



COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

**THE EFFECT OF PAPAYA POST-HARVEST LOSSES ON FOOD SECURITY OF
PRODUCING HOUSEHOLDS: THE CASE OF DUGDA WEREDA, EAST SHOA,
ETHIOPIA**

By

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Master of Science in Food Security and Development**

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Addis Ababa, Ethiopia

DECLARATION

I, **Asfaw Fita Bayu**, do hereby declare to Addis Ababa University School of Graduate Studies that this thesis is a product of my original research work, and it has not been submitted to any other university for any academic degree. Materials and information other than my own are dually acknowledged.

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As an adviser of the Thesis, we certify that we have read and evaluated the thesis prepared by Asfaw Fita entitled ‘ The Effect of Papaya Post-Harvest Loss on Food Security of producing Households: The case of Dugda Wereda, East Shoa, 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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Acronym and Abbreviation

AUC	African Union Commission
TAM	Theories like Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
APHLIS	African Post-Harvest Losses Information System
USD	United States Dollar
USA	United States of America
PHL	Post- Harvest Loss
FAO	Food Agriculture Organization
CSA	Central Statistics Authority
KG	Kilogram
MOA	Ministry of Agriculture
Qt	Quintal
G.C	Gregorian calendar
MOFAED	Ministry of Finance and Economic Development
FGD	Focus Group Discussion
KII	Key informant interview

ABSTRACT

Papaya has been produced in all regional states of Ethiopia and consumed as fresh fruit in most parts of the country. About 15, 572,313 Ethiopian small-holder farmers were involved in papaya production. Post-harvest loss of papaya was loss in quality and quantity; it appeared because of inappropriate handling practices, weak storage facilities, and poor transport logistics. The degree of post-harvest loss of papaya was increased 30%- 40% in developing countries and influenced the food security of households (Temesgen and Taye 2018). So, in the absence of a reliable and objective evaluation of the effect of papaya post-harvest losses on the food security of papaya producing households; the ways to minimize food insecurity of households of the study area are difficult. Yet, this study was intended to the effect of papaya post-harvest losses on food security of producing households in Dugada woreda. A cross-sectional design was used. Descriptive statistics is used to determine the farmers' practices by using percentage, mean, standard deviation, range, frequencies, and in addition inferential statistics to assess the factors affecting post-harvest losses at the household level. The ordinal logit method was used to analyze the relationships between post-harvest loss and the food security status of the papaya producing households. Focus Group Discussions were made and questionnaires based interviews were conducted to collect qualitative and quantitative data. This survey was conducted on a total of 212 sample households consisting of papaya producers where 90% of them were male respondents. All papaya producing respondents had monthly income ranging from ETB 3000.00 to 7500.00. Concerning the practice of technologies in papaya production (100%) of producers only practices grading papaya. Of the respondents, only 7.5% tried to prolong the shelf-life of papayas to minimize post-harvest loss and use modified technology like time for harvest and occasion to harvest papayas. Most respondents (i.e., 92.5%) produce papaya for market purposes. The amount of papaya lost was 8.87% of the total production and 9.5% of total papaya sale revenues. Concerning food security status of papaya producing households, 59.5 % of the households were food secure and about 9% of households were moderately food insecure, 23%, of households were mildly food insecure. Similarly, 8.5% of households were severely food insecure. The study results suggest that Training and technical support are needed for papaya producers, and the market value chain government and structure must be strengthened to reduce the post-harvest loss.

Key words: *post-harvest loss, food security, handling practice, households, food insecurity, harvest technology*

1. INTRODUCTION

1.1. Background

Fruits are classified as fleshy fruits and dry fruits: dry fruit includes legumes and cereal grains, and fleshy fruits include berries, aggregate fruits, and multiple fruits. Additionally, fruit is commonly considered as a fruit by its use of young, immature unripe fruits or mature ripe fruits of plants like pumpkin, watermelon, papaya, avocado, banana, etc. (Nimona, 2017). From 1800G.C. onwards papaya was distributed among various islands in the south of the Pacific. Papaya production has increased continuously during the last 50 years. For instance, the world papaya production increased was from 114,192 ha in 1961 to 420,279 ha and 438,239 ha since 2010 (Gabriela and Santamaría, 2014). Papaya has been cultivated in several countries for local consumption and export market. The world papaya production was estimated as 11.22 million metric tons in 2010. Asia was the top papaya-producing continent, with about 52.55% of the global production during the 2008 to 2010 period, followed by South America (23.09%) and Africa (13.16%) (Lemma et al., 2017). From Africa, Ethiopia is the highest top-ten papaya-producing country in the world (Edossa et al., 2021).

In Ethiopia, it was one of the economically important fruits grown in numerous parts of the country. It was produced at home gardens and semi-commercial levels by farmers and for home consumption and local market (Dadi et al., 2017). Papaya was produced in all regional states of Ethiopia and consumed as fresh fruit in most parts of the country. About 15, 572,313 Ethiopian households were involved in papaya production. The area of papaya production increased from 22,262.52 to 40,435.06 hectares from the year 2011 to 2015 which is an 81.6% total increment within five years intervals (Dadi et al., 2017). And Papaya was a beautiful and delicious tropical fruit with many nutritional and medicinal properties. The fruit contains 85% water, 10-13% sugar, 0.6% protein, and a fair amount of vitamin B1, B2, and C. The ripe fruit could also be consumed fresh, used for extraction of papain (use as a meat tenderizer), or the green fruit was employed by health and cosmetic industries amongst were going to use. It is used as raw materials for soft drinks, jams, and various preserves. The food canning industries also used ripe fruits as fillers in the manufacture of many products (Lemma et al., 2017). Yet currently, Food loss and waste may be a worldwide phenomenon and not restricted to the African continent.

Roughly one-third of the food produced within the global for human consumption gets wasted. Food losses and waste amount to roughly USD 680 billion in industrialized countries and USD 310 billion in developing countries (FAO, 2015). Total quantitative food loss in the geographical region has been estimated at 100 million metric tons in a very year. Post-harvest losses occur both in quantitative terms, affecting food availability and nutrition security, and in qualitative terms, affecting food use and utilization likewise as food availability. But by reducing the complete amount and quality of food available, Overall, PHL singly incorporates an amazing impact on the totality of food and nutrition security. Therefore having post-harvest losses from current levels would have an incredibly positive impact on reducing food insecurity on the African continent. (AUC, 2018) Quantity losses confer with people who result in the loss of the number of a product. Loss of quantity was more common in developing countries.

A recent FAO report indicates that at the global level, volumes of lost and wasted food in high-income regions were higher in downstream phases of the natural phenomenon, but just the opposite in low-income regions where more food was lost and wasted in upstream phases (FAO, 2014). In developing countries, food loss was during consumption whereas in developing countries it was start at the farm level to consumption. It was the following mechanical damage and injury, physiological processes, handling practices, lack of processing, inadequate packaging, poor logistics, and sub-optimal storage conditions (Tamerat and Anteneh, 2022).

Of the highly perishable fruits in Ethiopia, 0.5 million tons were tropical fruits like Banana, Mango, Papaya, Avocado, Guava, and Pineapple (CSA, 2012). Of the whole 39.7 million tonnes of total crops produced in Ethiopia, 23.1 million tonnes weren't highly perishable whereas 6.6 million tonnes were highly perishable (CSA, 2012). On the other hand, these fruits have high productivity; Papaya (170.5 qt/ha), Avocado (81.0 qt/ha), Banana (81.2 qt/ha), Mango (90.3 qt/ha) as compared to the national average crop productivity (20.0 qt/ha)(CSA,2012).

Fruits have high nutritive value compared to cereals and generate high income for the farmers as cited by (Desalegn Wondimu 2021). In Ethiopia especially, in Dugda woreda Bakale Girisa and Shubi Gemo kebele where the amount of papaya harvest was high the post-harvest loss started on- farm, handling practice was not improved and it impacts gaining nutritional food and income of households. The poor handling practice, weak premature harvesting, disease, lack of market

facilities, shortage of processing facilities, improper packing, and poor storage, leads up in the deterioration of papaya. This study is aimed at examining the effect of papaya post-harvest losses on the food security of households

1.2. Statements of the Problem

The post-harvest loss was food loss in quality and quantity; it appeared because of inappropriate handling practices, weak storage facilities, and poor transport logistics. Post-harvest loss of fruits and vegetables might be as high as 30%- 40% in developing countries (Temesgen and Taye 2018). On the other hand, the overall production increments of fruit harvesting were 172.87, 227.85, 262.92, 294.15, and 381.57% for banana, avocado, mango, citrus, and papaya, respectively. Edossa et al., (2021). These were fruits harvested for consumption and income generation by households to beat food insecurity in Ethiopia. Yet, due to their nutritious food fruit production was highly perishable food and post-harvest losses were high at the farm level and up to the marketing place. For instance, 21.75 % of the papaya production was lost at wholesaler levels, 15.6 % of papaya production losses at retailers' level, 12.5 % of papaya production losses during transportation, and 9.25% of papaya production losses during storage. And total, about 37.35% of papaya was lost in Jimma town (Dadi et al., 2017). In the study area, papaya producer households were hindered by post-harvest losses due to: a Lack of handling practices, a lack of coaching disease, a lack of proper storage facilities, a lack of packing materials, a lack of proper transportation, a lack of avoiding mechanical damage, and a lack of grading of their product, and a lack of experience to prolong shelf-life results post-harvest losses. (Dadi et al., 2017)

The shock of such food loss was reported in Ethiopia when the World Food Program Crop and Food Security Assessment Mission estimated the national grain balance. When the total post-harvest losses stood at 2.04 million heaps of grain at a time, Ethiopia's import requirement stood at 1.16 million tons (US Dept. of State, 2013, AUC, 2018). The study on the effect of papaya post-harvest losses on the food security of households' would assist in analyzing the number and value of losses and in identifying the factors liable for such losses. This successively would aid in developing proper measures to scale back post-harvest losses' effect on the food security of households. But, in the absence of a reliable and objective evaluation of the effect of papaya

post-harvest losses on the food security of households; the ways to minimize such losses are tougher. However, some studies have attempted to assess the percentile and value of post-harvest losses in fruit crops. This study attempted to examine the effect of papaya post-harvest losses on the food security of households in Dugada woreda Bakale Girisa and Shubi Gemo kebele.

The knowledge of examining the effect of papaya post-harvest losses on the food security of households' could even be useful to policymakers, administrators, and industrialists. The scientists and technologists were guided by the findings of such studies in concluding improvements within fruit production and post-harvest losses technologies geared toward minimizing these losses. And planners and policymakers were guided by such findings to formulate suitable policies that may help in reducing post-harvest losses.

1.3. Objectives of the Study

1.3.1. General Objective

General objective of this study was aimed to analyze the effect of papaya post-harvest losses on food security of producing households: the case of Dugada woreda (Bakale Girisa and Shubi Gemo) kebele in East Shoa Oromia regional state Ethiopia.

1.3.2. Specific Objectives

The specific objectives of the study were to:

- Assess papaya handling practices in the study area
- Estimate the amount and values of papaya post-harvest losses in the study area
- Identify the factors of post-harvest losses of papaya in the study area.
- Assess the food security status of papaya producing households in the study area

1.4. Research Questions

- What kinds of handling practices in the study area?
- How much amount of papaya losses at farm stages of the study area?
- How much value of papaya losses at market stage in the study area?

- What were the factors that influence post-harvest loss of papaya at household's level in the study area?
- How was the papaya used for food security status of farmers in the study area?

1.5. Significance of the Study

While there was some evidence to suggest that the process has led to improvement in handling practices management of households and decision was an urgent need for more improvement from harvest to supply chain. This paper attempted to Dugda woreda Bakale Girisa and Shubi Gemo kebele farmers' past experiences with providing access to conserve fruit production of papaya handling practice and post-harvest losses management, to minimize the post-harvest losses of papaya production. And was resolved the factors that affect their food security status at the household level, and strengthened their output and market value. The paper did so by specifically focusing on papaya perishable food so it played the role of public and private sectors in the provision of food security and researchers used as reference services.

1.6. Scope of the Study

The study was covered and focused on a specific in Dugda woreda; Bakale Girisa and Shubi Gamo kebele farmers of East Shoa Oromia regional state. And the study focused on the households of 450 in the study area. The effect of papaya post-harvest losses on household food security and the identification of the cause of Post-harvest loss and its management was the core point of the research. Methodologically, the study was descriptive and expository. In carrying out research, to make it manageable and focused it was important to delimit its scope.

1.7. Limitation of the Study

Conceptually, the study limitation does not incorporate the enabling environments to assess the supply chain and it also does not consider the marketable surplus of the fruit in the study area. The geographical limitation of the study was an emphasis on only two kebeles from the Dugda wereda.

1.8. Organization of the thesis

This thesis consists of five chapters. The first chapter was aimed at introducing the background, information of the study that consists of background of the study, Statement of the problem, objectives (general and specific), and research questions, significance of the study, limitation and scope of the study. The second chapter reviews related literature, empirical global and national experiences. The third chapter described the methodology and study area (i.e., location and climate), explain the research design, population sampling procedure, data collection tools and techniques, the ethical consideration, and the time frame of the thesis. The fourth chapter include the statistical analysis of the results and its discussion part. The fifth chapter includes the conclusion and the recommendation of the thesis.

2. REVIEW OF RELATED LITERATURE

2.1. Theoretical Literature Review of Papaya

Papaya tree was like plant that grows as one, hollow stalk with leaves and fruit at the highest. It was originated from Central America and spread to South America and other parts of the world during the sixteenth century. They had three basic plant types: male, female, and hermaphrodites. The males produce only pollen, never fruit. Only female and hermaphrodite plants typically produce fruit. For the pollination of female plants wind and insects were needed; however, hermaphroditic plants were self-pollinated. And papaya is climacteric fleshy fruit which is known by fast ripening after harvest. During post-harvest papaya fruit become fast changes in metabolism which results softening and sweetening. So the practice of post-harvest losses of papaya products of farmers provides adequate opportunities for farmers to increase their profitability by raising local value-added products, increasing bargaining power, enhancing market access, and promoting greater competition among producers (Peter, et al., 2017). Post-harvest losses even happened because of inappropriate post-harvest handling practices and inappropriate treatment methods during harvesting, marketing, transporting, and storage. Thus, post-harvest practices were extremely important to stay up and prolong the amount of harvested fruits and vegetables. Nevertheless, practices and technologies practice in agriculture among farmers and traders were low in Ethiopia (Emana, et al., 2017).

