

UNIVERSITY FOR DEVELOPMENT STUDIES

**FACTORS INFLUENCING POSTHARVEST LOSSES AMONG
VEGETABLE FARMERS AND TRADERS IN THE NORTH EAST
REGION OF GHANA**

KINGSLEY BEKANUO GANDAA



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VEGETABLE FARMERS AND TRADERS IN THE NORTH EAST
REGION OF GHANA**

BY

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**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF
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AWARD OF MSc. HORTICULTURE DEGREE**

DECEMBER, 2022



DECLARATION

Student

I hereby declare that this dissertation/thesis is the result of my original work and that no part of it has been presented for another degree in this University or elsewhere:

Candidate:

Signature..... Date.....

Name.....

Supervisors

I hereby declare that the preparation and presentation of the dissertation/thesis was supervised following the guidelines on supervision of dissertation/thesis laid down by the University for Development Studies.

Principal Supervisor

Signature..... Date.....

Name.....

Co-Supervisor

Signature..... Date.....

Name.....



DEDICATION

To my family, mother (Mrs. Christina Beneb), in memory of my father (Dr. Harold Bekanuo Gandaa) and my better half (Mrs. Dorcas Tiewul).



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ABSTRACT

A study was conducted in the north east region of Ghana to ascertain the vegetables produced and marketed by farmers and traders respectively and determine the causes of post-harvest losses among the farmers and traders. Multistage random sampling procedure was used to select respondents and a set of structured questionnaires were administered. The data collected were analyzed using simple descriptive statistics. 126 vegetable farmers and 45 vegetable traders were interviewed. The findings showed that majority (73 %) of vegetable producers in the North East Region were men, whereas majority (80%) of the traders was women. Also, 85.7 % of farmers and 93.3% of traders were in the age range of 20 - 50 years. The study also showed that majority (54.8%) of farmers in the Region did not have formal education likewise majority (40%) of the traders. Further, 65.1 % of the farmers and 66.7 % of the traders in the Region were married. About 15.87 % of the farmers and 20 % of the traders were widows. About 68.3 % of the respondents had 1 - 5 years of vegetable production experiences. Also, 27 % of the respondents had 6 - 10 years vegetable production experience while 3.2 % and 1.6 % had 1 - 15 years and above 15 years had production experiences respectively. Also, 36.5 % of farmers produced leafy vegetables while 31.7 % in each case produced tuber vegetables and fruit and bulb vegetables. At the trader level, 60% traded leafy vegetables, 33.33 % traded fruit and bulb vegetables while 6.67% traded tuber vegetables. Pest and disease attack, rot, poor handling, change in rainfall pattern, transportation systems and road network and insufficient/poor storage facilities were identified as the causes of vegetable losses at the farmer level in the Region. On the other hand, poor road network, lack of ready market, lack of quality packaging materials, poor handling and inadequate storage infrastructures were recorded as causes of vegetable loss at the trader level. It is therefore important that periodic trainings be conducted for vegetable farmers and traders in the study area on good agricultural and handling practices while good road networks in addition to production and market infrastructure be put in place for enhanced vegetable business.



TABLE OF CONTENTS

DECLARATION..... i

DEDICATIONii

ACKNOWLEDGEMENTSiii

ABSTRACTiv

LIST OF TABLESviii

LIST OF FIGURESix

ACRONYMSx

CHAPTER ONE..... 1

INTRODUCTION 1

 1.1 Background 1

 1.2 Problem Statement 3

 1.3 Justification of the Study..... 3

 1.4 Research Objectives 4

 1.4.1 General objective 4

 1.4.2 Specific objectives 4

CHAPTER TWO..... 5

LITERATURE REVIEW 5

 2.1 Definition of Vegetables 5

 2.1.1 Tuber Vegetable..... 6

 2.1.2 Bulb Vegetable 6

 2.1.3 Root Vegetable 7

 2.1.4 Stem Vegetable 8

 2.1.5 Leafy Vegetable..... 8

 2.1.6 Flower vegetable..... 9

 2.2 Basic Concepts of Postharvest Losses of Food..... 9



2.2.1	Types of losses in the post-harvest system	10
2.2.2	General post-harvest food losses	12
2.2.3	Ways in which losses occur	14
2.2.4	History of Post-Harvest Technology	15
2.2.5	Role of Post-Harvest Technology in Economic Development	16
2.2.6	Components of the Post-Harvest System.....	16
2.2.7	Types of Food Crops Stored	17
2.3	Activities Contributing to Vegetable Losses.....	19
2.3.1	Harvesting	19
2.3.2	Pesticide Application	19
2.3.3	Sorting and Grading	20
2.3.4	Packaging	20
2.3.5	Transportation	21
2.3.6	Storage	22
2.3.7	Marketing	22
2.4	Other factors influencing Postharvest Losses	23
2.5	Vegetable Production in Ghana	25
2.6	Postharvest Losses Estimation	26
CHAPTER THREE		28
MATERIALS AND METHODS		28
3.1	Description of the study area.....	28
3.2	Conceptual Framework	29
3.3	Data Collection.....	31
3.3.1	Data Sources	31
3.3.2	Sampling and sample size.....	31



3.4 Data analysis and presentation	32
CHAPTER FOUR	33
RESULTS	33
4.1 Brief Background of Respondents	33
4.2 Respondents years of Experiences in vegetable production	35
4.3 Types of vegetables produced and traded in the Region.....	36
4.4 Causes of Post-Harvest Losses of Vegetables at the Farmer level in North East Region.	37
4.5 Causes of Postharvest Losses of vegetables at the Trader Level in the North East Region	38
CHAPTER FIVE	40
DISCUSSION.....	40
5.1 Brief Background of Respondents	40
5.2 Respondents years of experiences in vegetable production.....	41
5.3 Types of vegetables produced and traded in the region	42
5.4 Causes of Postharvest Losses of Vegetables at the Farmer Level in North East Region	42
5.5 Causes of Postharvest Losses at the Trader Level in the North East Region	43
CHAPTER SIX	44
CONCLUSION AND RECOMMENDATIONS	44
5.1 Conclusion.....	44
5.2 Recommendations	45
REFERENCES	46
APPENDIX	53



LIST OF TABLES

Table 2.1 : Differences between durables and perishables..... 18

Table 4.1: Brief Background of Respondents 34

Table 4.2: Causes of Post-Harvest Losses of Vegetables in North East Region at the farmer level..... 38



LIST OF FIGURES

Figure 1: Tuber vegetable (Source; World Crops Database 2023). 6

Figure 2: Bulb vegetables (Source; World Crops Database 2023)..... 7

Figure 3: Root vegetables (Source; World Crops Database 2023)..... 7

Figure 4: Stem vegetable (Source; World Crops Database 2023)..... 8

Figure 5: Leaf vegetable (Source; World Crops Database 2023)..... 9

Figure 6: Map of the North East Region of Ghana 29

Figure 7: Conceptual Frame work..... 30

Figure 8: Respondents years of Experiences in vegetable production 35

Figure 9: Types of vegetables produced at the farmer level (A) and the trader level (B) in the North East Region. 37

Figure 10: Causes of Postharvest Losses at the Trader Level in the North East Region..... 39



ACRONYMS

C.I	Constitutional Instrument Directorate
CIRAD	Centre de cooperation internationale en recherché agronomique pour le development
FAO	Food and Agriculture Organization
GA	Fruit General Appearance
GASGA	Group for Assistance on Storage of Grain after Harvest
HA	Hectar
IDRC	International Development Research Centre
IITA	International Institute of Tropical Agriculture
JHS	Junior High School
KG	Kilogram
MDAs	Municipal District Assemblies
MMDAs	Metropolitans, Municipal, District Assemblies
MoFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organizations
<i>PhA</i>	Postharvest Action
PPRSD	Plant Protection and Regulatory Service Directorate
SHS	Senior High School
SPSS	Statistical Package for Social Scientist
TPI	Tropical Products Institute
WL	Weight Loss



CHAPTER ONE

INTRODUCTION

1.1 Background

Fresh fruits and vegetables are good sources of vitamins and minerals (Abushita, 2000). Postharvest management and storage conditions have an impact on the nutritional value and quality of horticultural produce (Sabani et al., 2006). Vegetables are normally harvested when their moisture levels are high unlike non-horticultural crops, which are harvested when the plant is ripe for grains, pulses, oil seeds, or fiber.

Solutions to issues of crop losses need to be prioritized for the improvement of income levels of farmers, the reduction of food insecurity, and the elimination of poverty and starvation, particularly in less developed nations (FAO, 2010). This may be because crop losses have a detrimental effect on the environment, food quality, and financial development. Globally about 1.3 billion tonnes of food are lost annually (FAO, 2011). Due to agricultural losses, water, land, management skills, labour, and other inputs that should have been channeled to profitable uses are all wasted.

