Comparative Analysis of Food Security Status of Farming Households in Eastern and Northern Regions of Ghana

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Abstract

Currently, almost 33 percent of the population of sub-Saharan Africa (SSA) are undernourished and is the only region of the world where hunger is projected to worsen over the next two decades. According to the World Food Program, over 2 million people were most vulnerable of becoming food insecure throughout Ghana in 2012. The issues of food security in northern Ghana has gained a top priority in many areas of policy making. However, the prevalence of food inadequacy as a result of insufficient resources to access food among individual household has led to increasing food insecurity in the country. By using the sixth round of Ghana Living Standard Survey (GLSS) data conducted from 2012/2013, the study aimed at analysing food security status across farming households in Eastern region and compare it to the Northern region of Ghana. The food security index generated from Cost-of-Calorie method was adopted and the recommended daily requirement was used to determine the household food security status. The factors influencing household food security status was then examined using logistic regression model. The analysis indicates that almost half of the sampled farming households in Eastern region (42.7%) and Northern region (46.0%) were food insecure. The depth of food insecurity indicates that farming households in Eastern region consumed 34% less than their daily calorie requirement while farming households in Northern region consumed 40% less than the requirement. The logistic result shows that monthly household income, off-farm activities and total quantity of own farm production positively and significantly influenced households' food security in Eastern region. It was revealed that household size negatively and significantly affected food security in Eastern region. Further, monthly household income, total quantity of own farm production and dependency ratio positively and significantly affected households' food security in Northern region. The factors that were negatively and significantly affecting household food security in Northern region included the size of households and the number of years spent in education. Policies which targeted to increase income of farmers through the provision of other activities aside farming, to help boost total yields of farming households, and intensive family planning awareness raising programs have key roles to play in these areas in order to improve households' food security in Ghana. The study recommends special training that relate to agriculture so that farmers can utilize whatever knowledge or skills acquired in their production activities to achieve food security in the future.

Résumé

Actuellement, 31 pourcent de la population de l'Afrique sub-saharienne est sous nourrie et cette région est la seule au monde où la famine est prévue s'aggraver au cours des deux prochaines décennies. Selon le *World Food Program*, plus de 2 millions d'individus étaient enclins à souffrir d'une insécurité alimentaire au Ghana en 2012. Le problème de sécurité alimentaire au nord du Ghana a gagné une priorité dans l'élaboration des politiques publiques. Cependant, la prévalence d'inadéquation alimentaire comme un résultat d'une insuffisance des ressources pour accéder à la nourriture dans les ménages individuels a conduit à situation d'insécurité alimentaire au niveau du pays. Nous utilisons la sixième vague du *Ghana Living Standard Survey* (GLSS) réalisé en 2012/2013 afin d'analyser le statut de sécurité alimentaire dans les ménages agricoles à l'Est du pays en le comparant aux régions du Nord. L'indice de sécurité alimentaire est calculé sur la base du coût de la calorie, et nous utilisons la consommation journalière recommandée afin de déterminer le statut de sécurité alimentaire du ménage. Ensuite, nous utilisons un modèle de régression logistique pour étudier le statut de sécurité alimentaire du ménage. L'analyse indique qu'approximativement la moitié des ménages agricoles dans les régions de l'Est (42,7%) et celles du Nord (46%) souffraient d'une insécurité alimentaire. La profondeur de l'insécurité alimentaire indique que les ménages agricoles au nord du pays consomment 34% en dessous des recommandations données pour une consommation journalière de calories tandis que les ménages agricoles du Nord en consomment 40% en dessous. Les résultats montrent que la sécurité alimentaire des ménages résidant à l'Est est positivement et significativement influencée par le revenu mensuel de ces ménages, leurs activités à l'extérieur de la ferme ainsi que la quantité totale de leur propre production agricole. A l'inverse, la taille du ménage affecte négativement et significativement la sécurité alimentaire dans ces régions. En outre, le revenu mensuel du ménage mensuel, la quantité totale de sa propre production agricole et le ratio de dépendance impactent positivement et significativement la sécurité alimentaire des ménages dans les régions du Nord. Les facteurs qui influent négativement et significativement la sécurité alimentaire des ménages dans les régions du Nord comprennent la taille du ménage et le nombre d'années d'éducation. Les politiques dont le but est d'augmenter le revenu des agriculteurs à travers la pratique d'autres activités à part l'agriculture et les programmes de planification familiale peuvent jouer un rôle majeur dans l'amélioration de la sécurité alimentaire au Ghana.

