UNIVERSITY FOR DEVELOPMENT STUDIES

THE EFFECTS OF YAM POST HARVEST LOSSES ON FOOD SECURITY IN THE KINTAMPO MUNICIPALITY OF THE BRONG AHAFO REGION OF GHANA

BY

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JULY, 2016

DECLARATION

STUDENT

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

Candidate's signature……. Date…….

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SUPERVISOR

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

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ABSTRACT

The study was carried out in the Kintampo Municipality in the Brong Ahafo Region of Ghana. The primary objective of the study was to determine the extent of yam postharvest losses and its effect on household food availability in the Kintampo Municipality. Stratified and random sampling techniques were employed to select a sample of 202 yam farmers for the study. The methods of analysis involved the use of chi-square, means and frequencies as well as an estimation of a logit model. The results show that the mean postharvest loss was 4.84 percent of total tubers harvested. The categories of farmers who experienced greater losses were as follows: male farmers (92.6%); farmers whose farms were accessible by road (86.1%); farmers who had no ready market (77.7%); farmers who were not involved in contract farming (85.6%); farmers who used whole tuber for sowing (79.7%); farmers who had no access to credit (57.4%); farmers who did not belong to any farmer group (79.7%); farmers who sold in the local market(54.5%); farmers who had basic education (55%); and farmers who used tractor to convey their yam produce to the market (62.9%). Postharvest losses were found to have positive and significant effect on food security. Food security has four dimension; availability of food, accessibility or affordability, utilization and stability. The main challenges facing farmers in overcoming postharvest losses were inadequate funds and labour supply. To reduce or eradicate postharvest losses in Kintampo Municipality, yam production must be modernized by increasing participation in contract farming and farm group as well as increasing mini set, access to credit, ready market and formal education. Also, the above mentioned category of farmers who experienced high losses must be targeted for support.

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DEDICATION

This piece of work is dedicated to my beloved wife, Mrs Sarah-Ivy Wekuri Tanye, my daughter, Blessing Bonganwmine Mornah Tanye and all the loved ones who supported me in diverse ways during the course of this work.

LIST OF ACRONYMS

NIB National Investment Bank

FAO Food and Agriculture Organization

NDPC National Development Planning Commission

GSS Ghana Statistical Service

KiMA Kintampo Municipal Assembly

MASLOC Micro Finance and Small Loans Centre

DACF District Assembly Common Fund

GNFS Ghana National Fire Service

NGO Non-Governmental Organizations

BAR Brong Ahafo Region

MoFA Ministry of Food and Agriculture

FBOs Farmer Based Organization

GEPC Ghana Export Promotion Council

GPRS Ghana Poverty Reduction Strategy

GCB Ghana Commercial Bank

EDIF Export Development and Investment Fund

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Food insecurity is a developmental challenge that has received enormous attention and discussion among governments and other development oriented organizations. Despite the efforts of many governments in Africa at achieving food self-sufficiency and/or food security, domestic production continues to fall short of consumption demand. The reason might not completely be attributed to low production levels, but food deficits may arise due to postharvest losses. In fact, it is a widely held view that one of the significant sources of food insecurity in Africa is post-harvest crop losses.

A number of definitions are given to post-harvest loss by different researchers and organizations. The notable among them is the definition by the United Nations Food and Agriculture Organization (FAO). According to FAO (1983), post-harvest loss is defined as any change in the availability, edibility, wholesomeness or quality of food that may prevent it from being consumed by some categories of people or from commanding an adequate price. This definition, though not exhaustive, highlights the most pertinent components of the phenomenon, in the sense that when a postharvest loss occurs, it either makes the food unavailable or where it is available, the nutritional content and physical appeal may not command an adequate price (Nyadanu et al, 2014).

Crop losses can occur at various stages in the production chain, notably pre-harvest, harvest and post-harvest stages. However, it has been estimated that pre-harvest and post-harvest food losses in Africa are higher than the global average, the effect of these losses on livelihoods are often negative and severe, especially on the rural folks and poor urban dwellers. It has been estimated that between 10 to 40% of Africa's crop productivity is lost on and off the farm mainly because of outmoded cultural practices such as subsistence farming. Causes of post-harvest losses are diverse and range from losses through handling and storage to marketing and/or consumption (Gitonga, 2013). This situation is more common in Sub-Saharan Africa because most farming communities do not have access to appropriate technologies, and also lack adequate infrastructure such as roads in the production centers. (Gitonga, 2013).

Undeniably, agriculture is the backbone of the Ghanaian economy with about 60% of the population being farmers. Ghana, like many other Sub-Saharan countries, is bedeviled with varying degrees of post-harvest losses. Agriculture, being the major economic activity, constitutes the main source of household income in the Kintampo Municipality.(GPRS,2002) The major food crops produced in the area are yam, maize, cowpea, cassava, rice, plantain cashew, mango and tomatoes. It is believed by the farmers that these crops have great potentials to increase the incomes of farmers.

The quantum of food that is unavailable for people because of postharvest losses is huge enough to provoke attention.

1.2 Problem Statement

Most developing countries such as Ghana continue to rely on the agricultural sector for economic growth, poverty alleviation, food security and environmental sustainability (Nuryartono *et al*, 2005). However, most domestic products, including yam go waste as they travel along the chain from the farm gate to the final consumer. Post-harvest losses of yam are one of the major challenges confronting yam farmers in Ghana. Considering the fact that majority of the yam farmers in Ghana are small scale holders and more than 90 percent of their livelihoods are dependent on crop farming, post-harvest losses of the crop pose a major threat to food and cash security. For instance, most farmers in the Brong Ahafo Region in general and Kintampo in particular, do not have access to food throughout the year, mainly due to huge post-harvest losses. This goes a long way to worsen the poverty situation in the district.

Meanwhile, to the best of the researcher's knowledge, there are not many empirical studies to document the extent of postharvest losses in the country and particularly in the district. Very limited information on the magnitude of yam postharvest losses means that there is little appreciation of the problem on the part of policy makers and development practitioners, and therefore little or no solution to the problem. Thus a baseline study to provide information on the magnitude of postharvest losses, the categories of farmers' mostly affected and the effect of such losses on the food security situation of the household is worth undertaking. This study seeks to provide answers to the following research questions:

1.3 Research Questions

1. What are the socioeconomic indicators of yam farmers as well as the inputs and other farming practices adopted in yam farming in Kintampo?
2. What levels of postharvest losses are experienced by the various categories of farmers in the Kintampo Municipality?
3. What is the effect of postharvest losses on household food availability?
4. What postharvest challenges do yam farmers in the Kintampo Municipality face?

1.4 Research Objectives

The primary objective of the study in the Kintampo Municipality is to determine the extent of yam postharvest losses and measure the effect on household food security. The specific objectives are to:

1. Determine the socioeconomic indicators of yam farmers as well as the inputs and other farming practices adopted in yam farming in the Kintampo Municipality
2. Investigate whether or not there are any differences in postharvest losses among the various categories of yam farmers.
3. Measure the effects of postharvest losses on food availability.

4. Explore the postharvest challenges that yam farmers face in the Kintampo Municipality.

1.5 Justification of the Study

Yams are highly perishable and very susceptible to mechanical damages when poorly harvested or handled. It is estimated that about 30 percent of yam produced never reach consumers for whom it is intended. Postharvest food losses contribute to high food prices by removing part of the supply from the market. This study is necessary to help provide information that may lead to interventions required to reduce or irradiate postharvest losses and to improve the livelihood of the people, particularly the rural farmers who constitute about 71 % (KiMA, 2011) of the farming population in the Kintampo Municipality.

1.6 Organization of the Study

The study is organized into five chapters as follows Chapter one gives the background to the study by identifying the study problem, research questions and objectives as well as the justification to the study. Chapter two consists of the literature review on yam production, consumption and post-harvest losses. Chapter three consists of the methods of data collection and analysis as well as a description of the study area and scope of the study while chapter four presents and discusses the findings of the study. Chapter five consists of a

summary of the methodology, key findings and conclusions and makes some recommendations emanating from the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 World Yam Production and Trade

Yam (*Dioscoreaspp),* a multi-species, polnoid, and vegetative propagated tuber, is cultivated widely in the tropics and sub-tropics. Yams are produced on 5 million hectares in about 47 countries in tropical and sub-tropical regions of the world (IITA, 2009). Yields are about 11 tonnes per hectare in the major producing countries of West Africa. According to FAO statistics, 48.7 million tonnes of yams were produced worldwide in 2005, and 97 percent of this total value was produced in sub-Saharan Africa (FAO, 2005). West and Central Africa account for 94 percent of world production. (FAO, 2005)

Nigeria is the leading yam producer with a volume of 34million tonnes, followed by Cote D'Iviore with 5 million tonnes followed by Ghana (with 3.9 million tonnes) and Benin with 2.1 million tonnes. Ethiopia (with 174,000 tonnes) and Sudan (with 137,000 tonnes) are the major producers in East Africa. Columbia (333,000 tonnes) leads the production in South America followed by Brazil (230,000 tonnes) while Japan (204,000 tonnes) is the leader in Asia (IITA, 2009). Yams are also important in the Caribbean (for example, Haiti with 197,000 tonnes in 2005), and the south pacific islands. (IITA, 2009).

In terms of exports to the international markets, Ghana is the largest exporter with a quantity of about 12,000 tonnes of yams annually. Average yam consumption per capita per day is highest in Benin (364 kcal) followed by Cote d' Ivoire (342 kcal), Ghana (296 kcal,) and Nigeria (258 kcal (IITA, 2009).

In Africa, the most important zones for the cultivation and use of yams stretches from Cote D'Iviore through Ghana, Togo, Benin, Nigeria, Cameroun, Gabon, Central African Republic and the Western part of the Democratic Republic of Congo (FAO, 2000). Nigeria produces about 70% of the world total yam. In a recent urban food demand study in three cities in northern Nigeria (i.e., Kano, Kaduna, and Abuja), 62% of households in Kano, 88% in Kaduna and 97% in Abuja purchased yams weekly (IITA, 2000).

2.3 Yam Varieties

The yield of yam depends on the type of variety cultivated. Varieties may vary across space, within and across countries.Yamasa tropical crop in the genus Dioscorea,has as many as an estimated 600 species among which 12 species are edible (Coursey, 1976). Within this genus are 6 economically important staple species. These are: *Dioscorearotundata*(white guinea yam), *Dioscoreaalata*(Yellow yam), *Dioscoreabulbifera*(aerial yam) *Dioscoreaesculenta*(Chinese yam) and *Dioscoreadumetorum* (trifoliate yam). Out of these, *Dioscorearotundata*(white yam) and *Dioscoreadumetorumalata* (water yam) are the most common species in Ghana. Yams are grown in the coastal region in rain forests, wood savanna and southern savanna habitats (Coursey, 1976). *Dioscoreaalata*cover major areas in Asia, whereas

Dioscorearotundata and *Dioscoreacayenensis*are commonly cropped in Africa (Mandal, 1994).

2.4 Importance of yam to household livelihood

Yam is a tuber crop which is produced in nearly every part of the tropical region. Its greatest importance is attained in West Africa where more than 90% of the worldwide production (40 million tons of fresh tubers) is being produced (Lucien, 2008). According to Lucien (2008), yams play three major roles in the production areas:

1. It is a staple diet for millions of people thus contributing to food security. In Cote d'Ivoire, yam is the best food crop on a quantity basis (3 million tons of tubers were produced in 2002) and it is consumed by two-thirds of the population.
2. Traditionally considered as a food crop produced for farmers' consumption, yam has achieved nowadays an economic importance.
3. A considerable amount of ritualism is developed around the production and utilization of yam, since for several decades yam has been embedded in the population habits and has socio cultural significance.

Yam production serves as a source of income generation to peasant farmers and the labourers who work on their yam farms as well as those who engage in its sale, the itinerant traders who assemble the crop from village to village and the marketers in urban areas who retail the commodity (IITA, 2000). Peels and waste from yam are often used for feeding poultry and livestock. According to Komolafe et al, (1993), the various uses to which yam is put tends to indicate that the crop (yam) is a famine crop. Asiedu (1989) reported that yam plays an

important role in social and religious festivals as it constitutes an integral part of the cultural heritage of many people in the yam growing areas of Nigeria.

Yams are a source of vitamin B_6, which is needed by the body to break down a substance called *homocysteine,* which can directly damage blood vessel walls. Individuals who suffer a heart attack despite having normal or even low cholesterol levels are often found to have high levels of homocysteine. Since high homocysteine levels are significantly associated with increased risk of heart attack and stroke, having a good supply of vitamin B_6 on hand makes a great deal of sense. High intakes of vitamin B_6 have also been shown to reduce the risk of heart disease.

Many consumers have found products in the market place that promote wild yam or wild yam extracts as substances that can help provide a natural alternative to hormonal replacement in women who have reached the age of menopause. Many of these products are provided in the form of creams that can be topically applied. Even though the food itself is not usually promoted by natural products companies, these yam- containing products have sparked interest in the relationship between yam and menopause. Yams do contain some unique substances called steroidasoponin, and among these substances are chemicals called dysgenic. Diogenes does, however, have an impact on hormonal patterns in studies involving animals, and may be helpful in lowering risk of osteoporosis, although scientists deny have not as yet had any studies in this area. Asiedu (1989)

Wild yam also has some history of traditional use in herbal medicine, especially Chinese herbal medicine, as a botanical that can affect organ system

function. While the focus has been on kidney function, wild yam (or Chinese yam) has also been used to support the female endocrine system. For example, there has been traditional use of this root in conjunction with lactation. Although research showed some very limited benefits from the wild yam cream and no side effects, none of the symptom changes statistically significant. In summary, it can be said that there is no research evidence to support the claim that yam has special benefits when it comes to menopause, but more research is needed in this area because there is a clear connection between yam, dysgenic, and endocrine function that is not yet understood.

2.5 General causes of postharvest storage losses

Agents responsible for postharvest food losses have been categorized into primary and secondary causes. A number of studies have examined the primary as well as the secondary causes of postharvest losses across the globe, particularly in developing countries. In this section, these causes are outlined.