Postharvest losses of vegetables stood at 40 % of total production due to bruising, diseases and pests, deterioration, excessive heat (Kitinoja, 2002; Ray and Ravi, 2005; Meena et al., 2009). As a result, losses after harvest are identified as a major contributor to food scarcities among third world nations.

In Ghana, postharvest losses are a major source of food scarcity (Babalola et al., 2010). Technological approaches towards minimizing postharvest losses are becoming increasingly important as a huge amounts of crop produce are



transferred to non-production areas to be stored for longer periods (Oyekanmi, 2007). Despite global efforts to improve production of food, accessibility to sufficient quantities of food remains a big challenge in underdeveloped countries. One of the issues that arise in the postharvest and market framework is food loss. By reducing food loss and increasing food production, the situation can be reversed, resulting in an increase in availability of food to meet demand.

Generally, food losses do not only affect yields of food produced, but also its presence and accessibility, and the opportunity for healthy foods to be sold. These losses have a significant impact on farm revenues in many locations. The quantities of food available increase when fresh produce losses decrease (Sablani et al., 2006).

Food loss occurs along the production to consumption pathway due to poor managerial skills and insufficient infrastructural facilities. Crop losses may be quantitative or qualitative (Egyir et al., 2008). Qualitative losses have to do with reduction in nutritional value and consumer preference. Quantitative losses refers to the reduction in weight of food material (on dry basis) between any two points of the postharvest system. Aulakh et al. (2013) reported that total crop losses after harvest are estimated to include losses from the farm, markets and consumption points.

Due to the perishable nature of vegetables and fruits, producers are confronted with quality challenges delivering them to market centers or during distribution. In addition, postharvest losses occur due to long distances between farm gates and markets, poor packaging, poor storage structure conditions and transportation networks (Alidu et al., 2016).



It is reported that in developing countries, up to 20 - 50 % losses occur in vegetables and fruits after harvest compared with 5 - 25 % in the developed world (Kitinija and Kamire, 2002; Kulanthai et al., 2006).

1.2 Problem Statement

Vegetable farmers and traders in the North East Region of Ghana are confronted with production and marketing problems.

According to Robinson and Kolavali, (2010), farmers and traders faced problems including lack of ready markets, fluctuations in rainfall patterns, seasonal production, pricing, poor quality of fruits and vegetables, and the lack of processing factories leading to inadequate production and marketing. Ayandiji et al. (2011) reported that little efforts have been made towards reducing postharvest losses in fruits and vegetables albeit large sums of money have been spent on irrigation, fertilization, and crop protection. Adepoju (2014) posited that postharvest food losses increase with poor handling of fruits and vegetables and the lack of storage facilities for farmers and traders.

1.3 Justification of the Study

Vegetables are highly perishable crops and liable to quick deteriorations and losses when poorly handled after harvest. Therefore, the need to avoid these losses cannot be over-emphasized especially against the rationalization that vegetables are in high demand among the consuming public.

The study explored the causes of postharvest losses of vegetables among farmers and traders in the North East Region of Ghana and would serve as a policy document to guide policy makers including Non-Governmental Organizations in the agricultural sector.



1.4 Research Objectives

1.4.1 General objective

The main objective of the research was to investigate the factors that influence post-harvest losses among vegetable farmers and traders in the North East Region of Ghana.

1.4.2 Specific objectives

- i. To identify and sample vegetable farmers and traders in the North East Region of Ghana.
- ii. To determine the types of vegetables produced and marketed in the region.
- iii. To determine the causes of post-harvest losses among vegetable farmers and traders in the region.



CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of Vegetables

A vegetable refers to any vegetative (tuber, bulb, root, stem, leaf, or flower) portion of a plant that can be consumed. Botanically, fruits and vegetables are classified depending on which part of the plant they come from. A fruit develops from the flower of a plant and contain seeds, while the other parts of the plant are classified as vegetables.

Vegetables are among the major sources of micronutrients in human diet. Vegetables are the edible plant organs of crops, excluding the fruits of shrubs and perennial trees that are picked and consumed when still fresh. Vegetables constitute crucial components of human nutrition, even though they are highly perishable. They include edible plant parts such as fruits, leaves, tubers, stems, roots, stalks, bulbs, and blossoms, and are often taken raw or in the cooked form. These include tomatoes, onions, amaranthus, okra, peppers, pumpkin, melon, carrots etc. Incorporating fruits and vegetables into one's regular diet has been linked to a lower risk of stroke, cardiovascular diseases, and cancers, to mention a few. Fruits and vegetables, due to their physiological makeup, deteriorate quickly in transit and storage, especially when ambient temperatures are high and relative humidity is low, resulting in significant crop losses. As a result, vegetable production necessitates close attention to all production processes as well as after harvest.



Vegetables have high moisture content which makes handling, transportation, and trading difficult, especially in the tropics where the environment is mostly unfavourable for preservation of fresh vegetable quality.

2.1.1 Tuber Vegetable

The potato is an example of a vegetable tuber. It is different from the root of the plant in that it is a special organ designed to store starches. Each year, the leaves of the plant will die back and regrow from the tubers in the spring.



Figure 1: Tuber vegetable (Source; World Crops Database 2023).

2.1.2 Bulb Vegetable

Anything in the *Allium* Family. Onions, shallots, leeks, and garlic are all examples of bulb.





Figure 2: Bulb vegetables (Source; World Crops Database 2023).

2.1.3 Root Vegetable

When the root of the plant is eaten, it is called root vegetables. Examples include carrots, parsnips, and beats.



Figure 3: Root vegetables (Source; World Crops Database 2023).



2.1.4 Stem Vegetable

The stems of asparagus, celery, rhubarb, and kohlrabi are commonly eaten and they are termed as stem vegetables.



Figure 4: Stem vegetable (Source; World Crops Database 2023).

2.1.5 Leafy Vegetable

The leaves of many plant varieties are consumed. Lettuce and spinach are two common varieties, though, cabbage and Brussels sprouts are also the leaves of the plant.





Figure 5: Leaf vegetable (Source; World Crops Database 2023).

2.1.6 Flower vegetable

Cauliflower and broccoli are both the flowers of the plant that are consumed before the flowers fully bloom. In contrast, fruits are seed containing organs that result from pollination.

2.2 Basic Concepts of Postharvest Losses of Food

When improper harvesting methods are used, as well as inadequacy of facilities at transit, storage, and even at sales point, postharvest losses occur. Postharvest losses occur after fresh vegetables have been harvested and transferred from the production source to the sales outlets. In the food supply chain, postharvest loss is also known as waste (Parfitt et al., 2010). Postharvest losses have also been divided into two categories namely qualitative and quantitative. The term qualitative loss refers to a reduction in nutritional value as well as odd changes in the appearance of food. Loss of nutritional and hydrocarbon value, loss of consumer acceptability, and loss of edibility are all examples of qualitative loss.



Quantitative loss refers to the loss of a physical commodity, resulting in a shortage in the quantity available (Egyir et al., 2008; Aulakh et al., 2013; Buzby and Hyman 2012).

2.2.1 Types of losses in the post-harvest system

Loss is a measurable decrease in food, which may be quantitative or qualitative, it is thus, any part of food that is desired but fails to reach its point of utilization (consumption) or if utilized fails to yield its full potential value (Siddiqui et al., 2015). Loss is shown in several ways including weight loss (quantitative), quality loss (qualitative), nutritional loss, seed loss (viability or germination), economic loss (monetary), loss of good will (reputation), unit loss (theft, embezzlement, fraud) and loss of marketing opportunities for the farmer, trader and consumer (Aulakh et al., 2013)

2.2.1.1 Weight loss occurs when there is a reduction in weight of food material (on dry basis) between any two points of the post-harvest system. Such physical or quantitative weight loss is caused by biotic and abiotic factors e.g evaporation of moisture, feeding by insects, rodents, birds and spillage. To determine weight loss it is important to know the weight of every unit of produce at the start and at the end of the period of storage.

2.2.1.2 Quality loss is subjective and difficult to measure and is influenced by experience and status. This is considered very important in the developed countries. This occurs because of several factors including:

- Foreign contaminants (e.g excreta, faeces, urine, insect bodies, plant fragments, stones, earth, shells, husks, hairs and droppings).



- Extremes of temperature and moisture.
- Moulds and mycotoxins.
- Poor harvesting (bruised, cracked or broken produce). On the basis of appearance products are graded by uniformity of size and colour, texture and mixture of dirt.
- Presence of smell and flavor.
- Chemical data e.g oil content, acidity, moisture content and toxins present or absent.

