

**ASSESSMENT OF POSTHARVEST LOSSES ALONG THE FRESH  
TOMATO VALUE CHAIN IN THE UPPER EAST REGION OF GHANA**

**BY**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON,  
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**DECLARATION**

I, Gavinus Anaba, hereby declare that with the exception of references to other people’s work, which have been duly acknowledged, the work contained in this thesis **“ASSESSMENT OF POSTHARVEST LOSSES LONG THE FRESH TOMATO VALUE CHAIN IN THE UPPER EAST REGION OF GHANA”** is the result of the research carried out by me under supervision in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon from August 2017 to July 2018. This thesis has not been presented either in whole or in part for any other degree in this university or elsewhere.

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## **DEDICATION**

This thesis is dedicated foremost to God Almighty for His mercies, favours and grace bestowed on me to carry out this piece of work.

The next dedication goes to my mother, Mrs. Rita Abdulai, father, Mr. Peter Anaba of blessed memory, sister, Evelyn Anaba and all my family members and friends whose selfless love and sacrifices have made me what I am today.

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## ABSTRACT

The study assesses the postharvest losses along the fresh tomato value chain in the Upper East Region of Ghana. Simple random sampling technique was used to select three districts from the Upper East Region and a total of 80 farmers, 30 wholesalers, and 80 retailers were interviewed using structured questionnaires. Descriptive statistics was used to estimate outcome of losses by each actor along the tomato value chain. Kendall's Coefficient of Concordance was employed to rank the major constraints that each group of actors faced along the tomato value chain. The study also employed the Tobit regression model to identify the factors influencing the proportion of postharvest loss of fresh tomato. On average, the total farm size cultivated by farmers in the Upper East Region was 13 ha. The study showed that output obtained at farmer level was 4.5 Mt/ha in the major season and 6.2 Mt/ha in the minor season, out of which 10% and 13% were lost, respectively. Wholesalers and retailers recorded a postharvest loss of 26% and 20% of their total purchases of fresh tomatoes respectively. Lack of ready market was ranked first by farmers and wholesalers as their major constraint. Retailers ranked lack of storage facilities as a major constraint. The study revealed various factors that significantly influenced postharvest losses of fresh tomatoes among actors (farmers, wholesalers, retailers) along the value chain. Female actors were found to be more prone to high levels of postharvest losses than their male counterparts. Wholesalers had a significant positive effect on losses of fresh tomatoes. With respect to location, it was observed that Bolgatanga Municipal, Kassena Nankana Municipal had significant negative effect on postharvest loss. It was also observed that Postharvest management training had a significant negative effect on postharvest loss of fresh tomatoes. The study recommended that Ministry of Food and Agriculture (MoFA) through its extension staff should intensify the provision of training of farmers and traders especially females on postharvest handling and management to reduce losses. The Municipal and District Assemblies and private sector investors in the study area should improve the road infrastructure linking farms to market centres to transport losses and provide suitable storage facilities and physical market structures to traders especially in the Bolgatanga Municipal and Kassena Nankana Municipal. Also, through formation of FBO's and Tomato Transport Traders Associations (TTTA's), farmers and traders can set up processing factories to process tomatoes into other products.

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## ACRONYMS

CSIR	Council for Scientific and Industrial Research
FAO	Food and Agriculture Organization
FBO	Farmer Based Organization
FSC	Food Supply Chain
GHS	Ghanaian Cedi
GIHOC	Ghana Industrial Holding Corporation
GSS	Ghana Statistical Service
GSSP	Ghana Strategy Support Programme
IFPRI	International Food Policy Research Institute
MoFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organization
PHL	Post-Harvest Loss
SRID	Statistics, Research, and Information Directorate
TTTA	Tomato Transport Traders Association
MMDAs	Metropolitan, Municipal & District Assemblies
PPRSD	Plant Protection and Regulatory Services Directorate
WL	Weight Loss

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the Study

Crop losses should be given prime concern so as to improve food security, increase farmer's income, and stop hunger especially in developing countries (FAO, 2010). This is as a result of the unfavourable effect crop losses has on the environment, economic development, and food quality. Globally, about 1.3 billion tonnes of food is lost every year. Water, land, managerial expertise, labour, and other inputs that could have been directed towards productive areas are all wasted because of crop losses (FAO, 2011). About 40% to 50% of vegetable crops produced are lost before they are consumed and this is caused by bruises, pest and disease attack, and rot (Kitinoja, 2002, Ray & Ravi, 2005).

Furthermore, 30% to 40% crop losses are normally recorded after harvest and this is caused by factors such as mechanical injuries, pest and disease attack, and rot due to microbial infection or excess heat (Meena *et al.*, 2009). Postharvest losses have therefore been considered to be one of the factors that influence food shortages in developing countries.

Postharvest loss has been a critical issue on food availability in Ghana (Babalola *et al.*, 2010). As more agricultural produce are being transported from producing areas to non-producing locations and stored for longer periods of time, postharvest loss prevention technology methods are needed (Oyekanmi, 2007). In spite of development made to increase food production globally, access to adequate food becomes a problem for the population in the third world. Food loss is one of the reasons that occurs in the postharvest and marketing structure. Reducing loss as well

as increasing food production can improve food supply.

Tomato (*Solanum lycopersicum*), which belongs to the family Solanaceae is extensively grown and consumed staple vegetable fruit in the world, and it is a good source of nutrients such as minerals and vitamins in food consumed by humans (Nasrin *et al.*, 2008, & Babalola *et al.*, 2010). According to Van der Hoeven *et al.* (2002), Solanaceae is the third main economically crop family after cereals and legumes and it is the most worthy in terms of vegetable crops and agricultural utility. FAO (1995) reported that tomato is a relevant cash crop in many countries it is ranked third after potato and sweet potato. The tomato fruit is an important "protective food" since it is classified as a vegetable in trade (Alam *et al.*, 2007). Tomatoes form a very significant part of human food especially in areas where it is eaten (Beecher, 1998). Tomato forms part of food consumed in Ghana and it is an important ingredient in Ghanaian dishes (Tambo & Gbemu, 2010; Osei *et al.*, 2014).

Tomato production over the past few decades was envisaged as one of the key drivers of both rural and urban areas in Ghana through job creation and poverty alleviation (Asare-Bediako *et al.*, 2007; Sugri *et al.*, 2013). Following Sugri *et al.* (2013), tomato production in the Upper East Region is noted as an antidote for the widespread unemployment and poverty for the majority of households. In general, food loss does not only reduce the quantity of food produced, but reduces availability, the saleability of wholesome food as well as the accessibility of the food and the effect of these losses impacts greatly on farm income at different locations. Insight of this, Sablani *et al.* (2006) indicated that food availability increases when there has been a reduction in fresh produce and significant in sustaining agriculture.

Food loss occurs along the value chain and it is caused by bad infrastructure and poor management. Food losses constitute both qualitative loss and quantitative loss (Egyir *et al.*, 2008). Total post-harvest losses occur when produce is being distributed from the farm to the market centres (Aulakh *et al.*, 2013). Qualitative loss constitute losses in the nutrient make-up, acceptability by consumers, and the edibility of a fresh produce forms the qualitative loss. These losses are normally experienced in developed countries (Kader, 2002). Quantitative loss is a loss in terms of reduction in volume and weight of a product. Quantitative loss has been a major problem in developing countries (Kitinoja *et al.*, 2011). FAO (2013) reported that globally, loss in food quantity and unwanted food in developed countries are experienced more in downstream stages of the food chain, but lower in developing countries where more food is lost and wasted in upstream stages.

Producers face problems with the supply of vegetable fruits such as tomato to market centres due to the perishability nature of these produce. Longer distances between the farm gate and the assembling markets and the postharvest technology management such as grading, packaging, storage, and transportation result in a larger proportion of fruit being lost at the various phases of the postharvest chain. Alidu *et al.* (2016) in their study reported that lack of technical support, poor market structures, poor handling of produce by farmers and other actors, bad road infrastructure, market intermediaries and consumers causes postharvest losses of vegetables.

Postharvest activities such as postharvest handling and storage practices affect the nutritional value of fresh tomatoes (Addo *et al.*, 2015). The growth cycle of tomatoes ends at the harvesting stage but begins with a chain of important activities that make sure that consumers acquire vegetables in the preferred state.

Maturation, ripening, and senescence are three clear-cut phases in the life span of vegetables and fruits that have been differentiated by postharvest physiologist. Maturation denotes fruit being ready for harvest (Arah *et al.*, 2015). Matured tomatoes are usually harvested when the plant is fresh and has high moisture content. Tomato farmers and traders in the tropics are confronted with special problems in handling, transportation, and marketing due to the perishability nature of the produce precisely. The storage life of fresh vegetables such as tomatoes depends on the good harvesting practices such harvesting quality ones (Hurst, 2010, & Kitinoja & Gorny, 2009). Fresh tomatoes easily damages and have short storage life if harvested in a fully ripened state. They reported that about 20% to 50% postharvest losses in developing countries are caused by losses on the farm, during transportation, and at sales points. Kitinoja and Kasmire (2002) reported that in developed countries, about 5% to 25% of fruits and vegetables are lost due to postharvest and about 20-50% in developing countries depending on the produce. About 30-40% postharvest loss in vegetables was attributed to inadequate postharvest handling, lack of infrastructure, lack of processing factories, lack of ready market and unavailable storage facilities (Kulanthai *et al.*, 2006).

In Ghana, tomato is considered as one of the essential vegetables in terms of cultivation, marketing, and utilization (Nkansah *et al.*, 2003). According Aryeetey (2006), 25,000 tonnes of tomato paste is consumed in Ghana at a cost of \$25 million, eventually making Ghana the second largest importer of tomato paste.

## **1.2 Problem Statement of the Study**

In the agricultural sector of Ghana, lack of ready market, poor pricing, production seasonality, the dependence on rainfed agriculture, putrescible nature of vegetable,

and unavailable processing factories to process vegetables into other forms are some problems faced by farmers (Robinson & Kolavali, 2010). Therefore, decreasing food losses reduces food importation, increases food availability, and improves the welfare of tomato producers (Adesina, 2012).

Little effort has been done to minimize post-harvest losses of vegetables such as tomato while many resources have been channelled into the planting of vegetables, irrigation, fertilizer application and crop protection measures (Ayandiji *et al.*, 2011). Therefore, increase in food availability, reduction in food importation, and the improvement of the welfare of the farmer is as a result of reduction in post-harvest food losses (Adepoju, 2014).

Tomato farmers, wholesalers, and retailers in the Upper East Region face some challenges in handling their produce which increases both qualitative and quantitative losses. Most of the challenges they face include lack of ready market, unavailable storage facilities, limited access to credit, lack of technical support, pest and disease attack and unreliable transport system. Beside the constraints there is also an issue of wholesalers travelling to Burkina Faso to buy fresh tomatoes to sell to retailers and consumers in the Upper East Region. Estimating the quantity and value of post-harvest losses of tomato at farmer level has been the subject of many studies. Assessing the post-harvest losses along the tomato value chain has been neglected. In view of this, the study seeks to address the following questions.

1. What are the proportion of losses that exist at each stage of the tomato value chain in the Upper East Region?
2. What are the factors that influence the proportion of loss at each stage of the value chain in the Upper East Region?

3. What are the constraints facing the various actors along the value chain in the Upper East Region?

### **1.3 Objectives of the Study**

The main objective of the study is to assess the postharvest losses along the fresh tomato value chain in the Upper East Region of Ghana. The specific objectives are:

1. To estimate the proportion of loss at each stage of the tomato value chain in the Upper East Region
2. To determine the factors that influence the proportion of loss at each stage of the value chain in the study area
3. To identify the major constraints that actors face at each level of the tomato value chain in the study area

### **1.4 Justification of the Study**

Tomatoes are short duration crops and highly perishable at the state leading to losses throughout the peak harvesting period. Due to the disparity between supply and demand during off season and economic consideration, there is the need avoid these losses and (Karim & Hawlader, 2005). In spite of this, using good food conservation methods to preserve tomatoes for longer periods is very important since there is a need to improve the storage life of tomatoes either in fresh or processed form. Estimation of postharvest loss results in the identification of potential postharvest interventions that could help address key contributors to losses along the value chain and subsequently help reduce losses.

The study will therefore contribute to knowledge by filling the existing gap in literature regarding the key contributors and factors that influence postharvest loss along the fresh tomato value chain. This study will help farmers, wholesalers, and retailers in the region to obtain knowledge on how to improve on their existing postharvest practices to help reduce postharvest losses of tomatoes in the value chain.

In the light of this, the study is relevant pertaining to the fact that it will provide an insight into how much tomato the study area loses as a result of post-harvest losses along the value chain so that useful resources could be allocated to help the actors in the value chain curb post-harvest losses of tomato and to enhance a profitable and efficient production system. Also, the study will be beneficial to relevant stakeholders towards designing research based policy framework and strategy for reduction of postharvest losses of tomatoes.

### **1.5 Organisation of the study**

The study is organized into five chapters. Following chapter one which provides the background to the study including introduction, problem statement, objectives of the study and justification of the study, chapter two provides review of literature relevant to the study. Chapter three presents the methodology of the study. The methodology covers areas such as conceptual framework, the method of data analysis, data collection, and the scope and limitation of the study are discussed in detail. Chapter four presents the results and discussions of the study. The study is concluded in chapter five, which provides conclusions and recommendations of the study.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter presents a review of relevant literature on postharvest losses of fresh tomatoes. The chapter is organized in sections as follows: Section 2.2 reviews the characteristics of tomato; Section 2.3 presents an overview of the basic concepts of postharvest loss; section 2.4 reviews the pre-harvest and postharvest activities contributing to postharvest loss; section 2.5 reviews marketing of tomato; section 2.6 reviews factors affecting postharvest losses and section 2.7 finally reviews the estimation of postharvest losses.

#### 2.2 Characteristics of Tomato

Tomatoes was brought to Europe by Columbus and other explorers by the late 1490s but originated in South America (Orzolek *et al.*,2006). According to van Dam *et al.*, (2005), tomatoes (*Lycopersicon esculentum* Mill) belong to the Solanaceae family and species like pepper, eggplant, tobacco, and potato belong to this type of family. Fruits or leaves of species of this family contain toxic alkaloids. According to Knapp *et al.*(2004), Solanaceae, Cestroideae, and Solaniodeae (to which Solanum belongs) are subfamilies and the huge Solanaceae family is made up of 96 genera and over 2800 species that are distributed within the subfamilies. In 1960, commercial tomato production began and consumers eventually accepted tomatoes.