2.1.1. Concepts of Papaya handling Practices

The deliberate act of separating the food material from the positioning of immediate growth or production, for instance, the reaping of papaya, the picking of fruits, the lifting of fish from the water, etc. was termed harvesting (FAO., 2018). Harvesting was accomplished by hand, mechanically assisted picking devices or mechanical harvester's robotics which offers the long-term potential of blending the efficiency of machines with the selectivity of humans. Factors during harvesting operations that would influence post-harvest quality include the degree of severity of mechanical damage induced by machines or humans, the accuracy of selecting acceptable rather than unacceptable fruit, the time of day of harvest and so the pulp temperature at harvest (Prusky, 2011). Post-harvest started when the tactic of collecting or trying out edible quality food from its site of immediate production has done. Post-harvest began at the moment of

separation of the edible product from the plant by a deliberate human act that started it farm to the table. Papaya harvesting systems had a period of production, a time for harvest, an occasion for transportation, where gathering, packaging, or selection occurs. Moreover, several periods of short or future storage; and a stage where food is distributed to the consumers, pre-harvest drying, transport, post-harvest drying, threshing, storage, processing, and marketing where necessary. Keeping with this, the time of harvesting was set by the degree of maturity. Among fruits, a difference made between the maturity of stalks (straw), ears or seedpods, and seeds, for those that affect successive operations, particularly storage and preservation (Tamerat and Anteneh, 2022).

In step with Panagiotis improving productivity and efficiency the smallest amount bit levels of food supply (including its management), of which an integral part was increasing the efficiency of post-harvest systems. Developing advanced post-harvest technologies would allow producers, wholesalers, retailers, and transportation companies throughout the fresh-produce value chain to confirm optimum quality, extended period, significant economic and environmental losses result from the dearth to retard ripening and associated excessive softening of fruits between harvest and marketing, while loss of water from fruit negatively affects their quality (El-Ramady et al., 2015).

As Tamerat and Anteneh, 2022 study, the technical activities of handling practice resulted in post-harvest losses; due to poor packaging, inadequate storage facilities, and traditional means of transportation like human labor, donkeys, mules, animal drawn cart and public transportation. Such loss was reduced by harvesting products at optimum maturity, through grading, packaging, and careful handling of the products, maintaining higher sanitation standards, decreasing injury incidence, and maintaining good storage and environmental conditions and also to reduce post-harvest loss during transportation using modified means of transportation like car, trucks, train and plan are crucial and good ways of technology practice.

2.2. Empirical Literatures of Papaya Post-Harvest Losses

Food losses occurring at the tip of the organic phenomenon (retail and final consumption) were called “food waste” because they were, to a greater extent, the results of the retailer and

consumer behavior (intentional losses) instead of malfunctions in production or within the supply chain (unintended loss). In medium- and high-income countries, food was wasted at the consumption stage, meaning it discarded when it was suitable for human consumption. In industrialized regions, significant food losses also occur early in the supply chains whereas; in low-income countries, food losses at farm level, and at middle stages the food wasted at the buyer level. In developing countries, food loss occurs at the stages of farming and through retail. These could be clear from a theoretical or value chain perspective. In practice, however, a major share of the consumption of most rural farmers in developing countries a situation, on-farm losses could be very different or perhaps separable from, losses at the household or consumption level (FAO, 2018).

The post-harvest loss was described as an integrated approach of the whole agricultural value chain that contributes to reduced levels of food losses. Thus were occurring in grains, fruits, fruits, oilseeds, and every one food crops, livestock, and fisheries production. Post-harvest losses in Kenya contribute up to 30% of food losses rising therefore; a significant challenge to the food security situation in Kenya. The United Republic of Tanzania reported that in Tanzania, despite the rise of cereal crops production at the national level, estimated at 9.455 million tons on average each year, but the technology they used for harvesting and processing cereals were poor, so this has led to post-harvest loss in the region 3.782 million tons on the average annually, a staggering 40% loss in annual national production of cereals is loss because of PHLs (AUC, 2018).

According to Tröger the post-harvest loss within the Ugandan pineapple industry was chiefly caused by the road situation during transport. Meanwhile, Santos et al., 2020 acknowledged that the post-harvest loss of the fruits and vegetables within the central supply in developing countries occurred during transportation due to improper storage, temperature, excessive handling by consumers, and the lack of sellers' hygiene level. In England, during Fruit processing antioxidant in the fruits was lost because of mechanical stress in the washing process, so mechanical injuries were major causes of losses the quality and quantity of fresh horticultural commodities (Dewhurst, et al., 2017). Severely existence of mechanical damage might be minimized by educating all person involved in harvesting (Tröger, et al., 2020). The factors that caused a post-harvest loss were the storage problem which was happening for five decades

(Antos, et al., 2020). In East Africa post-harvest loss of fresh fruits were more than in developed countries meanwhile, losses in developed countries were waste of food from consumers whereas, in the developing countries losses started at the production farm to consumption level.(Tamerat and Anteneh, 2022) and (Santos, et al., 2020). In Brazil and France lettuce was the third highest level (11.1%) of loss among the fruits in the central supply (Charles, et al., 2018).

According to Tröger, et al., (2020), the post-harvest loss around the world was occurred at fruit farmers who did not carefully harvesting and chose inexperienced workers to handle the logistic parts. During transportation, the papayas must protected using natural cartons or carts. Meanwhile, Santos, et al., (2020) stated that the fruit and vegetable sellers within the central supply of developing countries reduced the loss by donating the products to people in need, or by consuming them with their families. Moreover, Santos, et al., 2020 suggested the advance of the infrastructure to form a higher storage quality, training requirement for fruit producers and fruit sellers, especially in terms of hygiene and handling practices. As Dewhirst, et al., (2017) stated that the optimum shelf- life condition of fruits was usually 5-7 days after packaging. In Italy hydroponic sector using gibberellin during the fruit plantation would end an extended period of time the merchandise after harvest consequently (Charles, et al., 2018). The post-harvest loss was the for most obstacle in achieving sustainable fresh fruits and it results food insecurity, especially in developing countries where almost up to 40% of the harvested fruits and vegetables not adequately used for human utilization. In general, the works of literature started to boosting post-harvest loss. This progress requires sustainable technology and human resource (Miceli et al., 2019). In developing countries like Ethiopia, roads were not adequate for transport of horticultural crops. The transport vehicles for fresh fruit in Ethiopia were result post-harvest loss. Moreover, losses was happened due to, shortage of fruit management practices, predicting climatic conditions, pest control practice, harvesting practice ,and packing practices (Emana, 2017). In Ethiopia especially, in the study area post-harvest loss of fruits occurred because of a lack of storage, the road condition, a lacks of washing, a lack of good road network, a lack of good marketing channels amongst others, a lack of efficient harvesting time, a lack of proper transportation and marketing techniques and a lack of hygiene (Tamerat and Anteneh, 2022).

2.3. Food Security Situation in Ethiopia

International organizations and scholars described food security in distinct ways. The concept of "food security" was defined as "at the individual level, household level, global level, national level, and local level, when all people have physical and economic gained to be an active, balanced, and access to adequate, safe, and nutritious food at all times to satisfy their nutritional requirements and food preferences" (FAO, 2010). At present, a combination of these concepts, focusing on availability, access, usage, and stability, serves as a working concept for international organizations' programs. Food security was a notion that developed dramatically over time. Most of the concepts of food security differ from the one suggested by the World Bank where food security was defined as access to adequate food for an active, safe life, for all people at all times (World Bank, 1986). Availability (adequate supply of food); access by household production, purchasing in the market, or movement of food; reliability where availability and access were assured at all times; and usage relating to the necessary biophysical requirements (good health) needed for the adequate use of food to satisfy particular nutritional needs and protection were important elements of the concept (*Morteza., et al. 2022*). The availability of food ensures that adequate amounts of acceptable, essential types of food produced domestically, industrial imports, or food assistance were regularly available to or in inappropriate proximity to individuals. It was the number of domestic food supplies, net commercial imports, food assistance, and domestic development at the national level. Individuals have sufficient access to food because they have adequate wages or other means to buy or barter for adequate food amounts required to sustain an adequate level of diet/nutrition intake. Food stability refers to the consistent supply of enough food throughout the year without shortages (Jrad, et al., 2010). To be food secure, a community, household, or single person must always have access to enough food. As a result, the term "stability" can apply to both the availability and accessibility components of food security. Finally, as the food was properly used, appropriate production and storing methods were important, and sufficient knowledge of diet and childcare techniques exists and was applied. Adequate health and sanitation facilities exist, and adequate food use was understood (FAO 2010). The notion of food security has increasingly developed a more subjective sense than at first, incorporating the consistency and variety of needs from one individual to another, honoring local eating patterns beyond a solely quantitative approach. A multidisciplinary

definition, including fiscal, political, demographic, social, cultural, and technological aspects, is food security (EC, 2009).

In the past, Ethiopia was closely linked to extreme recurrent food shortages and famine, as reported in Dessalegn (1991), cited in Mesay (2008). Adverse climate changes, combined with high demographic pressure, environmental pollution, and technical and structural causes, have contributed to a decrease in per capita landholding size, contributing to a severe rise in the problem of food security in Ethiopia (PASDEP, 2005). The decline in per capita income and food production in Ethiopia and most sub-Saharan African nations has led to food insecurity (Sisay, 1995; Getachew, 1995). Recurrent drought and the long-term secular decline in resource endowment to Ethiopia's food insecurity issue. Similarly, FDRE (2002) reveals that Ethiopia's cause of food insecurity is connected to unusual and man-made shocks, such as drought and lack of productive property. There is currently a rising opinion that food shortages and hunger an issue was directly connected to the situation in Ethiopia. Among those countries in Sub-Saharan Africa with the most severe long-term food conditions, Ethiopia was classified as various historical reports have shown that, with several rain shortages and significant loss of livestock, Ethiopia has experienced some 44 severe famine catastrophes.

Around 8 million people in Ethiopia were affected, and an estimated 1 million died (Degefa, 2005). According to Devereux (1993), the term famine is used to describe severe food crises, and it is referred to as the worst manifestation of food insecurity. Sen (1981) indicates that when people can't regulate when they affect subsistence production, hunger prevails.

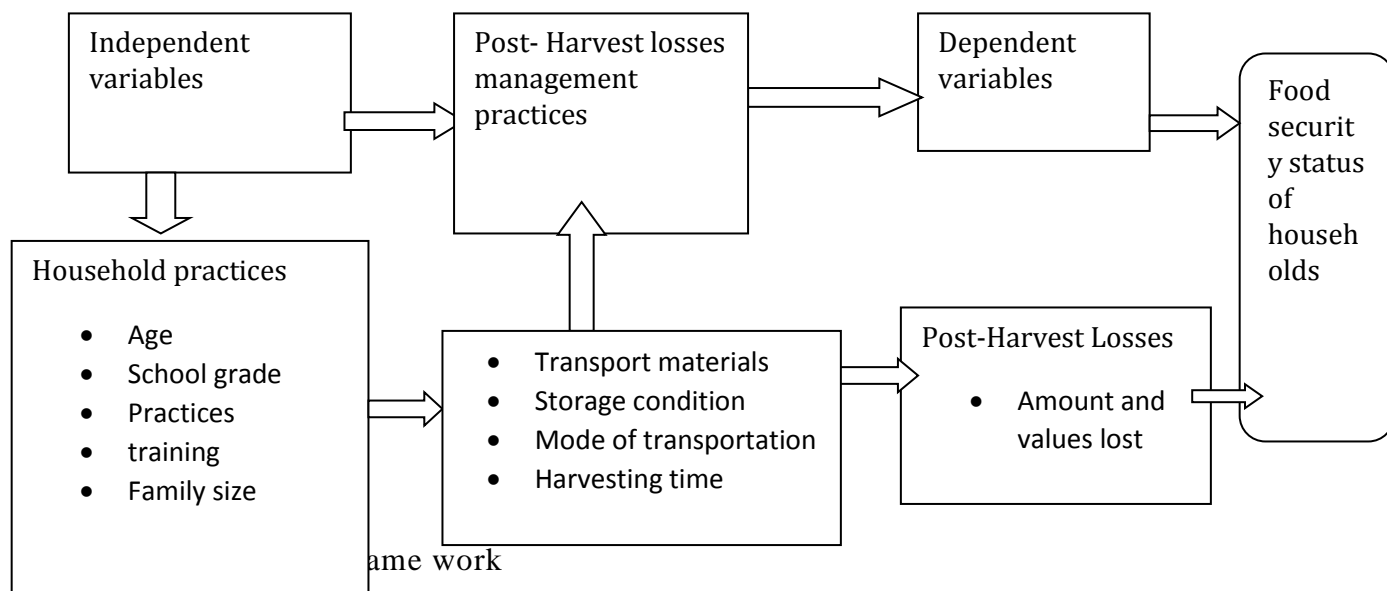
2.4. Literature gap of papaya post-harvest loss

A lot of research was exhausted analysis of handling practices and post-harvest loss of fruits and its determinants. A bit of literature focused on investigating valuable and providing chain loss production for farmers. In addition, the factors that influence the handling practice like improper handling practices, lack of proper packing materials, lack of experience of harvesting time, lack of transportation, and storage. Yet, now a day in developing countries, perishable fruits increase by 40 % (Nimona, 2017). In our country especially in the study areas thus, post-harvest handling was required consideration. It was of high significance to fight hunger, raise income and improve

food security and livelihoods when post-harvest loss reduction technologies were applied (Nshizirungu and Kitinoja, 2019). The written works of literature were not specialized in the evaluation of the application of practice of handling practices and innovation initiation can take as a gap.

2.5. Conceptual Frame Work

The fruit post-harvest loss was full to a lack of harvesting practice, harvesting time, packaging materials, storage system, and duration. As fruits had high nutrients, the spoilage time or period of the merchandise was short. Additionally, the current improper handling practices, packaging, and ways of transportation end up in losses of popper prices for farmers and traders. Inadequate packaging loses of moisture quickly when exposed to sunlight, hot conditions, and causal successive to papaya lead to losses. Poor market logistics could be a big concern in less-developed country. Totally, the papaya post-harvest losses were influenced by factors like harvesting time, packaging material, storage, and selling place sanitation.