2.2.1.3 Nutritional loss represents a decrease in the food value of the produce due to lowering of its protein, hydrocarbon and vitamin content. It occurs when the consumed food fails to produce its potential nutrient value either due to damage by insects, rodents, birds or deterioration by micro –organisms. Some pests selectively feed on some portion of the grain. Thus, rodents and caterpillars consume the germ, thereby destroying a high proteins and vitamins proportion. Weevils eat the endosperm and reduce the hydrocarbon content. A reduction in nutritional value can also affect the productivity of people. Nutritional loss is often overlooked in the developing world where because of food shortages, people just need food to fill their bellies and are less concerned about the nutritional value of the food they consume.

2.2.1.4 Loss in seed viability manifests in poor germination capacity and may have serious effects on the amount of food required the following year. It occurs through attack by insects, mites and rodents, which eat the germ and also from excessively broad variations in light, humidity or temperature.



2.2.1.5 Economic or monetary loss occurs when loss reduces income or necessitates expenditure to prevent it. When a farmer is forced to sell at the time of plenty (harvest time) at lower prices because he or she is unable to store, it amounts to economic loss. Damage done to packaging or storage containers (e.g sacks, sheets) because of activities of pests and anything that makes repairs necessary constitutes monetary loss.

2.2.1.6 Loss of goodwill (reputation): The concept of a country having a good or a bad reputation due to the quality of its produce in the world's market is comparatively new. However, there continue to be a growing prestige having the capacity to provide high quality produce. Local traders are now aware of the benefits (financial and otherwise) derived if business is built around quality and strict warehouse hygiene standards. As products meant for exports have to meet growing stringent standards, their reputation for quality will have considerable effects for the country's economy.

2.2.1.7 Unit loss represents theft, embezzlement and fraud with regard to true weight, and products that are carried away by rodents and birds, spillage from bags torn during handling or worn by rotting of fibers or attack by termites or bags in which holes have been made by rodents.

2.2.2 General post-harvest food losses

Food losses after harvest are highly locally specific in amounts and in their impact. Whereas loss suffered by crops growing on the field may be compensated by increased yields from other surviving plants, losses in the harvested produce are irrecoverable. The FAO (Food and Agriculture Organization) estimates one third (1/3) of loss occur every year with food products. The US National



Academy of Sciences estimated the total post-harvest loss to the developing world as 107 million tonnes valued at over \$105 billion dollars in 1976. A 50% decrease in post-harvest food losses in emerging countries would eliminate importation of food by some countries. Post-harvest losses mainly occur in developed and third world countries Supriya N. (2022). Naturally food losses occur through microbial attack, enzymatic action and chemical degradation. A greater portion of the food is lost at the level of quality standards. Population growth has reduced the food resources, as a result the management of the food loss is now of critical concern,

The awareness of the magnitude of this problem had been realized earlier and most countries were tasked to take action against post-harvest losses as a matter of urgency. To achieve this objective an organization called Group for Assistance on the Storage of Grains in Africa (GASGA) was formed in 1971. Although the acronym GASGA remained the same, the association changed its name to the Group for Assistance on Systems Relating to Grain after harvest and further changed to Group for Assistance on Storage of Grain after Harvest (GASGA). The five foundation organizations were IRAT (Institute de recherches agronomiques tropicales et des cultures vivries) (now CIRAD- Centre de cooperation internationale en recherche agronomique pour le developement (France)), IDRC (International Development Research Centre), IITA (International Institute of Tropical Agriculture), FAO (Food And Agriculture Organization Of The United Nations) and TPI (Tropical Products Institute) (now NRI- Natural Resource Institute (UK)). The main objectives of GASGA were to co-ordinate activities on post-harvest technology and to set up systems to prevent post-harvest losses. However, in 1999 a new global post-harvest forum,



PhAction, was created to replace GASGA. *PhAction* is to portray a more active approach to intervention within the post-harvest sector.

2.2.3 Ways in which losses occur

Post-harvest food losses occur through the following:

- Spillage and contamination.
- Attack by insects, mites, birds and rodents.
- Deterioration by fungi and bacteria.
- Primary processing, handling, storage.
- Environmental factors (temperature, moisture content, relative humidity, gases).
- Harvesting, transportation, drying, threshing, shelling.

Prevention of these losses would result in several benefits including:

- More and better-quality food available for consumption and sale by farmers.
- Increased incomes and higher living standards for farmers from the sale of increased quantity and better-quality products.
- Availability of more food to the non-farming population.
- Higher quality and competitiveness of export commodities in international trade.
- Improved transportation and marketing arrangements.
- Economic soundness for the country and pride in its global image.



2.2.4 History of Post-Harvest Technology

Storage of foodstuffs has been practiced from ancient times. Even some animals practiced storage to some extent. For example, squirrels hoard nuts, leopards store carcasses in trees. Ancient men preserved food by making roots that enabled them to live at one place as a country. Valley Food Storage (2019), reports food no longer had to be consumed in their raw forms or immediately after harvest, but could be preserved for use later. Each culture preserved their indigenous food sources using the same simple ideas of food preservation. In other words, it allowed civilization to form as their best survival foods were preserved.

The development of post-harvest technologies, such as the ability to store, was essential for the early development of human civilization. As humans evolved (14-16 million years ago) they moved from living at the edge of the tropical rainforest gathering fruits and nuts into the savannah. This meant that people had to cope with seasonal excess and shortages. This was only possible as people learnt to store their food. This time the human diet changed to include seeds as well as fruit, roots, tubers and meat. Seeds in the form of grains were more easily stored than the other forms of food. The evidence is also that the earliest crops to be domesticated were those that were easy to store, for example, wheat which was necessary not only as a food source, but to provide planting materials in subsequent years.

The early storage of grain seems to be associated with the development of fired clay pots. It is known that underground pits and silos were used 9000-11000 years ago in the Middle East and North Africa. Today both simple and sophisticated equipment are in place for storage after harvest. Humans continue



to domesticate other crops, but all early domesticated crops were notably easy to store e.g chickpeas, lentils, faba beans and later almonds, walnuts, figs, dares, apricots, grapes, olives etc.

2.2.5 Role of Post-Harvest Technology in Economic Development

Among the important roles played by a well-developed and efficient post-harvest system are:

- Attainment of food security by minimizing losses and ensuring quality.
- Lessening of poverty (more bearable).
- Reduction in post-harvest losses.
- Ensuring food safety, high quality and nutritive value of products.
- Acceleration of economic growth and development based on the establishment of agro processing industries.
- Employment generation.
- Income/revenue for the state and individuals.
- Availability of diverse variety of food producer products for consumption.
- Ensuring the availability of food and convenience of use.

2.2.6 Components of the Post-Harvest System

The major components of the post-harvest system include:

- Harvesting.
- The agricultural produce (form, varieties/breeds).
- Environmental factors (temperature, relative humidity, moisture, gases, light etc.)
- Presence of pests and diseases.



- Stored product environment.
- Structures for storage.
- Conveying and transportation.
- Processing and preservation other than for fresh market.
- Packaging and environmental issues.
- Quality assurance thus provision of confidence that quality requirements will be fulfilled via standards.
- Micro enterprise development.
- Marketing of agricultural produce following food laws and regulations.

2.2.7 Types of Food Crops Stored

Stored products can be grouped into two namely durables and perishables. Durable products have inherent ability to be stored for long without deteriorating because they designed by the plant for preservation. Examples are cereals (e.g maize, rice, wheat, sorghum, millet, barley, rye, oats) and grain legumes (e.g cowpea, groundnut, Bambara groundnut, soybean, chick pea, lima bean, broad bean, green/black gram, French bean, yardlong bean etc.). Plant products first stored and transported by man were all durables.

Perishable products need to be processed as they cannot be stored for long without deteriorating. They have storage life of a few days to months naturally depending on the type of produce. Perishable crops include fruits (e.g plantain/banana, mango, pineapple, citrus, pawpaw, and pea), vegetables (tomato, onion/shallot, okra, garden egg, pepper, cabbage, cauliflower, lettuce, cucumber, and watermelon), root and tuber crops (e.g cassava, yam, potato, cocoyam, sweet potato) and ornamentals. Perishable products show considerable variation in their



keeping qualities. As living tissues, perishables products modify the environment in which they are stored, by:

- Metabolizing to produce heat
- Respiring by using oxygen and producing carbon dioxide
- Losing water
- In some cases, attempt to reproduce. At the same time their requirements (light, water, mineral nutrients etc.) to sustain life are cut off or are no more supplied (from the mother plant) after harvest.