Causes of storage losses of yam tubers include sprouting, transpiration, respiration, rot due to mould and bacteriosis, insects, nematodes and mammals. Sprouting, transpiration and respiration are physiological activities which depend on the storage environment, mainly temperature and relative humidity. These physiological changes affect the internal composition of the tuber and result in destruction of edible material, which under normal storage conditions can often reach 10% after 3 months, and up to 25% after 5 months of storage.

Investigations on the biochemical changes in stored yam tubers have shown that changes in starch, sugars, and protein take place during long-term storage. A study of yam tuber (*D. dumetorum*) stored under ambient and cold room conditions showed a rapid drop in moisture and starch content and an increase in the total alcohol-soluble sugars and reducing sugars after 72 hours of storage. The rate of decrease in moisture and starch content and the rate of increase in sugar level were higher in tubers stored at room temperature than those stored under cold room conditions.

A study of the physical, chemical and sensory changes occurring in white yams *(Dioscorearotundata)* and yellow yams *(Dioscoreacayenensis)* stored for 150 days in traditional barns showed losses in moisture, dry matter, crude protein and ascorbic acid after 120 days of storage. Sensory evaluation rated the stored tubers higher than the fresh tubers. A similar study reported a 17-22% reduction in weight, 30-50% reduction in crude protein and 38-49 % increase in sugar content for two cultivars of white yams (*D rotundata)* stored in a barn. Generally, in stored tubers there is reduction in weight, crude protein, starch and mineral content while the sugar and fibre contents increase.

2.5.1 Primary causes of postharvest food losses

2.5.1.1 Biological

Consumption of food by rodents, birds, monkeys and other large animals causes direct disappearance of food. Sometimes the level of contamination of food by the excreta, hair and feathers of animals and birds is so high, that it makes the food not consumable for mankind. Insects cause both weight

losses through consumption of the food and quality losses because of their webbing, excreta, heating, and unpleasant odours that they can impart to food.

Biological control could reduce or eliminate some of the above problems. Such methods are also potentially more durable and much cheaper, and there are several instances where they have proved to be a dependable alternative to chemicals under field conditions. More recently, an increasing number of reports have focussed on the potential of *Bacillus spp*. The production of resistant endospores could allow these to persist on the surface of tubers, especially in the tropics, and would make them ideal candidates for use in biological control aimed at controlling spoilage organisms on yam tubers.

2.5.1.2 Microbiological

Microorganisms (e.g., fungi and bacteria) cause damage to stored foods. Micro-organisms usually directly consume small amounts of the food but they damage the food to the point that it becomes unacceptable because of rotting or other defects. Toxic substances initiated by molds (known as mycotoxins), cause some food to be condemned and hence lost. The best known mycotoxins is aflatoxin (a liver carcinogen), which is produced by the mold *Aspergillusflavus.* Another mycotoxin which is found in some processed apple and pear products is patulin, which is formed in the apple by rotting organisms such as *Penicilliumexpansum* which infect fresh apples before they are processed.

2.5.1.3 Chemical

Many of the chemical constituents naturally present in stored foods spontaneously react causing loses of colour, flavour, texture and nutritional value. There can also be accidental or deliberate contamination of food with harmful chemicals such as pesticides or obnoxious chemicals such as lubricating oil.

2.5.1.4 Biochemical reactions

A number of enzyme-activated reactions can occur in foods in storage giving rise to oft-flavours, discolouration and softening. One example of this problem is the unpleasant flavours that develop in frozen vegetables that have not been blanched to inactivate these enzymes before freezing.

2.5.1.5 Mechanical

Bruising, cutting, excessive pooling or trimming of horticultural products are causes of loss. Physical excessive or insufficient heat or cold can spoil foods. Improper atmosphere in closely confined storage at times causes losses.

2.5.1.6 Physiological

Natural respiratory losses which occur in all living organisms account for a significant level of weight loss and moreover, the process generates heat. Changes which occur during ripening, senescence, including wilting and termination of dormancy (e.g., sprouting) may increase the susceptibility of the commodity to mechanical damage or infection by pathogens. A

reduction in nutritional level and consumer acceptance may also arise with these changes. Production of ethylene results in premature ripening of certain crops.

2.5.2 Secondary causes of loss

Secondary causes of loss are those that lead to conditions that encourage a primary cause of loss. They are usually the result of inadequate or non-existent capital expenditures, technology and quality control.

Some examples are:

- Inadequate harvesting, packaging and handling skills.
- Lack of adequate containers for the transport and handling of perishables.
- Storage facilities inadequate to protect the food.
- Transportation inadequate to move the food to market before it spoils.
- Inadequate refrigerated storage.
- Inadequate drying equipment or poor drying season.
- Traditional processing and marketing systems can be responsible for high losses.
- Legal standards can affect the retention or rejection of food for human use by being too lax or unduly strict.
- Conscientious, knowledgeable management is essential for maintaining tool in good condition during marketing and storage.

- Bumper crops can overload the post-harvest handling system or exceed the consumption need and cause excessive wastage.

2.6 Socio-Cultural Aspects of Root and Tuber Crop Production

Yams are unique in human society as they are in the plant world (Degras, 1986). Besides, their genesis, which is tropical and African, yam, seems to have played a role in man's evolution. The fate of tropical man and yams are interwoven throughout the yam's entire growing system (Degras, 1986). Yams play a central role in the farming system and are important plants of traditional culture and religion (Hahn, 1984). Traditional ceremonies still accompany yam production indicating the high status given to the crop (Degras, 1986). Considerable amount of ritualism has developed around the production and utilization of yam. The most important manifestation of this ritualism is in the new yam festival celebrated at the beginning of the harvest season in most traditional areas of Nigeria (Ike and Inoni, 2006).

Yams play a significant role in the socio-cultural lives of people in some producing regions like the celebrated new yam festival in West Africa, a practice that is also extended to overseas where there is a significant population of the tribes that observe it. In some parts of Nigeria, the meals offered to gods and ancestors consist principally of mashed yam. According to Diop (1996), the ritual ceremony and superstition often surrounding yam cultivation and utilization in West Africa is a strong indication of the antiquity of use of this crop. In Nigeria, yam is considered to be a man's property and the traditional ceremonies that still accompany yam production indicate the high status given to the plant.

Seen from the perspective of the history of mankind, the societies whose nutrition is based on the cultivation of roots and tubers are very old cultures (Knoth, 1993). The settlement areas for these societies originally comprise the whole of the tropical equatorial region. During the course of history of mankind, almost all root and tuber societies have either been infiltrated by cereal cultivation societies or destroyed by their hegemonic strives. More or less intact, root and tuber societies have only been able to survive and retain their cultural heritage till today in West Africa (yam belt) and some islands of Oceania (Coursey, 1989 cited in Knots, 1993).

The vegetation cycle (planting, harvesting and storing) is frequently embedded in a series of rituals serving to protect the roots and the tubers (Knots, 1993). The harvest of roots and tubers is tabooed until certain rituals supported by religious sanctions have been carried out (Knot, 1993). In these societies the individual plant has a greater significance than the crop population. For yams for example, ridged beds and sticking systems are set up for each individual plant. It is the aim to maximize the yield for each plant (largest possible tubers) and not maximize the area output (Knot, 1993). This concentration on the individual plant is also illustrated in harvest technology with the greatest care, only a defined number of tubers are harvested from each plant allowing it to grow.

Post-harvest technology is also in line with the desire for harmony in societies. The purpose of this is more to avoid the longer periods of storage than to develop improved storage systems (Lancaster and Coursey, 1984). The traditional store for yams (yam barn) in West Africa does not only serve to

preserve the tubers but also has symbolic character and is a sign of economic prosperity and of the social influence of its owner, (Knot, 1993).

The overall field of post-harvest activities in these societies is often seen as an extension of household activities (Lancaster and Coursey, 1984). It is therefore not surprising that the post-harvest tasks are the responsibility of the women (Lancaster and Cousrey, 1984). Gender specific division of labour however shows some differences depending on the variety of crop. The women are thus involved in the cultivating and storing of cocoyam and cassava or even in charge of this. In contrast, the cultivation and storage of yam is exclusively the matter for men (Knot, 9183).

2.7 Constraints to Yam Production

Yam cultivation is generally limited by high costs of planting material and of labour, decreasing soil fertility, inadequate yield potential of varieties, as well as increasing levels of field and storage pests and diseases associated with intensification of cultivation (IITA, 2009). The labour requirements in yam cultivation for mounding, staking (especially in the forest zone), weeding and harvesting exceed those for other starchy staples such as cassava. These account for about 40% of yam production cost while 50% of the expenditure goes to planting materials (IITA, 2009). The seed yams are also perishable and bulky to transport. If farmers do not buy new seed yams, they must set aside up to 30% of their harvest for planting the next year. Increasing pressure from a range of insect pests (e. g. leaf and tuber beetles, mealy bugs, scales), fungi (anthracnose, leaf spot leaf blight, tuber rots), and viral diseases, as well as

nematodes contribute to sub-optimal yields and the deterioration of tuber quality in storage (IITA, 2009).

The shortage of yam setts has a major influence on yam production. Langyintuo (1996) notes that seed shortage is a major constraint to increase in yam production in the Guinea Savannah zone. At first, purchasing seed appear not to be common practice, farmers tend to use their own seeds for planting and only obtain them off-farm on an ad hoc basis (Langyintuo, 1996). Farmers' reluctance to exchange planting materials is explained, in part, by the belief that "seed yams carry along with them the fortunes or misfortunes of the farmer who grew them" (Tetteh and Saakwa, 1991). In spite of this, farmers do seek planting materials from external sources if:

- Their stocks are inadequate due to a poor harvest in the previous season
- They wish to obtain new varieties
- They plan to increase the area planted

Unfortunately, the quality of purchased seed yams is often poor. At the same time, it is normal for farmers to sell seed yams only once their own fields have been planted. This means that the purchasers tend to plant late which results in sub-optimal yields (Marfo et al, 1998).

2.8 The Impact of Post-Harvest Losses

Post-harvest food losses do not affect farmers/producers only but significantly endanger the livelihoods of other stakeholders across the value chain by reducing valuable incomes and profitability. According to de Lucia and

Assennato (1994), post-harvest losses refer to measurable quantitative and qualitative food loss in the post-harvest system. This system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food. Postharvest loss can be defined as the degradation in both quantity and quality of a food production from harvest to consumption. The term quantity losses also refer to those that result in the loss of the amount of a product. Loss of quantity is more common in developing countries (Kitinoja and Gorny, 2010). Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product. These losses are generally more common in developed countries (Kader, 2002).

Post-harvest losses occur during production, post-harvest handling and storage as well as processing, distribution and consumption stages. Post-harvest losses occur from a number of causes such as improper handling or bio-deterioration by microorganisms, insects, rodents or birds. If post-harvest losses are to remain at relatively high levels, it would be difficult to secure adequate food production for the increasing population.

2.8.1 The World Situation

The UN Food and Agriculture Organization (FAO, 2008) noted that with adequate investment and training, food loses could be drastically reduced. According to (FAO, 2008) post-harvest losses could range from 15 per cent to as high as 50 per cent of what is produced. The agency said the causes ‘‘include: harvesting at an incorrect stage of produce maturity, excessive

exposure to rain, drought or extreme temperatures, contamination by micro-organisms and physical damage that reduce the value of the product. FAO said crops also lose value because of spillage, damage from inappropriate tools, chemical contamination or rough handling (including heat build-up) during harvest, loading, packing or transportation.

They also have an impact on environmental degradation and climate as the land, water, human labour and non-renewable resources such as fertilizer and energy are used to produce, process, handled and transport food that no one consumes. Many of the losses which can be significantly reduced if there is adequate training occur because of erroneous transport and packing practices. FAO, collaborating with the World Bank and others has trained thousands of people in three continents to handle harvested food properly. For example, in Kenya, where mycotoxin contamination of grain staples is of major concern, the FAO, together with the Ministry of Agriculture, has provided technical training for stakeholders involved in food production.

Another major problem further highlighted during the 2008 food crises, is the inadequate and insecure storage facilities in many developing countries. Thus interventions by FAO and collaborating donor agencies can make a significant impact. For instance, in Guinea where between 70 and 80 per cent of the population depends on Agriculture for its livelihood; the FAO said a project was designed to reduce post-harvest losses from their usual level of around 20 percent to significant reduction levels.

2.8.2 The African Context

In Guinea, where between 70 and 80 per cent of the population depend on agriculture for its livelihood, a project was designed to reduce post-harvest losses from their usual level of around 20 per cent. Some 100 silos, ranging in capacity from 100 to 1800 kilograms, were distributed. Dozens of artisans were trained in the construction and installation of silos. As a result, farmers were able to reduce losses in their grain stocks to a minimum and defer sales until better conditions prevailed. All in all, more than 45000 silos have been installed or built in 16 countries and more than 1500 professionals, technicians and craft men have been trained in constructing and handling them. To make technologies such as these silos accessible to small farmers, interventions also are needed in other areas. In many developing countries farmers cannot afford the materials to build the silos, so FAO has set up revolving funds and loans to facilitate the diffusion of better storage containers. Other interventions involve establishment of innovative institutional mechanisms such as warehouse receipt systems

Despite these apparent successes, post-harvest losses still represent a problem in many countries. Post-harvest losses in Africa have opened a vista of un-tapped opportunities for agro-processors willing to invest on the continent. The opportunities are coming at a time when crop improvement programme by the International Institute of Tropical Agriculture (IITA) and national partners are offering better varieties and increasing yield. “This makes the private sector a key partner in providing solution to the losses,” said Peter Hartmann, IITA Director-General during a courtesy visit by the Swedish Ambassador to

Nigeria, Per Lindgarde, to IITA in Ibadan. Ambassador Lindgarde and Director-General Hartmann exchanged ideas on some of the agricultural challenges of Nigeria and Africa.

