal variations are the greater availability of products in the main harvesting season, which forced them to sell them at 6–25% discounted prices for alternative uses (Parmar, 2017).

3.12.3. 7. Selling price (Sp)

Production of horticultural crops is highly seasonal based, and the price is inversely related to supply. The situation is worsened by the perishability of the products and poor storage facilities (Emana and Gebremedhin, 2007).

3.13. Ethical consideration

The process of data collection, analysis and dissemination of findings was conducted in a way that protect respondents, maintain anonymity and confidentiality of their personalities. Respondents was not be identified by name during the research process. The researcher was request for explicit consent if the data collection involves images of the human elements of respondents. A consent was signed by the respondents wherever images are involved in the research process. The research process was guided by informed consent, do no harm, confidentiality and respect for privacy principles.

Table 3.2 Explanatory variable description and its expected sign

No	Variable	Description	Type of variable	Measurement	Expected sign
1	Age(Ahh)	Age of consumer and retailer	Continues	Years	+ve
2	Sex (Shh)	Sex of household head (Male or female)	Dummy	1, if Female and 0,If Male	+/_ve
3	Education level (El)	Education level of the householdhead	Continues	Grade	-ve
4	Marital status (Ms)	Marital status of hh head	Dummy	1,if single,2,if Marie,3, if Separted4,if widowed.	+/_ve
5	Family (Fsz)	Family size of consumer	Continues	Number	+/_ve

6	Selling experience **(**Se):	How many years do you sold fruit and vegetables	Continues	Year	+ve
7	Storage management system(SMS)	What type of storage management system do you use	Dummy	1.last in first out 2.first in first out 3.other	-ve
8	Loss of fruit and vegetables(LFV)	How much kilo of fruit and vegetable you sold from you purchased	Continues	Kilo	+ve
9	Storage materials (Sm)	What type of storage materials do you use	Dummy	1.plastic crates 2.wooden box 3.basket 4.unpacked 5.sacks 6. card board	-ve
10	Seasonality Demand (Sd)	Is there a seasonality demand	Dummy	0,if No and 1,If Yes	-ve
11	Income **(**Mi)	Monthly Income of retailers and consumers	Continues	Birr	-ve
12	Price variation (Sp)	Is there seasonality price variation	Dummy	0,if No and 1,If Yes	-ve
13	Temperature (To)	Is there exposure to sunlight	Dummy	0,if No and 1,If Yes	-ve
14	Loss	Did you sold all crop you	Dummy	0 if no and 1 if yes	-ve

		purchased			

4. RESULTS AND DISCUSSIONS

This chapter covers the results of the study on postharvest loss of fruit and vegetables and its effect on food security of consumers at lafto market. Both qualitative and quantitative data obtained from retailers and consumers. Also FGD and observation were applied, the obtained data were linked, presented and discussed. This chapter was separated and presented in four key sections: (1) demographic and socioeconomic state of the retailers and consumers (2) loss of fruit and vegetable based on crop type and average loss at the study area, (3) determinant factors affecting post-harvest loss of fruit and vegetables (4) food security status and determinants of food security of respondents were accessed, (5) effect of post-harvest loss on food security result were discussed.

4.1. Descriptive characteristics of the study participants

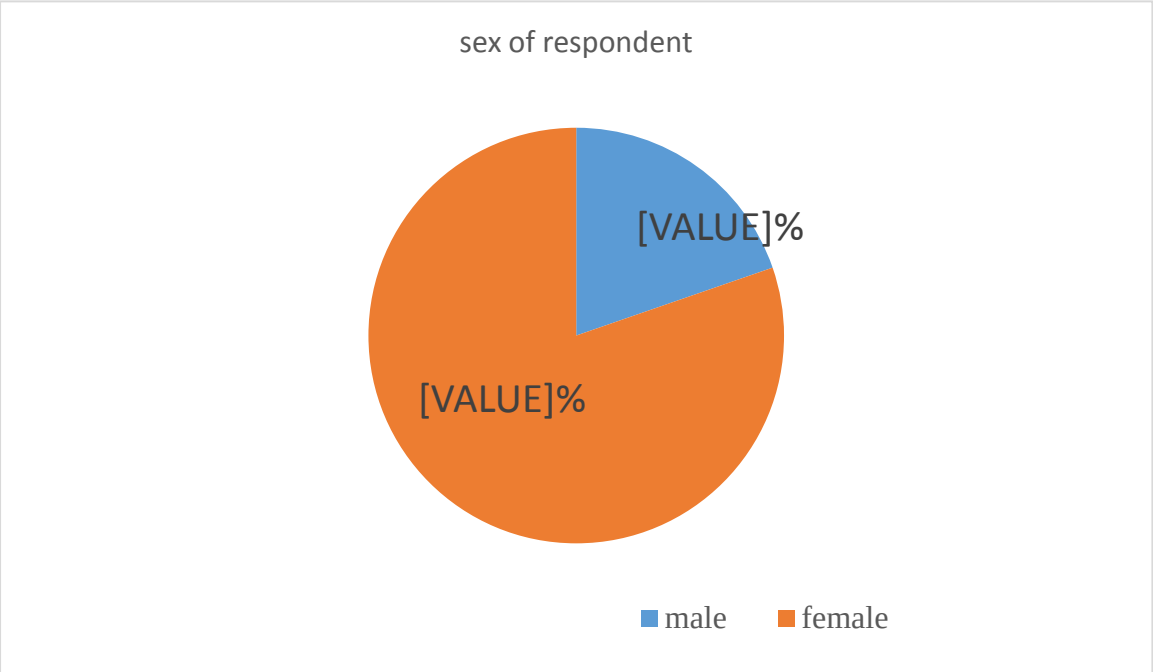
A total of 354 study participants were analyzed in the study and gave a response rate of 95.9%. the means age for this study participants were 35.1 year ,Around 24.8% respondents were age >29 most 32.7 % of the participants were found in the age range of 30-35 years and 10.1 % were age above 46 year this indicate most of them are reproductive age group. Regarding the educational level of the respondents 23.2 % were have less than grade 8 45.8% 9-12th grade, and 29.7 have above level 1 education**.** Regarding to family size of households 59% of respondents have small family size 37.85% medium and 3.11 % have large family size, While number of dependent persons in households 93.4% have 1-3 and 6.52% 4-6 dependent persons in households. According to this study 18.9% of respondents have <6000 birr income per month and 32.2% have >8600 birr income per month, the mean average monthly income were 8148 birr as similar with different studies (table 4.1).