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ABBREVIATION

AGRA	Alliance for a Green Revolution in Africa
AFC	Associates for Change
CHPS	Community Health Planning and Services
CCA	Climate Change Adaptation
CRS	Catholic Relief Service
DRR	Disaster Risk Reduction
FASDEP	Food and Agricultural Sector Development Policy
FP	Family Planning
GoG	Government of Ghana
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
MoFA	Ministry of Food and Agriculture
MDGs	Millennium Development Goals
UNDP	United Nations Development Program
USAID	United State Agency for International Development
WFP	World Food Program

Chapter 1 INTRODUCTION

The world population was estimated 6.07 billion for 2000 and it is projected to grow to around 9 billion by 2050 (Global Food and Nutrition Final Report, 2013). According to the report this growth is said to profoundly impose challenges in meeting future food consumptions. Moreover, a relevant increase in per calorie intake is also projected to increase at the same time. Food balance diet is also projected to increase globally with high demand in meat consumption due to increase in income. Averagely, the world per calorie daily availability is projected to increase from 2,789kcal per person per day in 2000 to 3,130kcal per person in 2020 which is a 12 percent increase (GNS, 2013). Currently, the proportion of people exhibiting undernourishment worldwide stands at 795 million including 780 million in the developing regions as reported by FAO, (2015: pp.4). The report revealed that "The share of undernourished people in the population, or the prevalence of undernourishment[1], has decreased from 18.6 percent in 1990/92 to 10.9 percent in 2014/16, reflecting fewer undernourished people in a growing global population" (FAO, 2015: p.8). Nevertheless, the report estimated that a 1.9 billion of people increased in population within the same period. But this increase has mainly taken place in developing countries where majority of the undernourished people live. The countries containing most of these people include China, South Asia, Central Africa and sub-Saharan Africa. The factors associated with the high prevalence of hunger in these parts of the world are mainly conflicts and natural disasters together with unsustainable livelihoods, ineffective governance and some scarce resources (IFPRI, 2012; UNDP, 2012). In addition, expertise estimated that 44 million people have been driven into poverty due to rising food prices in developing country since June 2010 which was closer to the rise of food costs level in 2008 (IFPRI, 2012). These afflictions are undermining the efforts to eliminate or reduce the persistent of hunger and food insecurity issues and also remain a big challenge for international community, national and local government as well as civil society (UNDP, 2012).

Africa for the past 10 years as observed by UNDP (2012) was known to have achieved world-beating economic growth rates which became among the fastest movers on the Human Development Index. In Africa, more than 70 percent of its population noted to be food insecure

[1] 'Undernourished' is defined as people whose dietary energy consumption is continuously below a minimum dietary energy requirement to maintain a healthy life and carry out light physical activity

live in rural areas. Sub-Saharan Africa (SSA) has about 65 percent of its total labor force employed in the agricultural sector and this contributes about 32 percent of the continent's GDP. Ironically, smallholder farmers who produce over 80 percent of the food supply in the continent make up about 50 percent of the food insecure[2] populations (AGRA, 2014). The figure below shows the percentage of food insecure population areas of Africa.

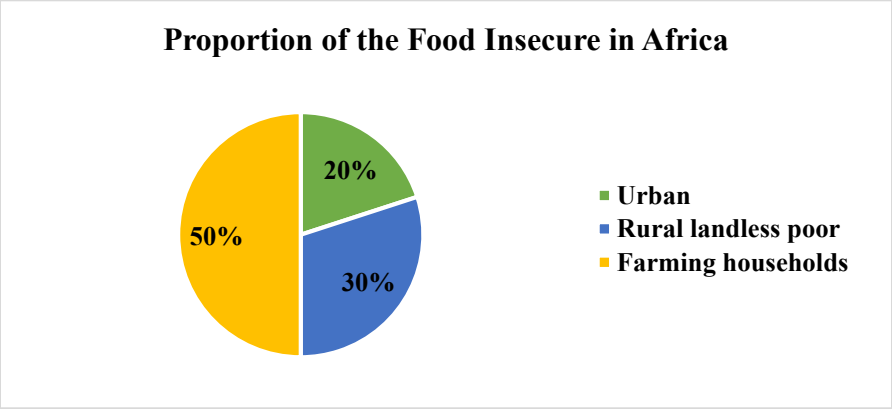


Figure 1.1: Proportion of Food Insecure in Africa
Source: FAO, (2011)