Nicola *et al.*, (2009) indicated that tomato is a short duration crop and requires relatively cool, and dry climate for good and yield. Ghana imports tomato at the minimum of six months since tomato demand is more than supply (Horna *et*

*al.*,2007)..Wenchi and Akumadan districts in the Brong Ahafo and Ashanti regions experience high tomato production (Amartey, 2013). Tomato is classified as the vegetable with the greatest number of varieties sold worldwide (Sacco, 2008). The availability of a wide range of varieties thus gives farmers the opportunity to choose the desired varieties for planting. MOFA (2008) recommended a number of tomato varieties suitable for cultivation in Ghana, and these varieties include Roma VF, Pectomech, Pectomech VF, Tropimech, Rio Grande, Cac J, Wosowoso and Laurano 70.ave been releasing new varieties to enhance the productivity of tomato farmers.

### **2.3 Basic Concepts of Postharvest Loss of Food**

Postharvest losses come about when inappropriate harvesting method is practiced, and how facilities occurs during transportation, storage, and even market centres. Postharvest losses are basically losses that occur during harvesting and when fresh tomatoes is being transported from the source of production to the sales point. Postharvest loss is regarded as the same as waste in the food supply chain (Parfitt *et al.*, 2010). Postharvest losses have further been broadly categorized into two groups. Qualitative loss refers to loss in the nutritional and caloric value, loss of acceptability by consumers and loss edibility of the commodity. Quantitative loss also refers to loss of actual commodity causing a reduction in the amount available (Egyir *et al.*, 2008; Aulakh *et al.*, 2013).

Food loss is categorize into quantitative and qualitative loss. Qualitative loss measures reduction in nutritive level and unusual changes in appearance of food. Quantitative only looks at the reduction in volume (Buzby & Hyman, 2012). Consumable foods that are loss because of deliberate and undeliberate actions of human is described as food waste.

## **2.4 Pre-Harvest and Postharvest Activities Contributing to Tomato Loss**

### **2.4.1 Harvesting**

The growth cycle of tomatoes ends at the harvesting stage but begins with a chain of important activities that ensure that consumers acquire vegetables in the preferred state. According to Orzolek *et al.*(2006), harvesting of tomatoes is labour intensive and should be harvested in matured green stage to avoid fruits from becoming overripe during transportation to long distanced market centres. They recommended that tomatoes should be harvested if they are vine-ripened and only if there is ready market. Normally, farmers harvest fresh tomatoes by using their hands and it varies among farmers. During harvesting, plastic buckets with smooth edges are used since fresh tomato fruits are highly perishable and can be easily crushed (Kitinoja, 2008).

During harvesting, high quality fresh tomatoes should be picked since tomatoes is highly susceptible to bruising. Hence good harvesting practices must be adopted (Hurst, 2010). He recommended that farmers during harvesting should not drop fresh tomatoes into picking containers at a height not more than 6 inches since it causes inter bruising.

### **2.4.2 Pesticide application**

FAO (1988) notes how insecticides must be applied. From two weeks before (prior to harvesting) only pyrethroid insecticides that degrade easily should be used to spray vegetables on the field. They therefore suggest the proper and correct use of insecticides such as Diazinon, Dimethoate and Sumithium in the organophosphate group and Karate in the pyrethroid group should be done. Haleegoah *et al.* (2006) also suggest that since the presence of pesticides and other chemicals on produce reduces

quality, spraying should be at correct time. Some insecticides have short and long persistent effects on crops when applied (Chichester, 1965). Persistent ones do not degrade easily but the less persistent ones are mostly recommended for use on vegetables and other food crops because they degrade relatively quickly (PPRSD-MoFA, 2000).

#### **2.4.3 Variety of tomato grown**

Roma, Pectomech, Tropimech, Rio, Grande, Cac J, Wosowoso, Laurano 70 are some varieties of tomato grown in Ghana (MoFA, 2008). Robinson and Kolavali (2010a) in their research reported that consumers prefer Pectomech variety over the local varieties since since it has a premium price over the local ones and suitable for processing. The varieties mostly grown in Veve, a noteworthy community which is found in the Upper East Region of Ghana are Roma, Tropimech, Pectomech (Clottey *et al.*, 2009).

According to Adu-Dapaah & Oppong-Konadu (2002) the variety of tomato is a major contributing factor for a lot of losses to tomato farmers. Their study revealed that most of the varieties were of foreign or unknown origin and therefore the need for the variety to be evaluated for adaption to the local environment before farmers adopt them. Furthermore, the use of such untested tomato variety often place genetic and environmental limitations on yield. This is due to poor adaption to the local environment or stress as high temperatures, drought, disease and pest. Cultivar types according to Nyamah *et al.* (2014) can also influence the postharvest performance of tomato fruits.

#### **2.4.4 Concept of sorting and grading**

Sorting is carried out the application of pesticides to get rid with damaged fresh produce to prevent the tendency of contamination (Kintinoja & Kader, 2005). Postharvest losses mostly occur during transportation, handling, storage, and processing and these inevitably contribute to secondary causes of losses. The losses come about because rough handling of produce during sorting and grading while preparing the fresh fruits for the market increases bruising and mechanical damage. Inappropriate transportation system also increases the crops susceptibility to decay and microbial growth (Barbosa-Canovas,2003). Bad postharvest handling activities during harvesting results to bruises and microbial infection of fresh tomato fruits especially when fruits come into contact with contaminated soil. Wasting time in harvesting and grading leads to heat build-up on farms which eventually causes faster senescence (Sudheer & Indira, 2007).

#### **2.4.5 Concept of packaging**

Harvested fresh tomatoes have to be sent to a packing house for various unit operations like cleaning, grading post-grading, treatment and packing for transport and marketing. Such a system reduces postharvest losses considerably. According to Sudheer and Indira (2007), almost all vegetable crops require special preparation before they are packed. All such operations such as cleaning, grading, waxing and pre-cooling of fruits should be performed in a parking house before packaging.

Packaging of fresh tomato fruits have great significance in reducing wastage. Factors driving postharvest losses such as mechanical damage, undesirable physiological changes and pathological deterioration can be avoided when vegetables like tomatoes are well packaged during storage, transportation and marketing. Quality fruits and

vegetable can be conserved for a longer period through good packaging (Sudheer & Indira, 2007). According to Issahaku (2012), fresh tomatoes that were packaged in wooden boxes recorded high losses. In his submission, about fourth-fifths of the sample size incurred losses due to low quality of tomatoes and inappropriate handling activities such as loading of cartons and head pans on each other and spillage of wooden boxes.

#### **2.4.6 Transportation**

Transportation is all forms of means used to convey foods from the point of production to the ultimate point of consumption. Poor handling and transportation lead to mechanical damage of fresh tomatoes due the perishability nature the tomato fruits. They estimated losses of tomatoes due to transportation that is from Bolgatanga to Accra to be about 20% (Bani *et al.*, 2006). Muhammed *et al.* (2012) reported that tomatoes should be transported in aerated trucks to avoid heat build-up and rainfall. A survey by Pala (2013) reported that when tomatoes are moved on bad roads in tropical areas tomatoes decompose faster than when they are moved on good roads in relative cold areas. An estimate of about 25% of postharvest loss was recorded at the relative cold zones. Bad nature of roads that causes vibration in vehicles, improper packaging materials, poor harvesting practices leading to mechanical damage, and poor handling enhance postharvest losses of tomatoes (Idah *et al.*, 2007).

#### **2.4.7 Storage of fresh tomatoes**

Moisture retentive films are used to reduce moisture content in vegetable crops which is more advantageous to consumers. Packaged produce tend to have high storage life than non-packaged ones (Sudheer & Indira, 2007). They reported that tomatoes wrapped with proof cellulose film will have their weight loss reduced by 25%

compared to non-wrapped tomatoes with proof cellulose film. Storing fresh tomatoes without cold storage facilities in tropical and subtropical zones can be strenuous compared to areas with cold storage facilities, therefore tomatoes need to be sent to market centres quicker in the tropical zones than the cold zones (Adarkwa, 2011). According to Kitinoja and Gorny (2009), farms or retail markets in Ghana lack storage facilities and those farms with storage facilities rather lack aeration and cooling.

Ashby (2000) reported that the best condition to transport fresh green matured tomatoes is 13<sup>0</sup>C to 21<sup>0</sup>C temperature and 90% to 95% relative humidity. Green matured tomatoes to be stored for 16 – 24 weeks, tomatoes can only be stored at 10<sup>0</sup>C temperature and 80% optimum humidity (FAO, 2008). Ellis *et al.* (1988) reported that tomato farmers and traders face major postharvest problems and need ready market for their produce and a stabilized price per box since they store their produce on farm or wholesale or retail market centres.

#### **2.4.8 Market facilities**

Kader (2004) suggested that assembling points should be available by marketing cooperative organizations to tomato farmers so that their produce can be gathered at one particular point for easy transportation to market centres or sale points. He further reported that MMDAs and marketing cooperatives can be involved in setting up and improving sale centres not necessarily the private sector.

Vegetable crops should be transported to sale points when there is readily market available. Postharvest losses of vegetable fruits like tomatoes can be avoided by a well-organized market system to enable farmers, wholesalers, and retailers increase their incomes (Sudheer & Indira, 2007).

## 2.5 Marketing of Tomato in Ghana

In Ghana, tomatoes can be marketed through various channels/routes. Robinson & Kolavali (2010) reported that fresh tomatoes marketing channel refers to the various routes available in moving the tomatoes from the farmer to the final consumer. Along each marketing channel is a marketing chain which comprises of a series of intermediaries that carry out various activities. Marketing chain refers to various intermediaries/marketing agents (such as farmer, wholesalers, brokers and retailer) that usually undertake various activities in shifting the commodity to the final consumer. The marketing channels taken by farmers to market fresh tomatoes should be capable of delivering tomatoes to the consumers in the desired form and at an efficient cost, relative to other channels. According to Orzolek *et al.*(2006), tomato farmers have six different options to market their produce, namely pick-your-own operations, roadside stands, local retailers, cooperatives, wholesale markets, and processing firms. Additional profits can be attained on fresh or processed tomatoes when postharvest handling is carefully addressed.

Some of the intermediary activities include sorting, grading, packaging, and loading/unloading, transportation, storage and distribution (Yeboah, 2011).. Though tomato farmers have multiple markets, proximity and availability of market are the key determinants of a particular market chosen by a tomato farmer in Ghana. This dilemma in marketing fresh tomatoes in the country can be partly attributed to the perishability of the crop and the restrictions imposed by “market queens” in marketing tomatoes in the key tomatoes wholesale markets in the country as noted by (Robinson & Kolavali, 2010).

## 2.6 Empirical Studies on Factors Affecting Postharvest Losses

### Models results:

Ayandiji *et al.* (2011) reported that the use of van or pick-ups as a method or mode of transportation which gave the highest frequency may not necessarily enhance postharvest losses as compared to the used of motorcycle and the bicycle and in the case of head loads. This clearly suggests that a proper means of transport will reduce quantity losses to the barest minimum. The analysis showed that quantity loss of fresh fruit increased as distance from farm to market also increased. This was due to overcrowding and packing of the tomatoes for longer period of time. The number of days spent on the field or on the vine after maturity and the number of baskets of tomatoes harvested also played significant role in postharvest losses. The effects of the independent variables were significant at a 5% level of probability with a coefficient of determination of 0.95. The increase in the age of the tomatoes at harvest increases losses due to fruit ripening and softening as it ages and these are prone to mechanical damage and fermentation with age. As size of farm increases, quantity loss also increases as a result of poor handling and lack proper storage facility.

An exponential log regression analysis carried out by Aidoo *et al.* (2014), indicated that gender of farmer (female), farm size, days of storage were positively related to postharvest losses while variables such as farmer-based organization membership, household size and type of cultivar cultivated were negatively associated with postharvest losses. The F-Statistics was significant at 1% implying that all the regressors had a significant effect postharvest loss of tomato.

According to Amikuzuno *et al.* (2010), there is a certain possibility that seasonal effects on the production of commodities may affect not only the quantity and quality,

but also other fundamental variables of market performance, such as market infrastructure, arbitrage decisions, and levels of transaction costs, prices and trade flows between spatially connected markets. Another research with regression results showed that about 94.8% of variation in the quantity of tomatoes loss from harvesting to marketing stage was explain by specified variables.

Addo *et al.* (2015) indicated that postharvest losses in the Upper East Region was estimated to be 10.85% and this was recorded at harvest operations but least in all other operations down the value chain. He attributed these losses to delay harvesting and pest and disease attack. This is followed by the Ashanti and Greater Accra. He also reported that socio-economic characteristics such as gender, age, marital status, level of education, household size and experience in tomato production and handling influenced postharvest losses of tomatoes.

According to Alidu *et al.* (2016), experience, age of fruit at harvest, quantity harvested (crates), household size, educational background were found to be significant. From their results, all the explanatory variables have negative significant effect on postharvest loss except quantity harvested which tend to have a positive significant effect on loss. Their regression results shows that Prob. > F = 0.000 which means that the entire model is fit and the  $R^2 = 0.761$  meaning 76% of the variation in the dependent variable is explained by the explanatory variables.

## **2.7 Estimation of Postharvest Losses**

According to Kader (2004), postharvest losses of horticultural crops can be classified as quantitative and qualitative losses. In developing countries, reducing quantitative losses is prime concern while qualitative loss reduction is a priority for the developed

countries. He cited that assessing qualitative loss is more difficult than assessing quantitative losses.

Gangwar *et al.* (2007) used averages and percentages to estimate postharvest losses of kinnow (citrus fruit) at each stage of the supply chain. The nature of postharvest value chain for various commodities suggests that losses would be different for different commodity groups. It also implies that loss levels may be dependent on the length of the chain each commodity faces each period and the number of handlers before final consumer.