Source : Modified from (Meskerem and Degefa model, 2015)

3. RESEARCH METHODS

3.1. Description of the Study Area

The study was conducted in Dugada woreda, in selected two kebeles (Bakele Girisa and Shubi Gemo) located in East Shewa Zone of Oromia National Regional State, Ethiopia, about 143Km Southeast of Addis Ababa. Dugda woreda's administration office was set up in Maki town. Dugda woreda is one of all the 12 woredas within the East Shewa Zone and it was Located within the central part of Dale and also the Woreda has 37 kebeles in its rural areas and three kebeles within the urban setting the middle of the town is set up a latitude and longitude of 8°9'N 38°49'E with an elevation of 1636 meters above sea level (CSA, 2008). It is bounded by Hora-Dambal, on the south by Adami Tullu and Jido Kombolcha, on the west by the Southern Nations, Nationalities and Peoples Region, on the northwest by the Southwest Shewa Zone, on the north by the Awash River which separates it from Ada'a Chukala, on the northeast by Koka Reservoir which separates it from Adama, and on the east by the Arsi Zone. The entire breadth of the Wereda is 1,459.53 square kilometers and out of land during this Woreda shows that 65.25% of its land was cultivated, 8.32% is a jungle, 3.55% was grassland, 12.54% was water bodies, and 0.31% and 10.03% were swampy and mountain range areas. Dugda Woreda has 2 major traditional agro-climatic zones, 45% Woyna Dega (mid-highland), and 55% Kola (lowland) (Tsegu, 2021). The Wereda has the eventuality for both crop and best products, which was especially accepted by households. The agro ecology within the Wereda was greatest fitted to different agricultural production. There was a variety of rivers and creator lakes that were being employed for irrigated farming, particularly for horticultural crop production. The common predict temperature in Dugda was 18.7c° in an exceedingly year average rainfall was 892mm. (SCA, 2007). The altitude of the Wereda ranges from 1500 m to over 2300 meters above sea level. The study area of Bakale Girisa and Shubi Gemo was 12km and 9kms isolated from Meki town respectively. The 2007 (SCA) national census conducted by the Central Statistical Agency of Ethiopia had an estimated total population of 144,910, of whom 74,561 were men and 70,349 were women.

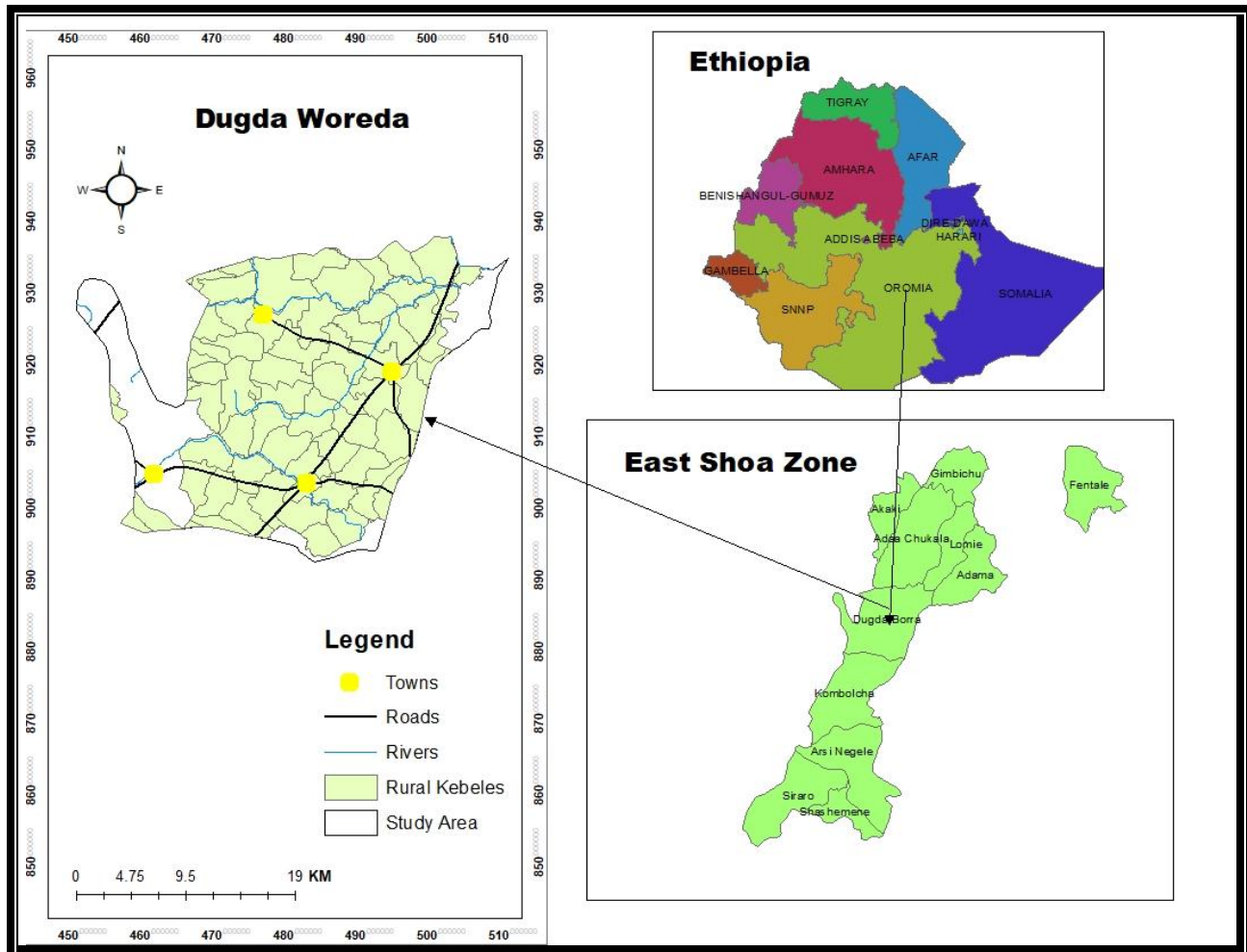


Figure 2: Map of Dugda Woreda

Source: Own GIS Map, 2022

3.2. Research Design and Approach

A cross-sectional design was used to examine the Effect of Papaya Post-Harvest Loss on the Food Security of Producing Households. A mixed approaches or qualitative and quantitative were used. Descriptive statistics were used to determine the households' papaya handling practices which included percentage, mean, standard deviation, range, and frequencies, and inferential statistics to determine the factors affecting post-harvest losses. The ordinal logit method is used to estimate the relationships between dependent and independent variables. And the researcher used Focused Group Discussions (FGD) and an interview was used to understand the qualitative survey questionnaires part of the study.

3.3. Sample Size Determination and Sampling Techniques

Dugda woreda was purposefully selected from the east Showa zone as the stage sampling procedure. Papaya farming farmers in Dugda woreda- Bekele Girisa and Shubi Gemo kebeles were selected based on the high volume of production. The target population of the study area affected by papaya post-harvest losses in selected Kebeles was 450. Yamane (1967) provides a simplified formula to calculate sample sizes. Similarly, the marginal error (e) of this study would be 5%, which is equal to 0.05

$$n = N / (1 + N(e)^2) = 450 / (1 + 450(0.05)^2) = 212$$

Therefore $450 / (1 + 450(0.05)^2) = 212$ respondents $450 / 212 = 2.1$ therefore every 3threspondents sequences.

n= Sample

N= Total number of population

e= Errors

Table 1. The proportion of sampling in two kebeles in 2022

Kebeles	Total population	Sample Size
Bakale Girisa farmers	205	100
Shubi Gemo farmers	245	112
Grand total of Sample size		212

3.4. Data Types and Sources

The study used both qualitative and quantitative approach to answer the research questions. The researcher used Primary data and secondary data to collect data from the farmers who engaged in papaya production. The Data were distributed randomly to papaya producers and collected then analyzed by using descriptive statistics such as percentages, frequencies, mean deviation, and standard deviation.

3.4.1. Methods of Data Collection

Data was generated from the study area actors using primary and secondary data sources to achieve the objective of the study.

3.4.2. Primary Sources of Data

The primary data were collected through various data collection methods such as questionnaires surveys, focus group discussion and key informant interview.

3.4.2.1. Key Informant Interview (KII)

In addition to the questionnaire-based survey, a key informant interview question was cited for the experts of the Agriculture and development office from Bakale Girisa and Shibi Gamo kebeles to provide relevant information on the effect of papaya post-harvest loose situations concerning farmers. The interviews were set by Afan oromo language .Using questionnaires with open and closed in-depth interviews conducted face to face to facilitate open dialogue to Agricultural Experts to obtain information on the effects of papaya post-harvest loss on households producers of food security. Therefore, in this research 6 KII were conducted.

3.4.2.2. Questionnaire Survey

The information was gathered using quantitative and qualitative survey questionnaires about the effect of papaya post-harvest loss at household level and post-harvest lose at market level. And in both cases the amount and values of lose at different stages because of different constraints. The total of the respondents was 212 then developed semi questionnaire was translated into the local language, Afan Oromo“ or ‘Amharic’ for the convenience of data collection during the survey.

3.4.2.3. Focus Group Discussion

In the study area, there was a total of 3 focus group (8 from each group) discussions of the open and closed questionnaires .The structured translated questionnaires in to local language Afan

Oromo in each group papaya producers was undertaken. Focus groups provided in sighted into how people thought and provided a deeper understanding of the phenomena being studied.

3.4.3. Secondary Data

The secondary data was collected to support primary data that gathered from different official data sources. This helped the researchers to minimize and cross-check the problem that occurred during primary data collection. However, the explicit analysis part using those data was excluded just to minimize the size of the paper but used implicitly for cross-checking, sample selection, and observing a regional, and national picture of papaya production trends and data on total land size and population.

3.5. Tools of Data Collection

The primary data was collected which included the field survey of the effect of papaya post-harvest losses on the food security of the household. Survey questionnaires, Focus Group Discussions (FGD), and the key interview were employed. Structured questionnaires were administered to respondents from farmers. Farmers and Agricultural Developmental Experts were discussed using questionnaires with open and closed questions and key informant interviews respectively. The question hunted to obtain information on papaya handling practices and its post-harvest losses (harvesting, storage, transporting, and marketing).

3.6. Techniques of Data Analysis

The survey data was analyzed by using descriptive and inferential statistics. Each specific objective was addressed by employing different techniques, as described as follows.

Examining papaya post-harvest handling practices by households

The status of handling practices: harvesting time, packaging, and transporting papaya production of the household was assessed by using descriptive and inferential techniques because applying post-harvest practices was used to reduce farmers' fruit loss after harvesting and before the consumption at the house household level. So, appropriate post-harvest handling practices and treatment methods were or prolong the shelf life of harvested papaya. Descriptive statistics such

as frequency, mean, median and percentile were employed by using SPSS version 20. In addition, data obtained from observation, FGD, and key informant interviews were analyzed qualitatively in narrative forms.

Estimate the amount and values of post-harvest losses of papaya at household level

The data were examined using both quantitative and qualitative losses data of papaya in post-harvest and converting the quantities and qualities of losses to financial terms by existing prices at the time of harvesting and sales. The qualitative data gathered by observations, FGD, and key informant interviews were analyzed qualitatively in the form of narrations. Data obtained from the survey were analyzed using quantitative methods of data analysis. In this study objective Ordinal logistic model is suitable for modeling with an ordinal dependent variable, for example, household food security (food secure, mildly food insecure, moderately food insecure, and severely food insecure), etc. The ordinal logistic regression model is especially appropriate because, like ordinary least squares regression, it identifies the statistically significant relationship between explanatory variables and dependent variables. But unlike ordinary least squares regression, ordered probit discerns unequal differences between ordinal categories in the dependent variable (Agrist, 2001).

Let Y_{ij} be an ordinal response variable with j categories for the i^{th} subject, alongside with a vector of covariates X_i . A regression model establishes a relationship between the covariates and the set of probabilities of the categories. $p_{ij} = P(y_{ij} = y/x_{ij})$. Usually, regression models for ordinal responses are not expressed in terms of probabilities of the categories, but they refer to convenient one-to-one transformations, such as the cumulative probabilities $p_{ij} = P(y_{ij} = y/x_{ij})$ we note that, the last cumulative probability is necessarily equal to 1, so the model specifies only $J-1$ cumulative probabilities.

An ordinal logistic regression model for an ordinal response Y_i with categories is defined by a set of $J-1$ equations where the cumulative probabilities $p_{ij} = P(y_i = y/x_i)$ related to a linear predictor $\beta^T x_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_j x_{ij}$ through logit transformation, i.e. The parameters α_j , called thresholds or cut points, are in increasing order ($\alpha_1 < \alpha_2 < \dots < \alpha_{J-1}$).

It is not possible to simultaneously estimate the overall intercept β_0 and all the J-1 thresholds: in fact, adding an arbitrary constant to the overall intercept, β_0 , can be counteracted by adding the same constant to each threshold α_j . This identification problem is usually solved by either omitting the overall constant from the linear predictor ($\beta_0 = 0$) or fixing the first threshold to zero ($\alpha_1 = 0$). The vector of the slopes β is not indexed by the category index j, thus the effects of the covariates are constant across response categories.

Cumulative logits

One way to use category ordering forms logits of cumulative probabilities are:

$$p_{ij} = p(y_i \leq j) = \pi_{i1} + \pi_{i2} + \dots + \pi_{ij} \text{ or}$$

$$p_{ij} = p\left(y_i \leq \frac{j}{x_i}\right) \\ = \pi_1(x) + \pi_2(x) + \dots + \pi_j(x)$$

The cumulative logits are defined by:

$$\text{logit} \left[p\left(Y \leq \frac{j}{x}\right) \right] = \log \left(\frac{p(Y \leq \frac{j}{x})}{1 - p(Y \leq \frac{j}{x})} \right) = \mathbf{In} \left[\frac{\pi_1(X) + \pi_2(X) + \dots + \pi_j(X)}{\pi_{j+1}(X) + \pi_{j+2}(X) + \dots + \pi_J(X)} \right]$$

Proportional Odds Model

A model that simultaneously uses all cumulative logits is:

$$\text{logit} \left[p\left(Y \leq \frac{j}{x}\right) \right] = \mathbf{In} \left[\frac{\pi_1(X) + \pi_2(X) + \dots + \pi_j(X)}{\pi_{j+1}(X) + \pi_{j+2}(X) + \dots + \pi_J(X)} \right] = \alpha_j + \beta_1 x_1 + \dots + \beta_p x_p = \alpha_j + \beta^T X$$

Where y is food security status (secure, mildly insecure, moderately and severely insecure)

X_1 is family size, X_2 is formal education, X_3 is ageand X_p is major type of UA practicing

Each cumulative logit has its intercept. They are increasing in j, since P(Y) increases in j for fixed X, and the logit is an increasing function of this probability. It is based on the assumption

that the effects of the independent variables $x_1, x_2 \dots X_P$ were the same for all categories, on the logarithmic scale. The Wald statistic was an alternative test, which is commonly used to test the significance of individual logistic regression coefficients for each independent variable (that is to test the null hypothesis in the logistic regression model that a particular logit coefficient is zero). If for a particular explanatory variable or group of explanatory variables, the Wald test is significant, then we would conclude that the parameters associated with these variables were significantly different from zero, so the variables should be included in the model. Both qualitative and quantitative outputs of the analysis were systematically presented, tabulated, and triangulated for better understanding in the result section of the paper

Identify the constraints of post-harvest losses of papaya in the study area farmers

In this objective data were gathered using survey questionnaires, observation, and key informant interviews, on constraints of post-harvest such as inappropriate storage, poor transportation, poor packaging materials, poor harvesting time, and lack of grading, and then the data would be analyzed using an ordinal logit model. After data collection data were coded and entered into the computer and analyzed by using SPSS version 20 the results were analyzed and interpreted. Finally, data that were gathered from FGD, KII, and observations were analyzed in the form of narration.