Agriculture in SSA has undergone a lot of reforms and until few decades ago, the agricultural landscape was characterized by sluggish growth, low factor productivity, declining farm size, and often linked to practices that degrade the environment (AGRA, 2014; Salama *et al.,* 2010). SSA is projected to increase in population with an additional 1.6 billion people by 2050 (AGRA, 2014). SSA has insufficient domestic production and so the continent spends about $30 billion to $50 billion a year to import food. IFPRI (2012) estimated that if continental food supplies do not increase, SSA will spend about $150 billion on food imports by 2030. The issue has become a major concern for both national and international food security advocates as meeting the food needs of families presently remains a serious challenge. The pivotal element for minimizing this predicament is an improvement in the agricultural sector as it remains the major source of incomes for the poor particularly in the region (FAO, 2015). The study therefore, empirically analyzes the food security status of farming households in Eastern and Northern regions of Ghana.

[2] Food insecurity is said to exist when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life.

1.1 Background of the Study Area

Improving food security in Ghana can promote economic growth, increase social stability and promote human welfare development. In the early 1980, Ghana has put into practices macro- and micro-economic policies as well as sectoral and fundamental reforms tailored at ensuring lofty and sustainable economic growth, food security and poverty reduction (Kuwornu, Demi and Amageshie, 2013). Strengthening food security is a focus for the government and non-government agencies in Ghana. This is because food security improvement supports political stability which establishes peaceful coexistence in a society. However, food insecurity leads to physical weakness and reduces performance in both adults and children (Helen, 2002).

Since the early 1980s, Ghana has shown a good economic performance among sub-Saharan Africa countries. The country has made an impressive progress in most of the afflictions facing several people in Africa particularly, the incidence of poverty. Besides, in relation to food security, Ghana has been moderately healthy as compared to other countries in sub-Saharan Africa and is on the path of substantially achieving most of its Millennium Development Goals (UNDP, 2012; MOFA, 2010). However, this achievement has been geographically disproportionate as UNDP (2012) evidenced that "there are concerns about the challenge of translating this impressive growth performance into the generation of productive and decent employment and eradication of income inequality" in the country. The major challenge in the country is making the economic growth much more equitable for sustainable human development towards the sustenance of its middle income status and the achievement of most of the MDG targets. Food insecurity is still prevalent in Ghana and in recent years the aim of government is to address this problem through agricultural improvement (Kuwornu *et al.,* 2013). Agricultural production is a critical component of Ghana's economy even though since 2006, agricultural development lags behind the service sector. Agriculture in Ghana, among others: (i) contributes over 30 percent of GDP (ii) creation of employment to about 44.7 percent of the labor force (iii) provision of raw materials for industries (iv) contributes to about three-quarters of export earnings (CRI-AGRA, 2009-2012; World Food Program, 2012; Ghana Statistical Service, 2014).

The economic policy of Ghana for the past decades has been focused on agriculture[3]. The aim of the policy is ensuring rapid and sustainable development as well as poverty reduction through agricultural centered strategy. This strategy is known as the Food and Agricultural Sector Development Policy (FASDEP) which ensures agricultural modernization with a focus on the private sector (MoFA, 2010).

Unfortunately, agricultural production has degenerated over time as the policy fails to prioritize it objectives. At the national level, per capita growth production of major food items in Ghana has not been sufficient to satisfy the demand of an ever-increasing population. The next section addresses characteristics of Ghana's agriculture sector leading to the prevalence of food insecurity.