Quality of tomato fruit can be measured using parameters such as general appearance, weight loss, firmness, decay, pericarp thickness, dry matter, total soluble solids, and storage life (Nyamah *et al.*, 2014). They compared the general appearance of different cultivars of tomato (Pechtomech, Royal, Akoma, Cal J, and Power). Fruit General Appearance (GA) scored by overall quality was based on the fruit general acceptability to the consumer. It was measured subjectively on an 8-point hedonic scale where 0 = poor (extremely defective), 2 = fair (defective), 4 = good (moderately defective), 6 = very good (slightly defective), 7 = excellent (not defective). Weight loss (WL) is also a measure of both quantity and quality loss of fruits and this is expressed mathematically as

$$WL = \frac{FW - IW}{IW} \times 100 \quad (2.1)$$

Where

WL = Weight loss

FW = Final weight

IW = Initial weight

According to Egyir *et al.*(2008), there are no generally accepted method used for assessing postharvest losses of fresh produce but whatever assessment method used depends on the prevailing circumstance. They further stated that in assessing existing operation of marketing, a problem occurs if losses are evaluated accurately. Losses maybe large but figures to back these losses may not be available because:

- Unavailable records;
- Records, if accessible, do not cover a long enough period of time;
- The figures available are only estimates made by many observers;
- Records may not truly represent a continuing situation; for example, losses may have been calculated only when unusually high or low;
- Loss figures may be intentionally over- or understated for commercial or other reasons in order to gain benefits or to avoid embarrassment (Egyir *et al.*,2008).

Egyir *et al.*(2008) provided some simple steps to follow when estimating losses:

Step 1: Evaluate quantity of commodity (j) held ( $tq$ ) and lost ( $qi$ ) at each link in the chain specified by respondents. Commodity (j) *held* at the beginning of the link in a chain for the analysis is expressed on a per unit basis (eg 50 kg bag of pepper; 100 kg bag of cereal, average tubers of yam etc).

Step 2: Find mean quantity ( $TQ_{ij}$ ) held and lost (given  $n$  number of respondents) at each  $i$ th link in the chain per commodity (j).

Hence,

$$TQ_{ij} = \frac{\sum tq}{n} \quad (2.2)$$

$$TQ_{ij} = \frac{\sum q}{n} \quad (2.3)$$

Step 3: Calculate the ratio of mean quantity lost to initial mean quantity held at each link in the chain per commodity as loss ratio (QL)

Hence,

$$QL = \frac{Q_{ij}}{TQ_{ij}} \quad (2.4)$$

Step 4: Find average of the sum of loss ratios for all links in the value chain for each commodity evaluated and calculate *raw* percentage loss per commodity. Hence,

$$\%TQL = \frac{\sum \frac{Q_{ij}}{TQ_{ij}}}{N} \times 100 \quad (2.5)$$

Where

%TQL = percentage post-harvest loss per commodity along the chain

$Q_{ij}$  = mean quantity lost at each *i*th stage along the value chain of the *j*th commodity

TQ = mean total quantity at start of distribution of *j*th commodity

N = total number of links along the chain

## **CHAPTER THREE**

### **METHODOLOGY**

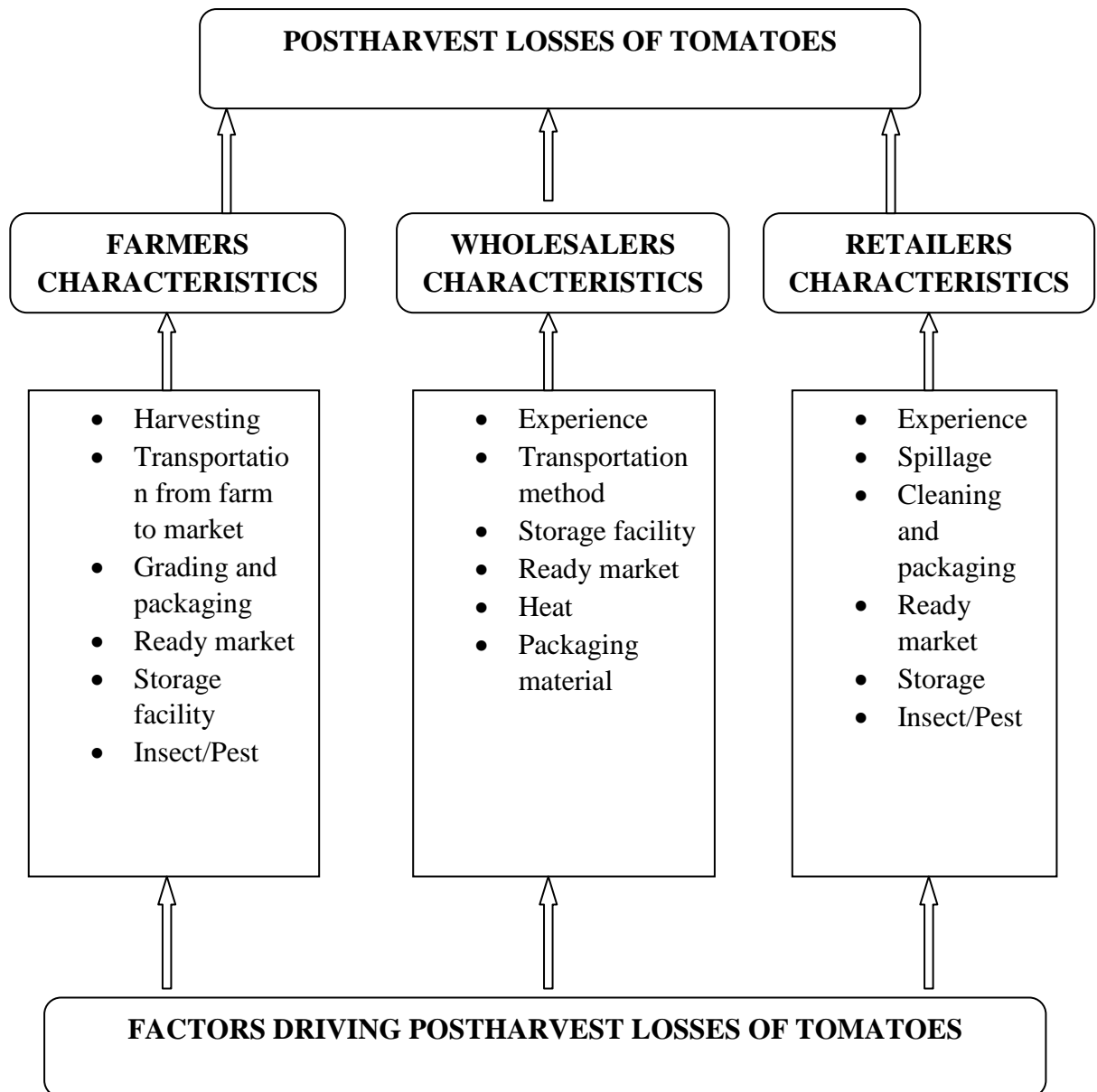
#### **3.1 Introduction**

This chapter focuses on the methodology of the study. The chapter is organized in sections as follows: Section 3.2 and 3.3 present the conceptual framework and the method of data analysis respectively; section 3.4 presents method of data collection; section 3.5 presents the scope and limitation of study.

#### **3.2 Conceptual framework of the study**

The conceptual framework of the study, which describes factors driving losses along the tomato value chain (Figure 3.1). The framework conceptualized that there are only three actors along the value chain. Postharvest losses occur at each stage of the value chain. Factors driving postharvest losses at the farmer level included experience, transportation method, storage facility, ready market, location of the farm, and insect/pest. Packaging material, heat, ready market, transportation method, experience are some of the factors that influence postharvest loss at the wholesale level. Also, location of the market centres and infrastructure available, ready market, storage are some of the factors that influence loss at the retail level.

However, lack of ready market and lack of storage facilities are the factors which are common among the actors along the value chain. Primary factors that influence postharvest losses among actors along the chain include pest and diseases, rot, bruises, and destruction by rodents. Bad nature of roads lead to congestion of tomatoes lead to mechanical injuries.



**Figure 3.1: Conceptual Framework**

Source: Author's illustration, 2018

Hot weather conditions especially, in the tropics contribute highly to postharvest losses since excess heat causes fresh tomatoes to rot. The packing houses or storage facilities used by actors in the value at the farm or sale points contribute to losses. Fresh tomatoes must be stored at the right moisture, temperature, and humidity conditions since fluctuations have significant effect on postharvest losses. Place and time of storage of fresh tomatoes also have great impact on postharvest losses since it

gives pest enough time to complete their reproductive cycle and increase in number. Favourable environmental conditions allow fast biological deterioration by catalysing the ripening process.

However, factors driving postharvest losses affect the productivity and effectiveness of each stage of the value chain as fresh tomatoes move from one actor to the other. Postharvest losses of tomatoes reduces the income made by each actor since they involve in handling of tomatoes. Extra care has to be taken in handling fresh tomatoes since they are highly perishable.

### **3.3 Method of Data Analysis**

This section presents the methods of analysis that was used to analyse the specific objectives of the study. Descriptive statistics was used to estimate outcome of losses. Kendall's Coefficient of Concordance was employed to rank the constraints by each actor and Tobit regression model was used to identify factors influencing these losses. StataSE 14 software was used for the regression.

#### **3.4.1 Estimating the proportion loss at each stage of the chain**

The purpose of this objective was to compute the amount of losses experienced by tomato farmers, wholesalers, and retailers along the value chain and further calculate loss in monetary terms. Total postharvest loss encountered by the three actors (farmers, wholesalers, and retailers) is given as total quantity of tomatoes harvested or bought minus the total quantity of tomatoes not used. Quantity of tomatoes that have not been used in this context comprises of total quantity of tomatoes not used as food, gift, and sold. The formula used to compute quantity loss is expressed as

$$TQ_L = TQ_H - TQ_U \quad (3.1)$$

It was assumed that computation of losses at each stage per farmer, wholesaler, and retailer started with standardized 52kg crate and was used to determine quantity loss along the postharvest chain. Total quantity loss was the sum of all losses experienced by 80 farmers, 30 wholesalers, and 80 retailers at each stage of postharvest handling activity. Thus the percent loss was expressed as a ratio of total quantity loss (in kg) to total quantity harvested (in kg) multiplied by 100.

$$\% L = \frac{TQ_L}{TQ_H} \times 100 \quad (3.2)$$

Estimating the value loss of tomatoes by each actor per 52kg, the unit prices per kilogram of good was estimated. The unit price was multiplied by total quantity losses incurred by various actors along the postharvest value chain to obtain the value loss of tomatoes.

$$V_L = (TQ_H - TQ_U) \times P_{KG} \quad (3.3)$$

Descriptive statistics was used to describe the outcome

Where:

$TQ_H$  = Total Quantity of tomatoes harvested

$Q_U$  = Total Quantity of tomatoes not used

$V_L$  = Value Lost

$P_{KG}$  = Market price of tomato per kg

$L$  = Quantity of tomatoes lost

Quantity lost was expressed as a proportion of total quantity per 52 kg crate by the tomato farmer, wholesaler, and retailer due to postharvest handling activities. Losses incurred by farmers, wholesalers, and retailers through sorting, grading, storage, packaging, and transportation were obtained from the actors along the value chain. Microsoft excel was used for the estimations. The above formulae were used to estimate losses accounted by each actor and calculate losses in monetary terms along the value chain.

### 3.4.2 Determining the factors that influence the proportion of loss

The Tobit regression model was used to determine the extent of influence and significance of key variables on the proportion of loss along the tomato value chain. The Tobit model was used because the dependent variable is continuous. That is, Y measures the proportion of tomato loss. An explicit specification of a single model for all levels i.e. farm, wholesale, and retail is as follows;

$$Y = A_0 + A_1EDUBASIC + A_2GENDER + A_3PHLTRAN + A_4MRKT + A_5EXP + A_6TRANS + A_7STORFAC + A_8KNMUN + A_9BOLMUN + A_{10}LSTORG + A_{11}WSALE + A_{12}RETAIL + \epsilon \quad (3.4)$$

Where;

- ‘Y’ represents the dependent variable (proportion of tomato losses (%))
- ‘A’ = parameter estimates, and
- ‘ε’=stochastic error term.

$A_0$  is the constant term (intercept) and  $A_1 \dots A_N$ , are the coefficients of estimates in the model. The explanatory variables are defined as in Table 3.1. (NB: One variable

(farmer) was dropped in the overall estimation to avoid dummy variable trap and it was used as the control or base in the model). The a priori expectations of each equation in the model are also provided in Table 3.1 to indicate the relationship between the explanatory variables and the dependent variable (i.e. proportion of tomato being lost). The relationship was either negative or positive.

NB: Same specification is used for individual levels by taking out variables that are not applicable to the particular level.

**Table 3.1: Description, measurement and a priori expectation of variables**

<b>Variable</b>	<b>Variable Description</b>	<b>Measurement</b>	<b>A-Priori Expectation</b>
EDUBASIC	Basic education	1 = yes, 0 = otherwise	-
GENDER	Gender	1 = male, 0 = female	-
PHLTRAN	Postharvest loss training	1 = contact, 0 = otherwise	-
MRKT	Ready market	1 = access, 0 = otherwise	-
EXP	Experience	Number of years	-
TRANS	Method of Transportation	1 = improved, 0 = Otherwise	-
STORFAC	Storage facility	1 = improved, 0 = otherwise	-
KNMUN	Kassena Nankana Municipal	1 = yes, 0 = otherwise	+/-
BOLMUN	Bolgatanga Municipal	1 = yes, 0 = otherwise	+/-

LSTORG	Length of storage	Days	+
WSALER	Wholesaler respondent	1 = yes, 0 = Otherwise	+/-
RETAIL	Retailer respondent	1 = yes, 0 = Otherwise	+/-

---

**Description and measurement of variables in the Tobit model:**

**Y:** This variable was dependent variable which was used to describe the proportion of PHL.

**Basic education:** This variable represents farmers, wholesalers, and retailers who have basic education. Basic education here refers to actors with Primary and Junior High education. Actors with basic education were assigned 1 while the others with no education were assigned 0.

**Gender:** The variable is specified as a dummy where a male actor is given a 1 value and female actor, a value of 0. Female actors are expected to experience high postharvest losses than male actors.