Table 4.1 Descriptive sociodemographic characteristics of the respondents

Variables	Category	Frequency	Percent
Age of the respondents	<29 year	88	24.86
	30-35 year	116	32.77
	36-40 year	76	21.47
	41-45 year	38	10.73
Educational level	less than 8th grade	82	23.2
	9-12th grade	162	45.8
	Level 1 and above	105	29.7
Family size	Small F.s(1-3)	209	59.04
	Medium F.S(4-6)	134	37.85
	Large F.s(>=7)	11	3.11
Number of dependent person in household	1-3	330	93.48
	4-6	23	6.52
Monthly income of house	<=6000 birr	67	18.93

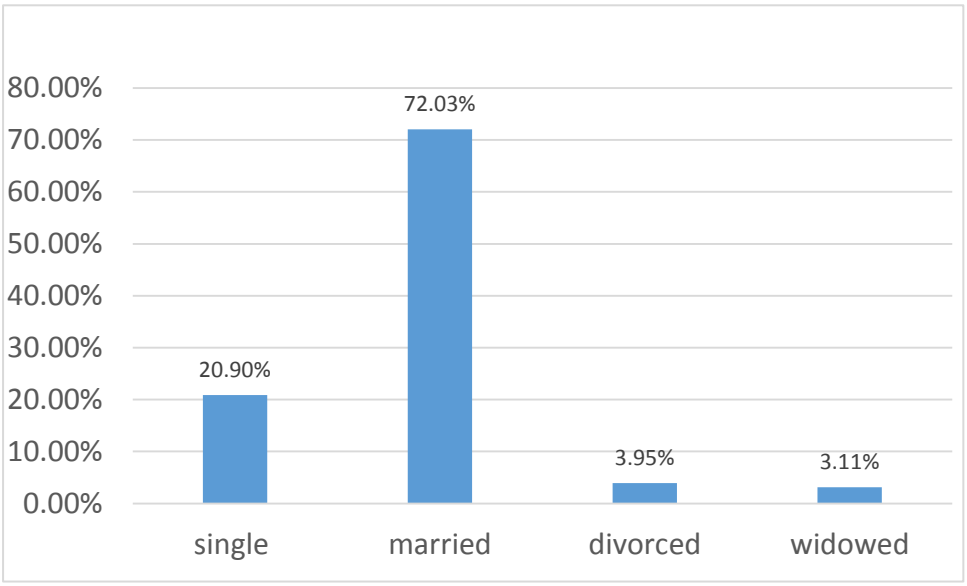
holds	6001-7500 birr	72	20.34
	7501-8600 birr	101	28.53
	>=8601 birr	114	32.20

Regarding the sex of the most of household head, 80.7% of them were males. Marital status of respondent 20.9 % were single, 72% married, 3.9% divorced and 3.1 % were widowed (figure 4.1 and 4.2).



Source; Own Survey

Figure 4.1 Sex of household heads



Source; Own Survey.

Figure 4.2 Marital status of household heads

4.2. Post-harvest loss of fruit and vegetables

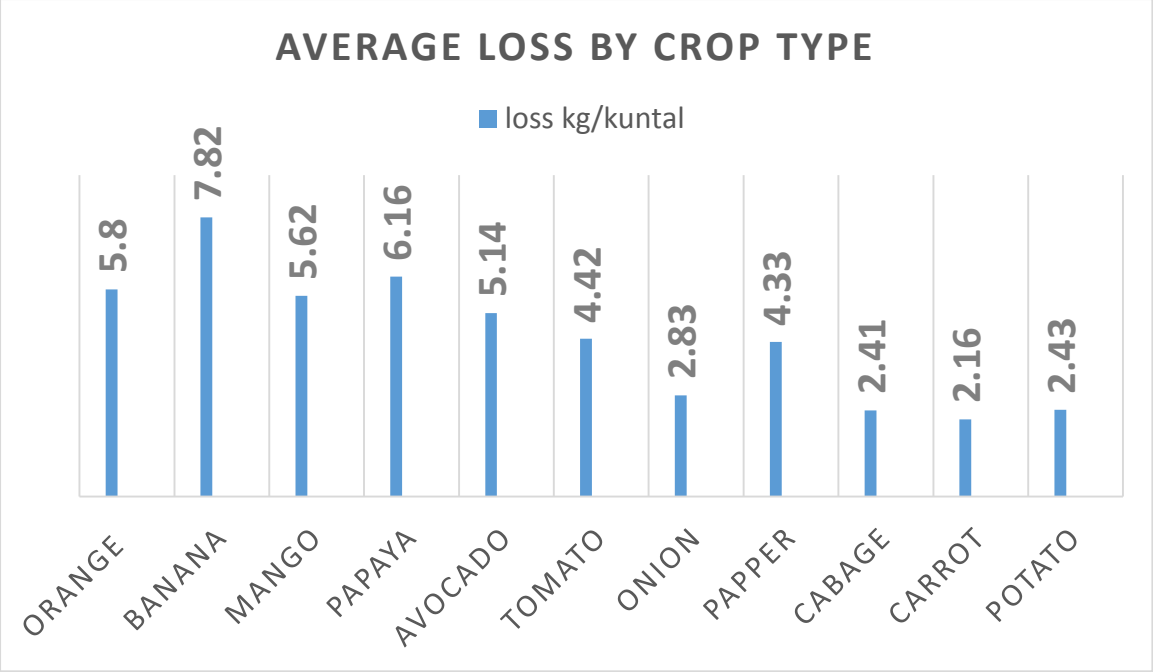
Regarding to loss of fruit and vegetable 19.2%of retailers sold all crop without loss in other hand most of them 80.8% of have loss (table 3).Retailers who sold without loss suggested on FGD that selling by decreasing price, use for Owen consumption before wasted and improves our storage mechanism by using first in first out method were important measures to reduce loss.

Table 4.2 Presence of PHL fruits and vegetables retailers

Presence of Post-harvest loss during retail	Frequency	Percent
No	34	19.2
Yes	143	80.8
Total	**177**	**100.0**

4.2.1. Estimated Average loss of fruits and vegetables among retailers in Kg

In this study, 84 % of the retailers said that all of purchased fruits and vegetables were not sold without losses. Moreover, 94.5% of the retailers showed that fruits and vegetables market were affected by seasonality. Average loss of fruits and vegetables in kilogram (kg) per quintal were assessed and revealed that 7.82% of Banana, 4.42% % of tomatoes ,5.8 % orange,5.62 mango,6.16% papaya ,5.14% avocado,2.83 % onion,4.33% peppers,2.41% cabbage and 2.16 %potato per quintal were affected by the problem(figure 4.3). Finding from similar study shows that estimated average losses of the fruits and vegetables for retailers range from 5 percent to 83 percent depending on the commodity nature. The maximum percentage of total loss for all fruits and vegetables was observed for lime/lemon (83 %) followed by tomato (30 %) during marketing/selling and transportation. Among the fruit crops, the maximum postharvest loss (55 %) was observed for lemon during marketing followed by banana (10 %), guava (8 %), and mango (8 %). Among vegetables, the maximum postharvest loss (18%) was observed for tomato during marketing followed by head cabbage (15 %), pepper (10%t), and carrot (14 %) (Yebirzaf and Esubalew, 2020). The survey result estimated 25.81% annual average perceived post-harvest losses of all crops. The quantity of self-reported post-harvest loss varies with the types of crops. Fruit and vegetables take the lead to the first by taking 33.38% of post-harvest loss (Sisay, 2022).



Source; Own Survey

Figure 4.3 Average loss of fruit and vegetables

4.3. Factors determining post-harvest loss

Retailer's characteristics such as sex, age, and educational status selling experience, crop type, temperature and seasonality demand of the market, were compared to see the significant variation between postharvest loss of fruit and vegetable. The finding of the present study reveals that from factors that are selected analyzed by researcher were selling experience of retailers had significant association with PHL of fruit and vegetable during retail and it matches with similar study of (Yebirzaf and Esubalew, 2020).Other factors like age, sex, educational status, exposure to sun, storage material and seasonal price variation were insignificant according to this finding, unsupported with finding of (Masood and Alemayehu, 2011) reported as formal education has a significant contribution to the postharvest loss which also supported by (Debeb, 2022) the average years of education of the household head have negatively and significantly affected the status and extents of post-harvest losses of crops at 10% levels of significance, implying household head who attended more education level in years better understand and implement agriculture instruction, grasp written material, and able to integrate the technical skills with the tacit local knowledge of post-harvest management practices. Thus, a higher educational level attendance of the household head in years suggests as important factor in decreasing the status and extents of post-harvest losses

of crops. The reason behind were the costumer flow and construction of the market may be change the result. According to similar studies gender and age of retailers had no significance However unlike to present study significant difference among educational status, packaging material and postharvest loss. Thus, postharvest losses are dependent on fruit and vegetable seller's educational status, selling experience, packaging material.