In most cases the post-harvest technologist needs to slow down metabolism in order to reduce the rate of developmental changes, senescence and decay. The main differences between durable and perishable products are summarized in the following table,

Table2.1 : Differences between durable and perishable vegetables

Durables	Perishables
Naturally designed for preservation	Not designed for preservation
Moisture content usually low, 10-15%	Moisture content usually high, 50-90%
Unit size is small less than one-gram	Unit size is large 5g to 6kg
Hard texture	Soft texture
Stable with inherent storage life of years	Perishable with natural storage life of a few days to months
Losses mainly caused by external factors (fungi, insects, mites, rodents, birds, molds)	Losses caused by external factors (fungi, bacteria and internal factors (respiration, sprouting, ripening, senescence and germination)



2.3 Activities Contributing to Vegetable Losses

2.3.1 Harvesting

The life span of vegetables finishes with harvesting, but it begins with a series of critical procedures that ensure that consumers receive it in the best possible condition. Vegetable harvesting is labour-intensive, according to Orzolek et al. (2006), and fruits should be collected in a matured green stage to prevent over ripeness during transit to long-distance market outlets. They argued that vegetables should only be harvested when they are still green and the presence of available market. Farmers typically gather fresh vegetables with their hands, though this differs by grower. Because vegetables are perishable and easily damaged, plastic buckets with clean edges are utilized during harvesting (Kitinoja, 2008).

Because vegetables are prone to bruising, good quality fresh vegetables should be harvested. As a result, suitable harvesting techniques must be followed (Hurst, 2010). He advised farmers not to dump fresh vegetables into collecting crates at a height of more than 6 inches during harvesting because this promotes bruising.

2.3.2 Pesticide Application

The FAO (1988) specifies how insecticides should be used. Only pyrethroid insecticides that breakdown easily should be sprayed on the field for the first two weeks (before to harvesting). They propose that pesticides such as Diazinon, Dimethoate, and Sumithium in the organophosphate class, and Karate in the pyrethroid class, be used in the desirable and proper ways. Because the presence of insecticides and other chemical substances on product affects quality, Haleegoah et al. (2006) reported that spraying should be done at the appropriate



time. When pesticides are used on crops, they have both short and long-term effects (Behera, 1999). The less persistent ones, on the other hand, are generally suggested for use on vegetables and other food crops because they breakdown more easily (PPRSD MoFA, 2000).

2.3.3 Sorting and Grading

To avoid contamination, sorting is practiced in the spraying of insecticides to discard broken fresh products (Kintinoja and Kader, 2005). Postharvest losses occur regularly at transit, handling, preservation, and processing, and these losses invariably accounts for secondary sources of loss. The losses are caused by bruising and mechanical damage caused by hard handling of goods during sorting and grading while preparing fresh fruits for the market. In addition, an inefficient transportation infrastructure raises the danger of crop degradation and microbial growth (Barbosa-Canovas, 2003). During harvesting, poor postharvest treatment causes bruising and microbial infection in fresh vegetable fruits, particularly when the fruits are exposed to touch with polluted dirt. Time wasted during harvesting and grading is affected by heat build-up on farms, which eventually leads to senescence (Sudheer and Indira, 2007).

2.3.4 Packaging

Freshly harvested vegetables must be transported to a packing house for the various unit operations such as cleaning, post-grading, treatment, and packing for transportation and marketing. Such a technique greatly lowers postharvest losses. All vegetables require particular care before being transported (Sudheer and Indira, 2007). Before packaging, all such procedures as washing, grading, waxing, and pre-cooling of fruits must be completed in a parking lot.



Fresh vegetable packaging has a huge impact on reducing food waste. When vegetables are correctly packaged throughout storage, transit, and marketing, postharvest losses such as mechanical damage, undesired physiological adjustment, and pathological decay can be avoided. Through adequate packing, high-quality fruits and vegetables can be preserved for a longer period of time (Sudheer & Indira, 2007). Fresh vegetables packaged in wooden containers suffered considerable losses, (Issahaku, 2012). The author further reported that, nearly a quarter of the sample size were lost owing to low quality vegetables and improper handling activities, such as combining cartons and head pans and spilling wooden boxes.

2.3.5 Transportation

Transportation refers to all modes of transport utilized to transport foods from their point of origin to their final destination. Due to the perishability of tomato fruits, poor handling and transportation result in mechanical injury to fresh vegetables. They estimated that roughly 20% of vegetables were lost during transportation from Bolgatanga to Accra Bani et al. (2006). According to Muhammed et al. (2012), vegetables must be delivered in ventilated trucks to avoid heat buildup and rain. Addo et al., (2015) reported that vegetables delivered on substandard roads in tropical places rot faster than those transported on motorable roads in relatively chilly areas. At the relative cold zones, an estimate of roughly 25% postharvest loss was recorded. Poor road conditions create vehicle vibration, poor packaging materials and harvesting techniques cause mechanical injury, while improper handling promotes vegetable postharvest losses (Idah et al., 2007).



2.3.6 Storage

Moisture retaining films are employed in vegetable crops to reduce moisture content, which is more important to customers. Produce that has been packaged has a longer shelf life than produce that has not been prepared (Sudheer and Indira, 2007). In comparison to non-wrapped vegetables with proof cellulose film, they claim that vegetables encased with proof cellulose film lose 25 percent less weight. In tropical and subtropical zones, keeping fresh vegetables without cold storage technologies is more difficult than in cold zones, hence vegetables must be dispatched to market outlets sooner in tropical zones than in cold zones (Adarkwa, 2011). In Ghana some vegetable farms or retail markets lack storage systems, and those that have storage systems lack aeration and refrigeration (Kitinoja and Gorny, 2009).

According to Ashby (2000), the optimal conditions for transporting fresh green developed vegetables are temperatures of 13°C to 21°C and relative humidity of 90- 95%. Green developed vegetables may only be preserved for 16–24 weeks at a temperature of 10°C and an average humidity of 80 percent (FAO, 2008). Ellis et al. (1988) reported that tomato farmers encounter pertinent postharvest challenges and require a timely market for their produce as well as a stable cost per container since their produce is stored on farm or in wholesale or retail markets.

2.3.7 Marketing

Marketing cooperative groups are required to make assembling sites available to vegetable growers, (Kader, 2004), put their produce together at one specific spot for convenient transit to markets or sale stations. He also remarked that



Metropolitan/Municipal/District Assemblies (MMDAs) and marketing cooperatives, rather than the private sector, can be involved in the establishment and improvement of sale centers.

Vegetable harvests must be delivered to sites where they can be sold when there is a ready market. Postharvest losses of fruit vegetables, such as tomatoes, can be prevented with a well-planned market system that allows farmers, and distributors to supplement their returns (Sudheer and Indira, 2007).

2.4 Other factors influencing Postharvest Losses

In contrast to the use of motorcycles or bicycles and in the case of head loads, Ayandiji et al. (2011) reported that the employment of vans or pick-ups as a source of transportation that provided the highest frequency may not automatically increase postharvest losses. This signifies that a good mode of transportation will reduce quantity losses to the absolute minimum. The study found that as the distance between the farm and the sales point grows, so does the amount of fresh fruit lost. This was attributed to overcrowding and the vegetables being packed for a considerable length of time. The number of days spent in the field or on the vine after maturity, as well as the number of baskets of vegetables collected, have a significant influence on postharvest losses (Moomin, 2005). With a determination coefficient of 0.95, the impacts of the independent variables were substantial at a 5% significance level. Fruit ripens and softens as it ages, and these are sensitive to mechanical injury and fermentation as they age, will result in increased losses as the maturity level of the vegetables at harvest increases. As the size of the farm grows, so does the amount of food lost due to improper handling and a lack of suitable storage facilities.



According to Aidoo et al. (2014), exponential log regression analysis, farmer gender (female), farm size, and period of storage were positively associated with postharvest losses, whereas farmer-based association membership, household dimension, and kind of cultivar grown negatively related with postharvest losses. The F-Statistics were significant at 1%, indicating that all regresses had a substantial effect on vegetable postharvest loss.

Seasonal influences on commodity production affect quantity, quality and other essential variables of market performance including levels of transactions, market facilities, decisions of arbitrage, and trade movements between spatially linked markets (Amikuzuno et al., 2010).

According to Addo et al. (2015), postharvest losses in the Upper East Region were assessed to be 10.85 percent, with the highest losses occurring at harvest operations and the lowest across the value chain. He attributed the losses to a combination of late harvesting and pest and disease attacks. The Ashanti and Greater Accra are also present. He also said that socioeconomic factors such as gender, age, marital status, level of education, family size, and tomato production and handling experience influenced postharvest losses.

Experience, maturity of fruit at harvest, quantity collected (crates); household size, and academic backgrounds were all found substantial (Alidu et al., 2016). All of the explanatory variables had an undesirable substantial effect on postharvest loss, except quantity collected, which appears to have a positive significant effect on loss, according to their findings. Their regression results reveal that Prob. > F = 0.000, indicating that the entire model is fit, and R2 =



0.761, indicating that the explanatory factors explain 76 percent of the variation in the dependent variable.