In Kenya alone, annual post-harvest losses in crops such as bananas are estimated at more than 50 percent but the figure is often higher in other parts of Africa. In Nigeria, the second biggest economy in sub-Saharan Africa, losses easily exceed one third for many crops. “Even in countries that are famine-prone, post-harvest losses are still huge challenges,” Hartmann said, “Choose any market in Africa and take a walk during the close of the day and you will see heaps of food that is waste.” Over the years, IITA in collaboration with national partners have developed technologies to tackle post-harvest losses via processing of Africa’s major staples including cassava, maize, bananas and cowpea. But this has been done piecemeal and on test sites. There is a need for such efforts at a pan African-scale and this means getting the private sector-small and big-involved. Apart from poor infrastructure which is the continent’s major problem, Africa needs more investments in processing and packaging of agricultural products.

2.8.3 Post-Harvest Losses in Ghana

The aim of multiple cropping is to increase the production from the land whilst providing protection of the soil from erosion. The method involves sequential cropping, growing two or more crops in a year in a sequence or inter cropping, growing two or more crops on the same piece of land at the same time. Many schemes involve a mixture of the two. This in effect will go a long way to

enhance the families' livelihood. Poverty levels in the community will eventually reduce.

Women are largely responsible for post-harvest handling of crops in Ghana's agricultural sector; a study (conducted May 18, 2010) headlined `Post-harvest losses threaten rural women's livelihood' in some thirty (30) farming communities in Ghana has shown. The study which was conducted by the Ghana Agricultural Workers' Union (GAWU) of the Trades Union Congress (TUC) and supported by the Canadian International Development Agency (CIDA) recorded 30% food losses in the post-harvest chain, a situation it said deprives most women of their livelihood and food security.

The study (conducted from March-May, 2010) headlined `Post-harvest loss management and women empowerment' sought among other things; to provide an inventory of the traditional and modern post-harvest control and management measures against the identified crops. It also sought to assess the social and economic profile of farmers, especially, women, and how post-harvest losses affect their livelihood.

One of the sources of food insecurity in Africa is post-harvest crop loss. Pre and post-harvest losses in Africa are higher than the global average and impact more severely on livelihoods, especially, the rural poor. It has been estimated that at least 10-40% of Africa's crop productivity is lost on and off the farm mainly because of outmoded cultural practices (subsistence farming). Most farming communities do not have access to appropriate technologies, a situation according to agricultural experts, is having a rippling effect on food security in the continent.

According to the study, 80% of women farmers are engaged in the post-harvest handling of crops and are visible in processing of crops such as maize, rice, cassava and yams. Findings of the report also revealed that post-harvest activities were found to be clearly gender tasked, with women predominance in activities such as; harvesting operation, gathering on farm, grading and sorting operations/carriage to home, drying, storage and marketing. The study also observed that women considered destruction by rodents and birds of farm produce during drying as the most important post-harvest challenge while men considered spillage during transportation as the most important post-harvest challenge.

Factors that may affect harvesting and post-harvesting are likely to make women economically powerless, thereby worsening poverty and food security in farm households. Currently, agricultural policies in Ghana on post-harvest loss management of crops have always been embedded in broad thematic areas with no clear cut emphasis, the study revealed. Gender roles in agricultural policies, particularly, post-harvest management, are not clearly indicated for guidance of implementing policies. However, the study in its quest towards rural women empowerment, recommended that policies on post-harvest management should incorporate gender roles and the need for agricultural training programs offered to extension workers in order to minimize losses, especially, by women.

It also recommended that policies on post-harvest management should build in special initiatives to reach women processors and traders by increasing the number of female extension workers, especially in areas where there are

cultural inhibitions to male workers communicate directly to women. Another significant recommendation the report noted was to recognize strategic needs of women such as limited access to and control over land, lack of agricultural credit and training modern farming practices and processing as well as to facilitate women's access to loans for collective business or individual level processing and training activities.

2.8.4 Major economic activities in the Kintampo Municipality

Agriculture being the major economic activity constitutes the main source of household income in the Kintampo Municipality. The major food crops produced in the area are yam, maize, cowpea, cassava, rice, plantain and soya beans, which have potential to increase the incomes of farmers. Despite the efforts of the farmers, frequent bush-fires, high cost of inputs, inadequate extension services, prevalence of pests and diseases, poor access to credit, poor market prices and market facilities account for the low yield of farm produce in the area. Marketing of farm produce is to a large degree done outside the community of production when that community does not have a ready market situated therein. Those who market them within the community have marketing centres as is the case in areas like Kintampo and Babatorkuma. Some are sent to other marketing centres outside the Municipality like Techiman, Zabrama, Yeji and Kumasi. Since the crops produced in the Municipal are almost broadly similar in all areas of production with little diversity, the tendency of market prices of the various produce getting depressed by large supplies at the same time, especially in the early and major harvesting seasons cannot be ruled out.

Inaccessibility to farms which are located in the hinterland also has a telling effect on marketing. Middlemen/women who are able to get into the hinterland influence greatly the prices of produce. The market tends in most cases to be a buyers' rather than a producers' one. This situation in itself constitutes a disincentive to increased production. The mode of payment for produce is basically cash and on some credit terms. Credit is offered to well-known customers. In a few instances, some of these deferred payments become bad debts to the producer.

2.9 Yam Production and Household Livelihoods

The production of yams has been very important to the welfare of many generations of people in Ghana and other countries in West and Central Africa (FAO, 2007). Yams certainly continue to be very important for food security, income generation and several socio-cultural events. The yam culture is an integral part of over 60 million people in the sub-region, where it provides multiple opportunities for poverty reduction and nutrition (Crusoe, 2004). Yam performs a very supportive role as far as the sustenance of human life is concerned. The following are some of these roles.

2.9.1 Food uses

Fresh tubers of yams are used to prepare traditional food dishes in Coted'Iviore, Ghana and Nigeria. Yams are most appreciated eaten in pounded form called 'fufu', a dough obtained by mortar-pounding tubers that have been

boiled until soft. These countries account for over 90% of yam production (FAOSTAT, 2003). According to Bricas (2003) most inhabitants of urban areas of West Africa eat boiled or fried yams, often as snack away from home. The use of yam flour (produced by milling dried chips) is another emerging habit. Yam flour is very well adapted to urban cooking requirements and is used to prepare a dough called 'Amala', a staple or occasional food for about 50% of the population of Cotonou (Benin) and towns of south western Nigeria. Amala is not perceived as a substitute for but rather as a food in its own right (Bricas et al., 1997).

2.9.2 Non-food uses

Yam produces starch which is an important ingredient in food and non-food industries such as paper, adhesives, plastic, textile and pharmaceutical industries tonnes of food through post-harvest losses. With SSA alone post-harvest food losses constitute more than 30% of the total food production especially in perishable foods (fruits, vegetables and root crops) estimated to be over US$ 40 billion in value.

In some African, Caribbean, and Pacific (ACP) countries, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can regularly reach as high as 40-50% (SPORE, 2011). These losses drain the effort of farmers considering the kind of investment made with regards to input use (such as fertilizers, seeds, agrochemicals etc.), land, labour and cash that went into yam production.

2.10 Differences in post-harvest losses across continents

In Africa, post-harvest losses of food are estimated at 25% of the total food crop harvested and post-harvest in less hardy crops such as fruit, vegetables and root crops can reach as high as 50% (Voices Newsletter, 2006). But in Asia, post-harvest losses for cereals and oil seeds is about 10-12% of the total food crop harvested. A survey conducted by the Australia Institute revealed that on a country-wide basis $10.5 billion was spent on items that were never used or thrown away. This amounts to more than $5000/capita/year. In the United Kingdom, households waste an estimated 6.7 million tonnes of food every year, around one third of the 21.7 million tonnes purchased. This means that approximately 32% of all food purchased per year is not eaten. In the United States of America, 30% of all food worth US$ 48.3 billion is wasted each year.

2.10.1 Effects of post-harvest losses and food waste

Post-harvest losses have effect on water and energy resources as well as the huge sum of money that goes in to the management of food waste. Agricultural production uses 2.5 trillion cubic metres of water per year and over 3% of the total global energy consumption and estimated food losses of about 30-50% of total production translates wasting 1.47-1.96 Gha (global hectares or 4931 million hectares) of arable land, 0.75-1.25 trillion cubic meters of water and 1% to 1.5% of global energy. Food losses also cause negative externalities to the society through the cost of management, greenhouse gas production and loss of scare resources used in production.

2.10.2Conceptual framework for effect of postharvest loss on food availability

The socioeconomic determinants of postharvest losses and the effects of food availability are conceptualized in Figure 2.1. The factors that influence postharvest losses are categorized into four; namely, farmer-specific, farm-specific, location-specific and policy variables. Farmer-specific factors include sex, age, education and household size. For instance it is believed that farmers with high education would better appreciate the adoption of more efficient improved farming practices as well as postharvest techniques. Farm-specific factors also include farm size, storage as well as the system of farming adopted on the farm by the farmers.

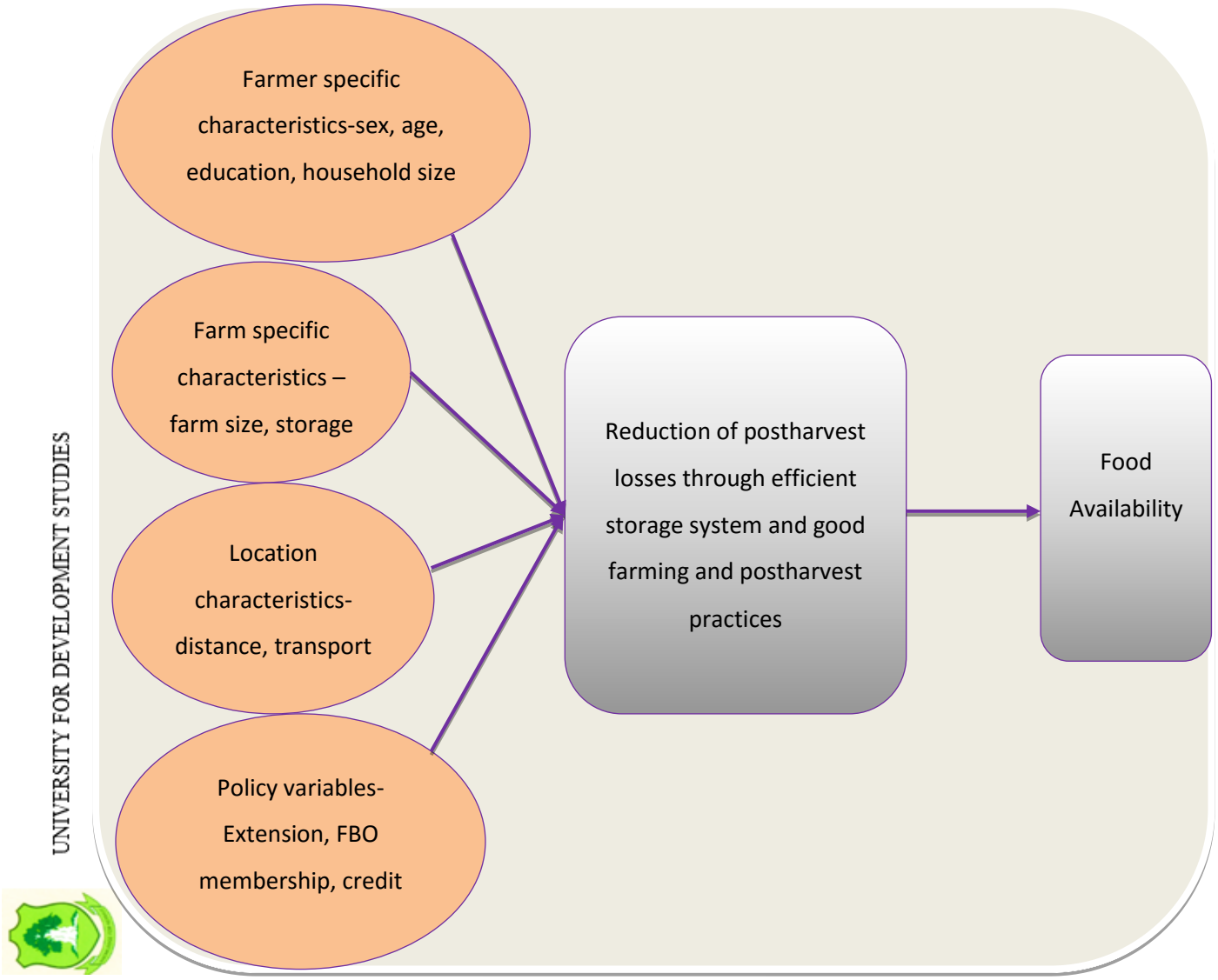

Figure 2.1: Conceptualizing the determinants and effects of postharvest losses

Locational factors such as proximity of the farm or farmer's house to the market or input stores also go a long way to determine the extent of postharvest losses. Other things being equal, proximity to the market and input stores would mean that for instance farm produce can be cart to the market centres on time to avoid spoilage or rottenness. The last category of factors includes membership to farmer-based organisations (FBOs) as well as access to credit and extension services. When the above categories of factors are

favourable they go a long way to impact on postharvest technologies, which eventually increase households' food availability. As indicated earlier, this study is based on the premise that *ceteris paribus*, households whose socioeconomic indicators are unfavourable have the tendency to experience high levels of postharvest losses and for that matter have food availability problems. The economic effects of postharvest losses are discussed in chapter three under the theoretical framework of the study.

2.10.3Empirical literature review on postharvest losses

Sustainable food supply is critical to ensuring food security. According to FAO (2008) food production will need to grow by 70% to feed the world population projected to be 9 billion by 2050 with more than half of this growth expected to come from SSA. Food losses are critical constraints to achieving food security. Almost every year the world loses about 1.3 billion tonnes of food through post-harvest losses and with SSA alone post-harvest food losses constitute more than 30% of the total food production especially in perishable foods (fruits, vegetables, root crops) estimated to be over US$ 40 billion in value.