1.1.1 Characteristics of Ghana's Agriculture

Ghana faces the challenge of making substantial progress in food security because average yields have remained stagnant. Ghana only produces 51percent of cereal needs, 60percent of fish requirement, 50percent of meat and less than 30percent of the raw materials needed for agro-based industries (MoFA, 2007). Over 80percent of agriculture in Ghana is made up of staple crops, 10percent accounts for poultry, livestock, and fishery production with less than 10percent of forestry (GSS, 2014; USDA, 2012). Agriculture in the country is predominantly smallholder, traditional and over-reliance on rain. Small farm sizes dominate the stretches of farm land, usually on household subsistence basis. An estimate of more than 90percent of agricultural production is done by smallholder farmers averaging 1.2 ha in size. The food crop sector of Ghana's agriculture is mainly rain-fed, except for few vegetable lands that is mostly irrigated. There is low shelve life for the harvested produce due to low technology for processing and storage (Nyanteng and Asuming-Brempong, 2003). The food crop sector is further challenged by low investment as government and individuals focus more attention on cocoa and other horticultural crops like palm and citrus to earn foreign currency (Kuwornu, Demi and Amageshie, 2013). Even though there has been a reasonable GDP growth, agricultural sector expanded only by 0.3 percent from a 2.9 percent fall in the period of 2014 (GSS, 2014).

The production of food crops in Ghana is mostly done on subsistence basis as 77percent of scattered unregistered smallholder farmers are involved in this practice (FAO, 2012). There are

[3] However, the country is currently experiencing rapid population growth and severe environmental degradation leading to increase in marginal lands for crop production. The population of Ghana as at 2012 was 24.8 million with an expected growth at an annual rate of nearly 1.7% per annum. In 2013 Ghanaian population increased to 26.3 million census recorded (GSS, 2014).

relatively larger farms but most of these farms are into plantation of cash crops such as cocoa, citrus or palm trees. Land preparation for crop production is traditionally done with hoes, machetes and slash, and burn method (no-till). The farmers have little or no power to increase their farm size, their yield and their income due to numerous challenges faced. The effect of limited irrigation development, limited adoption of improve seeds varieties, limited use of fertilizer, lack of seasonal credits lead to dwindle production (Al-Hassan and Poulton, 2009). These have over the years impeded improvement of food security in the country. The yields of food crop have generally been low because individual farmers are not in a position to attract investment enough to expand their farms and increase yield (Dabaga, 2014). This challenge of smallholder farmers has been intensified due to the lack of access to adequate insurance scheme. Thus, farmers are exposed to many dangers such as a reduction in the yields of the land, the loss of livestock from water shortage, and a higher risk of crop failure (Dietz *et al*, 2004, Hesselberg & Yaro, 2006, Assan *et al.* 2009).

More so, the confinement of agricultural production to rainfall due to low level of irrigation development and the poor nature of the soil decrease total yields and worsen food security. For example, maize forms a large share of typical Ghanaian's meals, but yields were observed to decline approximately by 25percent in the period of 1996-2000. This was primarily caused by reduction in soil quality, removal of vegetation as feeds for livestock and the burning of vegetation as well as crop residue, reduction in soil organic matter and the availability of plant nutrients. This defect results in an increase reliance on chemical fertilisers which is barely applied in the appropriate quantities due to poverty (Braimoh & Velk, 2004).

The low level of agricultural investment and subsidies for agricultural inputs on the part of government and private sectors, also has resulted in agriculture failure (Kuwornu et al., 2013). This has been evidenced in the current pressure on land grabbing for jatropha production, resource degradation, farm holdings disintegration, and low per capita food availability. The following section addresses the constraints and challenges of arable lands in Ghana.

1.1.2 Constraints and Challenges of Arable Land and Agriculture Productivity

In Ghana, about 35percent of the land areas is covered by forest, with savannah making up the remaining 65percent. The extent of forest cover has substantially been reducing throughout the 20th century due to the process of expanding agricultural land area to produce food for the growing

population, growth of settlements and the extraction of trees for timber (WFP, 2012). An estimate of 57percent of the land in Ghana is covered by arable land and only 31percent is under cultivation. The value of the land has been affected by deforestation, with agriculture also causing severe land degradation, siltation and erosion, mostly in the savannah. The traditional agricultural activities practiced in some part of the country continue to reduce the fertility of already degraded soils (Yaro, 2006; Marchetta, 2011).