**Postharvest loss management training:** This variable describe whether actors had training on postharvest loss management for the period 2017/2018. Actors who had access are assigned 1 and those who did not are assigned 0. Actors with knowledge in PHL management training will have smaller losses of tomatoes compared to the others without.

**Ready market:** This describes those actors who had ready market for their tomatoes. Actors who had access are assigned 1 and those who did not are assigned 0. It is

expected that those who have access to ready market for tomatoes will experience lesser PHL.

**Experience:** This variable is measured in years. It describes the number of years each actor is involved in farming or trading. It is expected that the higher the number of years of experience in tomato production or trading the less PHL.

**Transportation:** This variable describes the method of transportation used by each actor. Those who have access to improved transportation are assigned 1, otherwise 0. Bad nature of roads enhances greater PHL. Actors who use appropriate vans or trucks will experience lesser PHL than those who use motorbikes to transport tomatoes to sales points.

**Storage facility:** This variable describes whether actors have access to improved storage facilities or not. Those who have access to improved storage facility are assigned 1 and those who do not have access to improved storage facility are assigned 0. Those actors without improved storage facilities will have high PHL than those without.

**Kassena Nankana Municipal:** The reason for the inclusion of this variable in the model is to know how significant location has on PHL. This variable is defined whether a particular actor farms or trade in the Kassena Nankana Municipality. Actor who does business in this municipality is assigned 1, otherwise 0. Actors who operate in well-endowed areas will experience less PHL than those deprived areas. This can be associated to good nature of roads, market infrastructure, and readily available

market. The variable was used to compare with the control or base variable (Kassena Nankana West).

**Bolgatanga Municipal:** The reason for the inclusion of this variable is the model is the significant role location has on PHL. This variable signifies actors who farm or trade in the. An actor who does business in this municipality is assigned 1, otherwise 0. Actors who operate in well-endowed areas will experience less PHL than those in deprived areas. This can be associated to good nature of roads, market infrastructure, and readily available market. The variable was used to compare with the control or base variable (Kassena Nankana West).

**Length of storage:** This variable is measured in days. It describes the number of days actors store their produce. It is expected that the higher the number of days tomatoes are stored the high PHL and vice versa.

**Wholesaler:** The reason for the inclusion of this variable in the model is to know whether the quantity harvested or bought by an actor has an influence on PHL. It is expected that the higher the quantity harvested or bought the higher the PHL. A wholesale respondent is assigned 1, otherwise 0. The variable was used to compare with the control or base variable (farmer).

**Retailer:** The reason for the inclusion of this variable in the model is to know whether the quantity harvested or bought by an actor has an influence on PHL. It is expected that the higher the quantity harvested or bought the higher the PHL. A retail

respondent is assigned 1, otherwise 0. The variable was used to compare with the control or base variable (farmer).

### 3.4.3 Identifying the major constraints that influence postharvest loss

Constraints that actors face at each level of the value chain will be presented to respondents to rank according to level of severity. Kendall's Coefficient of Concordance (W) was used because it summarises the concordance between several ranked lists. Pearson correlation coefficient measures the linear relationship between two variables and Spearman's rank correlation coefficient assess monotonic functions.

Therefore, Kendall's Coefficient of Concordance (W) was the appropriate method in this study.

#### Hypothesis

**H<sub>0</sub>:** There is no agreement among the rankings of the respondents

**H<sub>a</sub>:** There is agreement among the rankings of the respondents

The Kendall's Coefficient of Concordance is specified as follows:

$$W = \frac{12[\sum T^2 - (\sum T)^2/n]}{nm^2(n^2-1)} \quad (3.7)$$

Where;

$m$  = number of sets of ranking by the farmers, wholesalers, and retailers

$n$  = the number of specific constraints being ranked.

The hypothesis and the significance of the rankings were further assessed using the chi-square test.

**Decision Rule:**

The null hypothesis ( $H_0$ ) is rejected if the F-ratio (calculated) is greater than the F-value from F-table.

Fail to reject the null hypothesis ( $H_0$ ) is rejected if the F-ratio (calculated) is less than the F-value from F-table

**3.4 Method of Data Collection**

This section presents the sources of data that was used for the study, the sampling approach that was used to conduct the survey, the sample size determination and geographical area of study.

**3.4.1 Sources of data**

Primary data was collected mainly through the administration of well-structured questionnaire. The questionnaires were pre-tested with 3 farmers, wholesalers, and retailers each in the study area. After the pre-testing exercise, the questionnaires were refined with other information from previous surveys. Questionnaires administered are found in appendix

**3.4.2 Sampling approach and size determination**

Prior to data collection, a preliminary survey was carried out to gain an overview of the study area. Officials from MoFA were consulted regarding the major tomato growing communities. Heads of vegetable farmer based organisations and traders

association were consulted, whose roles are enormous in mobilising their members for the exercise.

The population for this study constituted all farmers who produced tomatoes and traders who trade tomatoes for the 2017 cropping season in the three major tomato producing Districts. The Upper East Region was chosen for the study because it plays an enormous role in meeting the country's fresh tomato needs.

A multistage sampling technique was used to sample farmers, wholesalers, and retailers. The first stage involved the purposive selection of 3 Districts in the Region based on the intensity of tomato cultivation in these Districts. The chosen Districts include Kassena Nankana Municipal, Kassena Nankana West District, and Bolgatanga Municipal.

Secondly, with the help of Agricultural Extension Agents at the various Districts, 8 communities were purposively sampled based on the intensity of tomato production. 2 communities were chosen from Bolgatanga Municipal and 3 communities were selected from Kassena Nankana Municipal and Kassena Nankana West District each. The selected communities in the Bolgatanga Municipality were Sumbrungu and Sherigu; communities under Kassena Nankana Municipal were Korania, Yogbania and Bonia. Communities selected under the Kassena Nankana West District were Badunu, Nania, and Kalvio.

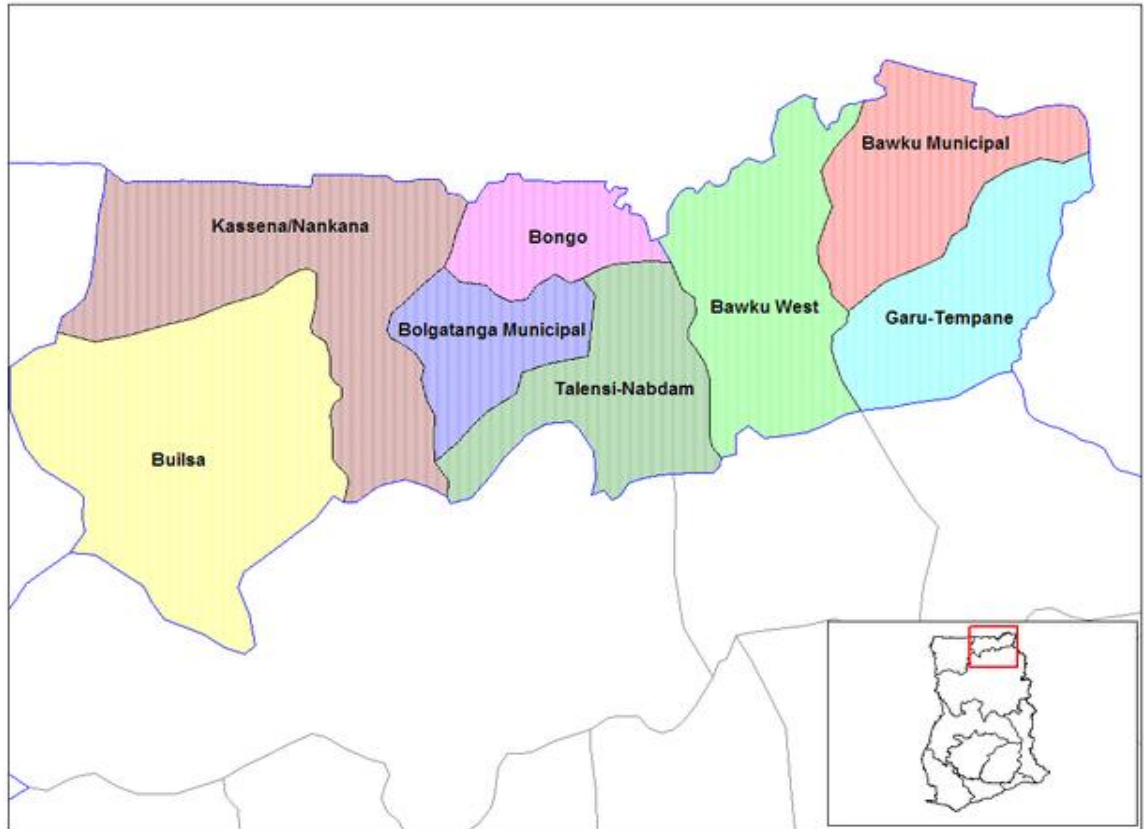
The third stage employed simple random sampling in selecting 10 tomato farmers, and 10 retailers from each community. 30 wholesalers were selected from 2 Districts.

**Table 3.4 Summary of Sample Size**

<b>Districts</b>	<b>Farmers</b>	<b>Wholesalers</b>	<b>Retailers</b>
Bolgatanga Municipal	20	14	20
Kassena Nankana Municipal	30	16	30
Kassena Nankana West	30	-	30
<b>Total</b>	<b>80</b>	<b>30</b>	<b>80</b>

### **3.4.3 Geographical area of study**

The Upper East Region constitutes the study area (Figure 3.3). It lies between latitude 10°15' and 10° 10' N, longitude 0° and 1° 4'W (MoFA, 2013). The region is bounded east by the Republic of Togo, it is also bounded west by the Upper West Region and north and south by the Republic of Burkina Faso and Northern Region respectively (Ghana Statistical Service (GSS), 2013; MoFA, 2013). The Upper East Region has a land size of 8,842 square kilometres, thereby constituting 3.7% of Ghana's land size (GSS, 2013; MoFA, 2013).



**Figure 3.2: Map of Upper East Region**

Source: Ghanadistricts.com

### **Vegetation and drainage:**

The region's natural vegetation of the region is made up of savannah woodland distinguished by dry spell resistant trees and grasses that get burnt during the prolonged dry season by bushfires or heat the sun (GSS, 2013). A small portion of the northern part of Bawku is characterised by Sudan Savannah vegetation. The topography of the region is predominantly undulating with gentle slopes ranging from 1% to 5% slopes. It is fundamentally drained by Red and White Volta and Sissili Rivers (MoFA, 2013). Dawadawa, sheanut, baobab and acacia are the most prevalent economic trees in the region.

**Climate:**

The region has one only rainy season pattern with a mean rainfall of 800 mm and 1,100 (GSS, 2013). Dry season starts from November to mid-February, distinguished by harmattan winds. Low humidity enhances high temperature during daytime. Temperature at this period s as low as 14<sup>0</sup> centigrade at night, and can be as high as 35<sup>0</sup> centigrade during the day (GSS, 2013).

**Demographic characteristics:**

The 2010 population census indicates that the region has a population of 1,046,545 persons, thus, constituting 4.2% of Ghana's population. The region has an annual population growth rate of 1.2%. The census results further indicate the predominance of females relative to males in the region (GSS, 2012). The population in the region is made up of 48.4% males and 51.6% females (GSS, 2012). Per the 2010 population census, a majority (51.6%) of the people in the region falls within the economic active range of 15 to 64 years old, thus indicating that if properly utilised can yield significant economic benefits to the region and the nation at large.

**Economic activities:**

The Upper East Region is largely agrarian. It has been estimated that about 80% of the region's active population is involved in agriculture (GSS, 2013; MoFA, 2013). Agriculture has propelled the region's economic status from the poorest to the ninth position among the ten regions in the country (MoFA, 2013). Crop farming, hunting, and animal rearing have been the prevalent economic activities of the people of the region. The agricultural sector has further created some prospects for the industrial

sector, as a result of the production of certain commodities like vegetables, cereals, legumes and ruminants in commercial quantities.

The Upper East Region produces about 25% of the country's ruminant needs (Okrah, 2010). The region has two major irrigation schemes which aid the cultivation of vegetables in the dry season (from November to April) and this is further facilitated by some other 172 dams and dugouts scattered over the region (MoFA, 2013). According to the GSS (2013); Okrah (2010), industrial activities in the region are fundamentally low with a cotton ginnery at Pusu-Namogo (near Bolgatanga) being the only operational factory in the region. The Northern Star Tomato Factory, the GIHOC meat factory, and the rice mills in the region are non-operational (GSS, 2013).

### **3.5 Scope and Limitation of Study**

The study assess the losses along the tomato value chain. The study addressed three specific objective and these were; to estimate the proportion of postharvest losses at each stage of the fresh tomato value chain, determine the factors that influence losses, and to identify constraints that each actor of the value chain faces. The study employed descriptive statistics, Kendall's Coefficient of Concordance, and the Tobit model to address the specific objectives. The study could not estimate qualitative loss since it was very difficult to measure the factors that cause that particular type of loss. The study only looked at the estimation of quantitative loss since qualitative loss is difficult to measure.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

Chapter four presents the results and discussions of the study. The chapter is organized in sections as follows: Section 4.2 presents the social and demographic characteristics. Following section 4.2 is section 4.3 which presents result on estimating the quantity of losses at each stage of the tomato value chain. Section 4.4 presents result on the ranking of major constraints that each actor face along the value chain and finally section 4.5 presents results and discussions on the factors influencing losses at each stage of the value chain.

#### 4.2 Social and Demographic Characteristics

From Table 4.1, it is observed that greater number of farmers in the region were males representing 75%. For the wholesalers, male and female represent 50% each and for the retailers, all respondents were female representing 100%. It could be inferred that farmers in the region are dominated by males. This could be attributed to the fact that women perform other domestic and economic roles like housekeeping and marketing of agricultural produce in society and may not have equal time for farming like their male counterparts. This finding corroborates those of current studies such as Awunyo-Vitor *et al.* (2016) and earlier studies such as Amankwah (1996) that suggest that farming in Ghana is male dominated. It could be inferred that all tomato retailers in the Upper East Region are females. This could be due to the fact that males are engaged in farming activities while the female rather deal in trading.