2.10.4 Main elements of the post-harvest systems

Post-harvest losses can occur during the harvesting periods, pre-harvest drying, transport, post-harvest drying, threshing, storage, processing and marketing. These factors have been categorized into internal and external factors. The internal factors occur at all stages in the food supply chain from the stage of harvesting, to handling, storage, processing and marketing. These factors

include; harvesting, pre-cooling, transportation, storage, grading, packaging and labelling, secondary processing, biological, microbiological and chemical factors. The external factors are those outside the food supply chain. These factors can again be grouped as primary categories: which are environmental factors and socio-economic patterns and trends. The environmental factors are climatic conditions and they include wind, humidity, rainfall, and temperature.

2.10.5 Food loss versus food waste

Food losses refer to the decrease in edible food mass (dry matter) or nutritional value (quality) of food that was originally intended for human consumption (FAO, 2013). Food waste on the other hand refers to food appropriate for human consumption being discarded, whether or not after it is kept beyond its expiry date or left to spoil. Food waste occurs at the food chain (retail and final consumption) and relates to retailers‟ and consumers‟ behaviour. Food losses in fresh produce chains are most prevalent in the continent where close to 70% of fruit and vegetables produced is lost along the supply chain. Food losses take place at production, postharvest and processing stages in the food supply chain (Parfitt et al., 2010).Food losses occur due to a number of factors such as lack of resources, poor processing facilities/ use of outdated technology, damp weather at harvest time, poor production practices/planning, transportation facilities, grading, lack of infrastructure, consumer preferences/attitudes, unavailability of financial markets, premature harvesting, lack of access to good quality packaging materials and technology, inadequate market systems.

In order to reduce food losses there is the need to adopt modern post-harvest technologies. Even though these technologies have been proved successful in Asia and other part of the world, they are not sufficiently adopted by farmers in most African countries. To succeed, interventions should be sensitive to local conditions and practices, be viewed within a value chain lens, and ensure that appropriate economic incentives are in place. These range from training in improved handling and storage hygiene to the use of hermetically sealed bags and household metallic silos, and are supported by enhancing the technical capabilities of local tinsmiths in silo construction (World Bank et al., 2011).

Post-harvest loss reduction will increase food availability without increasing the use of land, water and agricultural inputs. Reducing post-harvest losses along with making more effective use of crops, improving productivity of existing farmland, and sustainably bringing acreage into production is critical to facing the challenge of feeding increasing world population. A research conducted by ACF (2011) stated that post-harvest handling is one of the important areas that would help combat hunger, raise income and improve food security and livelihoods. The research finding shows that a reduction of just one percent in post-harvest food losses leads to a gain of UD$ 40 million annually. ACF (2011)

The study by Ayandiji *et al*, (2011) sought to investigate, among others, the determinants of postharvest losses among tomato farmers in Imeko-Afon local government are of Ogun State, Nigeria. They found that the means of transporting tomatoes from the farm to the market centres were as follows: bicycle (4.55%); motorcycle (22.73%); and van/pick-up (72.75%) and these

contribute greatly to postharvest losses in tomato production/marketing. There were no storage facilities. They also found that postharvest losses increased with long distance from the farm to the market, long period of stay of tomato fruits on the field after maturity and large quantities of produce. They also indicated that age, farm size, farm experience and contacts with extension agents had positive significant influence on farmers' storage adoption. The major constraints to the farmers' adoption according to their study were ignorance of technology existence on the part of the farmers and high cost of the technologies

According to Okoedo et al (2009), yam barn is the major traditional storage technique used by the farmers. The adoption of improved yam storage techniques was low with shelving being the most widely adopted and this leads to increased rate of yam postharvest losses Guisse (2010) found that postharvest losses of rice were considered too high by 90% of the rice farmers. It was also found that harvesting losses were higher (2.935%) when sickle harvesting method was used than when panicle harvesting method was used (1.39%). Threshing losses were also higher (6.14%) when threshing was done using a locally made wood box called "bambam" than when the bag beating method (2.45%) was used. Among others, Guisse concluded that even though SB 30 machine was more efficient than the SB 10 and the locally manufactured one, it did not produce competitive percentage head grains.

According to Kader, (2003), "there are wide ranges of postharvest technologies that can be adopted to improve losses throughout the process of pre-harvest,

harvest, and cooling, temporary storage, transport, handling and marketing disbursement.

Agbodza (2001) examined the effects of postharvest practices and socioeconomic factors on the quality and price of yam in Ghana with special reference to the Brong Ahafo Region. Also, the Hedonic-Pricing model was employed to establish a relationship between yam quality and its price. The results of the study showed that the use of cutlasses for harvesting milk yam (pricking), storage of yams in either local (traditional barns) or improved barns (GTZ barn) and chemical protection of seed yams among other practices were the commonest postharvest handling practices in the study area

According to Asante (2002), yam farmers, traders and exporters were of the view that the traditional harvesting and storage practices such as the use of cutlass in harvesting milky yam did not have a negative impact on the quality of yams. Also, lack of storage structures (sheds) in the yam markets meant that yams were exposed to heat from the direct rays of the sun leading to rottenness, especially in “puna”, one of the most preferred varieties of yam.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

The study was carried out in the Kintampo Municipality in the Brong Ahafo Region of Ghana. The Kintampo Municipality was established in 1988 under the Legislative Instrument (LI 1480). However, in 2004 the Kintampo South District was carved out from it, and it was renamed the Kintampo North District by Legislative Instrument of the Local Government Act, Act 462, LI 1762, now Kintampo Municipal by Legislative Instrument of the Local government Act, Act 462, LI 1871.

Kintampo Municipality is located between latitudes 8º45'N and 7º45'N and Longitudes 1º20'W and 2°1'E and shares boundaries with others, namely; Central Gonja District to the North; Bole District to the West; East Gonja District to the North-East (all in the Northern Region); (KiMA, 2011)

3.1.1 Climate

The Municipality experiences the Tropical Continental or Interior Savannah type of climate, which is a modified form of the Tropical Continental or the Wet-semi equatorial type of climate. The mean annual rainfall is between 1,400mm-1,800mm and occurs in two seasons; from May to July and from September to October with the minor season (May –July) sometimes being obscured. The mean monthly temperature ranges from 30°C in March to 24°C in August, with mean annual temperatures ranging between 26.5°C - 27.2°C. This climate gives rise to sunny conditions for most part of the year.

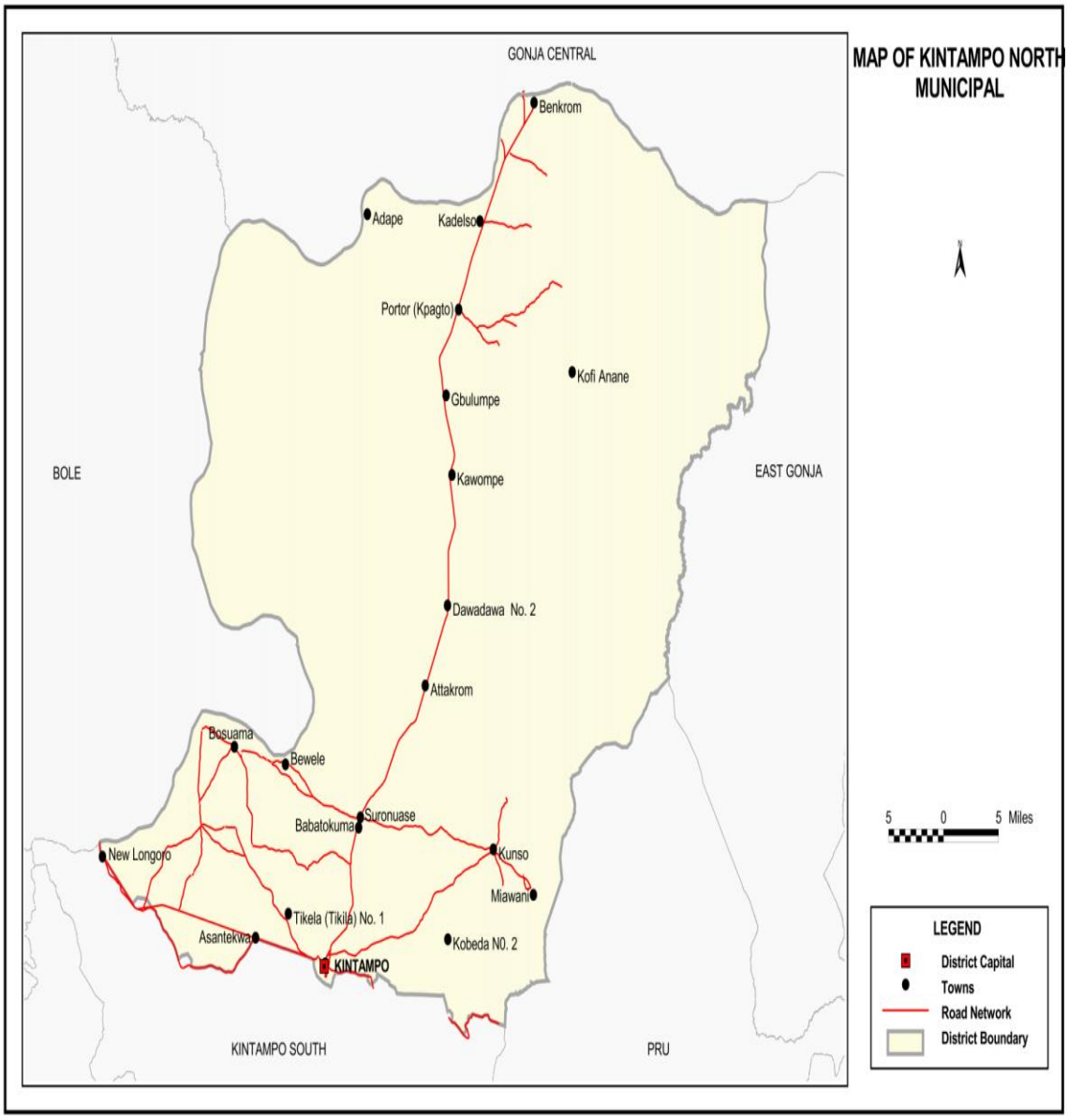

Figure 3.1: Map of Kintampo North Municipal Assembly

Figure 3.2: Map of Ghana indicating location of Kintampo Municipal Assembly

3.1.2 Vegetation

The Municipality comes under the interior woody savannah or tree savannah. However, owing to its transitional nature, the area does not totally exhibit typical savannah conditions. (KiMA, 2011)

Only trees such as the Mahogany, Wawa, Odum, Onyina, Baobab, Dawadawa, Acacia, and the Sheanut trees, which have adapted to this environment are found in the vegetation zone. They are few and scattered except along the margins of the moist deciduous forest where the trees often grow quite close together. Grass grows in tussocks and can reach a height of about 10 ft. (KiMA, 2011)

3.1.3 Soils

Soils in the Municipality belong to two main groups; the ground water lateral soils which cover nearly 3/5 of the Municipal in particular and the interior wooded savannah zone in general. The other soil group, covering the rest of the 2/5 of the Municipal is the savannah ochrosols occurring in the south and south- western parts of the Municipal. (KiMA, 2011)

3.1.4 Major Economic Activities

The Kintampo Municipal economy can be described as purely agrarian in that almost every resident in the area is a farmer. About 71.1% of the population is engaged in agriculture and its related activities as their main economic activity. The remaining 28.9% are distributed among commerce, industry and services. The major food crops produced in the area are yam, maize, cowpea, cassava,

rice, plantain,egushie, groundnut and beans. cashew, mango, tomatoes, onions, water melon, garden eggs and soya beans have potential to increase the incomes of farmers. (KiMA, 2011)

3.1.5 Markets

Apart from the weekly markets at Kintampo, Babatorkuma, Dawadawa, Gulumpe, and New Longoro which fall on every Wednesday, Sundays, Fridays, Fridays and Saturdays respectively, there is no market in the nearby or surrounding communities. (KiMA, 2011)

3.1.7 Accessibility to farm inputs

Farmers generally obtain farm inputs in the open markets at Kintampo, Techiman or Kumasi. The Kintampo Agricultural station makes available to farmers certified maize seeds. The sources of supply of the inputs could be from private sector operators accredited by the Ministry of Food and Agriculture (MoFA) and with proper checks in supervision and accounting put in place; the system is likely to be sustained. (KiMA, 2011)

3.1.8 Accessibility to farm credits

Basically, the farmer from his own personal savings finances farming ventures in every season. Majority of the farmers resort to this practice; followed closely by assistance from moneylenders, bank credits and support from friends and relatives. Only Kintampo Rural Bank Limited gives credit facilities for agriculture in the Municipal. For crop farmers, priority is given to yam farmers because about 80% of the farmers in Kintampo and its vast environs

are engaged in yam production, on account of its being the major staple export of the Municipal. (KiMA, 2011)

3.1.9 Marketing of farm produce

Marketing of farm produce is to a large degree done outside the community of production when that community does not have a ready market situated therein. Those who market them within the community have marketing centres as is the case in areas like Kintampo and Babatorkuma. Some are sent to other marketing centres outside the Municipality like Techiman, Zabrama, Yeji and Kumasi. Since the crops produced in the Municipal are in high demand.

3.2 Types and Sources of Data

Data for the study were largely collected from primary source through a field survey. However, few secondary data were also obtained to complement the primary data. The methods of data collection were questionnaire administration, focus group discussions, key informant interviews and personal observation. Semi-structured questionnaires and interview guides were the main instruments used for the data collection. Data gathered in this manner constituted the study's primary data. Secondary data were collected from offices of the Kintampo Municipal Assembly (that is, the municipal profile). Data on accident trucks that carried yams to other market centres was obtained from institutions such as Ghana National Fire Service (GNFS).

3.3 Sampling Techniques and Method of Data Collection

According to Manheim (1977), a sample represents a portion of the population which is selected and data collected on this portion in order to make inferences

about the whole population. Thus, sampling is used where the research design requires that information is collected from a population which is large or so widely scattered as to make it impractical to observe all the individuals in the population (Gyimah, 2012). To determine an accurate sample size, given the confidence level and total population size, we adopted the formula suggested by Krejcie and Morgan (1960) as follows:

$$n = \frac{N}{1 + N * e^2} \quad (1)$$

N = targeted population =50629 (KiMA, 2011)

e = margin of error = 0.05

n = sample size

According to Krejcie and Morgan (1960), the acceptable sample size of a population of 50,629 at 95% confidence level should be 381 observations. However, due to time, financial and other resource constraints, the sample size for this study was chosen to be 202 yam farmers.