Agricultural production in Ghana is generally dependent on rainfall, although an estimated 6,000 farm enterprises nation-wide were using some means of irrigation in 1999. In 2002, the total area under formal irrigation was around 11,000 hectares whereas the potential area–including inland valleys–that could be developed for irrigation is estimated at 500,000 ha (MoFA, 2007). In addition, the recent spike in global energy prices has led to foreign investments in biofuel production, FAO projected that Ghana will be among the biggest producers of Jatropha plantation in Africa by 2015 (FAO and IFAD 2010). This means that more arable lands will be used for cultivation and this will definitely result in low food crop production and high food price in the near future. Apparently, the country will only resort to the importation of food commodities instead of making relevant use of the available lands to increase domestic production. The nature of the one-rainy season couple with lack of irrigation system in northern Ghana has caused agriculture to mainly rely on rain and this has resulted in one harvest for every year in this area (Marchetta, 2011). Lack of irrigation systems caused farmers in some farming communities in Northern Ghana to use water from boreholes to irrigate their vegetable farms (ibid). Currently, a similar situation has also been observed in the Eastern part of the country (MoFA, 2010). Besides, other causes such as limited access to agricultural-related technology know how, and lack of knowledge about profitable soil fertility management practices are resulting to expansion into less-favourable lands.

Moreover, the kinds of land ownership practiced by most faming households in Ghana impede agricultural production. In Ghana, land is mostly regarded as family property which is shared among members of the family at the demise of the head of the family or clan. Therefore, an increase in the members of the family decreases farm size per person. The increase rate of land fragmentation among family members inhibits them from using land as collateral. The reduction rate of land per family induces landless labors and such people mostly resort to sharecropping in order to reduce the risk of being food insecure. Sharecropping exists when there is an agreement

between landowner and landless farmer to share the total farm output cultivated by the landless farmer after harvesting the crops (Kuwornu *et al.,* 2013).

1.1.3 Trade Effect to Agricultural Productivity

International trade for non-traditional sources such as cocoa and gold is common in Ghana than internal trade for certain food crops which production is subject to spatial difference. The production of cereals (maize, rice, millet), roots (cassava) and tubers (yam), the most widely used staple food crops, are rather erratic and vacillates between scarcity, sufficiency and glut, depending on the vagaries of the weather (MoFA, 2007). These crops form essential part of food basket and serve as major calorie providers to most households in Ghana (FAO, 2012). Though Ghana is self-sufficient in these crops, the sufficient food produced in Ghana is left rotten due to inefficient distribution as a result of poor roads and market information (Yaro, 2013). In Ghana, self-sufficient in staple crops in the harvesting season is followed by a sharp cut of food supply in the lean season, leading to shortages. In pursuance of higher profits, it does not fully satisfy local demand before exporting to the neighboring countries. Food importation has rather been on the increase with sustained decline in domestic production.

According to USDA (2012) report, Ghana's total food and agricultural imports increased from $1 billion in 2011 to $1.2 billion in 2012. Before, U.S exports 5percent of rice, wheat, poultry and consumer ready products to the Ghanaian market with increasing demand in recent times. Total U.S. agricultural, fish and forestry products export to Ghana in 2011 were a record high at $118.3 million, up from $76.2 million in 2010. Rice (48percent) and poultry (28percent) of this total make up the largest portion of US exports. Ghana imports mostly bulk/intermediate and consumer-ready commodities such as rice, wheat, sugar and poultry. Although US export to Ghana are mostly rice, poultry and wheat, exports of US value added and consumer-ready food products have also been increasing in recent years. Imports from Asia and South Africa have also grown in recent years. There is a high demand for imported food products, especially consumer ready products, due to limited selection of products provided by the underdeveloped domestic agricultural and food processing sector in Ghana (GSS, 2014).