**Table 4.1: Social and demographics characteristics**

Variables	Farmers (N=80)		Wholesalers(N=30)		Retailers (N=80)	
	Freq	(%)	Freq	(%)	Freq	(%)
<b>Gender</b>						
Male	60	75	15	50	0	-
Female	20	25	15	50	80	100
<b>Education</b>						
No school	36	45	17	57	19	24
Primary	18	22	8	27	23	29
Middle	1	1	3	10	-	-
JHS	20	25	1	3	26	33
SHS	4	5	1	3	10	13
Tertiary	1	1	-	-	-	-
<b>Main Occupation</b>						
Farming	55	69	11	37	8	10
Wholesaling	-	-	10	33	-	-
Retailing	-	-	-	-	72	90
Other	25	31	9	30	-	-

Source: Author's Computation, Field Survey, 2018

From Table 4.1, it is seen that majority of the farmers in the Upper East Region had no formal education representing 45%. For those who had formal education, majority had only Junior High School education representing 25%. However, majority of wholesalers in the Upper East Region had no formal education representing 57% and for the retailers, majority had Junior High School education (26%). For Senior

High/Technical (SHS) School and Tertiary Levels, only few farmers, wholesalers, and retailers attained those levels.

Also, from Table 4.1, it is observed that the main occupation for farmers was farming representing 69% of respondents. Example of food crop activities they engage in include vegetable farming such as pepper and cabbage. Livestock activities included animal rearing such as goats, cattle, and guinea fowls. This implies that the farmers rely on their farming activities for income generation and will endeavour to explore all avenues to improve upon their farming businesses. The other occupations farmers engaged in were mostly rearing and trading in animals and other food commodities and serving as tractor operators or labourers on other farms. The main occupation for retailers was retailing representing 90% of respondents. The only other occupation that retailers deal in is farming (10% of respondents). The main occupation for wholesalers is wholesaling (33% of respondents) but majority of wholesalers also deal in farming but on small scale (37% of respondents).

### **4.3 The level of Postharvest Losses along the Fresh Tomato Value Chain**

#### **4.3.1 Farmer level analysis**

The first objective of the study was to estimate the quantity of fresh tomatoes lost by various actors along the value chain. The results in Table 4.2 indicate that the total farm size under tomato production in the study area by all the respondents was 13 hectares. In 2017 cropping season, the major season recorded an output of 59,333 kg compared to a minor season output of 81,061 kg. 1,797.98 kg/ha and 2,456.39 kg/ha were averagely estimated as loss for major and minor season respectively. A survey by Aidoo *et al.* (2014) confirmed that farmers harvested 6,143.46 kg of tomatoes in the major season, out of which 40% were lost due to postharvest. 4,871.68 kg of

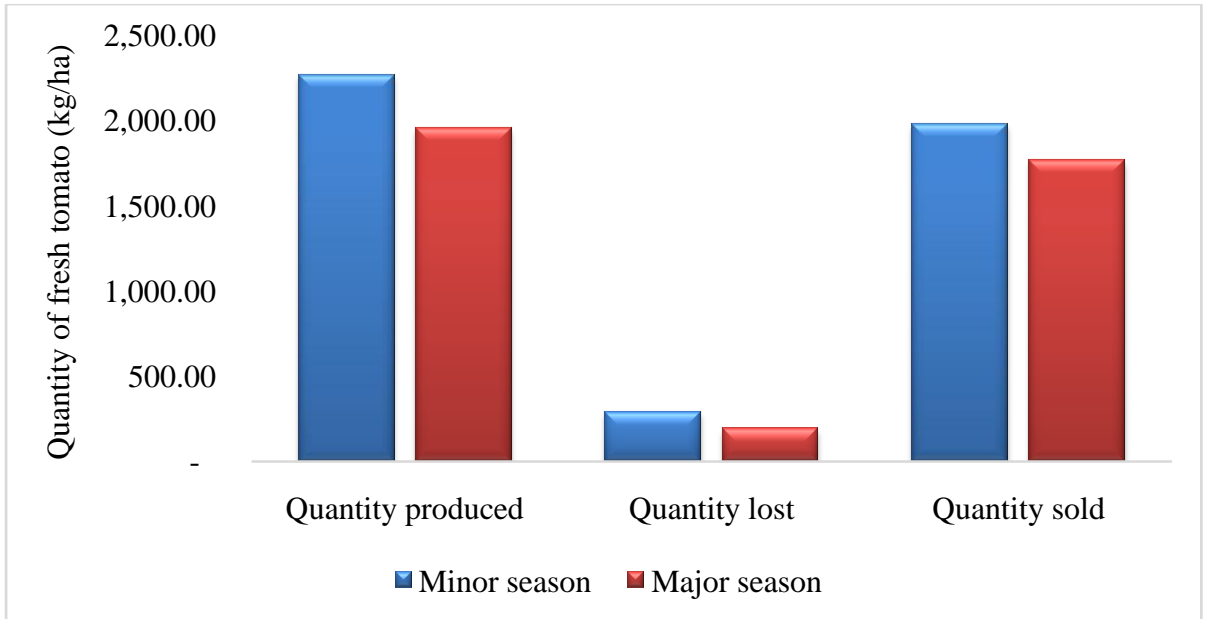
tomatoes in the minor season were harvested on an acre of land, out of which 14% were lost. The findings by Egyir et al. (2008) suggested that more of the PHLs for tomato occur during the minor season (30%) as compared to the major season (20%) and transportation seems to be a main driver for losses.

59,333 kg was harvested in the major season recording 10% losses and the value of lost in monetary terms was GHS27, 894.78. 81,060.98 kg was the output for the minor season which recorded 13% of lost and a value lost of GHS59,884.58. The quantities used(what was sold, used as gift, and what was consumed at homes) for both seasons were valued monetarily as GHS257,498.49 and GHS407,837.28 respectively.

**Table 4.2 Output of fresh tomatoes and postharvest losses**

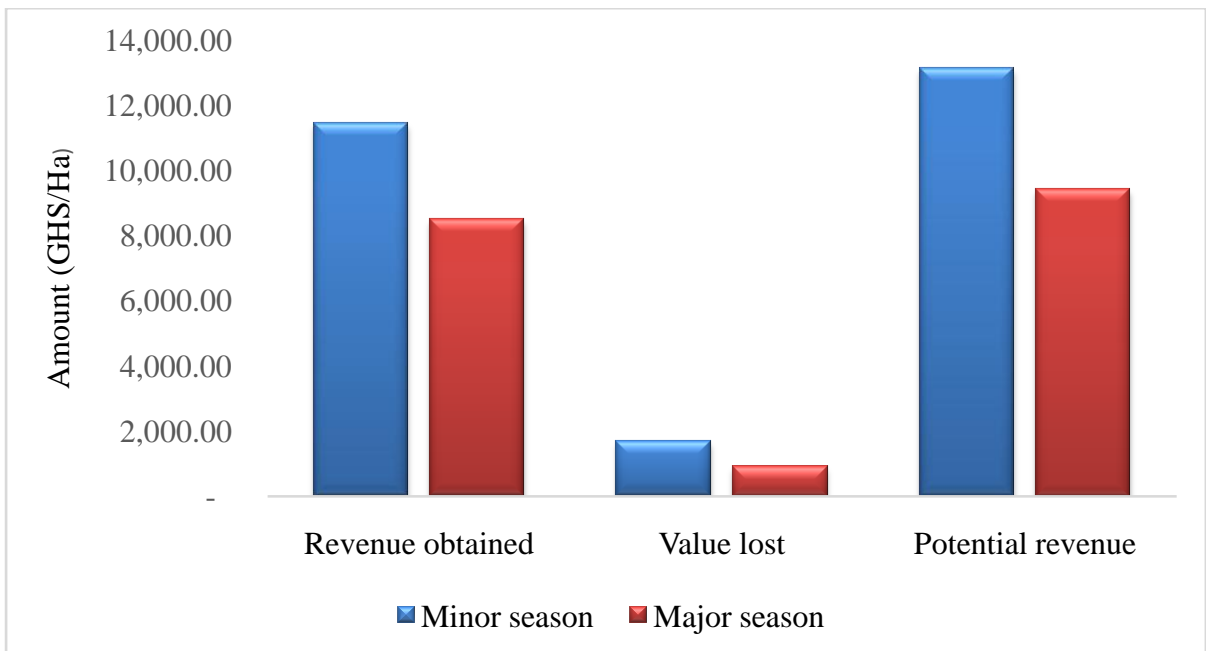
<b>Variable</b>	<b>Major Season</b>	<b>Minor Season</b>
Land area (ha)	12	14
Output (kg)	59,333.32	81,060.98
Quantity of output lost (kg)	5,799.33	10,378.61
Quantity used (kg)	53,533.99	70,682.37
Percentage of output lost (%)	9.77	12.80
Unit price (GHS / 52kg)	4.81	5.77
Revenue obtained (GHS)	257,498.49	407,837.28
Value lost (GHS)	27,894.78	59,884.58
Potential revenue ( (GHS)	285,393.27	467,721.86

Source: Author's Computation, Field Survey, 2018



**Figure 4.1 Analysis of losses on per hectare basis**

Source: Author's Computation, Field Survey, 2018



**Figure 4.2 Analysis of revenue on fresh tomatoes on per hectare basis**

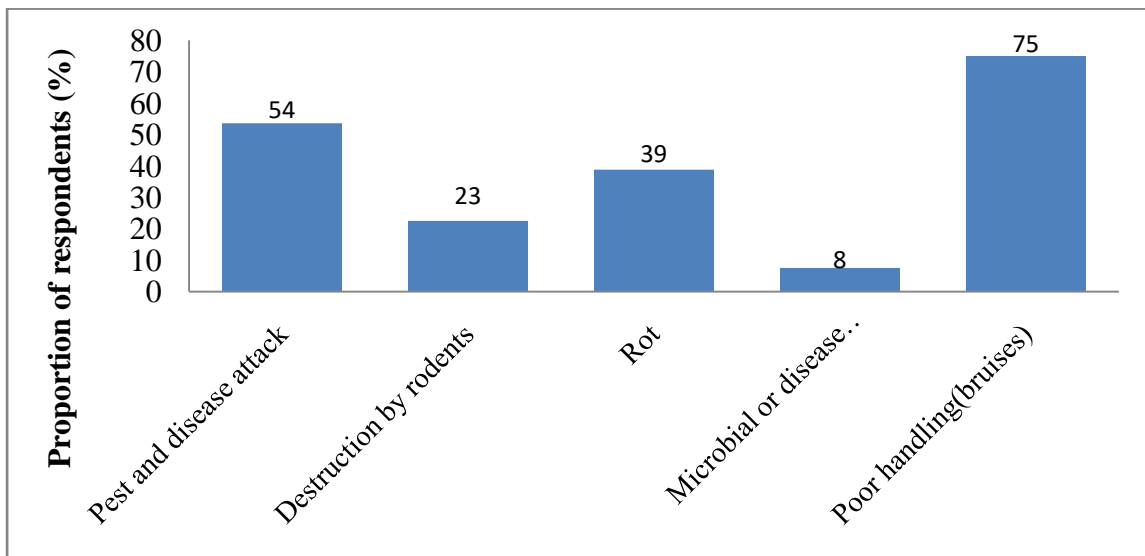
Source: Author's Computation, Field Survey, 2018

**Farmer perception of causes of postharvest losses of fresh tomatoes:**

Postharvest losses at the farmer level along the tomato value chain resulted largely from mechanical injuries such as rot and bruises (Figure 4.3). These primary causes were solely caused by activities on the farm. Farmers indicated that rot and bruises of

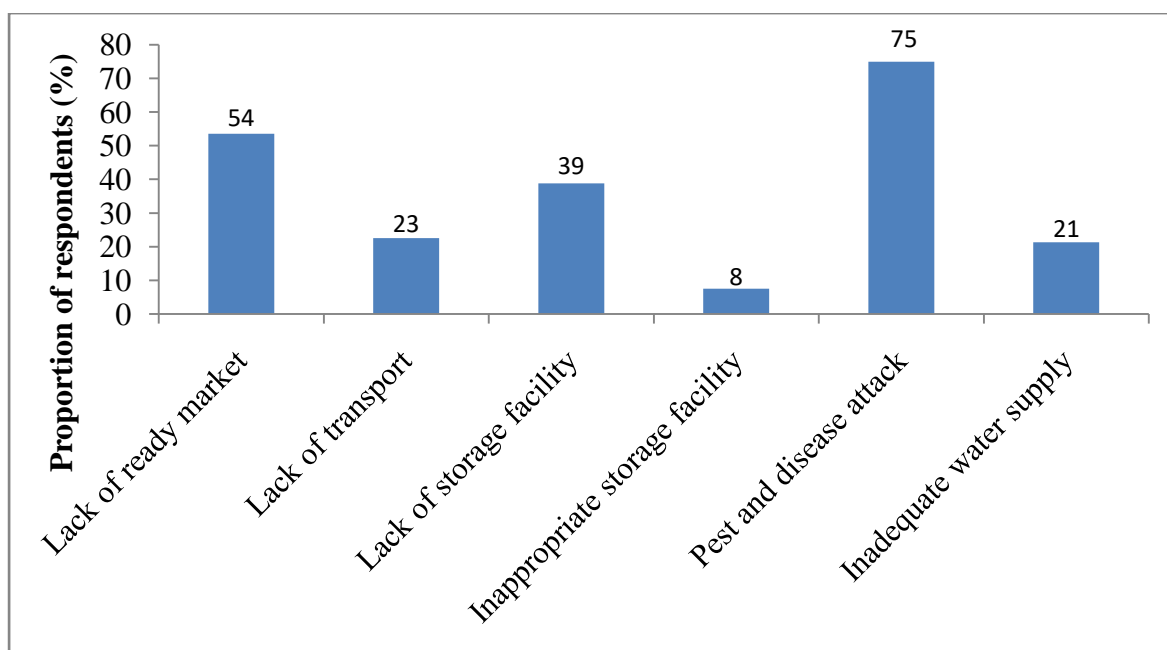
fresh tomatoes were as a result of excessive field heats, and when tomato fruits get contact with contaminated soil. Bruises were as a result of poor handling during harvesting, spillage during transportation from farm gate to market centres, and spillage during loading and off-loading both at farm gate and market centres. Farmers who decided to temporal process tomatoes (curing) recorded the minimal postharvest loss. Kitinoja and Cantwell (2010) confirmed that an average of 25% loss of ripe tomatoes occurred at the farmer level. The remainder of tomatoes were sold at lower prices because they manifested some variety of defects, decay, and damage.