The chi square test(X2 =0.877 and p =0.677) showed that educational level and postharvest loss have no significance unlike similar study finding indicated that educational status has (X2 =8.9422 and p =0.0301) a significant influence on the loss of horticultural crops after harvest. When the educational status and selling experience of the retailers increase, the loss of fruits and vegetables decreases. Selling experience have association with postharvest loss as mentioned on table most 78 retailers at minimum selling experience have loss ,when the selling experience increases the loss decreases. Similar studies result also indicated that selling experience has a significant relationship with postharvest loss. Result obtained from secondary data were find that the reason could be due to the experience they had which improved their awareness about handling methods of harvested fruits and vegetables (Yebirzaf and Esubalew, 2020).

The age of retailers does not significantly influence (X2 =6.132, p = 0.190) on postharvest loss of fruits and vegetables. Similar results were obtained from secondary data who reported age and postharvest loss have no significant relationship (Yebirzaf and Esubalew, 2020).Gender were had nonsignificant influence on postharvest loss, which supported by other studies obtained by secondary data review (Yebirzaf and Esubalew, 2020). From other secondary data review study gets different findings from present study (Abera, 2020) who explained that gender has a significant contribution to the postharvest loss of tomatoes. Around 93.4 % mentioned that price raised in summer season and also the demand increase at the same season, but there were no significance observed on chi square test cross tabulation result showed that similar loss regarding to seasons and price.

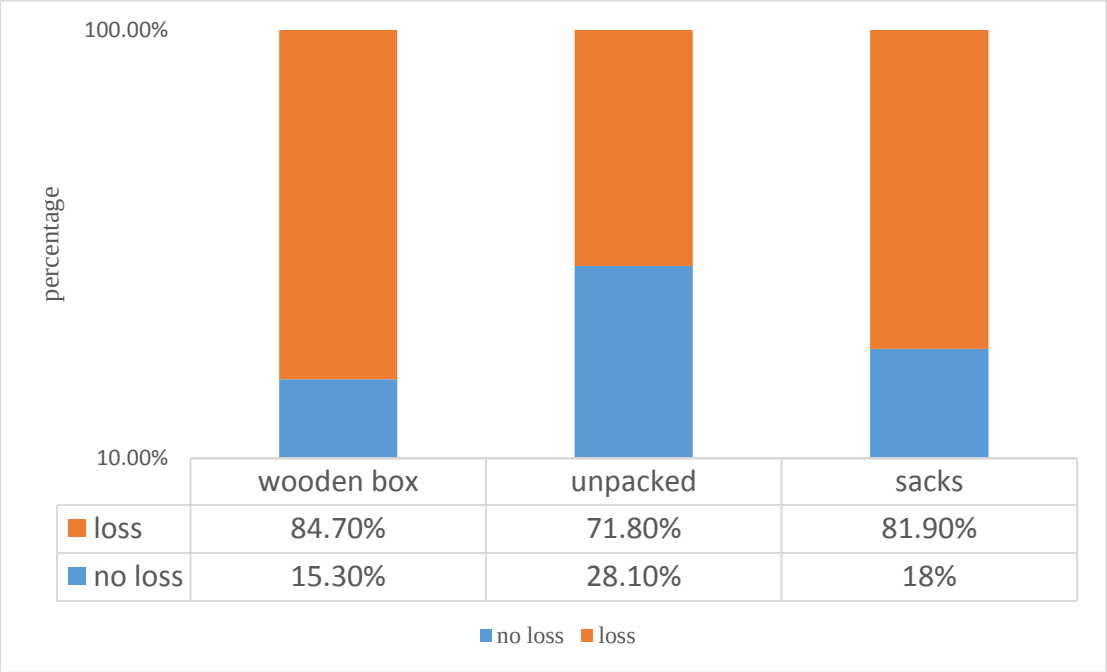
Table 4.3 Factors affecting postharvest loss of fruit and vegetables

Variables	PHL		Total	Chi square	
	Yes	No		X2	P

Level of education Retailers	less than 8th grade	7	30	37		0.677
	9-12th grade	15	71	86	0.877	
	Level 1 and above	12	38	50		
Age of retailers	<=29 yrs	13	31	44	6.132	0.190
	30-35yrs	11	47	58		
	36-40yrs	7	31	38		
	41-45yrs	2	17	19		
	>=46yrs	1	17	18		
Selling expriance of retailers	1-5 year	22	78	100	0.963	0.766
	6-10 year	11	56	67		
	11-15 year	1	8	9		

Around 40.6% percent of fruit and vegetable retailers used sacks and wooden box store fruit and vegetables. The lowest 18%, applicable storage material in fruit and vegetable retailers in the study area was unpacked for instance onions but there were no significant on PHL based on present study (Figure 4.3). The reason for the use of sacks and baskets as major storage material was their accessibility and low cost. However, such kind of packaging materials does not properly protect the product and causes damage due to improper temperature

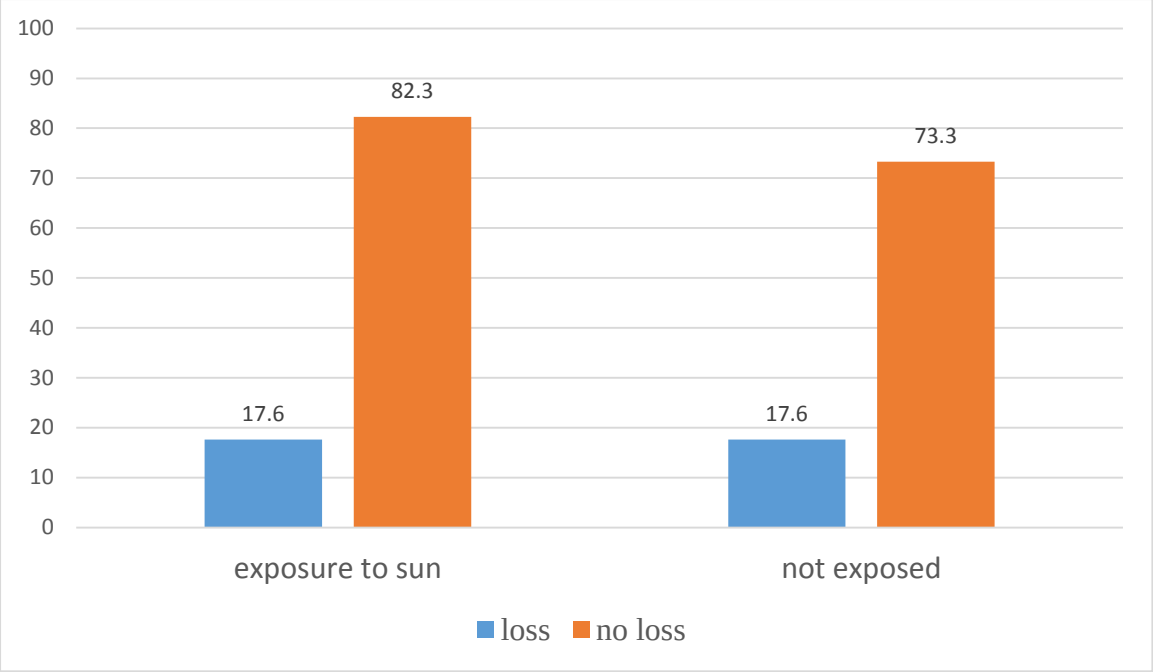
regulation as mentioned on FGD. Also storage material were differs based on crop type as observed on the study area.