Examine food security status of households

The food security status of households was examined using the HFIAS model. Household Food Insecurity Access Scale (HFIAS) was developed by Food and Nutrition Technical Assistance Project (FANTA) in 2006 intending to deliver a valid tool in developing countries for the situation of measuring food insecurity. It was similar, with cross-cultural equivalency. (Coates, et al. 2007). It was a crucial technique for the analysis of the access element of food security. HFIAS is the most up-to-date, fairly simple to run and methodologically rigorous dimension of food insecurity (Swindale and Bilinsky, 2007). HFIAS was used in this study to distinguish households who were food secure and food insecure (taking into consideration one element of food security: access). It has 9 general questions and each of the questions was asked with a recall period of four weeks (30 days). The replier was first asked an empirical question that was,

whether the condition in the question happened at all in the past four weeks (yes or no). If the respondent answers “yes” to an occurrence question, a frequency-of-occurrence question was asked to determine whether the condition happened at each (once or twice), sometimes (three to ten times), or often (more than ten times) in the past four weeks (Coates, et al., 2007). But if the replier said no to the first question, no need to go to the second. At first, the date should be coded frequency-asked-questions as 0 for all cases where the answer to the corresponding existence question was no and then the score was calculated for each individual by casting up the codes for each frequency-of-occurrence question. If the individual response to all nine frequency-of-occurrence questions was “sometimes” the code would be 2. The maximum score for the individual response is 27 and the minimum is 0 and that is when the individual answer "no" to all the questions therefore, the higher the score the more food insecure (access) the individual is, and the lower the score, the less food insecurity (access) the particular experienced. In the past four weeks, did you worry that your household would not have enough food? A

0 = No (skip to Q2)

1. = Yes 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)

Finally, the researcher used an ordinal logistic regression model to see the relationship between the food security status of households and post-harvest loss. The ordinal logistic model was the most commonly used multivariate technique that examines the relationship between ordinal categories of the dependent variable and one or more independent variables.

3.7. Variables Specification

Dependent variables

The attention in the practical study was seen the influence of papaya post-harvest losses. The food security of households [dependent variable] at the farm level and household will measure in terms of quintals of output lost per hectare.

Independent variables

Independent variables provide several factors which influence household food security. The papaya post-harvest losses at farm and households level are influenced by the handling practices of households due to age, lack of education, lack of training lack of information. The post-harvest losses at the different stages were influenced by a combined effect of various factors such as handling Practices, time of harvesting, appropriate storage packing/ handling, grading, mechanical damage, and sorting of transportation and shelf-life.

3.8. Validity

Is the level to which the research tool correctly measures the concepts under study and covers the proposed areas Pallant J. (2011). So, the study will apply to check whether the questionnaire can cover all areas of interest by involving experts. And guidance from the supervisor and other research experts will look for too.

3.9. Reliability

It was the procedure of the extent to which a research tool is free from errors and produces stable and consistent results (Chakrabartty SN, 2013) then the study applies to a reliability test in SPSS using to prove the dependability of the data collected.

3.10. Ethical Consideration

The Ethical clearance approval committee board accepted if the collected data from the respondent at different stages of papaya producer farmers/households were analyzed without any biases and exaggeration and valued miss conduct of research. Those data taken from any other secondary sources and former studies was cited and accredited and kept confidentially.

4. RESULTS AND DISCUSSIONS

This chapter presents the results and discussion of the study. It is divided into two subsections; the first sub-section summarizes results by using descriptive statistics such as percentages and frequencies to describe the characteristics of sampled households by using explanatory variables. Finally, the second sub-section discusses the food security status and papaya handling practices of respondents.

4.1. Characteristic of Study Population

This survey was conducted on a total of 212 households of papaya producers. The socio-demographic character of respondents is presented in table 2. Age distributions of the household members varied extremely, and the age of respondents ranged from 34-72 years. A majority (90%) of papaya producer respondents were male. All respondents were married. The family size of sample households ranged from four to eight. Of the respondents, 27.8%, 64.6%, and 7.5% of sample respondents had elementary, secondary education, BS and MSC education levels respectively. All papaya respondents had monthly income ranging from ETB 3000 to 7500.

Table 2: Papaya producer households' characteristics

Variables	Categories	Frequency	Percent	Remark
Education level	1-4 grades	16	7.5	
	5-8	43	20.3	
	9-12	137	64.6	
	BSC/MSC	16	7.5	
	Total	212	100	
Marital status	Married	212	100	
	Un married	0	0	
Sex	Male	191	90	
	Female	21	10	
Residence district of respondents	Bakale Girisa	100	47.2	
	Shubi Gemo	112	52.8	

Source: Own Survey Data (2022)

4.2. Handling practices of papaya in the study area

The deliberate act of separating the food material from the positioning of immediate growth or production, for instance, the reaping of papaya, the picking of fruits, the lifting of fish from the water, etc. was termed harvesting (FAO., 2018). Harvesting was accomplished by hand, mechanically assisted picking devices or mechanical harvester's robotics which offers the long-term potential of blending the efficiency of machines with the selectivity of humans. Concerning the practice of technologies in papaya production (100%) of producers only practices grading papaya. Additionally, all respondents thought that the use of handling practices can minimize losses, but all of them didn't use modified storage for papaya. Of the respondents, only 7.5% tried to prolong the shelf life of the papayas they produced to minimize the loss and only 7.5 uses modified technology like: period of production, time for harvest, occasion for transport to harvest papayas (table 3). This result supports the idea of (Tamerat and Anteneh, 2022) which says in fact, post-harvest begins at the moment of separation of the product from the plant that produced it by a deliberate mortal act to start it on its farm to the table. Papaya harvesting systems had a period of production, a time for harvest, an occasion for transportation, where gathering, packaging, or selection occurs. Moreover, papaya production needs several periods of short or future storage; and a stage where food distribute to the consumers, pre-harvest drying, transport, post-harvest drying, storage, processing, and marketing where necessary. The time of harvesting papaya production is set by the degree of maturity among papaya producers. The difference is made between the maturity of stalks (straw), ears or seedpods, and fruits, for those that affect successive operations, particularly storage and preservation. So, most of the respondents (92.5%) didn't use harvesting technology for papaya.

Table 3: Handling Practice of Papaya produces households

Variables	Categories	Frequency	Percent
Who mostly participate on papaya production	Male	212	100
	Female	0	00
	Total	212	100
Do you grade papaya before packaging	Yes	212	100
	No	0	0
	Total	212	100
Do you think using of handling practices can minimize losses?	Yes	212	100
	No	0	00
	Total	212	100
Do you use of modified storage?	Yes	0	0
	No	212	100
	Total	212	100
Are you always tried to prolong the shelf life of your papaya?	Yes	32	15.1
	No	180	84.9
	Total	212	100
Which technology do you use to prolong the shelf life of papayas?	Refrigerator	0	0
	Zero energy cooling chamber	0	0
	Grading	212	100
	Total	212	100
Do you use of modified transportation(truck, car)	Yes	140	34
	No	72	66
	Total	212	100
Do you use technology to harvest papayas?	Yes	16	7.5
	No	196	92.5
	Total	212	100

Source: own survey data (2022)

Transportation is one of the most important phases in the supply chain as a large portion of the produce goes to waste because of indecorous transportation. A quick and suitable transportation technique is necessary for the successful marketing and distribution of fresh yield. Care for fruit production households must make sure that while transporting papaya, there is the minimum movement of fruits. This idea is supported by (FAO 1986) which says the selection of transport vehicles to cover physical injury, a technique of transport, loading, and uploading during sun and rain, transport of fruits during cool hours of the night or early morning, or use of ventilated and refrigerated vehicles is helpful to reduce the waste during transportation. From Figure 3 all respondents 100% used only grading technology during transportation and no one of the respondents practice the refrigerator and zero cooling chamber technology during transporting papaya.

On how they transport papaya to wholesalers in the Woreda, a key informant had the following to say: “Papaya producers said transport papaya to the area available to wholesalers by a cart driven by horses, mules, and donkeys. Additionally, we face the high cost of transportation and market chain to sell our papaya produce to the central market and occasionally wholesalers bring their car to buy our papaya produce.”

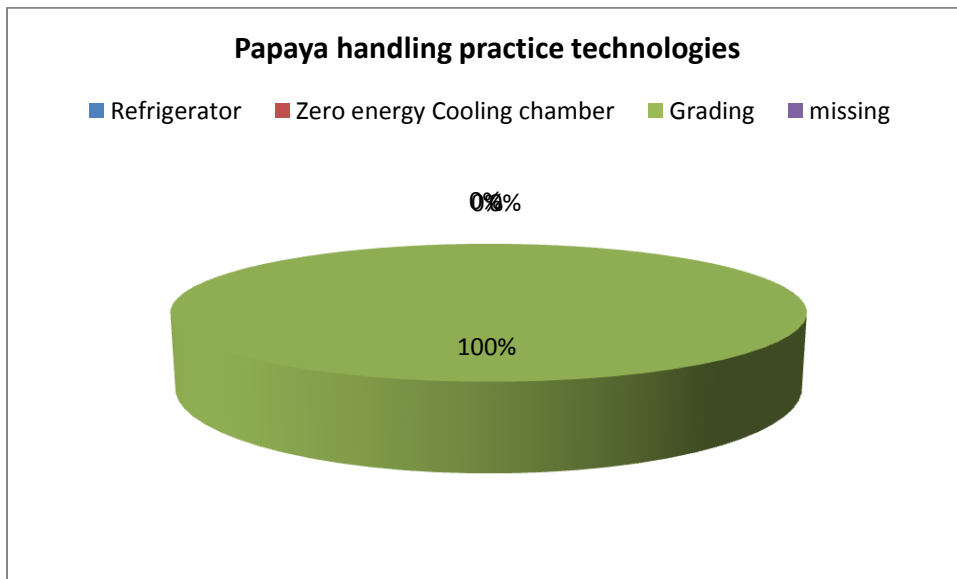


Figure 3: Papaya storage technologies use status

Source: own survey data (2022)

From figure 4. Of all respondents, only 34% used modified transportation like: trucks, cars, trains, plans for papaya during transportation and 66% of respondents didn't use any technologies for the transportation of papayas.

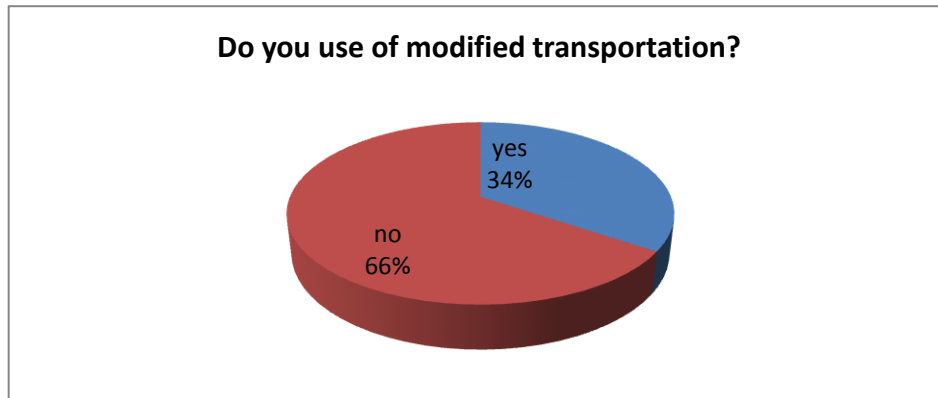


Figure 4. Use status of modified transportations for papaya

Source: own survey data (2022)

Concerning the use of techniques to ripen the papaya 15% of respondents replied that they put on a plain on a wood to ripen papaya and 85% of respondents replied that they put the papaya in closed bag to ripen (Figure5).

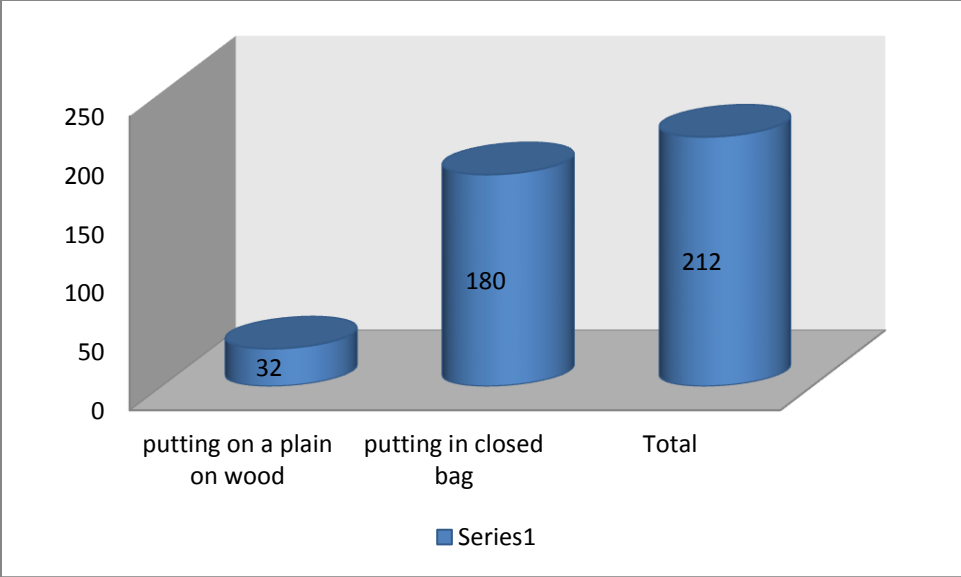


Figure 5: Techniques used to ripen papaya in Dugda woreda

Source: own survey data (2022)

According to data from table 4, most respondents (92.5%) produce papaya for market purposes and 7.5% of respondents replied that they produce the product for their use consumption. This complies with the finding stated as papaya is produced in home gardens and semi-commercial levels by farmers and at a commercial level by state farms for home consumption and the local market (Dadi et al., 2017). Of the total respondents 92.5% respondents replied that they had taken training on papaya handling practices and post-harvest losses of papaya and the rest replied that they never got the training. Of those who got the training 19.3% they participated only one time and the rest 65.7% participated two to three times. Concerning the willingness to use the technology all respondents replied that farmers will practice the technology if it will be made available.