Also, secondary factors that contributed to losses of tomato were pest and disease attack, unavailability of ready market, and lack of appropriate storage facilities (Figure 4.4). Lack of transport, inappropriate storage facilities, and inadequate water supply.



**Figure 4.3 Primary causes of losses**

Source: Author's Computation, Field Survey, 2018



**Figure 4.4 Secondary causes of losses**

Source: Author's Computation, Field Survey, 2018

**Table 4.3 Tomato output and losses at wholesale and retail level**

Variable	Quantity / Amount	
	Wholesale level	Retail level
Output (kg)	1,386,788.00	849,493.49
Quantity of output lost (kg)	358,384.00	168,197.82
Quantity used (kg)	1,028,404.00	681,295.67
Percentage lost (%)	26.00	20.00
Unit price (GHS / 52kg)	9.62	10.00
Revenue obtained (GHS)	9,893,246.48	6,812,956.70
Value lost (GHS)	3,447,654.08	1,681,978.20
Potential revenue ( (GHS)	13,340,900.56	8,494,934.90

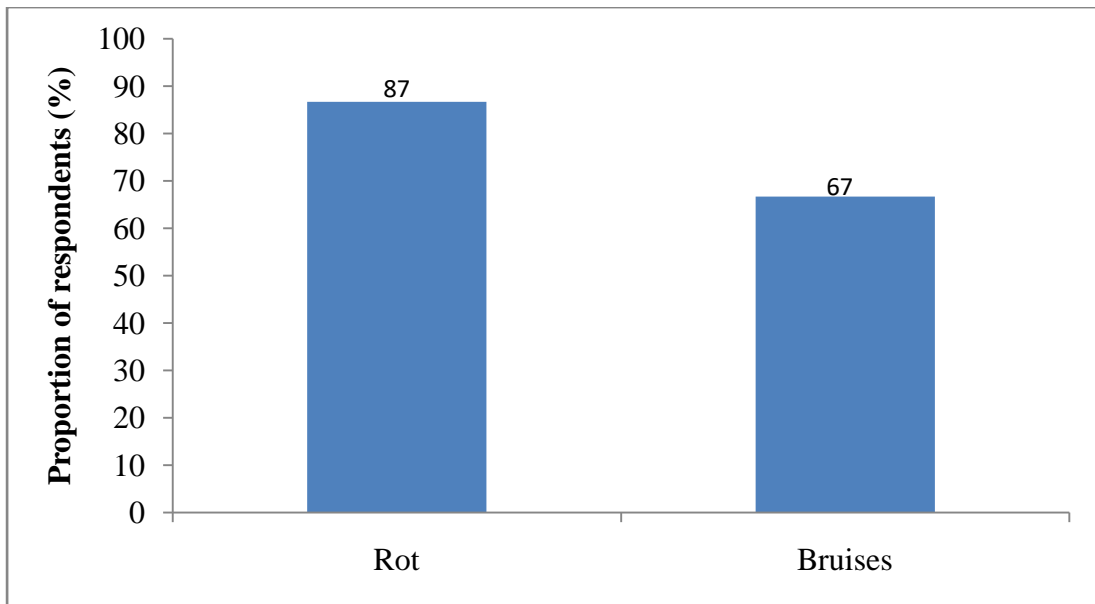
#### **4.3.2 Wholesaler level analysis**

From Table 4.3, the quantity of fresh tomato bought by wholesalers in the year 2017 was found to be 1,386,788.00 kg. Quantity used was 1,028,404 kg, recording a loss of 358,384.00 kg (26% postharvest loss). The quantity lost was valued at GHS3,447,654.08. According to Baniet *al.* (2006), losses of tomatoes along the route, which is from Bolgatanga to Accra recorded a loss of 20%. He attributed these losses to abrasive cuts and bruises.

#### **Wholesaler perception of causes of postharvest losses of fresh tomato:**

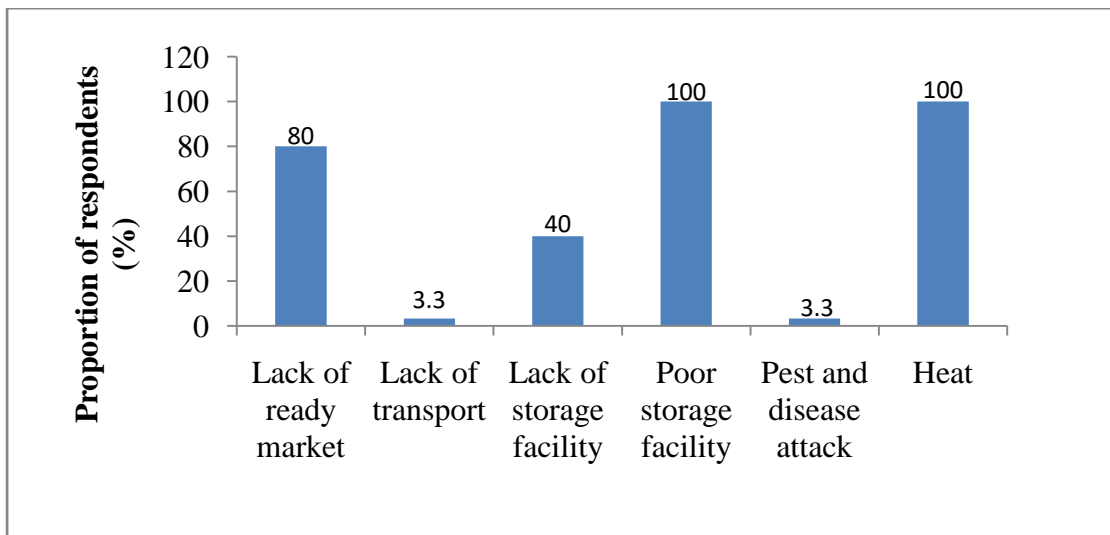
From the perspective of the wholesalers, rot and bruise became their major factors that contributed to postharvest losses. Heat build-up because of poor ventilated packaging materials led to rot. Bruises was a major concern raised by the wholesalers (figure 4.5). Over packed wooden crates of tomatoes causes compression stress which can lead to mechanical injuries. It is therefore advised to reduce the depth of the crate and provide padding material at the bottom and in between layers of tomatoes to prevent mechanical injuries. Kitinoja and Cantwell (2010) reported that an average of 10% loss was recorded at the wholesale level. The rest sold at a discounted price due to the manifestation of some defects.

The four major secondary causes of postharvest losses of tomatoes at the wholesale level in the study area were lack of ready market, poor storage facility, lack of storage facility and heat build-up during transportation. Lack of transportation and pest attack were minimal at the wholesale level the Upper East Region (Figure 4.6).



**Figure 4.5 Primary causes of losses**

Source: Author's Computation, Field Survey, 2018



**Figure 4.6 Secondary causes of losses**

Source: Author's Computation, Field Survey, 2018

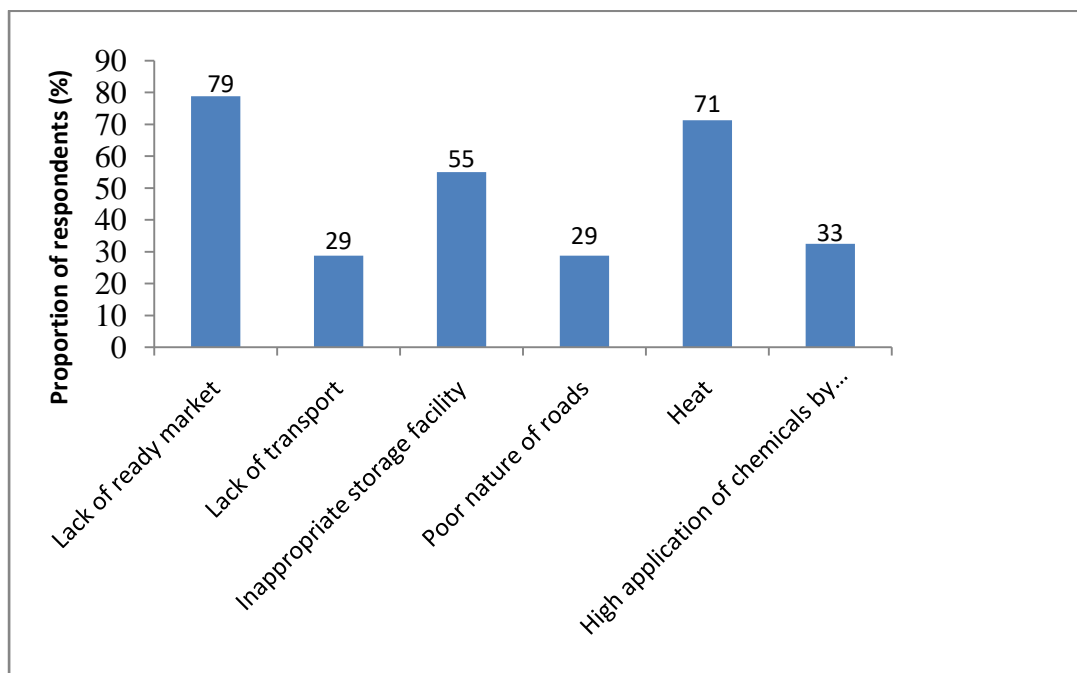
### 4.3.3 Retailer level analysis

The total quantity of fresh tomatoes purchased by retailers was estimated at 849,493.49kg (Table 4.3). Quantity of fresh tomatoes sold was 681,295.67kg, recording a loss of 168,197.82kg. This was valued at GH¢1,681,978.20 representing 20% of fresh tomato lost. GH¢8,494,934.90 was the potential revenue that could have

been generated in the absence of postharvest losses.

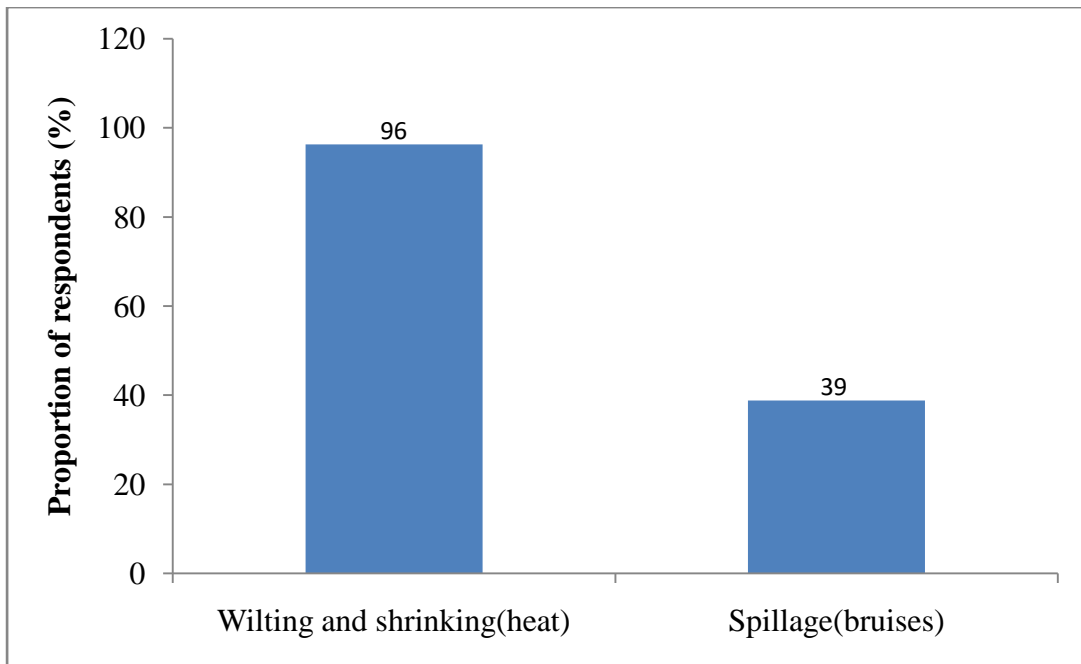
**Retailer perception of causes of postharvest losses of fresh tomato:**

Lack of ready market, heat build-up in inappropriate storage facilities, and high applications of chemicals by farmers were concerns raised by retailers in the study area (figure 4.7). Rot and bruises were also critical issues that led to postharvest losses of tomato. Wilting, shrinking and bruises were associated with the heat build-up the inappropriate storage facility and the use of aluminium basins as packaging and storage material (Figure 4.8). According to Kitinoja and Cantwell (2010), 50% losses was recorded at the retail level.



**Figure 4.7 Secondary causes of losses**

Source: Author’s Computation, Field Survey, 2018



**Figure 4.8 Primary causes of losses**

Source: Author's Computation, Field Survey, 2018

#### **4.4 Factors Influencing Postharvest Losses**

It is observed from Table 4.5 that wholesaler, gender, PHL training, Kassena Nankana Municipal and Bolgatanga Municipal had significant effect on losses of tomatoes across the entire value chain. Wholesalers had a significant positive effect on losses of tomatoes which is significant at 1%. This may be due to the fact that wholesalers buy more of fresh tomatoes from the farmers and transport them in large quantities to market centres for sale. Also, wholesalers experience more losses than the farmers since the farmer was used as the base in the model. Therefore, the more the quantity of tomatoes bought wholesalers the higher the losses.

It is observed from Table 4.5 that gender had a significant negative effect on losses and it is significant at 10%. Female actors were found to be more prone to high levels of losses than their male counterparts across the tomato value chain. Babalola *et al.*

(2010) had a different view and concluded that gender had no effect on postharvest losses of tomatoes. Harvesting and Postharvest handling activities are very labour intensive. Normally, households which have males as heads have more available man-hours, therefore more time for harvesting and other farm related activities compared to females who have less man-hours since they have family duties to attend to. This findings sought to agree with Adarkwa (2011) who indicated inappropriate harvesting methods and handling result in postharvest losses.