Source; Own Survey

Figure 4.4 Storage material' vs postharvest loss of fruit and vegetables

Deteriorate rate of harvested fresh commodities increases as they stay for a long time in the market as their exposure to sunlight and fluctuated environmental conditions ultimately changes their aroma, texture, and flavor. On the presence study there is no significant between sun exposure and postharvest, during observation the way retailers shop constructed were good enough to protect from sun and better storage from previous fruit and vegetables market.



Source; Own Survey.

Figure 4.5 Sun exposure vs postharvest loss of fruit and vegetables

4.4. Factors Determining the Food Security of retailers and consumers

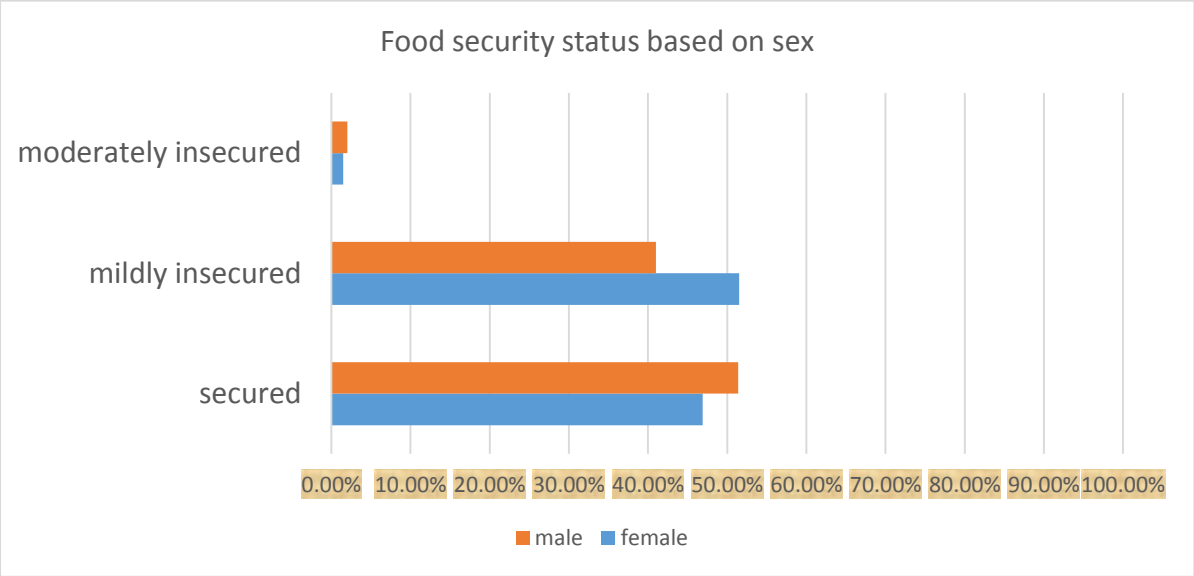
4.4.1. Descriptive Statics

The household characteristics such as sex, age, and educational status of the household head, family size, and dependency ratio as well as households' monthly income, were compared to see the significant variation between food secure and food insecure households.

4.4.1.1. Sex of the household head

According to the study, male-headed households accounted for 80.8% percent of respondents, while female-headed households accounted for 19.2% percent. From female headed households 46.9% were food secured, 51.5% mildly insecure and 1.5% were moderately

insecure. While Male headed households were 51.4% are secured, 41% mildly insecure and 7.5% were moderately insecure. In contrast, Because of gender differences among household heads, there was a significant difference in proportion between food secure and food insecure households (figure 4.8). As a result, male-headed households have a higher chance of being food secures than female-headed households. Because they are also in charge of domestic livelihood activities, female-headed households may have less time available to engage in productive livelihood activities.



Source; Own Survey.

Figure 4.6 Sex of retailers' vs postharvest loss of fruit and vegetables

4.4.1.2. Age of household head

Table describes the relationship between the age of the household head and the food security status of the household. The average age of the study's household heads was 35.17 years. The study found that 30-35yrs age group were have 66.6% food secure compared to other age group household heads, older households are more food insecure and less productive. In contrast Greater than 85% food secured house hold were age less than 40years (Table 4.4)

Table 4.4 Age of the respondents at Lafto fruit and vegetable market vs food security status

Age of Household	HFIAS

Head	Food Secured	Mildly Food Insecure	Moderately Food Insecure	Severely Food Insecure	Total
<=29 yrs	47	37	4	0	88
30-35yrs	76	35	3	0	114
36-40yrs	26	39	7	0	72
41-45yrs	14	18	4	0	36
>=46yrs	11	19	4	0	34
Sum	174	148	22	0	354
Total %	50.6%	43.0%	6.4%		100.00

4.4.1.3. Family size

According to the study, 72.4% food secure households were have smaller family size which is 1-3 family members. The mean value of family size for this study were 3.38, which the minimum family size were 1 and maximum 9 family members per household. (Table 4.5). To assess the trend, household size is divided into three categories: small (1-3 people), medium (4-6 people), and large (>=7 people). This finding suggested that households with fewer family members may have a better chance of becoming food secure than those with a large number of members, when the number of unproductive family members in a household is larger, putting more pressure on consumption rather than contribution to household income. Family size may be an indication of food security since it impacts the quantity and kind of

food eaten by the household. Similarly, other research (Gebre, 2012) identified a negative association between family size and household food security status.

Table 4.5 Family size of the respondents at Lafto fruit and vegetable market vs food security status

Household Family Size	HFIAS				
	Food Secured	Mildly Food in secured	Moderately Food in secured	Severely Food in secured	Total
Small(1-3)	126	79	3	0	22
Medium(4-6)	47	65	16	0	74
Large(>=7)	1	4	3	0	83
Sum	174	148	22	0	179
Total%	50.6%	43.0%	6.4%	-	100.0%

4.4.1.4. Monthly income of households

The level of the household income is the major factor influencing the food security status of the households. In this study, the mean monthly household income was 8148 ETB, while 3500 ETB minimum and 25000 ETB maximum monthly income. To assess the trend, income is divided into three categories: small (<6000 Birr), moderate (6001-7500 Birr), (7501-8600) and large (>=8601 Birr). In other words, the higher the household income, the more likely for the households to purchase foods of adequate quantity and quality. This finding indicated that Further, the study showed that there was a positive relationship between household income and food security, indicating that households with higher income could have more chances to achieve food security. In other words, the higher the household income, the more likely for

the households to purchase foods of adequate quantity and quality. For urban households, income has a direct relationship with food consumption at the household level whereby those households with higher income levels could have a diverse recipe of nutritious and quality food. In contrast, those households with low income could only purchase limited, less nutritious, and cheaper foodstuff. Similarly, (Tadele, 2019) reported that lower monthly income (in association with food price inflations), and increased costs of living contributed to food insecurity in urban areas (table 4.6).