Two main sampling techniques were used to select the sample for this study. These are the stratified and random sampling techniques. According to Kwabia (2006), simple random sampling ensures that every individual in the population has an equal chance to be included in the sample selected. The simple random sampling technique and stratified sampling were therefore employed for this study. One hundred and eighty seven (187) men and fifteen (15) women were selected for the study. This was based on the fact that the

population is homogenous and every yam farmer will have an equal chance of being selected.

3.3.1 Theoretical framework for the effects of postharvest technology adoption

In chapter two, the determinants and effects of postharvest losses on food security was conceptualized. It was observed that favourable socioeconomic indicators of famers would lead to lower levels of postharvest losses which in turn lead to increased food availability. In this section, Rutten's (2013) analysis of the broader effects on society of increased food supply through the adoption of efficient farming and postharvest techniques is reviewed.

Figure 3.1 depicts a typical yam market. The supply curve (SS) is upward sloping while the demand curve (DD) is downward slopping. Note that the supply curve (SS^1) measures a greater supply of yam to society than the supply curve (SS). Thus, SS measures supply with postharvest losses while SS^1 measures supply without postharvest losses. Let us assume that there are losses in the production and supply of yam in Kintampo. In that case the initial equilibrium (with postharvest losses) is at Point A where p^0 and Q^0 are the equilibrium price and quantity respectively. This means that given the original price p^0, more can actually be produced and supplied to the market (i.e. Q^2 at point B) or the original quantity Q^0 can actually be produced at a much lower cost (p^3 at point C)if losses were to be absent.

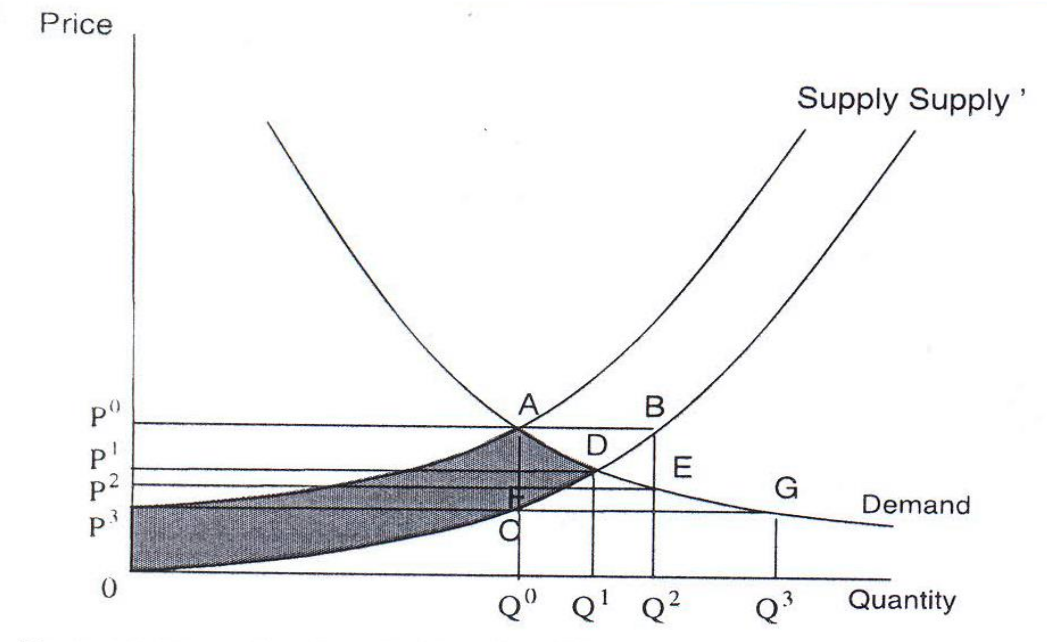

Figure 3:1 Impacts of reducing food losses in supply

Source: Rutten (2013)

3.3.2 Welfare impact of efficient storage system and farming practices

Given the original demand curve (DD), when there are efficient storage system and farming practices such that post-harvest losses are reduced, this would result in greater supply which results in lower price P1 and a higher equilibrium quantity Q^1 in the market as given by point D. At this new equilibrium, consumers can buy more food at a lower price resulting in a welfare gain to consumers as measured by the change in consumers' surplus of P^0ADP^1. Similarly, producers can sell more, but at a lower price, resulting in a change in producer surplus of P1D0-P0AP3, which is also positive. The overall welfare gain equals the sum of the change in the producer and the consumer surpluses, which amount to the area P3AD0, the shaded area between SS and SS' under the demand curve DD.

3.4 Methods of Data Analysis

The methods of analysis were both qualitative and quantitative. The qualitative aspect involves the use of chi-square, means and frequencies while the quantitative involves the estimation of a logit model. The chi-square and the logit regression model are explained below.

3.4.1 The Chi-Square

The chi-squared test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. Does the number of individuals or objects that fall in each category differ significantly from the number you would expect? Is this difference between the expected and observed due to sampling variation, or is it a real difference? In terms of the present study the researcher wish to find out whether or not there are significant differences in yam postharvest losses among the categories of yam farmers in the Kintampo Municipality.

Mathematically, the chi square is given as;

$$\chi^2 = \Sigma[(O_i - E_i)^2]/E_i \qquad (2)$$

where O_i is the observed frequency count for the ith level of the categorical variable, and E_i is the expected frequency count for the ith level of the categorical variable.

3.4.2 Regression analysis

Regression analysis on the other hand, is a statistical procedure for analysing associative relationships between a metric dependent variable and one or more independent variables. Among others, regression analysis helps us understand how the typical value of the dependent variable changes when any of the independent variables is varied, while the other independent variables are held constant. Regression analysis is widely used for prediction and forecasting.

A multiple regression model is of the form:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 + ... + \beta_n x_n + u \quad (3)$$

where: y = dependent variable; x = independent variables; u = error term with a mean zero and constant variance; and β = parameters to be estimated. They measure the effects of the independent variables on the dependent variable. Equation 3 is estimated by the following equation:

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + b_3 x + ... + b_n x_n \quad (4)$$

where: $\hat{y}$ = Estimated value of the dependent variable y: and b = the estimated value of the β parameters .

3.4.3 The Logit Model

In estimating equation 3 above, if the dependent variable is continuous (e.g. crop output of farmers), the Ordinary Least Squares (OLS) estimator may be used to obtain good estimates as specified in equation 4. However, in situations where the dependent variable is categorical (e.g. whether a household is food secure or not) the OLS estimator is not appropriate because the assumption of homoscedasticity (constant variance of the error term, u) is violated and the

predicted probabilities may lie outside the 0 and 1 range. In this case the appropriate model to use is a discrete choice model such as the Logit model.

The Logit model is suitable because it transforms p from $(-\infty,\infty)$ to (0, 1), thus ensuring that $0 \le \hat{p} \le 1$. The logit model assumes that there is an underlying response variable y_i^* defined by the regression relationship

$$y_i^* = \beta' x_i + u_i \tag{5}$$

Note that y_i^* is not observed in practice; what is observed is a dummy variable y defined by;

$$\begin{aligned} y &= 1 \quad if \quad y_i^* > 0 \\ y &= 0 \quad otherwise \end{aligned} \tag{6}$$

Thus, from the relations;

$$\Pr(y_i = 1) = \Pr(y_i > -\beta' x) = 1 - F(-\beta' x) \tag{7}$$

where F is the cumulative distribution function of u

The likelihood function is given as:

$$L = \prod_{y_i=0} F(-\beta' x_i) \prod_{y_i=1} [1 - F(-\beta' x_i)] \tag{8}$$

The functional form for F in equation 8 will depend on the assumptions made about u_i in equation 5. Since the cumulative distribution of u_i is the logistic, we have the logit model in which case;

$$F(-\beta' x) = \frac{\exp(-\beta' x)}{1 + \exp(-\beta' x_i)} = \frac{1}{1 + \exp(-\beta' x_i)} \tag{9}$$

Hence, $1-F(-\beta' x)=\frac{\exp(-\beta' x)}{1+\exp(-\beta' x_i)}$ (10)

In this study, the dependent variable is household food security. Household food security is unobservable but there is one of two food security conditions that a household may experience; either the household has enough food supply, including yam produce, throughout the year (in which case $y=1$) or the household runs short of food supply in the course of the year (in which case $y=0$).

3.5 Empirical model

The implicit empirical model is specified as in equation 11 below:

$$y = bx_1 + bx_2 + bx_3 + bx_4 + bx_5 + bx_6 + bx_7 + bx_8 + bx_9 + bx_{10} + bx_{11} + e_i \quad (11)$$

Where:

y = the number of tubers loss and X_1-X_{11} are independent variables, their definitions, measurement and *apriori* expectations are presented in table 3.1

Table 3.1 Definitions of variables and *apriori* expectation of parameter coefficients

Variable	***Definition***	***Unit of measurement***	***Apriori expectation***
Postharvest loss	Quantity of yam lost	Count of tuber	-
Yield	Output per unit area	Number of tubers	+
Income	Amount obtained	cedis	+
Age	Age of the respondents	years	+

Age square	the square of age	Years	+
Experience	Number of years in farming	Years	+/-
On –farm labour	Quantity of labour used	Number of people	+
Children	Number of children of farmer	Count of children	-
Distance	Distance from farm to market	Count of people	+
Credit	On farm access to loans/credit	1= yes, 0= otherwise	-
Education	Educational level of the respondent	Years	+/-

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents and discusses the results from the study. Specifically, the chapter presents the demographic, farm and location characteristics as well as some policy variables that influence postharvest losses. The latter part of the chapter examines how these socioeconomic indicators influence the level of postharvest losses in the study area.

4.2 Demographic Characteristics of Respondents

The demographic indicators of respondents presented in this section include sex, age, educational background and experience in yam farming

4.2.1 Sex

As presented in table 4.1, the distribution of sex from the survey was much skewed towards the males (92.6%). Only 7.4% of the yam farmers were females. The male dominance in yam production is not surprising because it is labour intensive. Yam farming requires a lot of physical strength, especially when it comes to clearing the land, making mounds, staking the yam and weeding, hence mostly done by men. The females on the other hand may not have both the physical strength and financial resources to go into yam farming. The male dominance in Kintampo Municipality is also due to the fact that immigrants mainly males come from the northern part of the country to do

settler farming. However, the women mostly help their husbands on their farms with very few of them having their own farms.

4.2.2 Age

In terms of age distribution, the highest percentage of the respondents fell within the 41 – 46 age brackets (42.6%), followed by those within the 35-40 bracket (24.8%) and 47-52 bracket (21.9%). Very few of them were above 52 years (9%). It is important to note that the highest percentage of the farmers were young adults, which is good for yam production, since the activity requires much energy.

Table 4.1: Sex and Age of respondents

Characteristics		*Frequency*	*Percentage*
Sex	Male	187	92.6
	Female	15	7.4
	Total	**202**	**100**
Age category	35-40	50	24.8
	41-45	86	42.6
	46-50	44	21.9
	51-55	12	6.0
	56-60	6	3.0
	60+	4	2.0
	Total	**202**	**100**

Source: Field Survey, 2011

4.2.3 Educational level of yam farmers

One of the important determinants of a farmer's ability to embark on prevention measures against post-harvest losses is the level of literacy. From Table 4.2, more than half of the respondents (55%) had attained the basic level of education, while 17.3% and 3% had had secondary and vocational education respectively. However, while 24.3% did not have any formal education, only 0.5% had schooled up to the tertiary level.

Generally, the level of education of the farmers in the study area, like it is nationally was low. This does not augur well for the adoption of improved postharvest techniques. A general observation during the survey was that most of these farmers still resort to the use rudimentary farming techniques, such as hoes and cutlasses for yam cultivation.

Table 4:2: Distribution of Educational Level of Farmers

Level	Frequency	Percent
No education	49	24.3
Basic education	111	55.0
Vocational	6	3.0
Secondary	35	17.3
Tertiary	1	0.5
Total	**202**	**100.0**

Source: Field Survey, 2011

4.2.4 Experience in farming and occupation

Apart from education that could enhance a farmer's level of knowledge and skill in preventing post-harvest losses, the number of years of farming also contribute to one's ability to adopt control measures against post-harvest losses. This could happen through 'learning by doing'.

Table:4.3 Minor crops cultivated by yam farmers

Crop	Frequency	Percentage
Beans	37	18.3
Cassava	27	13.4
Cocoyam	1	0.5
Cowpea	1	0.5
Groundnut	6	3.0
Maize	70	34.7
Millet	2	1.0
Okro	4	2.0
Pepper	5	2.5
Plantain	5	2.5
Rice	32	15.8
Soya bean	1	0.5
Tomatoes	10	5.0
Other Vegetables	1	0.5
Total	**202**	**100.0**

Source; Field Survey, 2011

In the survey conducted, it was revealed that 68.6% of the respondents had been farming yam for between 1 to 10 years; 25.4% had between 11 and 20 years of experience in farming, while 1% had over 40 years of farming experience. One could argue, based on this distribution of farming experience that farmers in the municipality have somehow depended on yam production as a means of livelihood. All the farmers involved in the survey in the municipality were engaged in yam farming, and yam was the major crop produced. However, farmers also produced on a smaller scale, crops such as beans, cassava, cocoyam, cowpea, groundnut, maize, millet, okra, pepper, plantain, rice, soya bean, tomatoes and other vegetables.

4.3 Farm and location characteristics

In this section we present among others the cost, output and revenue structures as well as the level of prices in the study area.

4.3.1 Distribution of farm size

The total number of acreages put under yam production by the respondents during the farming season under review ranged from 1 acre to 80 acres. The majority of respondents had yam farm size less than 10 acres (58.5%) while 40% had farm size between 10 and 19 acres. Also, only 0.5% and 1% respondents had farm sizes of 40 and 80 respectively. Averagely 2.5% of the farmers own a sizeable farm. This finding clearly shows that yam farming in the study area, like it is nationally is small-scale. Seini (2002) estimated that about 92% of crop farmers in Ghana are small scale farmers.