According to Nyanteng and Asuming-Brempong, (2003) Ghana exports because it wants to expand the export base to earn increase in foreign exchange. Particularly, since the mid-1980s, several other foods were exported from Ghana while several food types were imported annually. Ghana was still a net importer of fish, meat and rice. Among the exported food commodities were yam,

plantain, chillies, aubergine, pineapples, pawpaw, banana and fish. But this was criticized by the local consumers because of the inadequate domestic supply and high prices that threaten their food security. Another problem local consumers faced was that, the food mostly left for the domestic markets were those with poor quality from the selected ones for export. The country exports food with high quality in order to meet the export standard to avoid the fear of being rejected in the international market, leaving poor quality food in the domestic market. Nevertheless, the volumes of the respective exported commodities of annual production in the 1990s reduced. For instance, in the 1999 the volume of maize, yam, plantain and cocoyam reduce to 2.9%, 0.4%, 0.03% and 0.01%, respectively of their production. In addition, Ghana has a limited potential for agriculture trade because throughout the country there are some common problems affecting the improvement of agriculture. As evidenced by WFP, poor market infrastructure, such as roads, storage centres and selling places have restrained the smooth flow of agriculture trade and the positive impact on producers throughout the country (WFP, 2012). Local producers are mostly affected because of the increased number of foreign producers who have the ability and the strength to increase their production. For instance, local cotton producers in northern Ghana compete with European countries and the U.S. Some cotton growers who get subsidies from their government and this implicitly damaged local cotton producers due to lack of subsidy from the Ghanaian government. More so, the liberalization of trade has increased the importation of rice (70percent), maize (15percent) [Feed the Future, 2014], poultry and tomato paste. This has led to a substantial declined in the demand for traditionally produced varieties which serve as a major source of income to the local producers (CEPA & ODI, 2005; Khor & Hormeku, 2006). Efforts are however, being made by government and other humanitarian agencies to overcome the challenges faced by Ghana's agriculture through enhancing production potential and human resource development and institutional capacity building.

Food insecurity in Ghana is characterized by the prevalence of food inadequacy and low dietary energy diversity. For instance, WFP evidenced that food insecure households in Ghana is mainly link to poor diet quality to high income poverty particularly among farming households. The effect of inappropriate policies and their executions, the neglect of the poor and those affected in decision making are some of the problems exacerbating food insecurity in the country (Binyason, 2001).

Other studies argued that policies of donors, trade arrangement, and liberalization of the economy and some activities of the extractive industries affect agricultural sector hence food security (Aidoo, Mensah and Tuffour, 2013; Al-Hassan and Diao, 2007; ODI and CEPA, 2005). Thorough research on farming household's food security is essential when food insecurity alleviation is concern. This is because they contribute to availability of food at the national level through their subsistent own productions. Even though, fluctuations in own productions have limited this potential hence, undermining effort to reduce food insecurity determinants.

1.2 Problem statement

Ghana as part of Sub-Saharan Africa is moderately healthy in terms of food insecurity. However, the prevalence of food inadequacy as a result of insufficient resources to access food among individual household is observed to increase recently. FAO observed that about 7 percent of Ghanaians are facing food inadequacy[4]. Recently, the food security situation reported by WFP indicated that about 1.2 million people, representing 5 percent of Ghana's population are chronically food insecure and about 18 percent are facing food insecurity issues. Throughout the country, over 2 million people have also been considered vulnerable of becoming food insecure. Poor and economically vulnerable households averaging have low per capita food intake. The problem is predominantly among farming households already trapped in poverty and lack the resources for acquiring basic needs.

Unfortunately, policy makers seem to give less attentions to this problem. USAID observed that undernutrition due to insufficient calorie intake in certain parts of the country are recently increasing. Besides, the current statistics show that children under five years of age in the country also are exhibiting significant rate of wasting, stunted, and underweight, thus 8.2%, 22.7 % and 13.4 %, respectively[5]. Drought and other social instability factors have been the sources of vulnerability to food insecurity to most farming households and this may seriously disrupt

[4] FAO, (2014). Food Security Indicators. A core set of food security indicators. FAO defined the prevalence of food inadequacy as the measure of the percentage of the population that is at risk of not covering the food requirements associated with normal physical.