Table 4.6 Monthly income of the respondents at Lafto fruit and vegetable market vs food security status

Monthly income		Food security (HFIAS)				Total
		Secured	Mildly insecure	Moderately insecure	Severely insecure	
<=6000 ETB	Count	29	32	4	0	65
	% of Total	8.4%	9.3%	1.2%		18.9%
6001-7500 ETB	Count	21	39	8	0	68
	% of Total	6.1%	11.3%	2.3%		19.8%
7501-8600 birr	Count	48	43	8	0	99
	% of Total	14.0%	12.5%	2.3%		28.8%
>=8601 ETB	Count	76	34	2	0	112
	% of Total	22.1%	9.9%	0.6%		32.6%
Total	Count	174	148	22	0	344
	% of Total	50.6%	43.0%	6.4%		100.0%

4.4.1.5. Educational status

Education level of the household heads was identified to have an impact on food security of the households. The relationship between the education of household head and household food security is indicated in (Table 4.7). In this study, the education level of the household head determines the food security status of households with higher education levels providing more opportunities to involve in various business opportunities and skilled labor than the illiterate households. Further, this finding implies that a household head with a low education level was more likely to be food insecure. Uneducated family heads may have limited possibility to work as skilled labor, rather working as day workers who are seasonal. According to study finding, educated families had managed to engage themselves either in the town or in the capital notably participating in commercial operations, largely owing to the ability to fit into diverse systems, increased access to information. Similarly, (Mohammad et al., 2010), (Gebre, 2012), and (Chinnakali et al, 2014) revealed a favorable association between education and family food security.

Table 4.7 Educational status of the respondents at Lafto fruit and vegetable market vs food security status

Educational status		HIFAS				Total
		Secured	Mildly insecure	Moderately insecure	Severely insecure	
less than 8th grade	Count	26	46	6	0	78
	% of Total	7.7%	13.6%	1.8%		23.0%

9-12th grade	Count	82	67	10	0	159
	% of Total	24.2%	19.8%	2.9%		46.9%
Level 1 and above	Count	62	34	6	0	102
	% of Total	18.3%	10.0%	1.8%		30.1%
Total	Count	170	147	22	0	339
	% of Total	50.1%	43.4%	6.5%		100.0%

4.4.1.6. Marital status

According to the study, married single, divorced and widowed households accounted for 71,21,14,11 percent respectively, while in food secure groups, married households accounted for 71.5%, while separated and widowed households accounted for 8 %. In contrast, Because of marital status differences among household heads, as a result, male-headed households have a higher chance of being food secures than female-headed households. (Table 4.8).

Table 4.8 Marital status of the respondents at Lafto fruit and vegetable market vs food security status

Marital status	HIFAS				Total
	Secured	Mildly insecure	Moderately insecure	Severely insecure	
Divorced	4(1.2%)	9(2.6%)	1(0.3%)	0	14(4.1%)
Married	116(33.7%)	111(32.3%)	19(5.5%)	0	246(71.5%)

Single	47(13.7%)	25(7.3%)	1(0.3%)	0	73(21.2%)
Widowed	7(2.0%)	3(0.9%)	1(0.3%)	0	11(3.2%)
Total	174(50.6%)	148(43.0%)	22(6.4%)	0	344(100.0%)

4.4.1.7. Dependency ratio

To assess the trend, number of dependent people or economically in active group age>15 and people with disability in household is categorized into three categories: small (0-3person), and medium (4-6person). The correlation analysis revealed a strong association between household size and dependency ratio. Nevertheless, the dependency ratio would be more predictive of food insecurity than the average household size. The findings demonstrate that a large dependency ratio of members generates more stress in a household's food security (See Table 4.9).

This indicates that in predicting the likelihood of a household's food security, household size, specifically the dependency ratio, played an important impact on IDP households with significant numbers of economically inactive members are more likely to be food insecure than those with economically active people. Several more studies (Tesfaye, 2005, Ayalneh, 2009; Gebre, 2012 and Ibrahim, 2016) found an inverse association between household size/dependency ratio and food security.

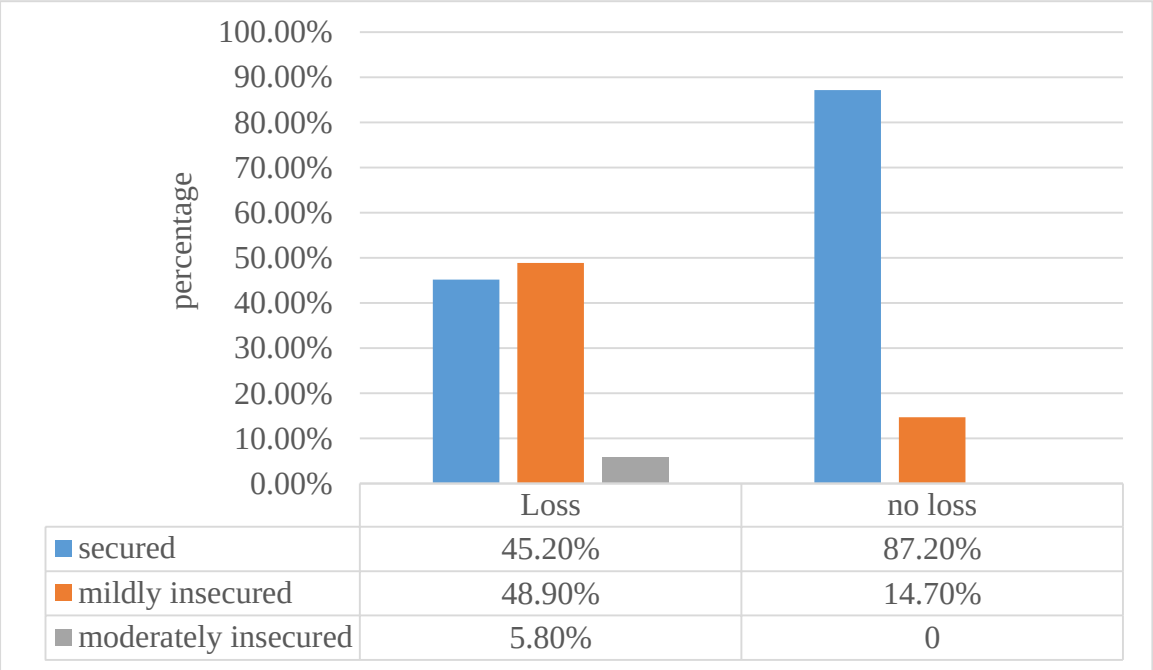
Table 4.9 Dependent family of the respondents at Lafto fruit and vegetable market vs food security status

Dependent family		HIFAS				Total
		Secured	Mildly insecure	Moderately insecure	Severely insecure	
1-3 families	Count	104	110	17	0	231
	% of Total	41.4%	43.8%	6.8%	0	92.0%
4-6 families	Count	6	9	5	0	20

Total	% of Total	2.4%	3.6%	2.0%	0	8.0%
	Count	110	119	22	0	251
	% of Total	43.8%	47.4%	8.8%	0	100.0%

4.4.1.8 Postharvest loss

According to the study finding postharvest loss increase the chance of being food insecure, 85.2% retailers were food secured from those who have no loss during retail in contrast 45.2% of food secured from who have loss. As mentioned on FGD were use different mechanisms to reduce PHL by selling with reducing price for food sellers and uses for own consumption in addition proper handling and storage like storing different crops separately and based on their perishability were observed at retailers who sold loss free (figure 4.7).



Source; Own Survey.

Figure 4.7 Postharvest loss of fruit and vegetables vs food security

4.4.1.9. Food security status of consumer's vs retailers

This finding result showed that 53.2% retailers were food secured which indicate retailers were more food secure than consumers 47.9% (table 4.10). The food security status may be the availability, and accessibility of food items plus the presence of high income profitability. Moreover, the present study showed that 80.8% of the retailer's had post-harvest loss of fruits and vegetables, which affects the individual, as well as economy of the country, in other hand 46.7% retailers were mildly and moderately food insecure.in the present study food security status of consumers and retailers categorized in to three due to no severely food in secured households according to the study finding.