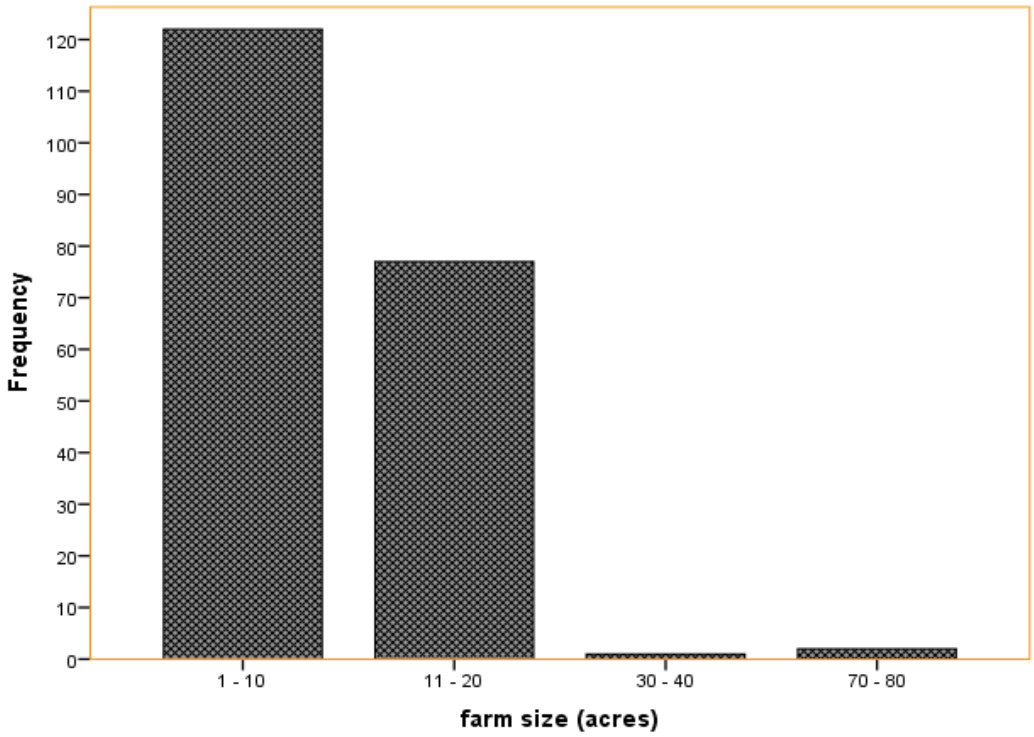

Figure 4.1: Distribution of farm size among yam farmers in the Kintampo Municipality

4.3.2 Planting materials

Yam farmers usually use various materials such as setts for planting. These include whole tubers and mini setts. Majority (79.7%) of the respondents according to the field survey use whole tubers for planting. The remaining 20.3% used mini-sett techniques. According to some respondents, sowing the whole tuber is a better method because it results in higher yields. However, there is a contrary view that using mini-sets to plant reduces disease and pest infestation. Mini sett is based on a simple technology whereby one tuber is used to produce multiple seed yams that lead to the cultivation of what is believed to be healthy tubers. With this technique, one yam tuber can be cut

into approximately 40 pieces or sett, of about 50-100 grams each. The yam mini setts are dipped into fungicide and nematicide which kills any infections already present before planting and prevents disease from appearing once planted. The yam setts then produce disease- free seeds which are ready for harvesting about five months after planting and used for field planting between February and April the following year (MiDA, 2010). Even though this technique promises to be healthy, it is yet to be embraced by many farmers, especially the commercial ones.

4.3.3 Resource use and yam production costs

The key inputs for the cultivation of yam in the study area were seed yam, land, labour, equipment for preparing the land, staking materials, and agrochemicals. Currently, most yam producers obtain inputs from local markets, but are constrained by high costs of materials, particularly seed yam, and difficulty in accessing credit. With respect to the tools used for harvesting yam, the survey results show that 72.8% of the farmers used the hoe, while 24.8% and 2.5% used the cutlass and the stick respectively. The implement used in harvesting the yams is very important. When the farm is so large, the best tool, in the context of small-scale African farming is the hoe because it is relatively fast. Both the cutlass and the hoe are used sparingly. The use of the hoe and cutlass in the harvesting process has a higher risk of post-harvest losses to the farmer. These farm tools inflict wounds on the tubers, thereby rendering them susceptible to rot. On the average farmers' spent GH¢1,500.00 per acre on their farms on labour and other related farming activities.

Table 4:4 Components of production cost of yam

Activity	*Average Cost per acre(GH₵)*
Clearing the land	45 – 3,000
Making mounds	50 – 2,400
Labour	2 – 400
Staking the yams	10 – 1,200
Weeding	30 – 5,000
Harvesting	20 – 1,200
Fertilizer	0 – 350
Pesticides	0 – 100
Weedicides	0 – 100
Mulching	0 – 99

Source: Field Survey, 2011

The key inputs for the cultivation of yam in the study area were seed yam, land, labuor, equipment for preparing the land, staking materials, and agrochemicals. From the field survey, farmers spent a maximum amount of GH¢ 15, 849per acre in an ideal situation on labour and other activities. On the other hand, some farmers spent a minimum amount of GH¢ 155 per acre. Currently, most yam producers obtain inputs from local markets, but are constrained by high costs of materials, particularly seed yam, and difficulty in accessing credit. Most farmers use traditional methods of generating planting materials, which results in lower quality yams. The mini-sett technique is used on a small scale and often farmers will keep the seeds that they have produced

rather than sell to others, therefore creating a market opportunity for a commercial seed yam supplier. (MiDA, 2010)

4.3.4 Income distribution from yam production

Table 4.5 indicates the amount obtained for selling 100 tubers of yams at the market. The price received per 100 tubers of yam ranges from GH¢ 45.00 to GH¢ 90.00 depending on the size of the tubers of yam. Most farmers perceived the prices per 100 tubers of yam to be good, while the rest admitted that the prices were better.

Table 4. 5: Average price received from sales of 100 tubers of yam

Amount (GH¢)	Frequency	Percentage
41-50	12	5.9
51-60	10	5.0
61-70	24	11.9
71-80	35	17.5
81-90	42	20.8
91-100	78	37.6
> 100	1	0.5
Total	**202**	**100**

Source: Field Survey, 2011

4.3.5 Yam production and post-harvest losses

From the field survey, the total number of yam tubers the farmer harvested per annum averaged about 122 tubers, with maximum 9000 tubers of yam per acre. According to the respondents, the reasons for the low levels of production include extensive heat during the sowing period and poor yam setts. Farmers who were fortunate to record high yield attribute them to proper farm management. These yields compare quite well with yields from major yam producing countries, where about 11 tonnes are produced per hectare, especially in the West African sub-region.

The first column of Table 4.6 below shows the class interval of the percentage of yam tubers lost after they were harvested. The results show that almost 90% of the respondents experienced less than 10% postharvest losses. The rest lost 10% or more during the farming season under review. The mean percentage loss was however, 4.84%.

Table 5.6: Distribution postharvest yam losses in the study area

Percentage loss	Frequency	%	Mean	Minimum	Maximum
0 – 4.9	128	63.36	1.80	0.0	4.80
5 – 9.9	51	25.25	7.03	5.0	9.91
10 – 14.9	12	5.94	12.25	10.0	14.29
15 – 19.9	7	3.47	17.19	16.67	19.86
20 or more	4	1.98	30.25	21.74	45.08
Total	**202**	**100.00**	**4.84**	**0**	**45.08**

Source: field survey December, 2011

From Table 4.7, the sources or agents of yam losses were storage (34.7%), harvesting (16.3%), animals (15.3%), ants (9.9%), thieves (9.9%) and transportation (6.4%). However 7.4% could not pinpoint exactly at what source they lost their tubers. Due to lack of adequate storage facilities, most farmers stored yams in the open. This exposed the tubers to much heat, and heavy losses were recorded during storage. Apart from storage losses, farmers also lost tubers of yams during harvesting, when much wounds are inflicted due to rudimentary farm tools such as hoes and cutlasses used for the harvesting.

Table 4:7 Stages/Agents responsible for loss of yam tubers

Agent	*Frequency*	*Percentage*
Animals	31	15.3
Ants	20	9.9
Harvesting	33	16.3
Storage	70	34.7
Thieves	20	9.9
Transport	13	6.4
Others	15	7.4
Total	202	100.0

Source: field survey December, 2011

4.3.6 Post-harvest handling and storage of yam

Table 4:8 shows that 49.5% of the farmers stored their yam tubers in barns, the key method of yam storage. The second commonest method was dug-holes (27.7%) followed by the bare floor (18.3%). Storing under shades/trees was the least popular method, adopted by only 4.5% of the respondents. Three main conditions are necessary for successful yam storage, namely; aeration, reduced temperature and regular inspection of produce. A good storage place for yams would determine the number or rate of spoilage. Fresh yam tubers can be successfully stored in ambient and refrigerated conditions. The recommended storage temperature is in the range 12°-16°C. Optimum conditions of 15°C or 16°C at 70-80% relative humidity or 70% relative humidity have been recommended for cured tubers (Martin, 1984; McGregor, 1987).

Table 4.8: Storage Facilities for Yam Tubers

Place	*Frequency*	*Percent*
Barns	100	49.5
Bare floor	37	18.3
Dug-out holes	56	27.7
Under shades/trees	9	4.5
Total	202	100

Source: Field Survey, 2011

In terms of yam preservation, 95.5% of the farmers indicated that they resorted to the natural methods of preservation in which no chemical is applied to the yam tubers. This natural method of storing yams greatly exposes yam tubers to potential attack, thereby leading to huge post-harvest losses. However, 4.0% of the farmers indicated that they used some form of chemicals or substances to preserve and stored the yams. When asked further to explain the kind of substances used, it was revealed that a substance called 'carbide' (sodium bicarbonate) was used in preserving the yams. According to the respondents the chemical is able to prevent insects and other destructive agents such as ants, termites and bugs. One respondent surprisingly stated that he stored the yams under shades of trees.

Yams are susceptible to a variety of pests and diseases during growth as well as postharvest. Attack by the yam beetle, and microorganisms such as nematodes and yam viruses are the most devastating. The major postharvest disease is tuber rots caused mostly by fungi. Fumigation is generally carried out using methyl bromide. Fencing, poisoning, and trap setting were the commonly used methods for controlling rodents according to the farmers.

The survey also probed further to discover whether government or any NGO had provided any storage facility to farmers in the municipality, the majority (82.2%) of the farmers indicated that there was no such facility in the area hence they either stored yams in the open, under trees, or in dug out holes. However, 17.8% of the farmers indicated that there was a facility in their area where individual farmers stored yams. The farmers indicated that the facility was provided by an NGO operating in the area. This facility is, on average

4km for the residents of the respondents and they paid an average fee of GH₵3.50 for storing 100 tubers in the facility.

4.3.7 Accessibility to production and marketing centres

From the field survey, most respondents travelled about 5 kilometres before reaching their farms. Others travelled beyond 10km before getting to their farms. This is a clear indication that most farmers had to travel long distances to their farms. In terms of marketing, the survey indicated that over 80% of the farmers walked up to 5 kilometres to reach the market with their produce. While the rest travelled as long as 50 kilometres to reach the market with their produce. Farmers who travelled long distances to get to the market stand the higher risk of suffering from losses due to accidents, truck breakdown, among others. The length of distance travelled to the market determines transport cost. The high transport cost, as well as other costs have a tremendous influence on profit and, consequently on food and cash security of the household. If ready market for their product was made available at the farm gate with good prices to farmers, the issue of travelling long distances to get to the market would save farmers hundreds of Cedis.

Inaccessibility to farms was another challenge encountered by some yam producers. The survey revealed that about 86% of the respondents had their farms accessible by vehicles, but they faced the added challenge of bad roads. They stated that since most of them usually produce in large quantities, it would be impossible to cart the produce on the head or by bicycles. The poor nature of the roads contributes to numerous accidents by vehicles, thereby

making farmers lose lots of yam tubers. About 14% on the other hand indicated that they had no vehicular access to their farms. One can imagine the difficulty such farmers endure when carting the yams to the roadside, markets or homes. This level of inaccessibility leads to huge post-harvest losses to the farmers.

From Table 4.9, approximately, 62.9% used tractors to transport their yam to their homes, while about 18.3% used Kia trucks. Few farmers transported their yam on the head or by cargo trucks. Again, the availability of transport has serious implications on post-harvest losses. After harvest, yam tubers are traditionally placed into woven baskets made from palm fronds or coconut fronds. These are ideal for transporting small quantities of yam tubers over short walking distances. The basket is carried on the head, shoulder, or tied to a bicycle and transported to the market or storage facility. Compression damage is reduced since the basket is able to bend and thereby reduce the amount of force acting on individual tubers.

Table 4. 9: Means of Transporting Yams from Farms to Homes

Means	***Frequency***	***Percentage***
Bicycle	24	11.9
Cargo	2	1.0
Carrying with Head	2	1.0
Kia	37	18.3
Motor king	10	5.0
Tractor	127	62.9
Total	202	100.0

Source: Field Survey, 2011

However, when large quantities of tubers are harvested, these baskets are not suitable because of their restricted sizes. Packaging tubers in full telescopic fibreboard cartons with paper wrapping or excelsior reduces bruising and enables large quantities of tubers to be transported over long distances. Tubers can be contained in loose packs, or units of 11 kg and 23 kg (McGregor, 1987).

In terms of means of transport to the marketing centres, table 4.9 shows that 62.9% normally used the tractor to cart their yam produce to the market. Again, 18.3% used Kia truck, while 5% used Motor King to cart the produce to the market. The tractor service still predominates and performs an important role in transporting yams in the study area. This could largely be attributed to the poor nature of the roads network in the municipality. Other vehicles find it very difficult to manoeuvre their way through the poor road network in the study area. Thus, the services of these tractors and trucks are very vital in reducing post-harvest losses in the area.