On average, all respondents travel around 134.3Km to reach the market places, thus all respondents replied that they sell their papaya products to wholesalers. Around 92.5% of respondents responded that they never got fair prices for their products. Most of the respondents (88.2%) never wait for buyers for fair prices and only 11.8% of respondents replied that they wait for around two days for buyers to get more fair prices.

According to three of the key informant interviewed they stated concerning the accessibility of the market they stated as “papaya producers mostly sell their products to wholesalers coming from Addis Ababa or elsewhere through local brokers without having enough information about the market.” This statement complements the findings of (Susanna, 2014) which stated as” the central market for horticultural products in Ethiopia is in the capital Addis Ababa, and none of the actors know of any other valuable market or distribution center in their areas and (Emana and Gebremedhin, 2007) stated as the market for horticultural products in Ethiopia usually does not create any added value other than moving the products closer to the consumer. Limited information access is one of the largest constraints for agricultural markets in Ethiopia. Together with this, a large number of intermediaries limit the information flow. This means that all the products that are not sold to home consumers at local markets need to be distributed to Addis Ababa from large parts of the country. Packaging of fruits helps in slowing down the transpiration and respiration losses. Regarding packaging materials, 92.9% of respondents said that they use a wooden box and the rest 7.1% use nothing packaging materials. This finding supports the idea of Wills et al. (1989) which is narrated as “there is a variety of packages, packaging materials and inserts available. The earliest packages were mostly created of plant materials such as woven leaves, reeds, and grass stems.” Also, Packaging of fresh produce is needed not only to provide control for ease of handling but to preserve post-storage product quality during distribution and in certain cases, to add value to the papaya during marketing. Packaging systems are product specific but may benefit quality retention through protection from handling abuse and humidity loss and restriction of metabolism (Wills et al., 1989). Additionally, the Packaging of papaya is an important step in the post-harvest cold chain. Packaging of fruits helps in slowing depressed transpiration and respiration losses. Some of the packaging materials also serve the purpose of moderating materials that minimize the bruising effect during transportation.

Table 4: Thoughts of training on papaya post-harvest practices

Variables	Categories	Frequency	Percent	Remark
what are the main uses of papaya	For sale	196	92.5	
	Own use	16	7.5	
	Total	212	100	
Did you get training regarding handling practice and post-harvest losses of papaya?	Yes	196	92.5	
	No	16	7.5	
	Total	212	100.0	
frequency of order of the training	0	16	7.5	
	1	41	19.3	
	2	64	30.2	
	3	75	35.4	
	Total	196	92.5	
Do you think farmers practice handling practices?	Yes	212	100.0	
	No	0	0	
	Total	212	100	
How long you are waiting till you get buyer?	Never wait	187	88.2	
	2 days	25	11.8	
	Total	212	100	
what kinds of packaging materials do you use for the movement of papayas to the market	wooden box	197	92.9	
	Use nothing	15	7.1	
	Total	212	100	
How do you sell your product(papaya)	To wholesaler	212	100.0	
	Total	212	100	
Do you think that you are get fair price for your product?	No	196	92.5	
	System	16	7.5	
	Total	212	100.0	
How is lacks of proper material affect papaya?	very low	164	77.4	
	Low	48	22.6	
	Total	212	100.0	

4.3. The Amount and values of papaya post-harvest losses in the study area

Concerning papaya production in the study area the amount of produce was 1866.5 quintals and 2823962.2642 in birr on average. The mean estimate of papaya production losses of per households in quintals was 165.707 quintals and 270660.3774 in Ethiopian birr. This amount of loss supports the idea which says “Post-harvest losses can even happen because of inappropriate post-harvest handling practices and unsuitable treatment approaches during harvesting, marketing, transporting, and storage. Thus, the practice of post-harvest handling is extremely important to stay up and prolong the amount of harvested fruits and vegetables. Nonetheless, practices and technologies practice in agriculture among farmers and traders are still low in Ethiopia” (Emana et. al. 2017)’. From table 5 the amount of papaya lost was 8.87% of the total production and 9.5% birr from the total values of papaya produce lost. This result of post-harvest loss is reduced to the finding of (Bantayehu et al., 2017), which showed as the average loss was high for Avocado (28%), Tomato (22%), Mango (21%), Papaya (19%). This difference was obtained because this study of papaya post-harvest loss mostly attention only to the farmer’s production level and it never includes other value chains. The average papaya produce was 200 quintals per season, this illustrates the amount of production of papaya in the study area was higher compared to the findings of (CSA, 2012) which says fruits have high productivity; Papaya (170.5 qt/ha), Avocado (81.0 qt/ha), Banana (81.2 qt/ha), Mango (90.3 qt/ha) as compared to national average crop productivity (20.0 qt/ha)(CSA,2012). This loss of papaya produce affects the food security of households by affecting the accessibility and availability pillars.

Table 5. Papaya post-harvest losses in quintals and in birr.

Variables	Frequency	Minimum	Maximum	Mean	Remark
papaya production in quintals	212	200.00	3500.00	1866.5094	
papaya production value in birr	212	280000.00	8000000.00	2823962.2642	
Estimate papaya production losses in quintals	212	40.00	340.00	165.7075	
Estimate papaya production lost value/in birr	212	140000.00	450000.00	270660.3774	

4.4. Drivers of post-harvest losses of papaya in the study area

From figure 6, it is possible to conclude that to access the central market they should have to travel 134.3Km. This distance from the market center makes farmers obligated to sell their papaya products to the production site to whole sellers for the fear of post-harvest loss during transportation and the effects of brokers. This finding supports the idea of (Santos et al. 2020) who stated that "the post-harvest loss of the fruits and vegetables within the central supply in developing countries occurred during transportation due to improper storage, temperature, excessive handling by consumers, and the lack of sellers' hygiene level". This is one of the most important steps in the supply chain as a large portion of the produce goes to waste because of indecorous transportation. A quick and proper transportation system is necessary for the successful marketing and distribution of fresh produce. Care should be taken to make sure that while transporting papaya, there is minimal movement of fruits. Transporting the fruits during cool hours of the night or early in the morning or using ventilated and refrigerated vehicles is helpful to reduce waste during transportation. This idea supports the finding of Ruben et al. (2007) who stated "Even however the system aims at a local market they can often be part of other market systems, usually through intermediaries. This often makes them part of a long chain; where their added value is shared by a large number of actors, the distances and the primary actors who limited market information."

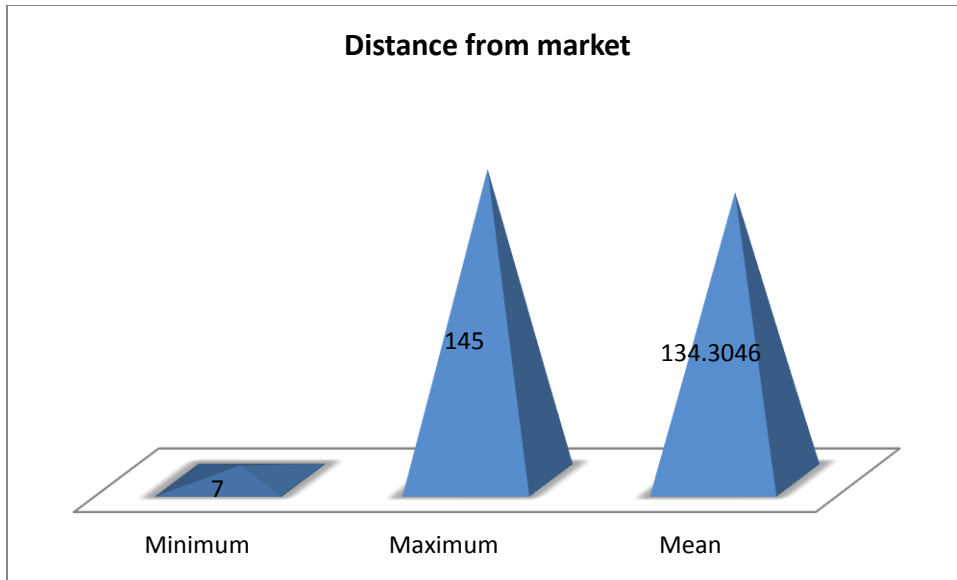


Figure 6: Travel from farm to market place in km

Source: Own survey data (2022)

Status of pest attack on papaya

According to the result obtained from figure7, most of the respondents (76%) replied that the status of pest attack on papaya is very high, 16% of them said that the status of pest attack is very low and 8% of them said the pest attack on papaya is medium. This idea supports the finding of FAO,(2006) which says factors such as fungal diseases, physiological illnesses, mechanical damage, or a combination of these are the leading causes of post-harvest losses and with findings of Armstrong,(1994) which stated as follows Many bacteria and fungi such as Colletotrichum, Phomopsis. Phytophthora, Rhizopus, and Fusarium are responsible for enormous losses after harvest. It is important to determine the pattern of infection of the various organisms so that appropriate control measures must developed to eliminate the disease

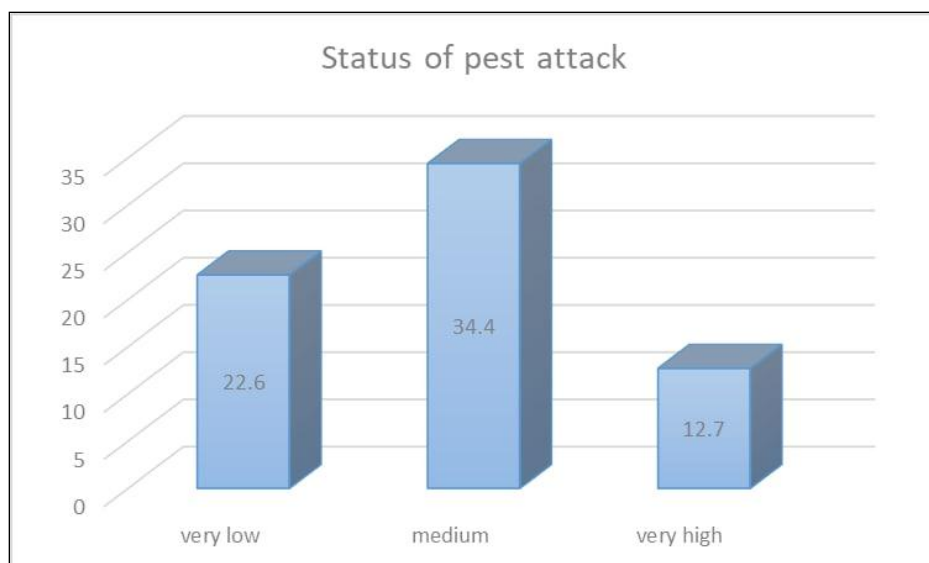


Figure 7: Status of pest attack on papaya

Source: own survey data (2022)

The lack of proper storage facilities affects papaya production. From figure 8, 34% of respondents replied that the lack of proper storage facilities affects papaya produce average, and 30%, 23%, and 13% of respondents replied very high, very low, and high respectively to the effect of lack of proper storage facilities on papaya production. This result comprises the ideas of the following findings; the level of post-harvest losses in a country has a strong relationship with the available technology and how developed the markets are (Parfitt et al., 2010). To reduce post-harvest losses of fruits and vegetables is of high importance for the actors to apply suitable post-harvest technology procedures, to have a long shelf-life and acceptable safety and quality of fruits (Kader, 2004). Proper storage practices are required for papaya fruit to avoid quality deterioration, primarily due to decay and accelerated softening. Storage is seldom done for the fruit which is destined for local markets. However, fruit exports require an optimum storage environment. Papaya fruit can be stored at ambient temperature (28-32°C) for about a week. Under refrigeration and when the temperature was decreased to 15°C, papaya fruits were exoticas remained at color index 1 for 22 days. However, papaya is a tropical fruit and should be stored at an optimum temperature of about 10-13°C to prevent chilling injury (Ignacio Chávez-Sánchez et al., 2011). Papaya fruits of Exotica could be kept at loose for two to three weeks and then ripe at 25°C (Ammy Anak Stephen Nanyi (2006). The storage life of papaya fruit can be extended by

hot water treatment which is effective in retarding disease infection (*Ignacio Chávez-Sánchez et al., 2011*)

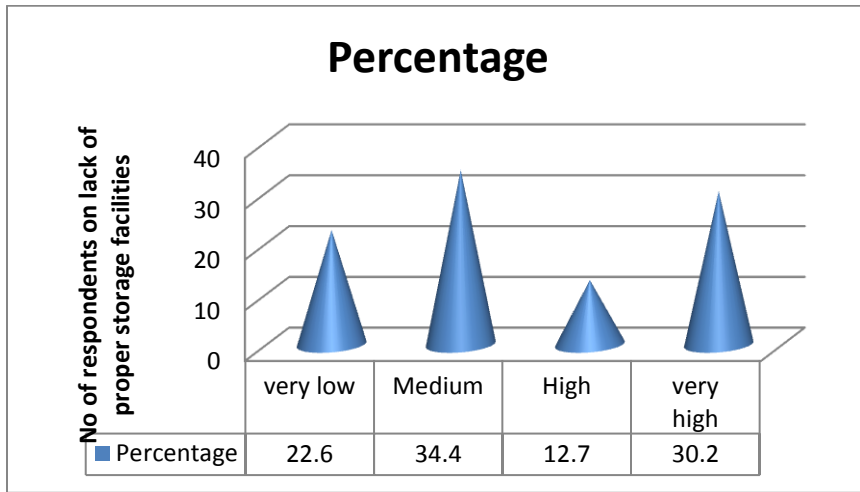


Figure 8 : Status of lack of proper storage facilities affects papaya produce

Source: own survey data (2022)

Concerning obtaining fair price from the papaya production 92% of the respondents replied that they think they do not have fair prices and only 8% of the respondents said that they obtained fair prices from papaya production.

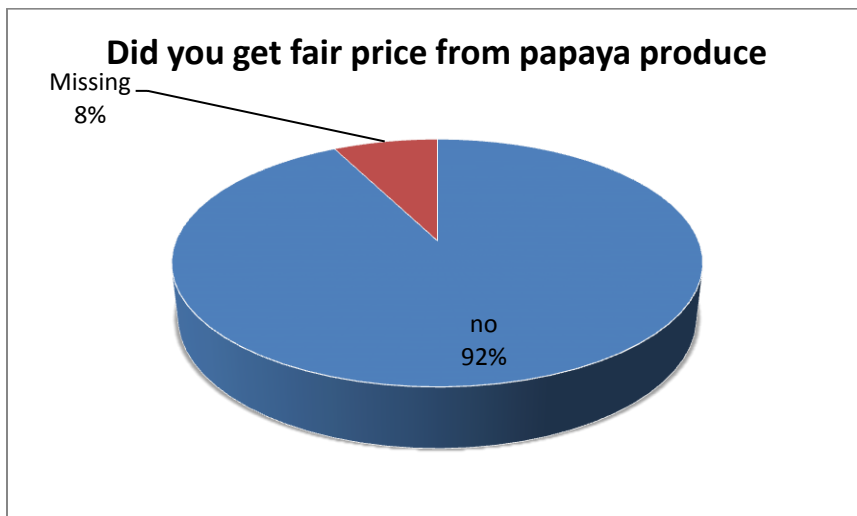


Figure 9: Get fair price from papaya produce

Source: own survey data (2022)

From figure 10, respondents replied (38%) that exposure to sunlight affects papaya on average, 25% of respondents replied that sunlight exposure has a very low impact on papaya production, and 13% and 16% of respondents thought that sunlight exposure has very low and low impact on papaya production.