Table 4.10 Food security status of consumer's vs retailers

	Food security				Total
	Secured	Mildly insecure	Moderately insecure	Severely insecure	
Consumers	83(47.9%)	76(43.9%)	14(8%)	0	173(100%)
Retailers	91(53.2%)	72(42.1%)	8(4.6%)	0	171(100%)
Total	174(50.5%)	148(43%)	22(6.3%)	0	344(100%)

4.4. Effect of post-harvest loss on food security

This study identified the effect of post-harvest loss of fruit and vegetables on food security status of consumers and retailers. From those factors affecting food security post-harvest loss of fruit and vegetables and household monthly income were significant on the study area by ordered logit regression analysis .This finding is similar with studies done the potential food security impact of the losses after harvest, which is feeding 23,458,502 persons every year between the specified study periods. This means that Ethiopia could reduce the number of

severely and moderately food insecure persons from 61.36 to 38.23% improvement in food security. To be very practical, 100% PHL management may not be realistic and if only 50% of the PHL in grains in Ethiopia could be saved, 11,729,251 persons could be fed up to the national grain per capita consumption, which is almost 20% improvement in national food security (Tadese 2022).

4.4.1. Ordered Logistic Regression analysis and interpretation

The researcher applied an ordered logit regression model to predict the impacts of variable on the food security status of consumers and retailers at lafto market. An ordered l logit model examine the impacts of a specific category of factors link to food insecurity status of research participants. Ordered logistic regression was a kind of logistic regression technique that when the response variable is classified more than two with having natural order or rank. When a dependent variable contains more than two categories and the values of each category have a meaningful Sequential sequence.

Looking at the ordered logistic regression table 4.11 below, the finding revealed that those who faced the postharvest lost were 12.355 times more likely to be moderately food in secured as compared to being food secured (AOR=12.355; 95%CI = 2.312 - 66.025, P-value=0.003). In addition to this, both the retailors and customers who had less amount of household income were found to be 1.0001 times more likely to be moderately food in secured as compared to that of food secured study participants. Meaning that when the household income increases from 3500 birr to 25,000 birr, the likely hood of moving from the moderately food in security to food security status increases by 1.0001 times (AOR=1.0001; 95%CI=1.0001, 1.001; P-value=0.032).

Table 4.11 Ordered Logistic Regression analysis

Variable		Food Security status			AOR(95%CI)	P-value
		Moderately Insecure	Mildly Insecure	Secured		
Sex	Female	1(1.5%)	34(51.5%)	31(47%)	1.608(0.544, 4.756)	0.391
	Male	21(7.6%)	114(41%)	143(51.4%	1	1

				)		
Marital status	Divorced	1(7.1%)	9(64.3%)	4(28.6%)	0.612(0.04, 9.281)	0.723
	Married	19(7.7%)	111(45.1%)	116(47.2%)	1.272(0.175, 9.217)	0.812
	Single	1(1.4%)	25(34.2%)	47(64.4%)	1.823(0.159, 20.875)	0.629
	Widowed	7(63.6%)	3(27.3%)	7(63.6%)	1	1
Family size	1-3 families	3(1.4%)	79(38%)	126(60.6%)	5.609(0.264, 118.989)	0.269
	4-6 families	16(12.5%)	65(50.8%)	47(36.7%)	4.352(0.246, 77.061)	0.316
	>=7 families	3(37.5%)	4(50%)	1(12.5%)	1	1
Dependent family	1-3 family	17(7.4%)	110(47.6%)	104(45%)	1.032(0.186, 5.731)	0.971
	4-6 family	5(25%)	9(45%)	6(30%)	1	1
Educational status	Less than 8^{th} grade	6(7.7%)	46(59%)	26(33.3%)	0.817(0.242, 2.765)	0.746
	9-12^{th} grade	10(6.3%)	67(42.1%)	82(51.6%)	1.018(0.367, 2.829)	0.972
	Level 1 and above	6(5.9%)	34(33.3%)	62(60.8%)	1	1
Post-harvest loss	**Yes**	**0**	**5(2.9%)**	**29(17%)**	**12.355(2.312, 66.025)**	**0.003**
	No	8(4.7%)	67(39.2%)	62(36.3%)	1	1
HH income (Minimum 3500 birr, Maximum 25,000 birr)					**1.0001(1.0001, 1.001**	**0.032**

Age of the participant (Minimum 21, Maximum 56 years)	0.943(0.870, 1.022)	0.152

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

According to the finding of this study post-harvest loss of fruit and vegetable were factor that hinders food security status of both retailers and consumers. Post-harvest loss determined mainly by crop type. Reduction of post-harvest losses of crops between market and consumer is crucial tasks to minimize the food gaps and thereby to ensure food and nutrition security in Ethiopia. The finding of present study most of study participants were reproductive age groups and from factors investigated by this study postharvest loss and household monthly income were significant for food insecurity of consumers and retailers .Based on the finding consumers were more affected by moderate food insecurity since there is no severe food insecurity. Selling experience were significantly associated with post-harvest loss of fruit and vegetables at the study area. This finding suggested that households with fewer family members may have a better chance of becoming food secure than those with a large number of members, when the number of unproductive family members in a household is larger, putting more pressure on consumption rather than contribution to household income. Integrated policy efforts with reduction of PHL can solve multiple problems with expected synergistic effects on the national economy and household food security.

5.2. Recommendations

- ✓ The Ethiopian ministry of agriculture, Ethiopian postharvest management society, FAO and other responsible bodies have to raising public awareness on the impacts of PHL of fruit and vegetable during retail on the national economy and food security dimensions.
- ✓ The attention given by the government, academicians, and researchers to the reduction of PHL is deficient and need an improvement.
- ✓ Nifas Silk Lafto Sub city woreda 11 urban agriculture office and marketing office should have to take measures to improve postharvest handling method of fruit and vegetables at retail level.
- ✓ Appropriate post-harvest measures have to be taken on each value chain from farm to fork with all coordination and integration of responsible bodies.
- ✓ Food security needs multi sectoral collaboration for instance working on reduction of population growth, enhancement of agricultural production and economic growth.
- ✓ In addition I recommend that other studies should have to be done on wholesale and farm level.

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8. QUESTIONER

8.1. Appendices

Appendix I- CONSENT FORM IN ENGLISH

Hello! My name is I…… am last year student of Addis Ababa university department of food security. I would like to have discussion with you and gather information about post-harvest loss of fruit and vegetables during market since you are retailer at the area of your shop. The interview will take at least 15 minutes.

Would you please cooperate in responding the following questions? Your response will never be exposed to any party and it is possible not tell your name and personal information. There is no obligation to participate in the study. You have full right to refuse participation refrain during interview and decline from answering to some or more of the question if you don't like to answer them.

I have been briefly informed about the study and clearly understood the objective of the study.

So I here approve my consent with my agreement to take part in the study.

☐ Agree ☐ Disagree

Thank you!!!