[5] Food-Security-Statistics@FAO.org.

production potential or the ability to obtain income for food access and utilization. Throughout the country, the highest number of households that have more than 30 percent of their income sourced from agriculture are located in the Eastern and Northern Regions. This makes the regions vulnerable to both natural and economic shocks due to the volatility nature of agricultural production in the country. However, most studies have focus in the northern part of the country, though not empirical and only few in the south which have been concentrated in the Central and Volta regions. Also no comparative analysis has been done between any region in the north and in the south. Documentation on the prevalence of food insecurity in farming households between regions is limited. Not many researches have focused analysing the food security status of farming households who are the most food insecure population. This study will fill the gap by studying the food security status of farming households in the Eastern region and compare it to the northern region. Moreover, an in-depth understanding of the socioeconomic and other factors influencing household food security deserve the undertaking of empirical studies which is necessary.

1.3 Study Purpose

The purpose of the study is to investigate the status of food security by comparing farming households in the Eastern and Northern regions of Ghana.

1.3.1 Specific objectives

- To identify the food security status of farming households in Eastern and Northern Regions of Ghana
- To analyze the extent and compare the indices of food security status of farming households
- To determine factors influencing food security status and their relative contributions to this pattern.

1.4 Rationale of the study

Understanding the food security status of households is very important since inadequate food intake before the age of two years could result in permanent effects on an individual ‘s physical and mental development as well as future potential (Victora *et al.,* 2008). The study aims at

investigating the status of farming household's food security. This will be achieved by examining the per capita calorie intake of farming household's members. In addition, the depth of the calorie deficit would be computed which will indicate the quantity of calories needed to lift the undernourished from the status quo ceteris paribus. This will serve as a complementary indicator to assess the multiple dimensions and manifestation of food insecurity to initiate policies for more effective interventions and responses. The study's finding will provide information for UN stakeholders in the country concerning the progress of the country's achievement for the Millennium Development Goal (MDG). Since the study seeks to compare household's food security for the two regions, knowledge about the deficit or surplus in both regions will provide information to the government in order to ensure the improvement of internal trade between regions in the country. The construction of socioeconomic profiles and household resources can help the government through the Ministry of Food and Agriculture in Ghana to provide the relevant inputs in policy making and perhaps use this information in planning location and format changes in interventions. The identification of the factors influencing food security will help stakeholders and food security practitioners to directly tackle the problem based on the relevant factors undermining their efforts and also individual households in order to reduce susceptibility to risk. Policy statements on food security seem to attach less important to transitory food insecurity and the risks of acute food crisis. The study's outcome will help minimize this perception and help to ensure optimal human growth and development. The findings of this study will also add to existing knowledge and body of literature by contributing to ongoing discussion of food security in developing countries. It will also provide some insights into addressing food security gaps for further research in Ghana.

1.5 Organization of the Study

The study is organized into six chapters. Chapter one covers introduction which include the overview of food security in worldwide and in the context of agriculture in Ghana. Chapter two entails literature review on the subject matter of the study including empirical studies done on food security. Chapter three commences by describing the methods for achieving the specific objectives and chapter four describe the data source, the study area and the variables used in the analysis. Chapter five outlines and discusses the results of the study's objectives. Finally, chapter six covers

the summary, conclusion of the study's findings, policy recommendations, limitations of the study and suggestions for further research.

Chapter 2 LITERATURE REVIEW

This literature review is divided into three main sections. Section 2.1 summarizes the evolution of food security concepts. Section 2.2 reviews the different causes of food security in developing countries. Section 2.3 presents the issue concerning food security measurements and also some empirical studies for identifying household's food security status as well as its determinants.

2.1 Evolution of Food Security Concepts: An overview

Food security became conspicuous in the early part of 1970s during the World Food conference. Prior to this conference the term food security was addressed in the aggregate level (Kidane, Alemu, & Kundhlande, 2005). Food security measures were focused on food supply at the national level because of the relevant deficits in the supply of food and also the high prices of food in the world market (FAO, 1983). After mid-1970s, the incidence of food insecurity continued to remain high in certain parts of the world although the situations of food supply and prices became favourable at the aggregate level (Sijm, 1997). This triggered many researches related to the nature and causes of food insecurity to change the focus from the aggregate unit to the household's unit (Sen, 1981). Ever since, it has become a household phrase which has attracted various definitions from several organizations and individual researchers. Maxwell and Frankenberger (1992) reported about 194 different studies on the concepts and definitions of food security. Another study also suggested that approximately 200 definitions of food security are in the system (Hoddinott, 1999). However, it was observed that the basis for all the different definitions was induced from the World Bank definition which is *"access by all people at all times to enough food for an active and healthy life"* (World Bank, 1986).