Table4.10: Means of Transporting Yams to the Market

Means	***Frequency***	***Percent***
Cargo	3	1.5
Kia	52	25.7
Motor king	12	5.9
Tractor	134	66.3
Urvan	1	0.5
Total	202	100.0

Source: Field Survey, 2011

4.3.8 Marketing of yam

This section looks at the availability or otherwise of ready market for the farmer and the various market forces affecting the farmers in the municipality. Further discussions are made on access to ready market by the farmers, where the farmers sell the yams, how much they spend on transporting 100 tubers of yams, how much they spend at the market on truck pushers, market tolls and potters. How many are involved in contract farming, and if so, how much are they given by contractors, how much do they gain after paying the contractors' sum, the cost of transporting 100 tubers of yams to the house, the cost of transporting 100 tubers of yams to the market, how much do they sell 100 tubers of yams at the market why at that price.

From the survey results, majority of the farmers (77.7%) had ready market for their yam produce. Access to market is a sure way to reducing post-harvest losses. Farmers who have ready market for the yams do not experience so much loss. Yam is heavily consumed by Ghanaians, who purchase fresh yams at local markets. Yam is typically brought to warehouses and purchased by wholesalers as well as individual consumers. The majority is sold in local markets. The export market has become the target for increased production (MiDA, 2010).

The survey revealed that, majority of the farmers sold their yam at the local market (54%), followed by outside town (32.2%) and on farm (12.4%). The

local market refers to Kintampo market (on Wednesdays). Most farmers prefer Kintampo market due to its proximity, which helps to reduce transport cost. The outside markets include Techiman, Tamale, Kumasi and Accra. Farmers transport yams to these markets in search of higher prices and profits. The rest of the farmers also sold their yams at the farm gate. Some farmers prefer selling the yams at the farm gate simply because they feel safe and also save transport cost. The price received may not be the best to the farmer but it is somehow preferred because many inconveniences are avoided. Access to market facility will help reduce post-harvest losses.

4.3.9 Transportation and other costs of marketing yam

The cost of transporting 100 tubers of yam, depending on the distance, ranged between GH¢=4.00 and GH¢ = 8.00. This is quite high, especially if the farmer has a lot of tubers to transport to the market centre. Transport cost alone serves as a barrier for farmers to send their yams to the market. Clearly, this may account for some of the reasons why some farmers preferred selling their product at the farm gate, even at cheaper prices. If farmers are unable to afford transportation costs, this would in the long run lead to post-harvest losses.

Other expenditures on transport cost include truck pushing, which was between GH¢ 1.00 and GH¢ 4.00 per 100 tubers. Fundamentally, the duties of the tuck pushers in the yam business cannot be over emphasized. They are usually required to push the yams to the trucks loading the yams to a particular destination.

Tolls are very important in the yam business. The farmers paid between GH¢ = 2.00 and GH¢ = 5.00 for market tolls. These tolls fundamentally serve as revenue generation for the yam production and marketing areas. Another cost borne by the farmers includes potter cost. Farmers pay averagely GH¢= 4.00 per 100 tubers for potters. Like the truck pushes potters are required to convey the yams to the big trucks that cart the yams to their final destinations.

4.3.10 Contract farming and yam production

The survey revealed that about 70% of the yam farmers in the municipality did not engage in any form of contract farming while the remaining 10% of farmers did some form of contract farming. Farmers involved in contract farming agree prior to the production season with buyers and take various sums of capital that would enable them produce their yams. They agree to pay back with interest, usually at the end of the production season.

Also, from the survey, 89.6% of the yam farmers, as against 10.4%, indicated that they did not receive any extension service from any organisation or institution. Those who had access indicated they received the service from NGOs (82%) and the Ministry of Food and Agriculture (MoFA) District office (18%). Over the years, inadequate extension staff from MoFA meant that NGOs have come in to provide services, which tend to be more efficient than what is provided by government. Clearly, from the statistics, it can be said that most yam farmers in the municipality do not have access to extension staffs. Thus, farmers are bound to face problems, especially during the harvesting and storage processes. Farmers who do not have access to extension service stand

the risk of recording higher post-harvest losses than those who have access because the extension officers educate farmers on some improved post-harvest hand lining techniques which will eventually reduce losses

4.4.0 Agricultural credit

One cannot overestimate the importance of credit in the production of yam. Farmers all over the world need credit to carry out their production and marketing activities. From the survey results, about 58% as opposed to about 41% of the respondents had access to agricultural credits. It is worth noting that, this is mainly from financial institutions such as the Kintampo Rural Bank, National Investment Bank (NIB) and Ghana Commercial Bank (GCB). Also, the Export Development and Investment Fund (EDIF) provide funding for some input suppliers and yam producers in the study area. The presence of these institutions, perhaps, explains why the majority of the respondents had access to credit.

Only about 20% of the respondents belonged to a farmer groups. Those in groups can pool their resources to purchase improved yam storage facilities as a group since those technologies are mostly expensive and most farmers cannot afford them as individuals. Also, yam farmers who are in groups can easily invite extension officers, expert or even colleague yam farmers who have been successful in trying a new postharvest handling technique to educate them more than an individual farmer. Lastly, the group members can easily learn good postharvest handling techniques from each other, something that will be difficult for those who do not belong to groups to benefit from

4.4.1 Differences in postharvest losses among categories of farmer.

As indicated in Chapter three, the ideal methodology should have been the regression model. However, the variables in the data are not proportional. In other words there are unequal or non-proportional figures for the various categories. For instance, only 10.4%, as against 89.6 % of the respondents received extension services, while 14%, as opposed to 86% were into contract farming in the study area. The percentages of respondents who belonged to a farmer group and those who did not have any group were also 80 and 20 respectively. According to Maddala (1983), when the data for the categories are unequal, the results tend to be skewed towards either the higher or lower values. Against this background, the postharvest losses were compared across the various categories of socioeconomic variables and tested using the chi-square. The essence is to investigate as to whether or not there are significant differences in postharvest losses among the various categories of farmers. From which categories postharvest losses were commonest so that in formulating policies, policy makers would be better informed where the concentration of their policies should be.

Among all the variables, except damage to yams during harvesting, the results show that there is a significant difference between the two categories of farmers with respect to yam postharvest losses. The chi square probabilities show that sex, ready market and techniques in sowing are significant at 1%, while accessibility to farm is significant at 5%. However, extension services, access to credit and farmer groups are significant at 10%.

From the results, the categories of farmers who experienced greater losses were as follows: male farmers (92.6%); farmers whose farms were accessible by road (86.1%); farmers who had no ready market (77.7%); farmers who were not involved in contract farming (85.6%); farmers who used whole tuber for sowing (79.7%); farmers who had no access to credit (57.4%) and farmers who did not belong to any farmer group (79.7%).In all, high levels of postharvest losses on the part of farmers whose farms were accessible by road did not meet the *a priori* expectation

Table 4. 11: factors of yam production

Variable	Category of farmer	Frequency	percentage	Chi-probability
Sex	Male	187	92.6	
	Female	15	7.4	
	Total	202	100	0.000
Farm accessibility	Access	174	86.1	
	No access	28	13.9	
	Total	202	100	0.026
Ready market for yam produce	Yes	157	77.7	
	No	45	22.3	
	Total	202	100	0.000
Contract farming	Yes	29	14.4	
	No	173	85.6	
	Total	202	100	0.000
Techniques in sowing yam	Mini –sett	41	20.3	
	Whole tuber	161	79.7	

	Total	202	100	0.001
Damage to yams during harvesting	Yes	199	98.5	
	No	3	1.5	
	Total	202	100	0.616
Receive extension service at farm	Yes	22	10.9	
	No	180	89.1	
	Total	202	100	0.074
Credit access	Yes	86	42.6	
	No	116	57.4	
	Total	202	100	0.097
Farmer groups in community	Yes	41	20.3	
	No	161	79.7	
	Total	202	100	0.099

Source: Field Survey, 2011

From Table4.11 and 4.12, the only variable that shows significant difference between the categories of farmers with respect to post-harvest losses at 1% level of significance is the sale of yam produce. The results show that post-harvest losses were highest among farmers who sold in the local market, as opposed to those who sold on the farm or outside the farmers' community. Our *a priori* expectations were that farmers who sold their produce outside the local communities would rather record the highest losses.

Table 4.12: Methods and techniques of yam production

Variable	Category of farmer	Frequency	percentage	Chi-squared probability
Yam storage	Chemicals	8	4.0	

technique	In shades	1	0.5	
	Natural	193	95.5	
	Total	202	100	0.418
Place of yam sales	Local market	110	54.5	
	On- farm	25	12.4	
	Outside	67	33.2	
	Total	202	100	0.000
Techniques of yam harvest	Cutlass	50	24.8	
	Hoe	147	72.7	
	Sticks	5	2.5	
	Total	202	100	0.484
Wealth status of farmer	Rich	15	7.4	
	Average	172	85.2	
	Poor	15	7.4	
	Total	202	100	0.109

Source: Field Survey, 2011

Between the educational level of farmers and the place for storing yams, the former shows a significant difference (at 1%) of post-harvest losses among the categories of farmers (Table 4.13). In all, farmers with basic education recorded the highest post-harvest losses (55%), followed by those with no formal education (24.3%), secondary education (17.3%) and vocational education (3.0%) in that order. Farmers who had tertiary education recorded the lowest losses (0.5%).

Table 4.13: Level of education and yam storage techniques

Variable	Category of	Frequency	percentage	Chi-

	farmer			probability
Level of education	None	49	24.3	
	Basic	111	55.0	
	Secondary	35	17.3	
	Vocational	6	3.0	0.000
	Tertiary	1	0.5	
	Total	202	100	
Place of yam storage	Barns	100	49.5	
	Bare floor	37	18.3	
	Dug holes	56	27.7	0.330
	Under shades	1	0.5	
	Under trees	8	4	
	Total	202	100	

Source: Field Survey, 2011

In the case of the means of transporting yam from the farm to the house, Table 4.14 shows that there is a significant (at 5%) difference among the categories of farmers who used the various means. The results show that those who used tractor recorded the highest losses (62.9%), followed by those who used Kia (18.3%), and those who used bicycle (11.9%). The lowest loss was recorded by those who used cargo (1%) as well as those who carried the produce on their heads.

Table 4. 14: Means of transporting yams from farm

Variables	Frequency	Percentage	Chi-probability
Bicycle	24	11.9	
Cargo	2	1.0	
Head carting	2	1.0	
Kia truck	37	18.3	0.035
Motor- king	10	5.0	
Tractor	127	62.9	
Total	202	100	

Source: Field Survey, 2011

From the table the Wald Chi-Square statistic is significant at 1% significant level. This means that the variables that have been found to be individual determinants of food security also jointly determine food security. Also, the Pseudo R-squared value of 25.18% means that the model, and for that matter the explanatory variables, were able to explain, on a whole, 25% of the variation in the dependent variables.

The main objective of the study was to measure the effects of postharvest losses on food availability. Postharvest loss has a negative effect on food availability and is significant at 1% significant level. That is to say that when households' postharvest losses increase, their food security situation worsens. Other significant variables that influence food availability are age, experience, on-farm labour and number of children. The positive and negative signs of the coefficient of age and age squared respectively mean that younger farmers have a better food security situation than their older counterparts. This is

plausible considering the fact that the former are generally more energetic and enterprising and so they can farm more and also engage in other socioeconomic activities that would go a long way to put more food on the table for their households. This is consistent with the positive coefficient of the on-farm labour which suggests that the greater the number of workers working on the farm the better their food security situation, other things being equal. On the contrary, the greater the number of children in the household, the more gloomy the food security situation of that household is. This is also understandable since normally, children add less to food security than they take away. In Donkoh et al (2013), the probability to spend on food is positively related to household size. The negative coefficient of the experience variable suggests that farmers who had long years of farming experience rather had food security problems. This is in contrast to our *a priori* expectations.

Table: 4.15 Effect of postharvest losses on household food security

Variable	Marginal effect	Std. Error	Elasticity
Postharvest loss/acre	-0.0270288*	0.0142	-0.3874634
Yield	0.000234	0.00016	0.1413887
Income	0.0000512	0.00005	0.1164391
Age	0.5525534***	0.18397	54.11602
Ages squared	-0.0053122***	0.00174	-24.33009
Experience	-0.015605*	0.00903	-0.3269487
On-farm labour	0.2905411***	0.10775	2.438096
Number of children	- 0.466489***	0.11142	-6.522166
Distance from farm to	- 0.0040599	0.00335	-0.0941049

market			
Access to credit	- 0.099521	0.0979	-0.3033155
Education	0.0065219	0.01374	0.0836979
Wald Chi-Square (12) = 32.72; P-value = 0.0011			
Pseudo R-squared = 25.18%; Count R-squared = 75%			

4.4.2*Challenges yam farmers face with respect to protecting their yam produce from spoilage or losses*

Further discussion is made on the challenges encountered in yam production, marketing, and storage. Table 4.16 indicate the challenges yam farmers face in the production process. The challenges that hinder the production of yams in the municipality are different perspective, meaning each farmer has a peculiar problem. About 68.3% of the farmers indicated that they do not have capital to start the yam production. The production of yams involves a lot of capital in order to produce on large scale. In other words yam production is capital intensive if the farmer wants to produce in commercial quantities. The farmer therefore needs capital to be able to go into large scale yam production. About 14% of the farmers indicated that labour difficulties are a challenge in yam production. Yam production is labour intensive in the sense that labour is required in all the stages of production, from clearing the land, making the

mounds, mulching, staking the yams, weeding under the yams, harvesting among others. About 12% of the farmers indicated lack of credit as a challenge. Credit facilitates the process of every business venture and yam production is no an exception.