2.5 Vegetable Production in Ghana

Vegetables can be sold in Ghana through a variety of means. Fresh vegetable marketing channel refers to the many channels accessible in the transit of the produce from the farmer to the final customer (Robinson and Kolavali, 2010). A marketing chain runs parallel to each marketing path, consisting of a number of intermediaries who perform a series of tasks. A marketing chain is a group of intermediaries/marketing merchants (such as farmers, wholesalers, brokers, and retailers) who work together to move a commodity from the producer to the final consumer. Farmers' marketing channels must be capable of delivering their produce to consumers in the appropriate structure and at a reasonable cost, when compared to other channels. Pick-your-own businesses, roadside stalls, local shops, cooperatives, wholesale markets, and processing firms are six different options for vegetable growers to market their produce (Orzolek et al., 2006). When postharvest handling is carefully managed, more revenues can be gained on fresh or processed produce.

Sorting, grading, packaging, loading/unloading, transportation, storage, and distribution are some of the intermediary tasks (Yeboah, 2011). Even though vegetable farmers have a variety of marketplaces, the proximity and availability of a market are the most important factors in determining which market a vegetable farmer in Ghana chooses. According to Robinson and Kolavali, (2010), the perishability of the crop and the limits imposed by "market queens" in



marketing vegetables in the country's primary vegetable wholesale markets contribute to the country's fresh vegetable marketing challenge.

2.6 Postharvest Losses Estimation

Losses of agricultural produce are characterized as quantitative or qualitative, (Kader, 2004). The reduction of losses in quantity is of great importance for less developed countries, while that of losses in quality a key concern for developed nations. The author further reported that determining qualitative losses is more difficult than determining quantitative losses.

Gangwar et al. (2007) estimated after losses of kinnow (citrus fruit) at every level of the supply chain using averages and percentages. The nature of the postharvest value chain for diverse commodities suggests that losses for individual product categories would be varied. It also means that loss phases may be influenced by the length of the supply chain each product meets at any one time, as well as the number of intermediaries before the final consumer.

General look, weight loss, firmness, decay, pericarp thickness, dry matter, total soluble solids, and shelf life are all indicators of vegetable quality Nyamah et al. (2014). Several vegetable cultivars (Power, Pechtomech, Cal J, and Akoma) were compared in terms of general appearance. The general appearance of fruits was determined by total quality and customer acceptance. It was graded on an 8-point hedonic scale, with 0 indicating poor (very defective), 2 indicating fair (defective), 4 indicating good (moderately defective), 6 indicating very good (slightly defective), and 7 indicating excellent (not defective). According to Nyamah et al. (2014), weight loss is a metric for quantifying both the quantity and quality of fruits lost, and it is stated mathematically as



$$\text{Weight loss} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100\%$$

According to Egyir et al. (2008), there are no universally acknowledged methods for estimating postharvest losses of fresh food, but whichever method is utilized is dependent on the circumstances. They also stated that when evaluating current marketing operations, a problem arises if losses are not appropriately assessed. Losses may also be large, but figures to back them up may be inaccessible due to:

1. the lack of reference documents;
2. the fact that archives, if available, may cover sufficient periods;
3. the existing figures are only estimates based on several observers;
4. records may not truly characterize an unending condition; for example, the losses might have been computed when they were strangely high or low;
5. Loss estimates may be purposefully exaggerated or misrepresented for business or other purposes in order to gain advantages or avoid humiliation (Egyir et. al., 2008).



CHAPTER THREE

MATERIALS AND METHODS

3.1 Description of the study area

The North East Region is one of Ghana's sixteen administrative regions. The region, was established 2019, through a referendum under Constitutional Instrument (C.I) 116.

The North East Region is located in the north of the country, with Nalerigu as its capital. With a population of 440,558, (Ghana Statistical Service, 2021). The region is divided into six Municipal and District Assemblies (Bunkpurugu District, East Mamprusi Municipal, Yonyoo-Nasuan District, West Mamprusi Municipal, Chereponi District, and Mamprugu-Moagduri Assemblies).

The North East Region with a total land area of 9,072 km² has the Upper East Region to the north, Togo to the east, the Northern Region to the south, and the Upper West Region to the west. The North East Region is much drier than southern areas of Ghana, due to its proximity to the Sahel, and the Sahara and consists of predominantly grassland vegetation, especially savanna with clusters of drought-resistant trees such as baobabs or acacias (Ngon, 2018). Between December and April is the dry season. The wet season is between June and November with an average annual rainfall of 750 to 1050 mm (30 to 40 inches) and temperatures reaching as high as 38 Degree Celsius at the end of the dry season, lowest at 21 Degree Celsius in December and January (Discover Ghana's North East Region, 2019).



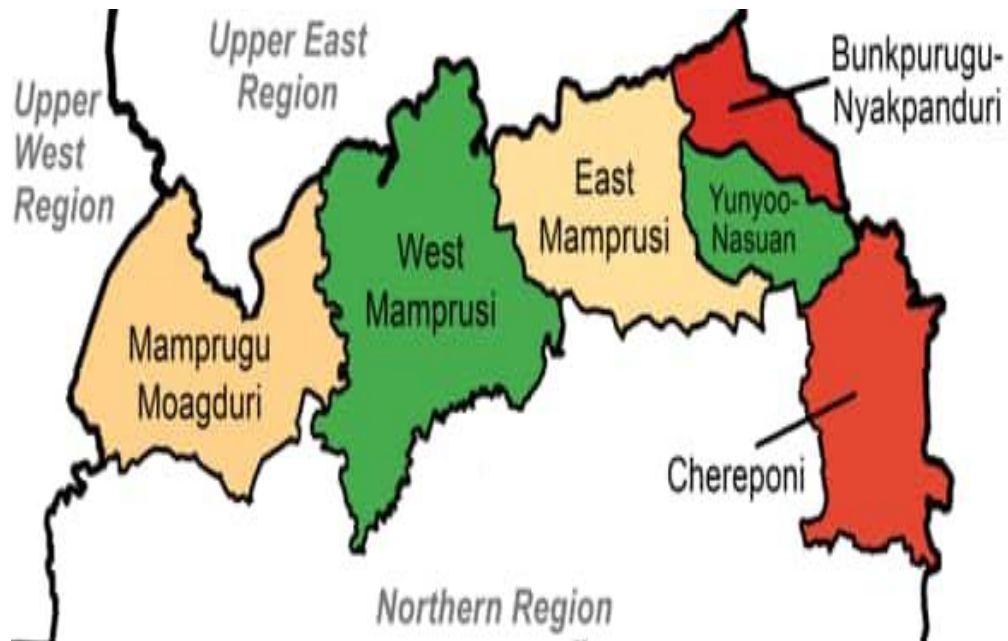


Figure 6: Map of the North East Region of Ghana

3.2 Conceptual Framework

The conceptual framework describes the elements that cause losses along the vegetable value chain (Figure 7). There are three participants throughout the value chain, according to the theory. Postharvest losses can be seen at any point along the value chain. Experience at the farmer level, mode of transportation, storage facility, ready market, farm location, and insect/pest infestation were all factors that contributed to postharvest losses. The influencers of the postharvest losses at the trader level include unavailability of proper packaging materials, poor transportation, unavailability of ready buyers, and lack of technical know-how.

The unavailability of ready buyers and storage structures, on the other hand, are aspects that all participants along the value chain share. Rot, bruising, and rodent damages are all major factors that influence postharvest losses among actors in the supply chain. Poor road conditions can result in mechanical injuries of vegetables.



The figure below describes various factors resulting in post-harvest losses in the vegetable production value chain from the farmer to trader.