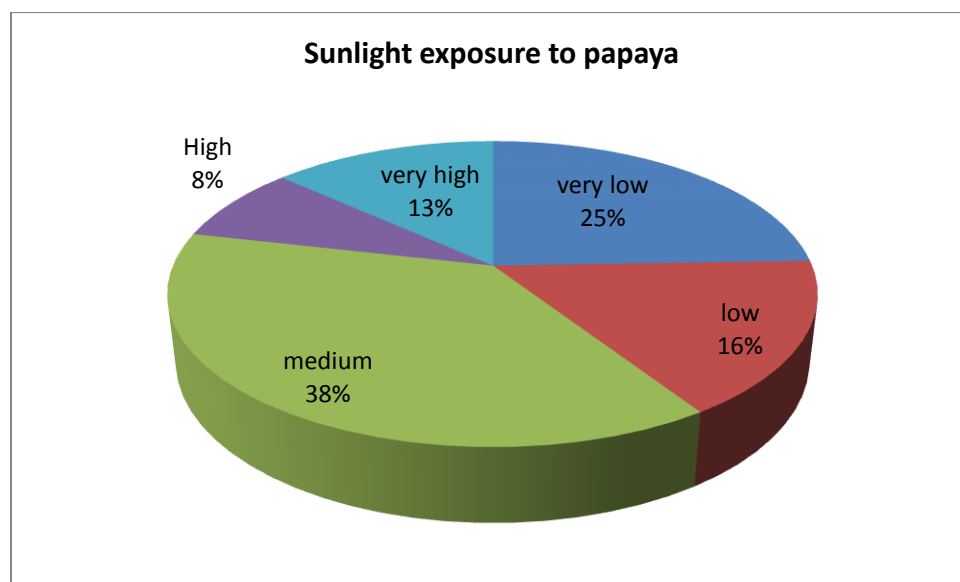


Figure 10: Sunlight exposure to papaya

Source: own survey data (2022)

4.5. Implications of papaya post-harvest loss on household food security

The government gives special attention to agriculture development in its all development strategy plans. In 2001/2 Sustainable Development and Poverty Reduction Plan (SDPRP) (MOFED,2002), the Rural Development Policy and Strategies in 2003 (MOFED,2003), subsequently in 2005/05 Plan for Accelerated and Sustainable Development to End Poverty (MOFED,2005), in 2009/10 Growth Transformation Plan-I (GTP-I) (MOFED,2010)and an extension to the latter in 2015/16 GTP-II was implemented and considered the agriculture sector as one of the major growth drivers of the economy (MOFED,2015). Even though all development plans emphasized the improvements of agriculture production and productivity and fostering commercialization, only the recent GTP-II plan gave specific attention to the minimization of post-harvest losses of crops and thereby ensuring food security in the country.

There has been less concern regarding post-harvest loss management of fruits and vegetables. According to table 5 of the result, the amount of papaya lost was 8.87% of the total production and 9.5% birr from the total values of papaya produce lost. This result of post-harvest loss is lesser than the finding of (Bantayehu et al., 2017), which showed as the average loss was high for Avocado (28%), Tomato (22%), Mango (21%), Papaya (19%). This difference was obtained because this study of papaya post-harvest loss mainly focuses only on the farmer's production level and it never includes other value chains. This implies only at the production level 8.87% of papaya was lost. This amount of produce impacts the food security of households. The average of estimated values of papaya post-harvest loss was 270660.3774 in Ethiopian birr which is equivalent to 5106.799 USD. 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 for post-harvest loss among others are inherent weaknesses in post-harvest handling techniques due to poor management practices, lack of infrastructure and appropriate equipment, and limited access to the market (FAO,2017). Reduction of post-harvest losses of crops between farm and market is a crucial task to minimize the food gaps and thereby ensure food and nutrition security in Ethiopia. However, a lack of understanding of the extent and associated contributing factors are posing major challenges to the effective implementation of grain post-harvest loss management strategies and to scaling up for all other crop types in Ethiopia (Sisay Debebe,2022).

4.6. Food security status of households

Fanta and its partners have identified a set of questions (see Table 6a) that have been used in several countries and appear to distinguish the food secure from the insecure households across different cultural contexts. These questions represent universal domains of the household food insecurity (access) experience and can be used to assign households and populations along a continuum of severity, from food secure to severely food insecure. The information which is generated by the Household Food Insecurity Access Scale (HFIAS) used to assess the prevalence of household food insecurity access. For example, geographic targeting to detect changes in the household food insecurity (access) situation of a population over time.(e.g., for monitoring and evaluation). The questions can be added to a standard baseline and final evaluation survey.

If assessing the change in the household food insecurity (access) situation between two or more years, it is important to administer the survey at the same time of year each time. The most appropriate time of year should be determined based on the intended use of the scale. When using the scale to determine the impact of a food security program, it is preferable to administer the survey during or directly after the worst of the lean season, because the greatest number of households is likely to be affected by food insecurity (access) at this time. This height of the lean season, however; may not be best unless the scale is used for geographical targeting because the program may not be able to differentiate between those who are severely food insecure during many months of the year and those who are food insecure only during the lean season. This may be important if the program is attempting to target areas with the greatest number of chronically food-insecure households.

This guide intends to provide a means for food security programs to easily measure the impact of their programs on the access component of household food insecurity. Understanding and measuring the impact of programming on the utilization component of food insecurity is equally important but is better accomplished using other measurement tools, such as anthropometric indicators. One aspect of utilization is the question of nutritional quality. In the context of the HFIAS, food quality questions do not refer directly to nutritional quality HFIAS was employed in this study to distinguish households in terms of their status of food insecurity. As can be observed in Table 6 b, 59.4 % of households were food secure and this finding is nearly to similar the finding of (Abaya and Mogessie , 2022) which was conducted in the Dugda Woreda focusing on the food security difference in fruit producers and non-producers and the finding indicated that about 61% of fruit producing and only 16% of non-fruit producing households were food secure, thus this study aligns with the food security status of fruit producers Moreover, 23%,of households were mildly food insecure. About 9 % of households were moderately food insecure. Similarly, 8.5% of households were severely food insecure, this proportion of mildly, moderately, or severely food insecure households also nearly similar to that of the findings of (Abaya and Mogessie, 2022), which is 25.2%, 7.5%, and 6.1% respectively. According to Jennifer Coates et al., (2007) practice fears, but infrequently. A mildly food insecure (access) household doubts about not having enough food sometimes or often, and/or is unable to eat favorite foods, and/or eats a more repetitive diet than preferred and/or some foods

reflected unattractive, but only rarely. But it does not decrease on quantity nor practice any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating). A moderately food insecure household losses quality more frequently, by eating a boring diet or unattractive foods sometimes or often, and/or has started to reduce on quantity by reducing the mass of meals or amount of meals, rarely or sometimes. But it does not practice any of the three most severe conditions. A severely food insecure household has progressed to critical hindmost on meal size or the number of meals often, and/or experiences any of the three most severe conditions (running with out of food, going to bed starving, or going a whole day and night without eating), even as infrequently as rarely. In other words, any household that practices one of these three conditions even once in the last four weeks (30 days) is reflected severely food insecure.

Table6a. The prevalence of the study area household food insecurity access scale, 2022

HFIAS	Occurrence		Frequency		
	Yes	No	Rarely (1)	Sometimes (2)	Often (3)
1. In the past four weeks, did you worry that your household would not have enough food?	127	85	34	92	0
2. In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	49	163	6	23	20
3. In the past four weeks, did you or any household member have to eat a limited variety of foods due to	68	144	49	10	9
4. In the past four weeks, did you or any 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?	68	144	49	9	10

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?	37	144	12	8	17
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?	37	144	12	8	17
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?	17	195	17	0	0
8. In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	212		0	0	0
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?	212		0	0	0

Table 6b: Categories of food insecurity

Category	fruit producers
Food secure	59.5%
Mildly food insecure	23%
Moderately food insecure	9%
Severely food insecure	8.5%

4.7. Determinants of Household’s Food Security

We employed ordinal logistic regression analysis to determine factors affecting household food security phenomenon. We hypothesized independent variables were expected to affect household food security.

The result of the ordinal logit analysis of the hypothesized independent variables which were expected to affect household food security is provided in Table 10.

The difference between -2log-likelihood for a model fitted with independent variables and -2log-likelihood for a null model (at step 0, before any variables have been added to the model) is distributed chi-square with degrees of freedom equals the difference between the numbers of parameters in the full and null models. The above table reveals that the small p-value from the LR test (0.000) would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero. This shows that the final model good fit than the empty model (without any predictors).

Table 7: Model Fitting Information

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	143.060			
Final	105.432	93.751	5	.000
Link function: Logit.				

Table 8 assessing goodness of fit involves investigating how the predicted values a closer to the observed values. The Pearson and deviance chi-square test was found to be not significant (p-value > 0.05), which shows that model estimates adequately fit the data. These results suggest good fit model.

Table 8: Goodness of Fit Test

Goodness-of-Fit			
	Chi-Square	Df	Sig.
Pearson	28.036	7	.120
Deviance	42.023	5	.212
Link function: Logit.			

In linear regression, R² (the coefficient of determination) summarizes the proportion of variance in the outcome that can be accounted for by the explanatory variables, with larger R² values indicating that more of the variation in the outcome can be explained up to a maximum of one. For logistic and ordinal regression models it not possible to compute the same R² statistic as in linear regression, so three approximations is computed instead (see table 8). Here, the pseudo R² values (e.g. Nagelkerke = 65.8%) indicates that all explanatory or independent variables explains a relatively high proportion of the variation between food security status. The above result revealed that the predictive power of the fitted model is 65.8% assessed through Nagelkerke R² (pseudo R²). This shows that 65.8% of the variation in the dependent variable is explained by the model.

Table 9. Pseudo R-Square (R²)

Pseudo R-Square	
Cox and Snell	.516
Nagelkerke	.658
McFadden	.426
Link function: Logit.	

A negative check in the column labeled "Estimate" indicates an inverse relationship of an explanatory variable with the log odds of the variable quantity. In contrast, a positive coefficient indicates a positive relationship to the log odds of the variable quantity.

The result from Table 10 depicts that all the independent variables namely family size, monthly income, total annual Papaya loss, and Loss on transporting in kg, and if the households family size increase, the probability of households being food secure would decrease by 12.47 instead of mildly, severely or moderately food insecure while the other variables in the model are held constant. This indicates as the number of household members or dependency increase had increased the risk of mildly, severely and moderately food insecure. The result revealed that if the monthly income of households increases, the probability of households being food secure would increase by 0.9159 instead of mildly, severely, or moderately food insecure while the other variables in the model are held constant. This indicates as the monthly income of a household increase had decreased the risk of mildly, severely, and moderately food insecure. If the total annual papaya loss increase, the chance of households being in a food secure would decrease by 0.6774 instead of mildly, severely, or moderately food insecure while the other variables in the model are held constant. This indicates as annual papaya loss increases had increased the risk of mildly, severely, and moderately food insecure. The result in the table above shows that If the total papaya loss on transporting to store in kg increases, the chance of households being in a food secure would decrease by 0.9934 instead of mildly, severely, or moderately food insecure while the other variables in the model are held constant. This indicates as total papaya loss on transporting to store in kg increase had increased the risk of mildly, severely, and moderately food insecure.

If the total papaya loss on use of improper handling or packing material in kg increases, the chance of households being in a food secure would decrease by 0.2049 instead of mildly, severely, or moderately food insecure while the other variables in the model are held constant. This indicates as total papaya loss on use of improper handling or packing material in kg increase had increased the risk of mildly, severely and moderately food insecure

Table10. The determination of household's food security

	Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval OR	
						Lower Bound	Upper Bound
Intercept= 1	4.6980	1.7550	7.1650	1	0.007	1.0702	7.0753
Intercept =2	2.0054	0.4530	11.0578	1	0.001	0.7541	4.4003
Intercept = 3	6.4250	1.7370	13.6830	1	0.000	5.0560	7.9053
Age	0.3930	0.1910	2.1210	1	0.700	0.1005	0.6753
House hold size	-12.4740	0.8910	195.8170	1	0.000	-14.217	-8.7520
Income	0.9159	0.2036	4.5020	1	0.000	0.6700	1.7000
Annually Papaya loss	-0.6774	0.2332	2.9110	1	0.000	-1.2400	-0.1100
Loss on transportation	-0.9934	0.1867	5.3200	1	0.005	-0.8700	-0.0100
Inappropriate storage loss in kg	-0.3005	0.1709	1.7600	1	0.078	-0.9600	-0.0800
Improper handling loss	-0.2049	0.1761	-1.1600	1	0.045	-0.5700	-0.1500
Use of improper display material							

Source: own survey data (2022)

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The study concludes that the papaya producer households understanding of papaya post-harvest losses, papaya post-harvest constraints and its protection practices in the study area as well as the regions which have the same ecology in Ethiopia could minimize losses. Additionally, giving attention for the losses of papaya in quintals and losses in birr which affects the food security status of papaya producer households has high value. This survey was conducted on a total of 212 households consisting of papaya producers. Their age was ranged from 34-72 years and their family size was ranged from four to eight. Most of the respondents (64.6%) had elementary education moreover; all papaya producer respondents had monthly income ranging from ETB 3000 to 7500. Concerning the practice of technologies in papaya production (100%) of producers only practices grading papaya additionally; all respondents thought that the practice of handling practices can minimize losses. Of the respondents, only 7.5% tried to prolong the shelf life of the papayas they produced to minimize the loss and only 7.5 uses modified technology to harvest papayas. Most respondents (92.5%) produce papaya for market purposes and 7.5% of respondents replied that they produce the product for their use consumption. This complies with the finding stated as papaya is produced in home gardens and semi-commercial levels by farmers and at the commercial level by state farms for home consumption and the native market (Dadi et al., 2017). Of the total respondents 92.5% respondents replied that they had taken training on papaya handling practices and post-harvest losses of papaya and the rest replied that they never got the training. Regarding papaya production in the study area the amount of produce was 1866.5 quintals and 2823962.2642 in birr on average and the mean estimate of papaya production losses of per households in quintals was 165.707 quintals and 270660.3774 in Ethiopian birr. Papaya producers said transport papaya to an area available to wholesalers by a cart driven by horses, mules, and donkeys but, they face high costs of transportation and market chain to sell their papaya produce to the central market and sometimes wholesalers bring their cars to buy their papaya produce. Concerning obtaining a fair price from papaya production 92% of respondents replied that they thought they do not have fair prices and only 8% of respondents said that they obtained fair prices from papaya production. The amount of papaya lost was 8.87% of the total production and 9.5% birr from the total values of papaya

produce lost. This result of post-harvest loss is lesser than the finding of (Bantayehu et al., 2017), which showed as the average loss was high for Avocado (28%), Tomato (22%), Mango (21%), Papaya (19%).