Date ----------

(----------)

Signature of the interviewer/data collector to certify the informed consent verbally

8.2. English version questioner

Part 1 Socio economic and demographic questions

1. Name retail shops…
2. Gender of house hold head

   1. Male 2.Female

3. Age of household head ----------
4. Marital status respondent

   1. Married 2. Single

   3. Widowed 4.Divorced

5. Education level ----------
6. Family size ----------
7. Number of dependent persons in the household……..

8. Monthly income ----------

9. Did you get credit from government or NGO?

1. Yes 2.no

10. If yes from whom did you get the credit?

1. From government 2.From NGO

Part 2 questions to assess food security status of retailers

HFIAS QUESTIONNAIRE

NO	QUESTION	RESPONSE OPTIONS	CODE
1.	In the past four weeks, did you worry that your household would not have enough food?	0= No (skip to Q2) 1=Yes	….|___|
1.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
2.	In the past four weeks, were you or any household member not able to eat the kinds	0= No (skip to Q3) 1=Yes	….|___|

	of foods you preferred because of a lack of resources?		
2.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0= No (skip to Q4) 1= Yes	….|___|
3.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
4.	In the past four weeks, did you or any	0= No (skip to Q5)	….|___|

	household member have to eat some Foods that you really did not want to eat because of a lack of resources to obtain other types of food?	1= Yes	
a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0= No (skip to Q6) 1= Yes	….|___|
5.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0= No (skip to Q7) 1= Yes	….|___|

6.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
7.	In the past four weeks, was there ever no food to eat of any kind in your household Because of lack of resources to get food?	0= No (skip to Q8) 1= Yes	….|___|
7.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0= No (skip to Q9) 1= Yes	….|___|
8.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past	….|___|

four weeks)

9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0= No (questionnaire is finished) 1= Yes	….|___|
9.a	How often did this happen?	1= Rarely (once or twice in the past four weeks) 2= Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	….|___|

Part 3 **questions associated with loss of fruit and vegetables**

1. Are you retailer? If yes proceed to next questions

1. Yes 2.No

2. Selling experience? ----------

3. Crop type you sold

1. Fruit 2.Vegetable 3.Both

4. What type of material do you use for the storage of fruits and vegetables?

1. Plastic crates 4.Unpacked

2. Wooden-box 5.Sacks

3. Baskets… 6.Card-board box

5. Is the crop exposed to sun during storage and selling?

1. Yes

2. No

6. What type of storage management system do you use for the fruits and vegetables while storing and dispatching?

1. Last in first out method

2. First in first out

3. Others

7. Do you sold all you purchase?

1. Yes 2.no

8. If no Reason if you couldn't sell all the fruit you bought

1. Poor quality 2.Reduced market
3. Demand 4.Owen consumption

9. Is there Supply shortage

1. Yes 2.no

10. In Which season the Supply shortage encounter

1. Summer 2.winter

11. Is there Seasonality of demand?

1. Yes 2.no

12. In which season the demand rise

1. Summer 2.winter

13. In which season the demand fail

1. Summer 2.winter

14. Does the price vary?

1. Yes 2.no

15. When the price rise

1. Summer 2.winter

Part 4 **questions associated with loss of fruit and vegetables by crop type**

s.no		Type of fruit and vegetable										
		orange	Banana	mango	Papaya	Avocado	Tomato	Onion	Pepper	cabbage	carrot	potato
1	From which you by how much kuntal/kilo do you sold with good condition?											
2	How much kuntal/kilo do you loss?											

8.3. Focus Group Discussion (FGD) Checklist

Dear Respondents,

The main objective of this focus group discussion is to collect primary data from retailers about post-harvest loss of fruit and vegetables. Therefore, as an FGD participants, I believe that you will provide relevant information that will contribute to the success of this research which will be used for further academic investigation. In addition, the research findings will be used to inform government and non-governmental organizations strategies and program development.

Your answers will be held completely confidential and will not be shared to third party. You will not be identified by name in any way. If you do not have to answer any questions that you do not want to answer, and you may end this interview at any time you want to, you are free to do so. However, your responses to my questions are valuable, and will help us better understand the existing situation under study. We would greatly appreciate your participation in the focus group discussion which was taken about 30 minutes to an hour.

Would you be willing to participate knowing that you will be doing so voluntarily and there will not be any monetary returns?

Thank you and please "tick" one of the boxes below (to be filled by the FGD facilitator who is either the researcher or the research assistant)

☐ Consent given

☐ Consent declined

1. General information

a. Location

i. City: Addis Ababa

ii. Sub city-Nifas Silk Lafto

ii. Woreda: 11

iii. Specific location: located in the south-western suburb of the city

b. Participants

i. Total number of participants: Male: 37 Female: 5

ii. Age distribution of participant's b/n 18-55

Questions for focus group discussion

1. Is there Supply shortage?
2. Is there Seasonality of demand?
3. Does the price vary?
4. When the price rise?
   What type of storage mechanism do you use?
5. What are the causes for the losses during storage?

8.4. Amharic translated questionnaires

<u>የ ተሳትፎ ማጠየ ቂያ ቅፅ</u>

ጠፍ ይስ ጥልኝ፡ ፡ ስ ሜ..... ይባላል፡ ፡ የ አዲስ በባ ዩኒ ቨር ሲቲ በማስ ተር መር ሀ ግብር በ ሀ ገ ር ልማት የ ምግብዋስ ትና ዲፓት ትመን ትየ መጨረሻ አመት ተማሪ ኝ ፡ ፡ አሁን ከእ ር ሶ ጋር እ ዚህ የ ተገ ኘሁ ት የ አ ትክልትና ፍራፍሬን ግድላ ይስ ለ ሚያ ግ ጥ ምበልሽ ት ጋር በ ተገ ና ኘ በ ሚደ ር ገ ውጥኛ ትላ ይ ተሳ ታፊ እን ዲሆኑ ነ ው

በ ዚህ ቃለ ማጠይቅ ለ መሳ ተፍ ስ ምን መግለ ጽ ወይ ም የ ግል መላ ያ ማከ ወቅ አ ያ ስ ፈ ል ግ ዎት ም፡ ፡

ከ እ ኛ ጋር ሊወያ ዩ ባ ል ፈለ ጉ ት ጉ ዳ ይላ ይ ወይ ይ ቱን እ ዲቀ ጥሉ አ ይገ ደ ዱም፡ ፡

ራ ስ ዎን ከ ቃለ ማጠይቁ ለ ማገ ለ ል ቢፈ ልጉ እ ን ዲቀ ጠ ጥሉ ወይ ም ማ ከ ን ያ ቱን እ ን ዲያ ሳ ወቁ አ ይገ ደ ዱም፡ ፡ በ ጥና ቱ ላ ይ ለ መሳ ተፍ ፈ ቃደ ኛ አ ለ መሆ ን ወይ ም ጥና ቱን አ ቋር ጦ መ ጣ ት በ እ ር ስ ዎ ላ ይ የ ሚ መጣ ውን ችግ ር የ ለ ም፡ ፡

ለ ዚህ ቃለ ምል ልስ ፈ ቃደ ኛ ቢሆኑ ም ኪ ጋ ና ችን የ ላ ቀ ነ ሙ፡ ፡

ጥያ ቄ ካለ ዎት ወይ ም ገ ለ ጻ ወላ ይ ግልጽ ያ ልሆነ ገ ር ካለ ሀሳ ቦ ን ቢገ ልጹ ልን በ ደስ ታ እ ን ሚል ሳ ለ ን ፡ ፡

የ ተሰጠዎትን ማበራርያ ከተገ ነ ዘ ቡእ ና በ ቃልማጠይቁለ መጎ ተፍፈ ቃደኛ ከሆኑ እ ባ ከዎን ከዚህ በ ታች በ ወረ ቀትላ ይባ ለ ወየ ስ ምምጎ ትመገለ ጫቅጽላ ይስ ምምጎ ትዎን ይግለጹ፡ ፡

<u>የ ስ ምምጎ ትሚ ጋገ ጫቅጽ</u>

ከላ ይስ ለ ጥና ቱበ ቂሚ ጃተሰ ጥቶ ኛልስ ለ ጥና ቱምተረ ድቻለ ሁምን ምኢ ይነ ትጥያ ቄየ ለ ኝምኳ ለ ዚህ መኳ ሞምዜን ወ ይምኢ ለ መኳ ሞምዜን አ ረ ጋግጣለ ሁ፡ ፡

ተስ ሜምቻለ ሁኢ ልተስ ማ☐ ☐

እ ና መኳ ግ ና ለ ን !!!