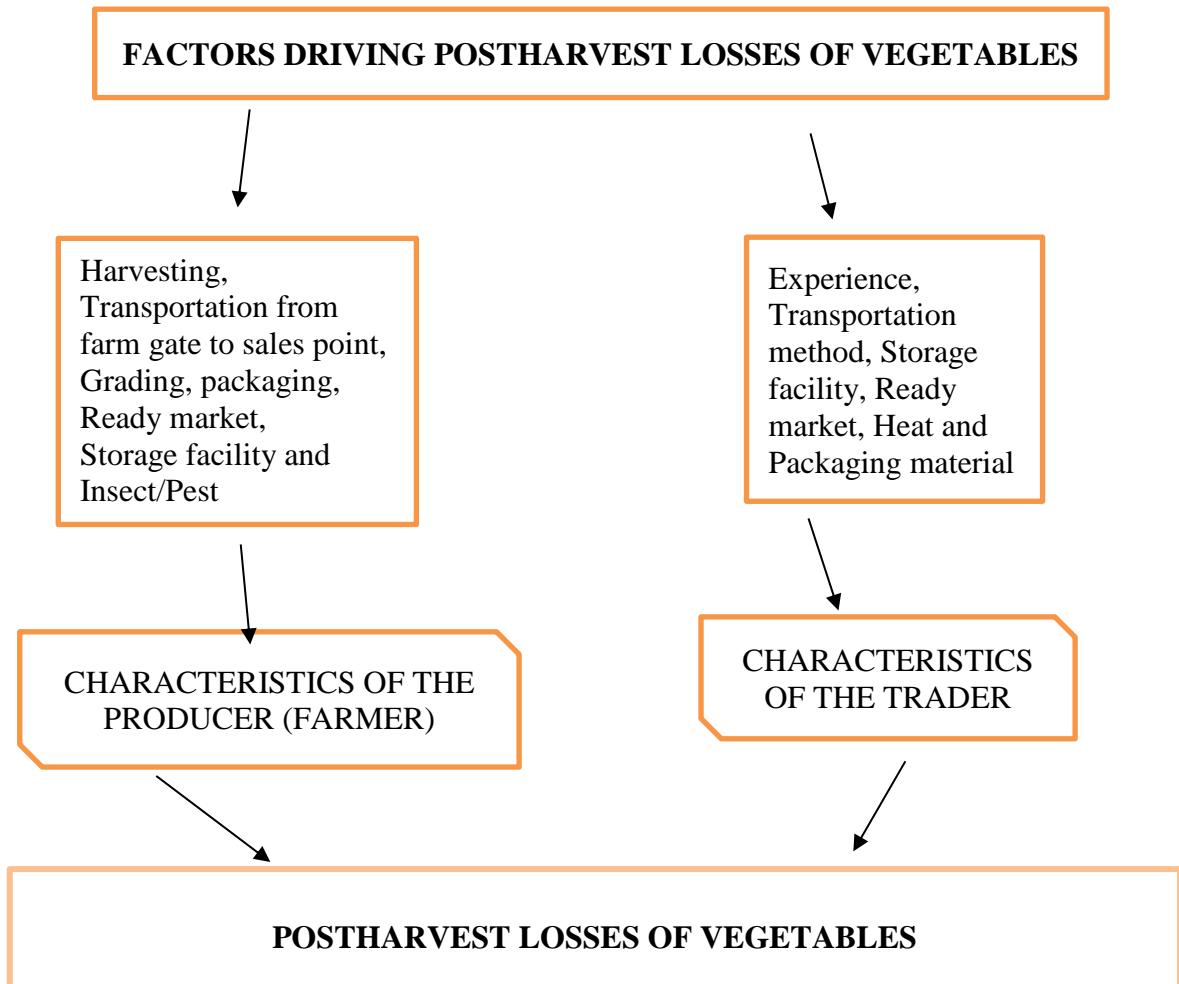


Figure 7: Conceptual Frame work.

Hot weather, particularly in the tropics, contributes significantly to postharvest losses because excessive warmth causes vegetables to decay. Losses are caused by the packing buildings or storage structures used by actors in the value chain at the farm or selling outlets. Because fluctuations in moisture, temperature, and humidity have a substantial impact on postharvest losses, fresh vegetables must be maintained at the appropriate temperature, humidity, and moisture levels. The location and timing of fresh vegetable storage have a significant impact on



postharvest losses because it allows pests to complete their reproduction and multiply. By speeding the ripening process, favorable environmental circumstances allow for rapid biological deterioration.

3.3 Data Collection

3.3.1 Data Sources

The data was collected from both primary and secondary sources. Primary data was collected in most cases by administering a structured questionnaire. Some data were also taken through observation and personal communication with the vegetable producers and traders. Pre-testing of questionnaire was done by randomly selecting ten (10) vegetable producers and five (5) traders from different parts of the study region. The questionnaires were fine-tuned from the pretest. Secondary data was procured from text books, internet, journals and other published articles.

3.3.2 Sampling and sample size

Three (3) Districts namely Mamprugu-Moagduri, West Mamprusi and Chereponi were selected for the study in the north east region. A total of nine (9) communities were randomly selected from the three Districts using purposive sampling. In the Mamprugu-Moagduri District, the communities selected included Zanwara, Kubori and Loagri. The communities selected in the West Mamprusi District were Nasia, Wulugu and Lingbinsi, while, Komba, Ando and Chereponi were selected in the Chereponi District. In each community, fourteen (14) vegetable producers and five (5) traders were randomly chosen giving a total of 126 vegetable growers and 45 vegetable traders.



3.4 Data analysis and presentation

The data was analyzed in SPSS version 16 to estimate the consequence of losses using simple descriptive statistics such as frequencies and percentages. The results were presented in tables, bar graphs and pie charts.



CHAPTER FOUR

RESULTS

4.1 Brief Background of Respondents

Farmers in the North East Region are dominated by people in the age group of 20 - 40 years (Table 4.1). A total number of 108 respondents representing 85.7 % farmers were in the age range of 20 - 50 years. Fourteen (14) traders were also in the age range of 20 - 50 years. These findings showed that younger age groups were more involved in farming and trading activities than those above 50 years. Out of the 126 farmers, 73% were males (93) while 34 respondents (27 %) were females. For the traders, females were dominant. Out of the traders 15 respondents, 12 were females (80 %) and the remaining 3 respondents were men.



Table 4.1: Brief Background of Respondents

Response Variable	Respondents			
	No. of famers	<u>Percentage (%)</u>	No. of traders	<u>Percentage (%)</u>
Age (years)				
20-30	26	20.6	5	33.3
31-40	50	39.7	5	33.3
41-50	32	25.4	4	26.7
51 and Above	18	14.3	1	6.7
Gender				
Male	92	73	3	20
Female	34	27	12	80
Education				
None				
Primary	69	54.8	6	40
JHS/Middle school	20	15.9	4	26.7
SHS	25	19.8	2	13.3
Islamic education	5	4	1	6.7
Tertiary	7	5.6	0	0
	0	0	2	13.3
Marital status				
Divorce	3	2.4	1	6.7
Married	82	65.1	10	66.7
Single	13	10.3	1	6.7
Separated	8	6.3	0	0
Widower	20	15.87	3	20



The majority (54.8%) of farmers (Table 4.1) in the North East Region did not have formal education. Primary and junior high schools accounted for 15.9 % and 19.8 % of the population, respectively. Only 4 % had senior high education while none had tertiary education. Similarly, majority (40 %) of the traders had no formal education, 26.7 % and 13.3 % were primary and JHS school leavers, respectively while 13.3 % had tertiary education.

Most of the farmers and traders in the Region were married; 65.1 percent and 66.7 percent, respectively. About 15.87 % of the farmers and 20 % of the traders were widows.

4.2 Respondents years of Experiences in vegetable production

About 68.3 % of the respondents had 1- 5 years of vegetable production experiences (Figure 8). Also, 27 % of the respondents had 6 - 10 years vegetable production experience while 3.2 % and 1.6 % had 11-15 years and above 15 years production experiences randomly.

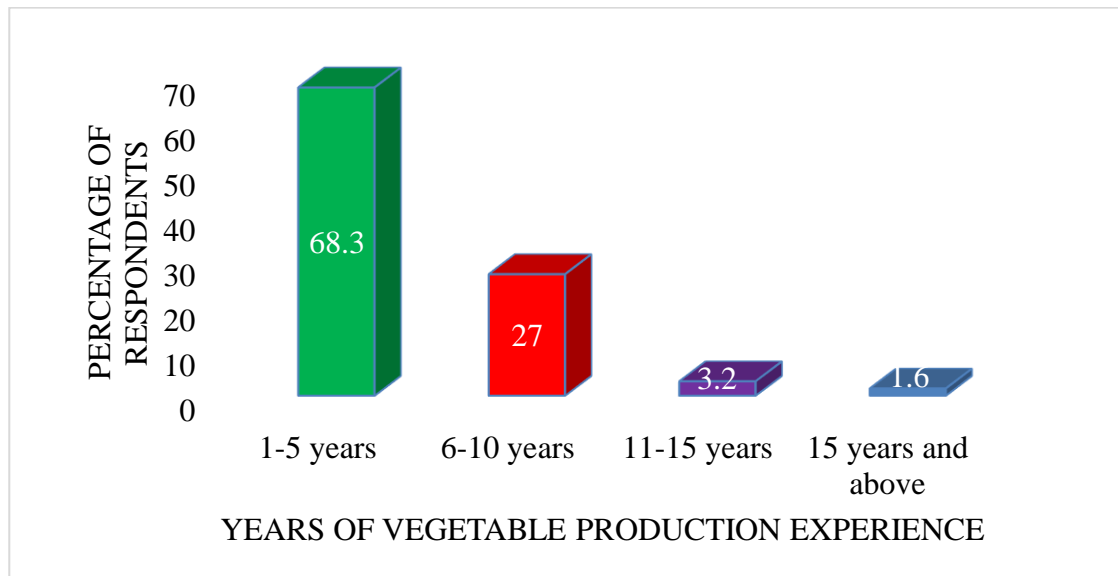


Figure 8: Respondents years of Experiences in vegetable production



4.3 Types of vegetables produced and traded in the Region

Out of the 126 respondents, 46 of the respondents (36.5 %) produced leafy vegetables, 31.7 % of the respondents (40) were those that produced tuber vegetables and the remaining 40 respondents were engaged in other vegetable productions such as fruit and bulb vegetables. At the trader level, 60 % traded leafy vegetables, 33.33 % traded fruit and bulb vegetables while 6.67 % traded tuber vegetables.