Table 4.16 Challenges of yam production in the study area

Problems	Frequency	Percent
Lack of credit	25	12.4
Inadequate labour	29	14.4
Lack of capital	137	67.8
Insufficient rain	3	1.5
Poor roads	3	1.5
Insufficient sets	3	1.5
Poor tools	2	1.0
Total	202	100.0

Source; Field survey December, 2011

About1.5% of the farmers indicated that insufficient rainfall, poor roads system, lack of sets and poor tools usage are challenges. Nonetheless, most farmers in the study area depend on rain fed agriculture hence the farmers in the yam business are not left out of the hook. The importance of good road system in all spheres of the Ghanaian economy cannot be over emphasised. Poor roads lead to accident which destroys the yam being transported to the market. Some farmers lack good setts for sowing. When the farmer is able to get viable sets then the farmer is assured of good yield.

Table 4.17 Challenges of marketing yam in the Kintampo Municipality

Problems	Frequency	Percent
Bad roads	2	1.0
Poor service	5	2.5
Low prices	12	5.9
Poor prices	22	10.9
No access roads	1	.5
Poor transport	1	.5
High lorry fare	3	1.5
No transport	156	77.2
Total	**202**	**100.0**

Source: field survey December, 2011

Farmers outlined the challenges they face during the marketing of the yam. From the above Table 4.18, 77.2% of the farmers indicate that lack of transport facility is the major challenge they face in the yam industry. Transport plays an important role in the yam industry. The inability of farmers to have transport available to convey their farm to the market is a major challenge. About 11% of the farmers indicated that low price is a challenge they face during marketing. About 6% of the farmers indicated that low price is a challenge they face during marketing. Poor or low price is a major challenge because the farmer livelihood depends so much on the pricing of the product in the market.

A number of farmers indicated that, bad roads, poor customer service, high transport cost among others are challenges they face in yam marketing.

Table 4.18 challenges of storage yam farmers' face in the study area

Problems	Frequency	Percent
Animals	10	5.0
Lack of facility	192	95.0
Total	202	100.0

Source: Field survey December, 2011

The above table shows the challenges during yam storage farmers' encounter. About 95.0% of the farmers indicated that lack of storage facilities is a major challenge. About 5.0% of the farmers indicated that destruction of yam by rodent pests such as rats and mouse is a major challenge.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The study was carried out in the Kintampo Municipality in the Brong Ahafo region of Ghana. The primary objective of the study was to determine the extent of yam postharvest losses and measure the effect on household food availability in the Kintampo Municipality. Two main sampling techniques were used to select the sample for this study. These are the stratified and random sampling techniques. The sample size for this study was 202 yam farmers. The methods of analysis were both qualitative and quantitative. The qualitative aspect involved the use of chi-square, means and frequencies while the quantitative involved the estimation of a logit model.

The key findings were as follows:

1. Yam production was dominated by male farmers (92.6%); the modal age group of the farmers was 41-45 (55%); most of the farmers had basic (55%) or no education (24.3%) in the study area, amongst others.

2. The categories of farmers who experienced greater losses were as follows: male farmers (99%); farmers whose farms were accessible by road (86.1%); farmers who had no ready market (22%); farmers who were not involved in contract farming (85.6%), amongst others. In all, high levels of postharvest losses on the part of farmers whose farms

were accessible by road did not meet the researcher's *a priori* expectations.

3. Postharvest losses were found to have positive and significant effect on food availability. Other factors that had positive effects on food availability were age and off-farm labour. However, the number of children of a farmer had a negative significant effect on food availability.
4. The main challenges facing farmers in overcoming postharvest losses were inadequate funds and labour supply.

5.2 Conclusions

1. Yam farmers in the Kintampo Municipality are small-scale farmers with little or no education. Basically, the system of production is traditional with the use of simple farm tools like hoes and cutlass as well as traditional storage structures like barns.
2. Even though all the yam farmers experienced postharvest losses, the degree of severity differed among the categories of farmers based on the following socioeconomic indicators: sex, education, farm accessibility; techniques in sowing; participation in contract farming; access to ready market, extension services; credit and farmer groups.

3. Postharvest losses and high family sizedo not augur well for household food availability. However, a relatively youthful farmer as well as a greater number of farm labour enhance household food availability.

5.3 Recommendations

1. Measures such as good roads, access to credit among others must be put in place to reduce or eradicate postharvest losses in Kintampo Municipality so as to enhance the food security situation in the area.
2. To do this, yam production must be modernized by increasing participation in contract farming and farm group as well as increasing mini set, access to credit, ready market and formal education. Specifically, researchers and NGOs should support farmers to access mini sett and other lasting varieties of yam to cultivate. Also, capital and credit need to be made available and accessible to the yam farmers. This would ensure that farmers farm at the right time and are able to employ the labour needed.

Similarly, government should endeavour to make schools available and accessible to wards of farmers. It should also make adult literacy classes available and accessible to farmers who are willing to be educated. Transportation plays an important role in the yam industry. Government and other stakeholders are therefore called upon to improve on roads network leading to rural areas which are major yam producing centres. Transportation goes in tandem with good or access roads. Tractors and

other means of transport should be made available to farmers either on rental basis or very affordable. The feeder road network must also be improved to increase farm accessibility.

3. While yam farmers in the study area should be supported to have access to credit and other farm inputs, the following category of farmers should be given priority: male farmers; farmers whose farms were accessible; on-contract famers; farmers who sold their yam produce at the local market; farmers who did not belong to farmer groups; farmers who used whole tubers for cultivation; farmers who had low formal education; farmers who used tractor to convey their yam produce; as well farmers who lacked extension services, credit and ready markets; these category of farmer are prone to price variability in the market and they stand to be at the losing end.
4. Lastly, NGOs, government and private investors can also design an insurance policy as well as simple but efficient storage facilities for farmers.

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APPENDICES

Appendix 1 Questionnaire

UNIVERSITY FOR DEVELOPMENT STUDIES

CENTRE FOR CONTINUING EDUCATION AND INTERDISCIPLINARY RESEARCH

QUESTIONNAIRE

This questionnaire is designed to solicit your views on issues relating to the impact of post harvest losses on the income of yam farmers in kintampo in the Kintampo municipality of the Brong Ahafo Region of Ghana mainly for policy makers and academic purposes. It will be appreciated if you could answer the following questions as honestly as possible. Your responses will be treated as confidential.

Thank you.

Kindly tick (√) the appropriate response in the box or where indicated

SECTION A: ADMINISTRATION

1. Questionnaire No. …….
2. Name of community……
3. Name of interviewer……
4. Date…….

SECTION B: DEMOGRAPHIC INDICATORS

1. Sex: male [ ] female [ ]
2. Age……
3. Marital status: married [ ], Single [ ], Divorce [ ]

Household members [ ]

4. No. of children…….
5. No. children helping in your farm ……..
6. Highest Educational level.[ ] No formal education [ ] Basic Education

   [ ] Secondary [ ] Vocational [ ] Tertiary
7. Occupation: Major occupation [ ] Yam farmer

   Minor occupation……..
8. How many years have you been farming yams? .....

9. What other crops do you cultivate?.....

SECTION C: FARMER CHARACTERISTICS

1. What was your yam farm size last year?

……..

2. What was the total farm size of other crops last year? ……

3. What was the cost structure per acre last year on the following?

Cost structure

Activity	No people	cost
Clearing of land		
Making of mounds		
Mulching		
Staking the yam		
Weeding under the yam		
Harvesting the yam		
Others		

4. **Output and Revenue structure last farm season**

Activity	**Quantity / percentages**
Harvested	
Eaten	
Sold	
Spoilt and rotten	
Stolen	
Other (specify)	
Amount obtained	

5. **among the spoilt tubers**

Activity	**Percentage / quantity**
Rotten	
Burnt	
Eaten by animals	
Eaten by insects	

6**. At what point or stage**

Rotten	
Burnt	
Broken	
Eaten by animals	
Eaten by insects	

7. **What kind of**

Animals	
Insects	
Fire	
Others	

8. What in your opinion are the solution?.....

9. Who should do what?

Farmer……..

Assembly…….

Government……...

NGOs…….

10. Do you lose some of the tubers of yam during the following periods?

Harvesting [ ] transportation [ ], storage [ ], others……..

11. What number of tubers is lost? 1[ ], 5 [ ], 20 [ ], 100, others……

SECTION D: STORAGE FACILITY OF YAM FARMER

1. Where do you store your yam produce? ( ) in dug out holes, ( ) in bans, ( ) on the bare floor, other (specify) ……..

2. For how long can you keep/ store your yams? …….

3. How do you store your yam produce? ( ) with chemicals, others specify ……

4. Has government or other NGOs provided storage facilities for your yams in the community? Yes / No

   If yes, how close in the facility to your farm? 1 km ( ), 2km ( ), 3km ( ),

   Others.....

   How close is the facility to your house? ……..

5. Do you pay for using the facility? Yes / No

   If Yes, how much do you pay for- storing 100 tubers of yams?…….

6. For how long will you store your yam to pay that much?.....

7. Do you patronize the facility? Yes / No.

   If Yes why?.....

   If No why?.....

SECTION E: ACCESSIBILITY BY YAM FARMER.

1. What is the distance from home to the farm? ……

2. What is the distance from farm to the market? …….

3. What is the distance from the home to the market? ……

4. Is your farm accessible by vehicles? Yes / No

5. By what means do you carry your yams from the farm to the house ……

6. By what means do you carry your yams to the market? ……

SECTION F: MARKETING OF YAM PRODUCE

1. Do you have ready market for your yams? Yes/ No

   If No why?.....

2. Where do you sell your yams?

   ( ) on the farm to market women

   ( ) in the local market

   ( ) outside town (name the market) ……

3. How much do you spend on transport for a hundred tubers of yam? ……

4. How much do you spend on the following at the market?

( ) truck pushers …….

( ) Market tolls …….

( ) Potters …….

5. Are you involve in contract farming? Yes/ No

If yes, how much are you given? ……..

How much do you gain ……..

6. What is the cost of transporting 100 tubers of yams to the house ……

7. What is the cost of transporting 100 tubers of yams to the market ……

8. How much do you sell 100 tubers of yams? … And why at that price …….

SECTION G: POLICY VARIABLE

1. Do you use any techniques in sowing the yam? Mini set ( ) whole tuber ( )

2. How do you harvest your yams? By the use of sticks ( ), cutlass ( ), hoe ( ), others (specify) …….

3. Do you cause damage to the yams by the harvest process? Yes/ No

4. Do you receive extension since at your farm? Yes/ No

5. How many times a year …….

6. from whom? Government ( ), NGO ( ), others (specify) ……

7. Do you have access to credit? Yes / No

8. How much did you get last farm season? ……

9. To do what? ……..

10. How did you spend it?.....

11. Do you have farmer groups in the community? Yes / No

12. What are the problems you encounter as a group? ……

13. What are the benefit you get as a group?.....

SECTION H: IMPACT ANALYSIS

1. Does your yam produce take you to the end of the year? Yes / No

   If no in what month do you run out of yam?.....

2. What do you do when you run out of yam?.....

3. What percentage of your total food supply comes from yams?.....

4 What percentage of your total cash comes from your yam produce?.....

SECTION I: POVERTY INDICATORS

1. How do you consider you status? ( ) Rich, ( ) poor, ( ) Average Rich /Poor

2. Do you own a; ( ) a car, ( ) motor bike, ( ) Tractor, ( ) bicycle, others…….

3. Do you own or hire your house? ( ) Own, ( ) Hire

4. How many of your Children are in school?

   No of Children in the house…….

   No in primary school…….

   No in JHS

   No in SHS

   No in Tertiary

5. Do you hold any position in the community?.....

6. Are you able to pay your Children school fees? Yes /No. Why……

7. Are you able to perform other social responsibilities in the community such as funerals, outdooring, weddings, and paying royalties? Yes/No

How much do you contribute……

8. Has your life improved ever since you started farming yam? Yes / No.

SECTION J: THE WAY FORWARD

1. What are the problems encountered in your yam

(a) Production…….

(b) Marketing……..

(c) Storage……

2. What can be done to resolve the problems?

Government: Give Loans ( ) Build facilities, others……

NGOs: Give credit ( ) give training, others……

Community: communal labour ( ) Susu, others……

Farmer: - use proper implements, others …….

3. What long term help do you want government to help former generally in Ghana?

Create on issuance system for farmers ( ) Mechanize agriculture ( ) develop farmer groups in the Districts, others……

Thank you.

Appendices II

TRADERS

Focus group discussion interview guide

1. Do you do contract farming? Yes / No.
2. Where do you do your marketing?.....
3. How much do you buy 100 tubers of yam from the farm gate?.....
4. How much do you sell 100 tubers of yam at the market?.....
5. How much do you pay for?

   Transportation……..

   Loading boys charge……

   Revenue collectors charge……..

   Others…….

6. What are the problems you encounter in?

   Transportation……..

   Marketing……..

   Storage…….

7. Do you have trader groups in the community? Yes / No

8. What are the problems you encounter as a group? ……

9. What are the benefits you get as a group?.....

10. What do you think about the magnitude of post harvest losses? [ ] high [ ] low [ ] average others……..

11. How do they come about? [ ] human factors [ ] animal factors [ ] natural factors

Others……..

12. How can you help to resolve them?

……

……

……

……

Appendices III

FARMERS

Focus group discussion interview guide

1. What was your yam farm size last year? …….

2. What was the total farm size of other crops last year? ……

3. What was the cost structure per acre last year on the following?

Cost structure

Activity	No people	cost
Clearing of land		
Making of mounds		
Mulching		
Staking the yam		
Weeding under the yam		
Harvesting the yam		
Others		

4. **Output and Revenue structure last farm season**

Activity	Quantity / percentages
Harvested	
Eaten	
Sold	
Spoilt and rotten	

Stolen	
Other (specify)	
Amount obtained	

5. **among the spoilt tubers**

Activity	**Percentage / quantity**
Rotten	
Burnt	
Eaten by animals	
Eaten by insects	

6**. at what point or stage**

Rotten	
Burnt	
Broken	
Eaten by animals	
Eaten by insects	

7 **what kind of**

Animals	
Insects	
Fire	
Others	

8. How can post harvest losses be minimized?.....

9. Who should do what?

Farmer……..

Assembly…….

Government……...

NGOs……

Thank you.