Food and nutrition protection was described at the World Food Summit in 1996 as a situation where “all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and Food preferences for an active and healthy life. Concerning food security status 59.5 % of households were food secure and about 9 % of households were moderately food insecure, 23%, of house households were mildly food insecure and, 8.5% of households were severely food insecure.

5.2. Recommendation

Since the finding of this study showed that there was a low practice of post-harvest technologies, low access of market information, lack of storage facilities, supply of averting technologies, training and technical supports are needed by regional and federal agricultural development experts, international non- government projects like FAO in order to expand experience for papaya producers and the regional government with federal agricultural minister should strengthened a market chain to lessen the roles of middlemen between the central market and papaya producers.

Concerning food security status, around half of the respondents were food insecure. This food insecurity status could be averted by minimizing papaya post-harvest loss and by increasing their sources of income and strengthening the roles of regional and federal agricultural and finance institutions.

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ANNEX I: QUESTIONNAIRES

Dear respondent,

The overdoing objective of this questionnaire survey is to collect baseline data for Dugda woreda, Bakale Girisa and Shubi Gemo kebele. The information will be used to monitor the progress of the study area that influences the effect of papaya postharvest losses. Therefore, your responses to the questions are valuable and will be held in utmost confidentiality to be used only for the analysis of this research. If you accept to participate in this research, you will be doing so voluntarily, and there will not be any monetary returns. You are also free to refuse to respond to any questions you do not feel comfortable answering or to withdraw from the research altogether. This survey questionnaire will take about an hour of your time to respond to the questions. Thank you in advance for your cooperation.

Note to the enumerator: Please note that this study is, to examine the effects of papaya post-harvest losses on food security of households. The required data need to be collected from that Bakale Girisa and Shubi Gemo kebele.

Directions ----please use the direction of question and either circle the number or write in numbers

Expectations/Indicators as per the ToR	No	Questions	Category	Code
The study areas	1	Residence of the respondent	Bakale Girisa	1
			Shubi Gemo	2
Socioeconomic background of the respondents	2	Residential area	Rural	1
	3	Sex of the respondent	Male	1
			Female	2
	4	Household size (<i>write in numerical value</i>)		[]
	5	Age of the respondent (<i>Write in numerical value</i>)		[]
	6	Monthly income of the household (in birr)		[]
	7	Marital status of the respondent	Single	1
Married			2	
Divorced			4	
Widowed			3	
Polygamy			4	
	Other (specify): _____		5	

	8	How many years have you lived in this area (<i>write in numerical years</i>)	[]	
	9	Your education level, in grade level	Cannot read and write	1
			Read & write, but no formal education	2
			Grade 1 – 4	3
			Grade 5 – 8	4
			Grade 9 – 12	5
			Diploma/Levels	6
			BSc/MSc	7
			Above BSC/MSc	8
(a)The handling practices by the house holds	10	Who mostly participate on papaya	Male	1
			Female	2
	11	Do you pack your papaya before selling?	Yes	1
			No	2
	12	If yes how? Which one do you use?	Woven leaves	1
			Reeds	2
			Grass stems	3
			Cartons	4
			Plastics	5
	13	Which handling practices is applied by households?	Transport materials	1
			Storage condition	2
			Model of transport	3
			Harvesting time	4
			Packing materials	5
	14	Do you use handling practice?	Yes	1
			No	2
	15	If ‘yes’ for how many years?	One	1
			Two	2
			Three	3
			Four	4
			Five	5
	16	Do you think using of handling practices can minimize losses?	Yes	1
			No	2
	17	Do you use of modified storage?	Yes	1
			No	2
	18	Are you always tried to prolong the shelf life of your papaya?	Yes	1
			No	2
	19	Which technology do you use to prolong the shelf life of your	Refrigerator	1
			Cooling chamber	2

		papaya?	Grading	3
	20	Do you use of modified transportation	Yes	1
			No	2
	21	What technique do they use to let papaya ripen?	Putting on a plain on wood	1
			putting on metal sheet	2
			putting on warm floor	3
			putting in closed bag	4
			other specify	5
	22	What are the main uses of papaya production?	For consumption	1
			For sale	2
			For animal feed	3
			Others specify	4
	23	Did you get training regarding handling practice and post-harvest losses of papaya?	Yes	1
			No	2
b) The amount and values of post-harvest losses at different stages	24	If your answer is 'yes' for the question above, would you please list the frequency of order of the trainings (from most to least? (write in numerical value)		[]
	25	How long you wait till you get buyer?	(days/hours)	[]
	26	What is the annual income of papaya production in a year 2014?	Papaya production in quintals(use numeric)	[]
			Papaya production value/in birr	[]
	27	Production losses due to post harvest constraints? In 2014	Estimate papaya production losses in quintals(use numeric)	[]
			Estimate papaya production losses value/in birr	[]
			Estimate papaya production losses in quintals(use numeric)	[]
	28	Estimate of loss of percent for papaya	On the way transporting to store:	[]

		at households?	Practice of improper packaging material	[]
			Inappropriate storage:	[]
			At farm level to get buyers?	[]
	29	What kinds of packaging materials do you use for the movement of papayas to the market?	plastic crate	1
			wooden-box	2
			Cartons	3
			Basket	4
	30	How long do you travel from farm to market place?	In km:----- minutes	[]
	31	How do you sell your product?	Direct to the consumer Other	1
			To wholesaler	2
			To retailer	3
	32	Do you think that you are getting fair price for your product?	Yes	1
			No	2
	33	If the answer is No, what are the reasons? (Multiple answer possible)	Due to weak market organization	1
			Due to lacking access to right marketing place	2
The constraints of papaya postharvest losses.	34	How is lacks of proper materials affect papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	35	How is papaya attacked by pests and diseases?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	36	How lacks of proper storage facilities is affect papayas?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
37	How lacks of cold storage is affect	Very high	5	

		papaya?	Very low	1
			Low	2
			Medium	3
			High	4
	38	How sunlight Exposure to papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	39	How is Waiting the buyers affect papayas?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	40	How severities of delayed harvesting time affect papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	41	How is grading or sorting (size, color grading) affect papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	42	How lacks of proper harvesting tools is affect papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	43	How lacks of food processing papaya nearby farm is affect papaya?	Very high	5
			Very low	1
			Low	2
			Medium	3
			High	4
	44	How the distance from farm to market is affect papayas?	Very high	1
			Very low	2
			Low	3
			Medium	4

			High	5
	45	How much papaya losses do you faced annually?	In kg	[]
	46	Estimate the total papaya loss in kg at different stages.	on the way transporting to store in kg	[]
			use of improper handling or packaging material in kg	[]
			Inappropriate storage in kg	[]
	47	What transporting material do you use during storing the product, in most cases this year?	Shallow wooden boxes	1
			Long big wooden boxes	2

Assessment of Food security status (Household Food Insecurity Access Scale (HFIAS) Measurement Tool) .

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	. ____
1a	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 of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	. ____
2a	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	. ____
3a	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 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?	0 = No (skip to Q5) 1 = Yes	. ____

4a	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	_ _
5a	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	. _ _
6a	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	. _ _
7a	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	0 = No (skip to Q9)	. _ _

	hungry because there was not enough food?	1 = Yes	
8a	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 /	. ___
9a	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)	. ___

ANNEX 2: KEY INFORMANT INTERVIEW GUIDE

Place of interview -----

Sex -----

Phone no-----

Education level: Cannot read and write=1, Read & write, but no formal education=2, Grade 1 – 4 =3, Grade 5 – 8=4, Grade 9 – 12=5, Diploma/Levels =6, BSc/MSc BSc/MSc =7, Above BSC/MSc=8

Dear respondent,

The overriding objective of this study is to collect data for Dugda woreda, Bakale Girisa and Shubi Gemo kebelas. The information will be used to monitor the progress of the study area that influences the effect of papaya postharvest losses. Therefore, your responses to the questions are valuable and will be held in utmost confidentiality to be used only for the analysis of this research. If you accept to participate in this research, you will be doing so voluntarily, and there will not be any monetary returns. You are also free to refuse to respond to any questions you do not feel comfortable answering or to withdraw from the research altogether. This survey questionnaire will take about 45 minutes of your time to respond to the questions. Thank you in advance for your cooperation.

1. What are the constraints and opportunities for Papaya marketing?
2. What are the causes of papaya post-harvest losses?
3. What general outlook do you have over the post-harvest losses of Papaya?
4. What do you consider when setting the price of your produce?
5. What do you recommend for minimizing post-harvest losses of papaya?

Thank you in advance for your cooperation

ANNEX 3: FOCUS GROUP DISCUSSION GUIDE

Place of discussion ---

Sex composition of the discussants-----

Education level: Cannot read and write=1, Read & write, but no formal education=2, Grade 1 – 4 =3, Grade 5 – 8=4, Grade 9 – 12=5, Diploma/Levels =6, BSc/MSc BSc/MSc =7, Above BSC/MSc=8

Dear respondent,

The overriding objective of this study is to collect data for Dugda woreda, Bakale Girisa and Shubi Gemo kebele. The information will be used to monitor the progress of the study area that influences the effect of papaya postharvest losses. Therefore, your responses to the questions are valuable and will be held in utmost confidentiality to be used only for the analysis of this research. If you accept to participate in this research, you will be doing so voluntarily, and there will not be any monetary returns. You are also free to refuse to respond to any questions you do not feel comfortable answering or to withdraw from the research altogether. This survey questionnaire will take about an hour of your time to respond to the questions. Thank you in advance for your cooperation.

Thank you in advance for your cooperation

1. What do you think the cause for the water losses of papaya?
2. What techniques do you use to prolong or increases the shelf life of papaya?
3. What technology do you practice to handling practices and post -harvest losses of papaya?
4. What do you think the way to minimizing papayas postharvest losses?

DABALATA 1: QAJEELFAMA GAAFILÉE ODEEFFANNOO IRRATTI

Bakka gaaffii fi deebii -----

Saalaa -----

Sadarkaa barnootaa: Dubbisuu fi barreessuu hin danda'u=1, Dubbisuu, garuu barnoota idilee hin qabu=2, Kutaa 1 – 4 =3, Kutaa 5 – 8=4, Kutaa 9 – 12=5, Dippiloomaa/Sadarkaa =6, BSc/MSc BSc/MSc =7, BSC/MSc=8 ol

Kabajamaa deebii kennituu,

Kaayyoon qorannoo kanaa daataa aanaa Dugda, Bakale Girisa fi Shubi Gemo walitti qabuudha.. Odeeffannoon kun adeemsa naannoo qorannichaa bu'aa qisaasa'ina paapaayaa sassaabbii boodaa irratti dhiibbaa uumu hordofuuf kan oolu ta'a. Kanaafuu, deebii gaaffileedhaaf kennitan gatii guddaa kan qabuu fi xiinxala qorannoo kanaa qofaaf akka ooluuf iccitii guddaa ta'een kan qabamu ta'a. Qorannoo kana irratti hirmaachuuf yoo fudhatte, fedhii keetiin kan gootu ta'a, bu'aan maallaqaas hin jiru. Akkasumas gaaffii deebisuuf mijataa sitti hin dhaga'amne kamiifuu deebii kennuu diduu ykn guutummaatti qorannoo irraa of baasuu bilisa. Gaaffiin qorannoo kun gaaffilee deebisuuf yeroo keessan keessaa gara daqiiqaa 45 fudhata. Tumsa keessaniif dursinee galatoomaa.

Hubachiisa lakkaa'aa: Qorannoon kun, dhiibbaa kasaarri paapaayaan sassaabbii boodaa wabii nyaataa maatii oomishaa irratti qabu akka ta'e hubadhaa. Daataan barbaachisu sana ganda Bakale Girisaa fi Shubi Gemo irraa walitti qabamuu qaba.