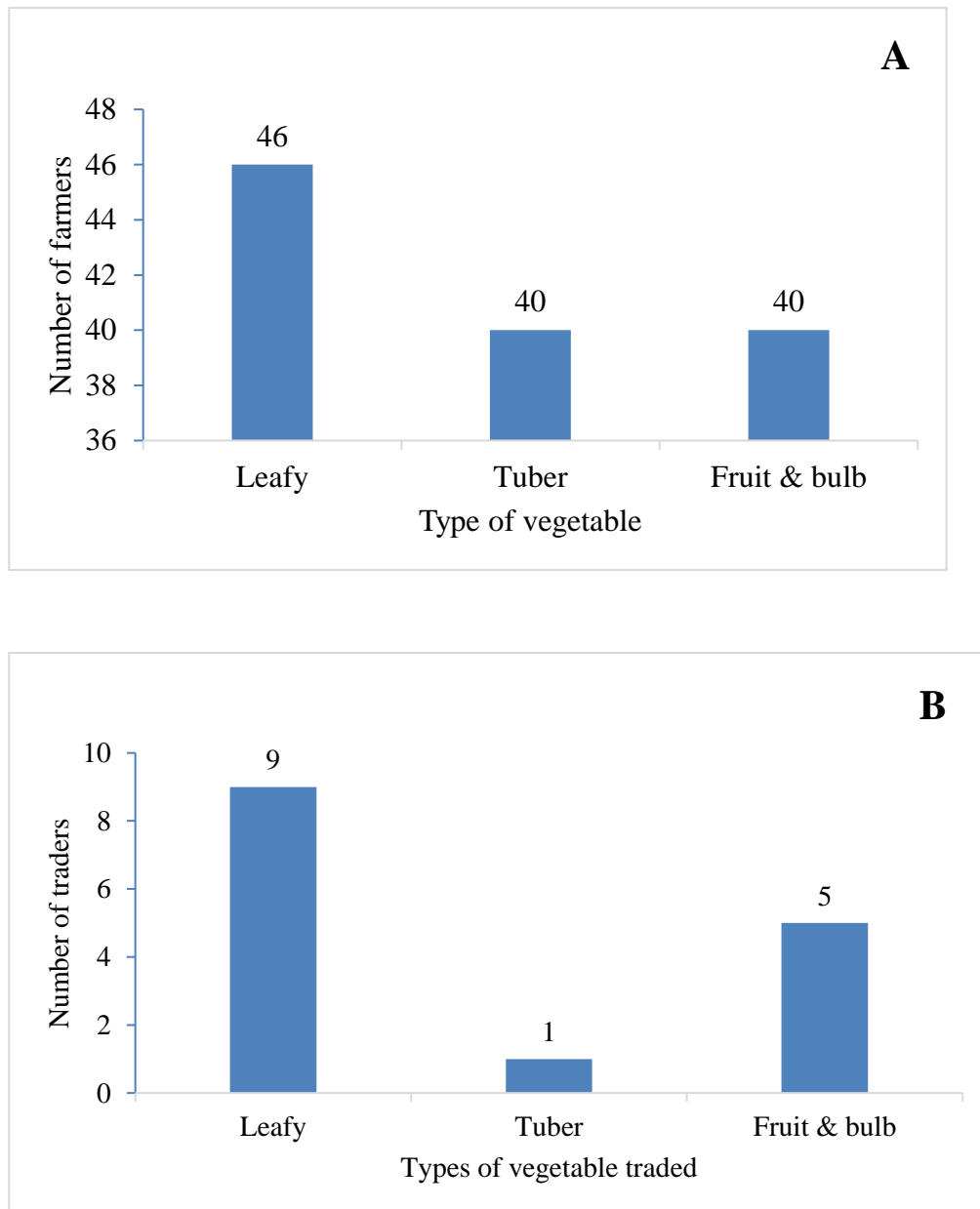


Figure 9: Types of vegetables produced at the farmer level (A) and the trader level (B) in the North East Region.

4.4 Causes of Post-Harvest Losses of Vegetables at the Farmer level in North East Region.

Table 4.2 shows the possible causes of postharvest losses that vegetable farmers in the North East Region faced. Pest and disease attack, rot, poor handling, change in rainfall pattern, and others such as poor transportation systems and road network and insufficient/poor storage facilities were identified as the causes



of vegetable losses at the farmer level in the Region. Majority (39.7 %) of the farmers complained that change in rain fall pattern was the major cause of their vegetable losses.

About 23.8 % of the respondents indicated their losses were due to poor handling during harvesting, packaging, transportation, and storage. However, about 19.8 % and 11.9 % of the respondents attributed their vegetable losses to rot and pest and disease damage respectively, as a result of high temperatures, poor storage facilities and sometimes lack of ready markets.

Table 4. 2.: Causes of Postharvest Losses of Vegetables at the Farmer level in North East Region

Cause of losses	Farmers (N = 126)	
	Frequency	Percentage (%)
Pest and disease damage	15	11.9
Rot	25	19.8
Poor handling	30	23.8
Changes in Rain Feed	50	39.7
Others specified	6	4.8

4.5 Causes of Postharvest Losses of vegetables at the Trader Level in the North East Region

Poor road network, lack of ready market, lack of quality packaging materials, poor handling and other factors including inadequate storage infrastructures, limited resources such as moisture meters, cooling facilities and technical



backstopping from governmental and non-governmental organizations were recorded as causes of vegetable loss at the trader level (Figure 10). About 54 % of the traders in the Region attributed their losses to poor road networks from vegetable production areas to the market. Also, 13 % of the traders linked their losses to insufficient packaging materials, lack of ready markets and 20 % of the losses are linked to insufficient moisture meters and cooling facilities.

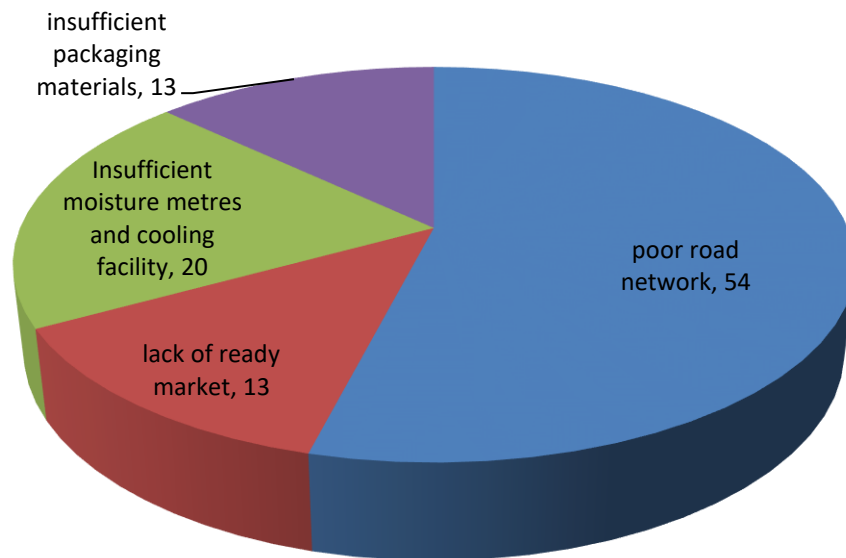


Figure 10: Causes of Postharvest Losses at the Trader Level in the North East Region



CHAPTER FIVE

DISCUSSION

5.1 Brief Background of Respondents

These findings showed that younger age groups were more (85.7 %) involved in farming and trading activities than those above 50 years. For the traders, females were dominant. The majority (73 %) of the farmers in the area were men which suggest that the men were more into farming than the women. This could be due to the fact that the women were involved in other economic activities such as marketing, processing, and hence did not have the same amount of time for farming as their male counterparts. The majority (80 %) of the traders being females might be as a result of females getting more involved in the daily sales of vegetables than males in many parts of the country.

Females were highly exposed to higher levels of losses than males among the vegetable producers and traders in the Region. Babalola et al. (2010) disagreed with this assertion that gender had no bearing on vegetable postharvest losses and that harvest and postharvest handlings required technical effort but findings from the field indicated that, gender was one of the major factors leading to postharvest loss in the vegetable production value chain since women were mostly engaged in other domestic activities such as cooking, taking care of children and washing other than the farming or trading. Male-headed households typically had higher man-hours, and allowed greater harvest time than other farm operations, as opposed to female-headed households, who had less man-hour due to family commitments including taking care of children and house chores. The finding is in tandem with Adarkwa (2011) who reported that improper harvesting procedures and handling led to postharvest losses.