ቀን ----------የ ሚ ጃ ሰ ብሳ ቢው ፊ ር ማ_____

ቃለ ማጠይቁ

የ ተደረ ገ በ ትቀን _____ የ ተጀሚ በ ትሰ ዓት_____

ያ ለ ቀበ ትሰ ዓት_____

የ ተቆጣጣሪ ወስ ም_____ ፊ ር ማ_____

የ አሚርኛማጠይቅ

ክፍል 1

1.የ መሸጫሱቁስ ም/ቁጥር

2.ጸታ

1.ወንድ 2. ሴት

3. እደሜ……..

4.የ መላሹ የ ትዳር ሁኔታ

1.ያገባ

2.ያላገባ

3.የ ፈታ

4.አግብቶ የ ሞተበት

5. የ ትምህርትሁኔታ;

6.የ ቤተሰብ ብዛት……..

7.እራሳቸወን ያልቻሉ የ ቤተሰብ አባለት በዛት……

8.ወርሀዊ ገቢ……..

ክፍል 2 የ ምግብ ዋስትና የ ሚመለከቱ ጥያቄዎች

ተ.ቁ	**ጥያቄ**	**መልስ**	**ኮድ**
1.	ባለፉት አራት ሳምንታት ወስጥ ስለ ምትመገቡት ምግብ ተጨነቃችኻል?	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|
1./	ምን ያህል ጊዜ ይሆናል	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)	….|___|
2.	ባለፉት አራት ሳምንታት ወስጥ በችግር ምክንያት	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ)	….|___|

	የ መትፈልጉትን አይነ ት ምግብ ሳትማ ቡ ቀረ ታችሁ ታውቃላ ቹ?	1=አዎ	
2./	ምን ያህል ጊዜ ይሆና ል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምን ታት) 2= አን ዳን ድ ጊዜ (ባለ ፉት 4 ሳ ምን ታት ከሶ ስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለ ፉት 4 ሳ ምን ታት ከ አስር ዜጌ በላ ይ)	
3.	ባለ ፉት አራት ሳ ምን ታት, በ ቸግር ምክ ን ያ ት ወስ ን የ ምግብ አይነ ት ተመ ገበ ው ታውቃላ ቹ?	0= አይ (ወደ ቀጣይ ጥያ ቄ እለ ፍ) 1=አዎ	….|___|
3. /	ምን ያህል ጊዜ ይሆና ል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለ ፉት 4 ሳ ምን ታት) 2= አን ዳን ድ ጊዜ (ባለ ፉት 4 ሳ ምን ታት ከሶ ስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለ ፉት 4 ሳ ምን ታት ከ አስር ዜጌ በላ ይ)	….|___|

4.		0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|
4./	ምን ያህል ጊዜ ይሆናል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)	….|___|
5.	ባለፉት አራት ሳምንታት, በችግር ምክንያት በቂ ምግብ ስለሌለ ትንሽ ምግብ ተመግባቹ ታውቃላቹ ?	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|
5. /	ምን ያህል ጊዜ ይሆናል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)	….|___|
6.	ባለፉት አራት ሳምንታት, በችግር ምክንያት በቂ ምግብ ስለሌለ ትንሽ ምግብ ተመግባቹ ታውቃላቹ?	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|

6. /	ምን ያህል ጊዜ ይሆናል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)	….|___|
7.	ባለፉት አራት ሳምንታት, በችግር ምክንያት በቂ ምግብ ስለሌለ ምንምምግብ ሳተመ ቡ ተመግባቹ ታውቃላቹ ?	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|
7. /	ምን ያህል ጊዜ ይሆናል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ) 3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)	….|___|
8.	ባለፉት አራት ሳምንታት, በችግር ምክንያት ምግብ ስለሌለ ሳትመ ቡ አድራቹ ታውቃላቹ?	0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) 1=አዎ	….|___|
8. /	ምን ያህል ጊዜ ይሆናል?	1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) 2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ)	….|___|

3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)

9. ባለፉት አራት ሳምንታት, በችግር ምክንያት የርሀብ ስሜት እየተሰማቹ ሳትበሉ ተኝታቹ ታውቃላቹ ? 0= አይ (ወደ ቀጣይ ጥያቄ እለፍ) ….|___|

1=አዎ

9. / ምን ያህል ጊዜ ይሆናል? 1= አልፎአልፎ (አንድ ሁለት ጊዜ ባለፉት 4 ሳምንታት) ….|___|

2= አንዳንድ ጊዜ (ባለፉት 4 ሳምንታት ከሶስት እስከ አስር ጊዜ)

3= ብዙ ጊዜ (ባለፉት 4 ሳምንታት ከ አስር ዜጌ በላይ)

ክፍል 3 ከአትክልትና ፍራፍሬ ማቀላቀት ጋር ተያያዝነት ያላቸውጥያቄዎች

1.ሻጭኖት

1.አዎ 2.አይ

2.ስንት አመት መሸጥ ልምድ አሎት

3.የ ሚሸጡት የ ምግብ አይነ ት

1.ፍርፍሬ 2.አትክልት 3.ሁለቱንም

4.ከሚሸጠበት ቦታምን ያህልኪሎሜትር ይሆናል

5.በምን አይነ ት ሚቀመጫነ ውየ ምታስቀምጡት

1.በፕላስቲክ ሳጥን 5.በከረጢት

2.በእንጨት ሳጥን 6.በባዶ

3.በቅርጫት 7.በካርቶን ሳጥን

6.በሚያስቀምጡና በሚሸጠበት ጊዜ ለጸሀይ ተጋለጡናቸው

1.አዎ 2.አይ

7.አትክልተና ፍራፍሬን በምታስቀምጠበትጊዜእና በምትሸጠበትጊዜምን አይነ ትዘዴነ ወየ ሚጠቀመት

1.መጀመሪያ የገባውን መሸጥመጨረሻየገበውን ማስቀመጥ

2.መጀመሪያ የገባውን መጀመሪያመሸጥ

3.ሌሎች……..ይጠቀስ

8.የገዙትን ሁሉ ይሸጣሉ

1.አዎ 2.አይ

ክፍል 4 በኪሎግራምበምንያህልብርነ ወየ ምትገዙትየ እያንዳንዱአትክልትናፍራፈሬይገለጽ

1.ብርቱካን 7.ሽንኩርት

2.መዝ 8.ቃሪያ

3.ማንጎ 9.ጥቅልጎመን

4.ፓፓያ 10.ካሮት

5.አቮካዶ 11.ድንች

6.ቲማቲም

10.አጠቃላይ ከገዛቹት ምን ያህሉን ኩንታል በጥሩ ሁኔታ ሸጣቹ

11.አጠቃላይ ከገዛቹት ምን ያህል ኩንታል ተበላሸ

12.የ ተበላሸውወደ ገንዘብ ሲቀየር ምን ያህል ነው

13.ምን ያህሉ በሜቃመጥበት/በሚሰሯበት ወቅት ተበላሸ