Kallattii ----maaloo kallattii gaaffii fayyadamii yookaan lakkoofsa sana geengoo godhi yookaan lakkoofsaan barreessi

Expectations/Indicators as per the ToR	No	Gaafilee	Category	Code
The study area	1	Bakka jireenyaa deebii kennaa	Bakale Girisa	1
			Shubi Gemo	2
	2	Naannoo mana jireenyaa	Baadiyyaa	1
Socioeconomic background of the respondents	3	Saala deebii kennituu	Dhiira	1
			Dhalaa	2
	4	Guddina manaa (gatii lakkoofsaatiin barreessi) .		[]
	5	Umurii deebii kennituu (Gatii lakkoofsaatiin barreessi) .		[]
	6	Galii ji'aa mana keessaa (birriin) .		[]
	7	Haala gaa'ila deebii kennituu	kanhinfuune	1
			kanfuudhe	2
			kanwalhiikan	4
			Kan abbaan manaa irraa du'e	3
Hadha mana heeduu kan qabu			4	
Kan biroo (specify): _____			5	
8	Waggaa meeqa naannoo kana jiraatte (waggaa lakkoofsaan barreessi) .		[]	
9	Sadarkaa barnootaa deebii kennituu	Kan hindubifneef hin barreessine	1	

			Kan dubisuuf barreesuu garuu b/nota iddilee kan hin qabne	2
			Daree 1 – 4	3
			Daree 5 – 8	4
			Daree 9 – 12	5
			Diploma/Levels	6
			BSc/MSc	7
			Above BSC/MSc	8
(b)The handling practices by the house holds	10	Kamtu yeroo baay'ee sassaabii paapayyaa irratti hirmaata?	dhiira	1
			dhalaa	2
	11	Paapayyaa otto hin haguugin dura adda baaftuu?	eeyyee	1
			lakki	2
	12	Mala sasaabii biro(kan naannoo biraa madaqsuu) shaakaluun qisaasa'insaa ni hir'isa jettee amantaa?	eeyyee	1
			lakki	2
	13	Bakka kuusaa fooyya'aa fayyadamtau?	eeyyee	1
			lakki	2
	14	Paapayaa nyaataaf ta'u tursiisuuf ni yaaltu?	eeyyee	1
			lakki	2
	15	Paapayaa omishuuf mala ammayaa ni fayadamtuu?	eeyyee	1
			lakki	2
	16	Geejiba ammayaa'aa ni fayadamtuu?	eeyyee	1
			lakki	2
	17	Paapayyaan akka bishaatuf ogummaa attamii fadamtu?	a.Xawulaa irra afuun	1
			b. eelee irra afuun	2
			c. putting on warm floor laafa oa'a irra	3

			afuun	
			d.jooniyaan ukaamsuun	4
			e. kan biro yoo jiraate	5
	18	Faayidaan paappayya inni ijoon maali	nyaataaf	1
			gurgurtaaf	2
			Nyaata looniif	3
			Kan biro	4
	19	Haala sassaabii fi qisaasa' inna sassaabii paappayyaa irraati leenjii argatanii?	eeyyee	1
			lakki	2
b) The amount and values of post-harvest losses at different stages	20	Yoo deebiin kee 'eeyyee' ta'e haaangamiif akka ta'e guddaa irra xiqqaati (lakkooftaan kaa'ii)		[]
	21	Qonnaan bulaan haala sassaabii san shakalee?	eeyyee	1
			lakki	2
			Kan biroo	3
	22	Gurguruuf bittuu hangam eegdu? Sa'aatii/guyyaa		[]
23	Omisha paappayya irra qonnaan bulaan waagga kana galii hangam argata kan bara 2014 irraa?	Omisha pappayyaa kumtaalaan(lakkofsaan)	[]	
		Omisha pappayyaa qrshiin	[]	
	24	Omisha qisaasa'e rakkoo sassaabii irra kan ka'e?	Tilmaama Oomisha pappayyaa qisaasa'ee kuntaalaan ([]

			lakkoofsaan)	
			Tilmaama Oomisha pappayyaa qisaasa'ee qarshiin (lakkoofsaan)	[]
	25	Qisaasa'inna pappayyaa perceentaan yeroo gara gabaa deemu	Ooyiruu iraa gara kuusaa yeroo deemu:	[]
			hanqina waan ittiin haqina waan iittin huuganiin	[]
			Hanqina kuusaan:	[]
			Ooyiruu irratti yeroo bituu eegan?	[]
	26	Pappayyaa gara gabaa geesuuf maaliin haguugdu?	feestaalaan	1
			Saanduuqa mukaan	2
			kaartonaan	3
			zambiliin	4
	27	Ooyiruu irraa hanga gabaaatti hangam deemsisa? ykn sa'aatiin	Kilometraan	[]
	28	Oomisha keesan attamiin gurgurtu?	Kallattiin wara nyaatuuf	1
			Daldalaa walii galaaf	2
			Warra qoqqoodee gurguruuf	3
			(kan biro ibsi)-----	4
	29	akka yaaddutti oomisha keetiif gatii sirriin argadhe jettaa ?	Eeyyee	1
			Lakki	2
	30	Yoo deebiin kee lakkii ta'e sababiin isaa maali?(Fiaadhu deebisi)	Qindoomini gaaabaa dadhabaa ta'uu isaa	1
			Hanqina gabaan bakka sirii ta'uu dhabuu	2

			loogii qindeessaa qonnaan bulaa giduun jiruun	3
			Qisaasa'uu Oomishaa irraa kan ka'e	4
			Kan biro (ibsi): _____	5
The constraints of papaya postharvest losses.	31	Hanqinni meshaale oomisha pappayyaa irratti dhiibbaa qabaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	32	Paappayyaan hangam ilbisootaaf dhiibeen hubama?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	33	Hanqinii bakka kuusaa sirrii hangam pappayyaa irratti dhiibaa qabaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	34	Hanqinii kuusaa dilallaa pappayyaa irratti hangam dhiibaa qabaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
35	Aduu pappayyaa irratti dhiibaa	Baayyee xiqoo	1	

		hangamii abaa?	xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	36	Bittuu pappayyaa eeguun hangam miidhaa abaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	37	Pappayyaa yeroon sassaabuu dhiisuun hangam miidha qabaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	38	Raakkoon bifaaf bocaan adda baasuu dhiisuu hangam pappayyaa miidha?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	39	Hanqinni meeshaalee sassaabii hangam paappayyaa miidha?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	40	Hanqqinni warshaa paappayyaa	Baayyee xiqoo	1

		nyaataaf oolchu dhihootii dhibuun hangami miidhaa qaba?	xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	41	Fageenyi ooyiruuf gabaa giduu jiru hangam paappayyaa irratti dhiibbaa qabaa?	Baayyee xiqoo	1
			xiqqoo	2
			Giddugaleesa	3
			Olaannaa	4
			Baay'ee olaanaa	5
	42	Waggaatti qisaasa'ina hangamiitu si mudataa?	kilogiraamaan	[]
	43	Qisaasa'ina walii gala paappayyaa irratti ta'u tilmaami .	Yeroo geejibaa(kg)	[]
			Haala gaariin funaanu fi haguugduu sirrii fayyadamuu dhiisuun (kg)	[]
			Bakka kuusaa sirrii fayyadamuu dhiisuun (kg)	[]
			Bakka agarsiisaa sirrii dhabuu ____kg	[]
	44	Bara baranaa kana bakka kuusaatti meeshaalee kamiti fayyadamtu?	Saanduu mukaa dhiphaa	1
			saanduuqa mukaa bala ba'aa	2

Assessment of Food security status (Household Food Insecurity Access Scale (HFIAS) Measurement Tool).

lak	Gaaffii	yaaada deebii	Code
1	Turban arfan darbanitti abbaan manaa koo nyaata gaga hin qabu jetanii yaaddoftaniitu ?	0 = lakki (gaaffii 2ffaatti darbi) 1=eeyee	. ____
1a	Kun yeroo attam attamii ta'aa?	1 = (al tokko ykn lamma torbban arfan darbanitti) 2 = altokko tokko (sadii hanga kudhanii turban arfan darbanitti) 3 = yeroo mara (al kudhanii ol turban arfan darbanitti)	. ____
2	Turban arfan darbanitti ati ykn maatiin kee gosa nyaata nyaachuu feetan dhabdaniituu hanqinni qabeenyaa(resource) isin mudatte jiraa irraaa kan ka'ee?	0 =lakki (darbbi gaaffii 3ffaati) 1=eeyyee	. ____
2a	Kun hangam hangamiin uumama?	1 = darbee darbee (al tokko ykn lama torban arfan darbanitti) 2 = al tokko tokko (al sadii hanga kudhanii torbban arfan darbanitti) 3 = yeroo mara (al kudhanii ol torbban arfan darbanitti)	. ____
3	Turban arfan darbanitti atti ykn maatiin kee nyaata gosa adda addaa nyaachuuf hanqinna qabeenyaan daangeffamtaniitu?	0 = lakki (gaffii 4ffaatti darbi) 1 = eeyyee	. ____
3a	Kun hangam hangamitti sin mudataa?	1 = darbee darbee (torbanitti ykn torban	. ____

		<p>lammati torbban arfan darbanitti)</p> <p>2 = al tokko tokko (sadii hanga kudhanii torban arfan darbanitti)</p> <p>3 = yeroo mara (al kudhanii ol torbban arfan darbanitti)</p>	
4	Torbban arfan darbanitti ati ykn maatiin kee hanqinna qabeenyaa irraa kan ka'e nyaachuu otto hinbarbaadi nyaani nyaattan jira kan feetan bitachuuf maallaqa dhabuu irraa kan ka'e ?	<p>0 = lakki (gaaffii 5ffatti darbi)</p> <p>1 = eeyyee</p>	. ____
4a	kun hangam hangamitti sin mudataa?	<p>1 = darbee darbee (torbanitti ykn torban lammati torbban arfan darbanitti)</p> <p>2 = al tokko tokko (sadii hanga kudhanii torbban arfan darbanitti)</p> <p>3 = yeroo mara (al kudhanii ol torbban arfan darbanitti)</p>	. ____
5	Torban arfan darbanitti ati ykn maatiin kee hanqina nyaataa irra kan ka'e hanga nyaachuu qabdaniin gadi nyaattaniituu?	<p>0 = lakki (gaaffii 6tti darbi)</p> <p>1 = eeyyee</p>	____
5a	kun hangam hangamitti sin mudataa?	<p>1 = darbee darbee (torbanitti ykn torban lammati torbban arfan darbanitti)</p>	. ____
6	Torban arfan darbanitti atti ykn maatiin kee dhiyaana nyaachuu qabdaniin gadi baay'ee xiqqoo nyaataniitu hanqina nyaataa irraa kan ka'e?	<p>2 = al tokko tokko (sadii hanga kudhanii torban arfan darbanitti)</p>	. ____

6a	Kun hangam hangamitti sin mudataa?	3 = yeroo mara (al kudhanii ol torbbaan arfan darbanitti)	. ___
7	Torban arfan darbanitti otto homaa hin nyaatin dabarsitniituu waan nyaattan tokkolee dhabuu irraa kan ka'e ?	1 = darbee darbee (torbanitti ykn torban lammati torbbaan arfan darbanitti)	. ___
7a	kun hangam hangamitti sin mudataa?	2 = al tokko tokko (sadii hanga kudhanii torban arfan darbanitti)	. ___
8	Torban arfan darbanitti ati ykn maatiin kee waan nyaatamu dhabuu irraa kan ka'ee hagabuu bultaniituu bela'aa ?	0 = No (skip to Q9) 1 = Yes	. ___
8a	kun hangam hangamitti sin mudataa?	1 = darbee darbee (torbanitti ykn torban lammati torban arfan darbanitti) 2 = al tokko tokko (sadii hanga kudhanii torban arfan darbanitti) 3 = yeroo mara (al kudhanii ol torbbaan arfan darbanitti)	. ___
9	Torban arfan darbanitti ati ykn maatiin kee waan nyaatamu dhabuu irraa kan ka'ee hagabuu ooltaniitu bultaniituu bela'aa ?	0 = lakki (gaaffiin dhumate) 1 = eeyyee /	. ___
9a	kun hangam hangamitti sin mudataa?	1 = darbee darbee (torbanitti ykn torban lammati torbbaan arfan darbanitti) 2 = al tokko tokko (sadii hanga kudhanii torbbaan arfan darbanitti) 3 = yeroo mara (al kudhanii ol torbbaan arfan darbanitti)	. ___

DABALATA 2: QAJEELFAMA AF-AF-AFIINSA ODEEFFANNOO IRRATTI

Bakka gaaffii fi deebii -----

Saalaa -----

Sadarkaa barnootaa: Dubbisuu fi barreessuu hin danda'u=1, Dubbisuu, garuu barnoota idilee hin qabu=2, Kutaa 1 – 4 =3, Kutaa 5 – 8=4, Kutaa 9 – 12=5, Dippiloomaa/Sadarkaa =6, BSc/MSc BSc/MSc =7, BSC/MSc=8 ol

Kabajamaa deebii kennituu,

Kaayyoon qorannoo kanaa daataa aanaa Dugda, Bakale Girisa fi Shubi Gemo walitti qabuudha.. Odeeffannoon kun adeemsa naannoo qorannichaa bu'aa qisaasa'ina paapaayaa sassaabbii boodaa irratti dhiibbaa uumu hordofuuf kan oolu ta'a. Kanaafuu, deebii gaaffileedhaaf kennitan gatii guddaa kan qabuu fi xiinxala qorannoo kanaa qofaaf akka ooluuf iccitii guddaa ta'een kan qabamu ta'a. Qorannoo kana irratti hirmaachuuf yoo fudhatte, fedhii keetiin kan gootu ta'a, bu'aan maallaqaas hin jiru. Akkasumas gaaffii deebisuuf mijataa sitti hin dhaga'amne kamiifuu deebii kennuu diduu ykn guutummaatti qorannoo irraa of baasuu bilisa. Gaaffiin qorannoo kun gaaffilee deebisuuf yeroo keessan keessaa gara daqiiqaa 45 fudhata. Tumsa keessaniif dursinee galatoomaa.

1. Dhidhaalee fi carraan gabaa Paappaayaa maali?
2. Sababoonni rakkoon sassaabbii papaayaa booda maal fa'a?
3. Kasaaraa sassaabbii booda Paappaayaan dhufu irratti ilaalcha waliigalaa akkamii qabdu?
4. Gatii oomisha keessanii yeroo murteessitan maal ilaalta?
5. Kasaaraa paapaayaa sassaabbii boodaa xiqqeessuuf maal gorsitu?

Tumsa keessaniif dursinee galatoomaa

DABALATA 3: QAJEELFA MARI GAREE ODEEFFANNOO IRRATTI

Bakka gaaffii fi deebii -----

Saalaa -----

Sadarkaa barnootaa: Dubbisuu fi barreessuu hin danda'u=1, Dubbisuu, garuu barnoota idilee hin qabu=2, Kutaa 1 – 4 =3, Kutaa 5 – 8=4, Kutaa 9 – 12=5, Dippiloomaa/Sadarkaa =6, BSc/MSc BSc/MSc =7, BSC/MSc=8 ol

Kabajamaa deebii kennituu,

Kaayyoon qorannoo kanaa daataa aanaa Dugda, Bakale Girisa fi Shubi Gemo walitti qabuudha.. Odeeffannoon kun adeemsa naannoo qorannichaa bu'aa qisaasa'ina paapaayaa sassaabbii boodaa irratti dhiibbaa uumu hordofuuf kan oolu ta'a. Kanaafuu, deebii gaaffileedhaaf kennitan gatii guddaa kan qabuu fi xiinxala qorannoo kanaa qofaaf akka ooluuf iccitii guddaa ta'een kan qabamu ta'a. Qorannoo kana irratti hirmaachuuf yoo fudhatte, fedhii keetiin kan gootu ta'a, bu'aan maallaqaas hin jiru. Akkasumas gaaffii deebisuuf mijataa sitti hin dhaga'amne kamiifuu deebii kennuu diduu ykn guutummaatti qorannoo irraa of baasuu bilisa. Gaaffiin qorannoo kun gaaffilee deebisuuf yeroo keessan keessaa gara daqiiqaa 45 fudhata. Tumsa keessaniif dursinee galatoomaa.

1. Bishaan paapayaa keessa jiru maaliif waan hiratu sitti fakkaata?
2. Paapayaan nyaataaf ta'u yeroo dheeraaf akka taa'u gochuuf ogummaa akkamii fayadamuu qabna ?
3. Yeroo sassabbii qisaasa'ina papaayya hambisuuf mala ammayyaa attamii shaakaltani?
4. Qisaasa'ina papaayyaa yeroo sassaabii hambisuun attamiin danda'ama jettee yaada?