The majority (54.8 %) of farmers (Table 4.1) in the North East Region did not have formal education. Primary and junior high schools accounted for 20 % and 25 % of the population, respectively. Only 4 % had senior high education while none had tertiary education. Similarly, majority (40 %) of the traders had no formal education, 26.7 % and 13.3 % were primary and JHS school leavers, respectively while 13.3 % had tertiary education. Education is very important as far as controlling postharvest losses is concerned. Knowledge of how high temperature, direct exposure to sunshine and unsanitary conditions, and mechanical injuries facilitate deterioration of vegetables after harvest is pivotal in helping to reduce postharvest losses. Thus, farmers and traders with more education would most likely know how to handle vegetables after harvest to reduce deterioration and losses.

Most of the farmers (65.1 %) and traders (66.7 %) in the region were married. This suggests that married people were the most involved in vegetable farming and trading in the region followed by widows.

5.2 Respondents years of experiences in vegetable production

About 68.3 % of the respondents had 1-5 years of vegetable production experiences (Figure 4.1). Also, 27 % of the respondents had 6 - 10 years vegetable production experience while 3.2 % and 1.6 % had 11-15 years and above 15 years production experiences randomly. These findings show that as the years of production experience increased, the percentage of respondents with such length of experience decreased.

Experience plays a major role in every work or business, of which vegetable production is no exception. Limited experience or skills lead to poor production



and handling of vegetables resulting in limited productivity and poor handling. Length of experience in vegetable production contributes immensely to the reduction of postharvest losses of vegetables. This is because experience and knowledge on the various vegetables help to handle them in the best way possible to slow down deterioration.

5.3 Types of vegetables produced and traded in the region

From the results, 36.5 % of the respondents produced leafy vegetables, 31.7 % produced tuber vegetables while the rest produced other vegetables such fruit and bulb vegetables. This showed that there was no wide variation in the number of producers for the various vegetables in the Region. At the trader level, 60 % traded leafy vegetables, 33.33 % traded fruit and bulb vegetables while 6.67 % traded tuber vegetables. This indicates that leafy vegetables were the main vegetables produced and traded in the region.

5.4 Causes of Postharvest Losses of Vegetables at the Farmer Level in North East Region

From Table 4.2, pest and disease attack, rot, poor handling, change in rainfall pattern, and others such as poor transportation systems and road network and insufficient/poor storage facilities were identified as the causes of vegetable losses at the farmer level in the Region. Majority (39.7 %) of the farmers complained that change in rain fall pattern was the major cause of their vegetable losses. They explained that their vegetable production was rain-dependent and thus erratic rainfalls usually affected their production. They added that heavy downpours also destroyed their vegetables. About 23.8 % of the respondents indicated their losses were due to poor handling during harvesting, packaging,



transportation, and storage. However, about 19.8 % and 11.9 % of the respondents attributed their vegetable losses to rotting and pest and disease damage respectively, as a result of high temperatures, poor storage facilities and sometimes lack of ready markets.

Exposure to contaminated soils and unhygienic environments are major sources of pest and disease infestation. Poor harvesting management, spilling during conveyance from farm gate to sale outlets, and spilling during off taking and off-loading at farm gates and sale points all contributed to the vegetable losses. According to Kitinoja and Cantwell (2010), at the farmer level, an average of 25 % of vegetables loss occurs.

5.5 Causes of Postharvest Losses at the Trader Level in the North East Region

Poor road network, lack of ready market, lack of quality packaging materials, poor handling and other factors including inadequate storage infrastructures, limited resources such as moisture meters, cooling facilities and technical backstopping from governmental and non-governmental organizations were recorded as causes of vegetable loss at the trader level (Figure 4.3). About 54 % of the traders in the Region attributed their losses to poor road networks from vegetable production areas to the market. Also, 13 % of the traders linked their losses to lack of packaging material, lack of ready markets.



CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

36.5 % of farmers produced leafy vegetables while 31.7 % each produced tuber vegetables and fruit and bulb vegetables. At the trader level, 60% traded leafy vegetables, 33.33 % traded fruit and bulb vegetables while 6.67 % traded tuber vegetables.

Pest and disease attack, rot, poor handling, change in rainfall pattern, and others such as poor transportation systems and road network and insufficient/poor storage facilities were identified as the causes of vegetable losses at the farmer level in the region. On the other hand, poor road network, lack of ready market, lack of quality packaging materials, poor handling and other factors including inadequate storage infrastructures, limited resources such as moisture meters and technical backstopping from governmental and non-governmental organizations were recorded as causes of vegetable loss at the trader level.

More men were engaged in vegetable production than women in the North East Region of Ghana. However, vegetable traders in the Region were mostly women. Most of the vegetable farmers and traders in the region had no formal education. Vegetable farming and trading were predominantly engaged by married people and widows in the region.



5.2 Recommendations

1. The District Assemblies in collaboration with the Ministry of Food and Agriculture (MoFA), should hold regular seminars and workshops for farmers on good agricultural practices and also to assist in the provision of postharvest handling and management trainings to vegetable farmers and traders through their communities Agricultural Extension Agents, in order to lower the degree of losses in their businesses.
2. The various District Assemblies should create a link with financial institutions to organize financial literacy trainings for both farmers and traders to facilitate their businesses most especially female producers and traders.
3. District Assemblies, as well as other stakeholders should assist in the provision of cooling facilities and physical market structures to vegetable farmers and traders. The partnership in the study area would assist in improving the road infrastructure connecting farms to market centers.



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APPENDIX

University for Development Studies

Nyankpala Campus - Department of Horticulture

Assessment of Postharvest Losses among Vegetable Farmers and Traders in North East Region, Ghana

Research Questionnaire for Vegetable Farmers

All the information provided here will be treated as **STRICTLY CONFIDENTIAL**.

Date of survey.....
Name of enumerator.....

A. Demographics Information of Respondents

1. Gender of respondents (a) Male b) Female
2. Age Range of Respondent a) 20 - 30 years b) 31- 40 years c) 41 - 50 years d) 50 years and above
3. What is your Marital Statues a) Married b) Single c) Widow d) Divorce e) Separated
4. What is your formal education level? a) Primary b) Middle/JSS c. Secondary /SSS d. Tertiary e. Islamic education f. None g. Others Specified.....
5. How many years have you been farming?
(a) 1-5 years (b) 6-10 years (c) 11-15 years (d) 16 and above



6. What kind of vegetable do you produce?
(a) Root [] (b) Stem [] (d) Leaf [] (e) Seed [] (f) Fruit [] (g) Others specified.....

7. How long do you keep you tomatoes seedling before transplanting?.....

8. At what time do you harvest your produce?

(a) Morning [] (b) Afternoon [] (c) Evening []

9. What material do you use for harvesting? (a) Sacks [] (b) Boxes [] (c) Crates [] (d) Others Specified.....

10. What are the causes of postharvest losses among vegetable farmers in the region?

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11. What are the factors affecting vegetable farmers in the region?

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12. How does post-harvest losses impacted vegetable farmers in the region?

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13. What are the possible strategies measures that can adopt to reduce losses among vegetable farmers and traders in the region?

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Thank You.



University for Development Studies

Nyankpala Campus - Department of Horticulture

Assessment of Postharvest Losses among Vegetable Farmers and Traders in North East Region, Ghana

Research Questionnaire for Market Women

All the information provided here will be treated as **STRICTLY CONFIDENTIAL**.

A. DEMOGRAPHY CHARACTERISTICS

1. Gender of respondents (a) Male [] b) Female []
2. Age Range of Respondent a) 20 - 30 years [] b) 31- 40 years [] c) 41 - 50 years [] d) 50 years and above []
3. What is your Marital Statues a) Married [] b) Single [] c) Widow [] d) Divorce [] e) Separated []
4. What is your formal education level? a) Primary [] b) Middle/JSS [] c. Secondary /SSS [] d. Tertiary [] e. Islamic education [] f. None [] g. Others Specified.....
5. What is your source of income?
(a) Funds from market association [] (b) Bank [] (c) Owned funds []
(d) Others specified.....

B. Information's In the Business

6. How long have you been in the business? (a) 1 - 5 years [] (b) 6 - 10 years []
(a) 11 - 15 years [] (d) 16 years and above []
7. What is your source of transportations? (a) Own Car []
(b) Association Car [] (c) Public transport [] (d) others specified.....



8. What material do you use for carrying your items? (a) Boxes []

(a) Crates [] (c) sacks [] (d) others specified.....

B. Challenges In The Business

9. What are the challenges you encounter in the business?

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Thank you