**Table 4.5 Tobit regression results of the determinants of losses**

<b>Variable</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>P &gt;  t </b>
Wholesaler	17.97954***	3.682096	0.000
Retailer	8.959855	5.493116	0.105
Basic education	-2.38981	1.945355	0.221
Gender	-4.667372*	2.628274	0.077
Experience	-0.0080656	0.1326487	0.952
PHL training	-4.405784*	2.361396	0.064
KassenaNankana			
Municipal	-3.738001*	2.218186	0.094
Bolgatanga			
Municipal	-6.609806***	2.467149	0.008
Ready market	-1.041244	2.058243	0.614
Storage facility	0.6032911	0.9855423	0.541
Transportation			
method	3.356814	2.267233	0.140
Length of storage	2.501443	2.476625	0.314
//sigma	11.78506	0.6584327	

No. of obs =190; LR chi2 (12)=84.05; Prob>chi2=0.0000; Pseudo R2=0.0588

\*, \*\* and \*\*\* denotes significant levels of 10%, 5% and 1% respectively

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Source: Author's Computation, Field Survey, 2018

In the case of postharvest loss training, it was noticed that it had a significant negative effect on postharvest loss across the value chain. This implies that training was more important to actors (farmers, wholesalers, and retailers) in helping to reduce losses across the value chain even among inexperience and illiterates. Frequent training of various actor along the tomato value chain is a sure means of reducing postharvest losses. With respect to location, it was observed that Kassena Nankana Municipal and Bolgatanga Municipal had significant negative effect on postharvest losses which is significant at 10% and 1% respectively. This means that the two locations are well endowed with resources and infrastructure such as good road network, adequate market structures and information dissemination, and improved storage facilities than the third District (Kassena Nankana West). This sought to agree with Issahaku (2012) who reported that inadequate infrastructure such as bad nature of roads, storage facilities, and limited access to credit facilities lead postharvest loss.

Furthermore, Kassena Nankana Municipal and Bolgatanga Municipal have large market size where there is ready market for fresh tomatoes and good road network to market centres. Yeboah (2011) reported that the bad nature of roads in the Brong Ahafo Region makes it difficult, time consuming and costly for tomato farmers to transport produce from the supply areas to sales points. This was confirmed by 76% of farmers and traders in the region. Kader (1986) indicated that the time wasted between moving fresh tomatoes from the farm gate to the market centres can result in losses.

## 4.5 The Major Constraints of Actors along the Fresh Tomato Value Chain

### 4.5.1 Farmer constraints

The third objective was to identify the major constraint that each actor faces along the value chain. Kendall's coefficient of concordance (W) was used to rank constraints that actors face at each level of the value chain. Table 4.8, 4.9, and 5.0 represent ranked constraints that farmers, wholesalers, and retailers face respectively.

The results in table 4.8 indicate that among the eight constraints in the region, farmers ranked lack of ready market as their most pressing constraint. The moment fresh tomatoes are harvested and there is no market, the high perishability nature of the produce facilitates its spoilage. This finding sought to agree with Aidoo *et al.*, (2014) who reported that lack of ready market for fresh tomatoes was the main cause of postharvest losses. Lack of financial support was the second most important constraint tomato farmers face in the region. Farmers require finances to buy improved varieties of tomato seeds, buy agrochemicals and inputs and to hire labour. Lack of financial support, pushes farmers to cultivate smaller lands to match their financial capabilities. Lack of storage facilities was considered as the third important production constraint. Unreliable transport system was considered to be least important constraint. MoFA (2011) reported that unavailability of storage facilities, limited access to credit, high cost of production, unreliable transport system, and lack of knowledge on postharvest techniques were the constraints faced by tomato farmers in Ghana. Also, analyses showed by Ayandiji *et al.* (2011) suggested that as size of farm increases, quantity loss also increases as a result of unavailability of storage facility and poor handling.

Kendall's coefficient of concordance (W) was 0.138 which is asymptotically significant at 1%. Meaning that there is 13.8% agreement among rankings of the

constraints by tomato farmers. Hence the null hypothesis that there is no agreement among the ranking of constraints is rejected.

**Table 4.8 Constraints identified by tomato farmers in the UER**

<b>Constraints</b>	<b>Mean score</b>	<b>Rank</b>
Lack of ready market	3.48	1st
Lack of financial support	3.58	2nd
Lack of storage facilities	4.14	3rd
Low pricing	4.28	4th
Pest and disease attack	4.68	5th
Lack of technical support	4.76	6th
High cost of production	5.21	7th
Unreliable transport system	5.87	8th
<b>Statistics</b>		
N	80	
Kendall's W <sup>a</sup>	.138	
Chi-square	77.077	
df	7	
Asym. Sig.	.000	

Source: Generated from field data, 2018

#### **4.5.2 Wholesaler constraints**

The results in table 4.9 indicate that among the eight constraints in the region, lack of ready market was ranked as the most pressing constraint facing tomato wholesalers. Wholesalers who buy fresh tomatoes from farmers to retail or sales point rely on ready market to sell their produce since tomatoes are high perishable. Lack of financial support was ranked second by wholesalers. Access to credit or finances mean that wholesalers will be able to buy fresh tomatoes from farmers the quantity required, pay for transportation, and appropriate packaging material. This is

confirmed by Adu-Dapaah and Oppong-Konadu (2002) that lack of access to credit facility remain a major constraint to small-scale businesses in Ghana.

Also, lack of storage facility and inadequate warehousing were constraints raised by wholesalers. This was explained that investing in these facilities requires huge sums of capital. This is confirmed by Issahaku (2010) that they major constraints that confronted the tomato value chain were inadequate storage and warehousing facilities, lack of financial support, low prices, inadequate transport facilities, and poor quality of tomatoes. High cost of production was considered to be least important constraint by wholesalers.

Kendall's coefficient of concordance (W) was 0.604 which is significant at 1%. Meanin that there is 60.4% agreement among the rankings of the constraints by the tomato wholesalers. Hence the null hypothesis that there is no agreement among the ranking of constraints is rejected.

**Table 4.9 Constraints of fresh tomato wholesalers in the UER**

<b>Constraints</b>	<b>Mean score</b>	<b>Rank</b>
Lack of ready market	1.85	1 <sup>st</sup>
Lack of financial support	2.37	2 <sup>nd</sup>
Lack storage facilities	3.08	3 <sup>rd</sup>
Unreliable transport system	3.63	4 <sup>th</sup>
Lack of technical support	5.55	5 <sup>th</sup>
Low pricing	5.65	6 <sup>th</sup>
High cost of production	5.87	7 <sup>th</sup>
<b>Statistics</b>		
N	30	
Kendall's W <sup>a</sup>	.604	
Chi-square	108.673	

df	6
Asym. Sig.	.000

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Source: Generated from field data, 2018

#### 4.5.3 Retailer constraints

The results in table 4.10 indicate that among the eight constraints in the region. Retailers ranked unavailability of storage facilities as the most pressing constraint. Retailers in the study area store fresh tomatoes in common storerooms in markets after a daily activity because retailers do not have their produce bought in a day. This findings sought to agree with Atanda *et al.* (2011) who reported that the absence of storage facilities and appropriate pack house results in the perishability of the fresh produce. Lack of ready market was ranked second by retailers. Retail considered to be very high and therefore, ranked as the second most important constraint faced by retailers.

Tomato retailers considered lack of financial support as the third important production constraint. Access to finances enable retailers to buy the right quantity of tomatoes from farmers, take care of packaging cost and labour cost, and the appropriate storing facility are needed are Unreliable transport system was considered to be least important constraint. Kendall's coefficient of concordance (W) was 0.470 which is asymptotically significant at 1%. Meaning there is 47% agreement among rankings of the constraints by tomato retailers. Hence the null hypothesis that there is no agreement among the ranking of constraints is rejected.

**Table 4.10: Constraints of fresh tomato retailers in the UER**

<b>Constraints</b>	<b>Mean score</b>	<b>Rank</b>
Lack of storage facilities	2.02	1 <sup>st</sup>
Lack of ready market	2.51	2 <sup>nd</sup>
Lack of financial support	3.01	3 <sup>rd</sup>
Low pricing	4.60	4 <sup>th</sup>
Lack of technical support	4.63	5 <sup>th</sup>
High cost of production	5.51	6 <sup>th</sup>
Unreliable transport system	5.72	7 <sup>th</sup>
<b>Statistics</b>		
N	80	
Kendall's W <sup>a</sup>	.470	
Chi-square	225.422	
df	6	
Asym. Sig.	.000	

Source: Generated from field data, 2018

## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter presents a summary of the study, conclusions and recommendations of the study area.

#### 5.2 Summary and Major Findings of the Study

The study was set out to assess the postharvest losses along the fresh tomato value chain in the Upper East Region of Ghana. Descriptive statistics, Tobit regression model, and Kendall's Coefficient of Concordance were used to analyse the key objectives of the study. The data was collected from 80 farmers, 30 wholesalers, and 80 retailers.

The study found that majority of farmers in the Upper East Region were males representing 75%. It could be inferred that Upper East Region is dominated by male farmers are dominated by males. For the wholesalers, male and female represent 50% each and for the retailers, all respondents were females. Majority of the farmers and wholesalers in the Upper East Region had no formal education while majority of the retailers had Junior High School education.

The total farm size under tomato production in the study area by all the respondents was 13 hectares. It was observed that quantity of output lost during the major season was 5,799.33 kg and its value in monetary terms was GH¢27,894.78. Quantity of output lost during the minor season was 10,378.61 kg, which was valued at GH¢ 59,884.58.

Farmers reported that pest and disease, rodents, rot, microbial infection, and poor handling were the only primary causes of loss in the Region. Also, the secondary factors that contributed to postharvest losses of fresh tomatoes by farmers were pest attack, lack of ready market, lack of lack of storage facilities, lack of transport, inappropriate storage facilities, and inadequate water supply.

It was found that out of 1,386,788.00 kg of fresh tomatoes were bought by wholesalers, 358,384.00 kg was recorded as lost valued at GH¢ 3,447,654.08. Rot and bruise were observed to be the primary causes of postharvest losses of tomatoes. The four major secondary causes of postharvest losses of tomatoes with respect to wholesalers in the study area included lack of ready market, poor storage facility, lack of storage facility, heat build-up during transportation, lack of transportation and pest attack.

It observed that out of 849,493.49kg of quantity of fresh tomatoes bought by retailers in the year 2017, recorded a postharvest loss of 168,197.82kg valued at GH¢1,681,978.20. Lack of ready market, heat build-up in inappropriate storage facilities, and high applications of chemicals by farmers were the secondary causes postharvest losses of fresh tomatoes raised by retailers in the study area. Bruises, wilting and shrinking were observed to be primary causes.

The study found that wholesaler, gender, PHL training, Kassena Nankana Municipal and Bolgatanga Municipal had significant effect on losses of tomatoes across the entire value chain. Wholesalers had a significant positive effect on losses of tomatoes which is significant at 1%. Gender had a significant negative effect on losses and it is significant at 10%. Kassena Nankana Municipal and Bolgatanga Municipal had significant negative effect on postharvest losses which is significant at 10% and 1%

respectively.

It was observed that lack of ready market was ranked as the most important and critical constraint facing tomato farmers and wholesalers in the Upper East Region while lack of storage facilities was seen to be a critical constraint of retailers in the study area.

It was observed that lack of ready market was ranked first by tomato farmers and wholesalers in the study area. Lack of storage facilities was also ranked first by retailers.

### **5.3 Conclusions of the Study**

The following conclusions were drawn from the findings of the study: On the issue of quantity of losses of fresh tomatoes along the value chain, it can be concluded that losses could be as high as 10% and 13% for tomato farmers for the major and minor season respectively. Wholesalers and retailers could experience postharvest quantity losses of approximately 26% and 20% respectively. The main causes of losses were categorized as primary and secondary. Primary causes included pest and disease attack, rot due to heat, and bruises. Secondary causes lack of ready market, lack of storage facilities, and inappropriate transport system due to the bad nature of roads in the region

With respect to factors influencing losses, it can be concluded that wholesalers, gender, PHL training, Kassena Nankana Municipal and Bolgatanga Municipal had significant effect on postharvest losses of fresh tomatoes across the entire value chain in the study area.

From the study it can be concluded that lack of ready market was ranked first by tomato farmers and wholesalers while retailers ranked lack of storage facilities as first.

#### **5.4 Recommendations of the Study**

The findings of the study lead to the following recommendations:

- i. The Ministry of Food and Agriculture (MoFA) through its extension staff should intensify the provision of training for farmers and traders especially females on postharvest handling and management to reduce losses. Farmers must also be educated on record keeping in order to keep account of farming activities.
- ii. The Municipal and District Assemblies and other stakeholders in the study area should provide suitable cooling facilities and physical market structures to traders in order to reduce postharvest losses.
- iii. Through formation of FBOs and Tomato Transport Traders Association (TTTA), farmers and traders can set up processing factories to process tomatoes into other products.
- iv. Seminars and workshops should be organized by the Ministry of Food and Agriculture (MoFA) for farmers on a regular basis on employing good agricultural practices such as improving upon farming practices and the use of improved tomato variety such as Pectomech.
- v. The Municipal and District Assemblies and private sector investors in the study area should improve the road infrastructure linking farms to market centres to reduce transport losses.

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**APPENDICES**

**Appendix 1: QUESTIONNAIRES 001**

**University of Ghana**

**Department of Agricultural Economics and Agribusiness, Legon**

**ASSESSMENT OF POSTHARVEST LOSSES OF FRESH TOMATOES  
ALONG THE TOMATO VALUE CHAIN IN THE UPPER EAST REGION OF  
GHANA**

**QUESTIONNAIRE FOR FARMERS**

This study is an *Assessment of Post-Harvest Losses along the Tomato Value Chain in the Upper East Region* in partial fulfilment of the award of Master of Philosophy in Agribusiness. All information gathered will be treated with much confidentiality and would solely be for academic purposes. Your support and contribution would be very much appreciated. For further enquiries, please contact him on [ganaba001@st.ug.edu.gh](mailto:ganaba001@st.ug.edu.gh) or call 0242071966

**DEMOGRAPHY CHARACTERISTICS**

Date of interview:

1. Name of Interviewer ..... Tel  
No.....
2. District .....
3. Town/Community.....
4. Name of respondent.....
5. Age of respondent .....
6. Gender: 1) Male [ ] 2)Female [ ]

7 What is your educational status? Tick as appropriate

Primary  Middle/JSS  c) Secondary /SSS  Tertiary

Islamic education  none  other.....

8. What type(s) of work (major) do you do in addition to farming? .....

9. How long have you been farming tomatoes? .....yrs

10. What is your tomato farm size now? .....

11. What other vegetable crops do you cultivate?

Lettuce  Cabbage  Beans  Pepper  Green Pepper

Eggplant  Others  (Please specify).....

12. Which cultivar of tomato do you prefer? a) local  b) exotic

13. Is postharvest loss a problem to you? a) Yes  b) No

14. Please name the variety/varieties of tomato you cultivate.

a) ..... b)..... c).....

15. Source of planting materials? a) Family  b) Friends  c) MOFA

d) Others  (Please specify).....

16. What informs your choice

Market preference  ease of cultivation  very portable

less postharvest damage  Others  (Please

specify).....

17. What type of record keeping do you

practice?.....

18 Do you get any form of support to help improve on production?

Yes  / No

19. If "Yes" where did you get this training?

Private institution [ ] Farmer-base organization [ ] MOFA [ ]

Other [ ] (Please specify).....

20. If "Yes" what form of support do you usually get?

Financial [ ] Subsidy of farm equipments [ ] Technical [ ]

Free farm equipments [ ] Free Agrochemical supply [ ] Subsidy on agrochemicals [ ] Other [ ] (Please specify).....

***HARVESTING AND HARVESTING OPERATIONS***

21. How do you harvest your produce?

Manual [ ] mechanical [ ]

22. If Manual, then specify. By knife cutting [ ] by hand twisting [ ]  
cutlass [ ]

23. What is the average maturity period of produce?

2-3 months [ ] 3-4months [ ] 4-5month [ ] If different please specify.....

24. What time of the day do you harvest your fruits?

Early in the morning[ ] After sunset (evening) [ ] Any time of the day[ ]

25. At what stage of maturity of the fruit do you harvest?

When fully ripe[ ] when partially ripe[ ] when green and unripe [ ]

26. How do you check for the maturity of your produce before harvesting?

By hand feel[ ] By visual observation[ ] Uses an instrument to measure [ ]

27. Do you grade your produce immediately after harvesting? Yes [ ] No [ ]

28. What quality indicators do you use for grading your produce? (Tick as many as applicable)

a) colour [    ]

b) size [    ]

c) Weight [    ]

d) shape [    ]

e) Physical blemishes [    ]

29. What quantity of produce do/did you now harvest from your plot?  
.....(kg)

30. What quantity of produce do you sell on farm? .....(kg)

31. What quantity did you give as gift and used in your home for cooking?  
..... (kg)

32. Do you encounter insect pest on the vegetable? Yes [    ] No [    ]

33. Can you name some of these pests

a)..... b)..... c).....

34. What is the nature of damage they cause? Please State

.....  
.....

35. Apart from the pest do your crops experience some disease problems?

Yes [    ] No [    ]

36. Do you know what causes these diseases?

.....  
.....

37. Please describe the losses you incur, including the quantity and during harvesting and

the immediate post-harvest processing.

Stages of Handling	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Harvesting Operations			
Gathering, transport, packing etc at farm			
Grading and sorting operations at farm			
Temporal processing (Drying, curing, etc)			
Transport to home, store, or market			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=rotting of  
fruits 5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage  
8=Boring by insects 9=others (specify)

38. What do you think should be done to minimize these losses?

a).....

b).....

***LOSSES AT STORAGE AND STORAGE PRACTICES***

39. Do you store some of the produce after harvest? Yes [ ] No [ ]

40. If yes, where do you store them before marketing? On farm [ ] At home [ ]

41. How long does your vegetable store?.....(days)

42 Describe the types, and quantity incur during storage at home or farm.

Location of Storage	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Storage on farm			
Storage at home			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=rotting of fruits

5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage 8=Boring by insects

9=Others (specify)

43. How do you package your produce for storage?  
Specify.....

44. What are the major storage problems of your produce?

a) .....

b) .....

45. Do you encounter some pests (insects, mites, and rodents) at storage?

Yes [ ] No [ ]

46 If yes, how do you control these pests?

Specify.....

.....

47. What are some of the ways you adopt to improve the storage life of the vegetables?

.....

.....  
48. Which of the following accounted for the losses? (Tick as many as applicable)

- Lack of ready market [ ]
- Lack of transport of produce [ ]
- Lack of storage facility [ ]
- Poor storage [ ]
- Pest attack [ ]
- Others [ ] (Please specify.....)

49. Do you have any postharvest loss management knowledge?

Yes [ ] / No [ ]

50. If “Yes”, did you acquire this knowledge through a special training in postharvest loss management? Yes [ ] / No [ ]

51. Where did you get this training?

- School [ ]
- Farmer’s forum [ ]
- MOFA farmers’ field day [ ]
- Traditional [ ]
- Other [ ] (Please specify).....

52. Which of the following challenges do tomato farmers face in your community?

Challenges	Rank
Lack of storage facilities	[ ]
Lack of financial support	[ ]
Lack of technical support	[ ]
Lack of ready market	[ ]
Unreliable transport system	[ ]
High cost of production	[ ]

Low pricing  [ ]

Other  (Please specify).....



Primary [ ] Middle/JSS [ ] Secondary /SSS [ ] Tertiary [ ]

Islamic education [ ] None [ ] Other.....

8. What type(s) of work (major) do you do in addition to trading? .....

9. How long have you been in this tomato business? .....yrs

10. What type variety of tomato do you deal in?.....

11. Do you have any reason for your choice? Yes [ ] / No [ ]

12. Give reason for your choice

.....

.....

.....

13. What quantity of tomatoes did you buy in the year 2017?.....(kg)

14. Out of the total quantity of tomato bought in the 2017, how much was sold?.....(kg)

15. What quantity did you give as gift and used in your home for cooking?  
..... (kg)

16. Please provide names for the most important communities where you get your produce.

a)..... b)..... c).....

17. Where do you obtain your vegetable produce from?

On farm [ ] Purchase from farmer [ ] Purchase from retailer[ ]

Others[ ] (Please specify) .....

18. Please describe the losses you incur, including the quantity and during purchasing and immediate post-purchase period.

Stages of Handling	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Gathering packing etc at purchasing point			
Grading and sorting operations home, store, or market			
Transport to home, store, or market			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=Rotting of fruits 5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage 8=Boring by insects 9=Others (specify)

19. What packaging material do you use for your produce?

wooden crates  Cardboard boxes  Woven palm baskets  Plastic crates

Other  (please specify).....

20. Do you transport your produce from the farm gate to the market centres? Yes  / No

21. If "Yes" what is the distance from the farm gate to the market

centres?.....(km)

22. If "Yes", what is your mode of transportation?

Human labour [ ] Rented trucks [ ] By own vehicle [ ] Others [ ]

(Please specify).....

23. Do you incur commodity losses from the point of purchase to the point of sale?

Yes [ ] No [ ]

24. Which of the following accounted for the losses? (Tick as many as applicable)

Lack of ready market [ ]

Lack of transport of produce [ ]

Lack of storage facility [ ]

Poor storage [ ]

Pest attack [ ]

Others [ ] (Please specify).....

25. Do you have any postharvest loss management knowledge?

Yes [ ] / No [ ]

26. If "Yes", did you acquire this knowledge through a special training in postharvest

loss management? Yes [ ] / No [ ]

27. Where did you get this training?

School [ ] Farmer's forum [ ] MOFA farmers' field day [ ]

Traditional [ ] Other [ ] (Please specify).....

28. How do you determine the price of tomato?

Production cost [ ] Availability or scarcity of the product [ ]

Price of other competitors [ ] Other (specify).....

29. Do you usually store produce? Yes [ ] No [ ]

30. If yes, where do you store the produce?

At home [ ] At market or sale point [ ]

**LOSSES AT STORAGE AND STORAGE PRACTICES**

31. Please describe the types, quantity losses you incur during storage at home or market.

Location of Storage	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Storage on farm			
Storage at market or sale point			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=Rotting of fruits 5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage 8=Boring by insects 9=Others (specify)

32. Which storage facility do you keep your produce? Standard storage facility [ ] Improved storage facility [ ] Common storeroom [ ] Other (specify).....

33. How long do you store the produce? Please (specify).....

34. How long does it take to sell your produce? Please Specify.....

35. What do you think can be done to reduce the losses?

.....  
.....  
36. Which of the following challenges do you face as a retailer?

Challenge	Rank
Lack of storage facilities	[ ]
Lack of financial support	[ ]
Lack of technical support	[ ]
Lack of ready market	[ ]
Unreliable transport system	[ ]
High cost of production	[ ]
Low pricing	[ ]

Other[ ](Please specify).....

**University of Ghana**

**Department of Agricultural Economics and Agribusiness, Legon**

**ASSESSMENT OF POSTHARVEST LOSSES OF FRESH TOMATOES  
ALONG THE TOMATO VALUE CHAIN IN THE UPPER EAST REGION OF  
GHANA**

**QUESTIONNAIRE FOR RETAILERS**

This study is an *Assessment of Post-Harvest Losses Along The Tomato Value Chain in the Upper East Region* in partial fulfilment of the award of Master of Philosophy in Agribusiness. All information gathered will be treated with much confidentiality and would solely be for academic purposes. Your support and contribution would be very much appreciated. For further enquiries, please contact him on [ganaba001@st.ug.edu.gh](mailto:ganaba001@st.ug.edu.gh) or call 0242071966

**DEMOGRAPHY CHARACTERISTICS**

Date of interview:

1. Name of Interviewer..... Tel  
No.:.....
2. District.....
3. Town/Community.....
4. Name of respondent.....
5. Age of respondent .....
6. Gender:      Male      [   ]                      Female      [   ]

7. What is your educational status? Tick as appropriate

Primary [ ] Middle/JSS [ ] Secondary /SSS [ ] Tertiary [ ]

Islamic education [ ] None [ ] Other.....

8. What type(s) of work (major) do you do in addition to trading? .....

9. How long have you been in this tomato business? .....yrs

10. What type variety of tomato do you deal in?.....

11. Do you have any reason for your choice? Yes [ ] / No [ ]

12. Give reason for your choice

.....  
.....  
.....

13. Please provide names for the most important communities where you get your produce.

a)..... b)..... c).....

14. Where do you obtain your vegetable produce from? (Tick as many as applicable)

On farm [ ] Purchase from farmer [ ] Purchase from wholesaler[ ]

Others[ ] (Please specify) .....

15. What quantity of tomatoes did you buy in the year 2017 from farmers?.....(kg)

16. What quantity of tomatoes did you buy in the year 2017 from wholesalers?.....(kg)

17. Out of the total quantity of tomato bought in the 2017, how much was sold?.....(kg)

18. What quantity did you give as gift and used in your home for cooking?  
 ..... (kg)

19. Please describe the losses you incur, including the quantity and during purchasing and immediate post-purchase period.

Stages of Handling	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Gathering packing etc at purchasing point			
Grading and sorting operations home, store, or market			
Transport to home, store, or market			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=Rotting of fruits 5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage 8=Boring by insects 9=Others (specify)

20. What packaging material do you use for your produce?

wooden crates [ ] Cardboard boxes [ ] Woven palm baskets [ ] Plastic crates [ ] Other [ ] (please specify).....

21. Do you transport your produce from the farm gate to the market centres? Yes [ ] / No [ ]

22. If "Yes" what is the distance from the farm gate to the market



30. Do you usually store produce? Yes  No

31. If yes, where do you store the produce?

At home  At market or sale point

**LOSSES AT STORAGE AND STORAGE PRACTICES**

32. Please describe the types, quantity losses you incur during storage at home or market.

Location of Storage	Nature of loss (see code below)	Quantity of produce harvested (weight)	Estimated losses (Quantity)
Storage on farm			
Storage at market or sale point			

1=Weight loss 2=Presence of insects 3=Destruction by rodents/birds 4=Rotting of fruits 5=Wilting and shrinking 6= Microbial or disease infections 7=Spillage 8=Boring by insects 9=Others (specify)

33. Which storage facility do you keep your produce?

Standard storage facility  Improved storage facility  Common storeroom   
d) Other (specify).....

34. How long do you store the produce?

Please (specify).....

35. How long does it take to sell your produce? Please Specify.....

36. What do you think can be done to reduce the losses?

.....  
.....

37. Which of the following challenges do you face as a retailer?

Challenge	Rank
Lack of storage facilities	[   ]
Lack of financial support	[   ]
Lack of technical support	[   ]
Lack of ready market	[   ]
Unreliable transport system	[   ]
High cost of production	[   ]
Low pricing	[   ]
Other [   ] (Please specify).....	

**Appendix 2: Tobit regression results of the determinants of fresh tomato losses in detailed**

Variable	Coef.	Std. Err.	t	P >  t	95% Conf.	Interval
Wholesaler	17.97954***	3.682096	4.88	0.000	10.71336	25.24572
Retailer	8.959855	5.493116	1.63	0.105	-1.880156	19.79987
Basic education	-2.38981	1.945355	-1.23	0.221	-6.228738	1.449117
Gender	-4.667372*	2.628274	-1.78	0.077	-9.853956	0.5192134
Experience	-0.0080656	0.1326487	-0.06	0.952	-0.269321	0.2537008
PHL training	-4.405784*	2.361396	-1.87	0.064	-0.2541496	9.065718
KassenaNankana						0.6393247
Municipal	-3.738001*	2.218186	-1.69	0.094	-8.115327	
Bolgatanga			-2.68		-11.47843	-1.741182
Municipal	-6.609806***	2.467149		0.008		
Ready market	-1.041244	2.058243	-0.51	0.614	-5.102941	3.020452
Storage facility	0.6032911	0.9855423	0.61	0.541	-1.341559	2.548142
Transportation			1.48		-1.1173	7.830928
method	3.356814	2.267233		0.140		
Length of storage	2.501443	2.476625	1.01	0.314	-2.385882	7.388768
//sigma	11.78506	0.6584327	3.00		3.94092	19.16086

No. of obs =190; LR chi2 (12)=84.05;

Prob>chi2=0.0000; Pseudo R2=0.0588

\*, \*\* and \*\*\* denotes significant levels of 10%, 5% and 1% respectively

**Appendix 3: Field pictures**