This definition was further transformed by FAO to include the aspect of nutritional value and food preferences. This is the standard definition proposed by the World Food Summit held in Rome which explained food security[6] as "*a situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life"* (FAO, 1996). According to Ojogho, (2010), the

[6] Food insecurity is the absence of food security and applied to a wide range of phenomena ranging from famine to period hunger to uncertain food supply (Bokeloh *et al.,* 2009).

additional aspect of 'safe and nutritious' stress food safety and nutritional composition while the addition of food 'preferences' broadens the concept of food security from nothing less than access to enough food, to access to the preferred food. The operational definitions of food security in contemporary projects of the international organization have been focused on different components of food security (Kidane *et al.,* 2005). For instance, the operational definition of food security in Ghana by the Ministry of Food and Agriculture is "good quality nutritious food hygienically packaged, attractively presented, available in sufficient quantities all year round and located at the right place at affordable prices" (MoFA, 2007).

The widely accepted food security definition by FAO later in 2009, reinforces multidimensionality of food security which involved *food availability* (supply side), *food access* (demand side), *food utilization* (demand side) and *food stability* (supply side) Ogundari, (2013). When food supply is implicitly or explicitly influenced by factors such as climatic events (e.g. drought, flood) and/or natural disasters (e.g. earthquake, tornado), food availability is affected (FAO, 2006; Barret and Lentz, 2010; Akudugu and Alhassan, 2012). Access to food does not only signify the achievement of food availability or the aggregate availability of food in the market but can also be determined by several factors such as the financial resources of the household, market prices, social, cultural and political factors of the location (World Bank, 2008; Beyene & Muche, 2010; Hoddinott 2012; Tewodros and Tefera, 2014). Food utilization is affected by several conditions but the most relevant are nutrients loss during food processing, inadequate sanitation, improper care and storage, and some cultural practices which negatively influence the consumption of nutritious food at the household level (Barret and Lentz, 2010; Akudugu and Alhassan, 2012; Tewodros and Tefera, 2014). Stability is affected by shocks or cyclical events such as seasonal shortage, and this captures the susceptibility of individuals to food insecurity due to interruptions in access, availability or utilization (FAO, 2004; WFP, 2009). There is an interconnection between these four dimensions of food security conditions. The logic behind these dimensions is that a large amount of food at the global level does not assure food security at the national or regional level. This implies that availability is necessary but not sufficient to ensure access, which in turn, necessary but not sufficient for effective utilization and stability. For instance, in 1990 UNDP estimated calorie supply at the global level and this was 110 percent of the total requirements. Nevertheless, 100 million of people as well as over a one third of the world's population in the same period suffered from acute famine and food deficit, respectively (UNPD, 1992). In spite of the fact that

food production has been increasing globally in recent years, food insecurity, undernourishment, and hunger remain the core agenda of the world (FAO, 2014).

Food security concept is further analyzed under temporal and spatial dimensions. Temporal dimension refers to the period over which food security is analyzed. The temporal dimension of food security in the literature is widely classified into two dimensions: chronic and transient food security (Ojogho, 2010; Reutlinger and van Holst Pellekaan, 1986). *Chronic food insecurity* is a more persistent phenomenon, and this happens as a result of continuing or structural poverty, and lack of access to food (Ojogho, 2010). *Transient food insecurity* however, is a temporary declined in the household's ability to access enough food caused by activities such as periods of intensified pressure due to natural disasters, economic collapse or conflict (World Bank, 1986; Reutlinger, 1987; FAO, 2002). Transient food insecurity is seasonal and remains a major challenge to farming households during the period prior to harvest when stocks are low, and food prices become high (Stephens and Barrett, 2011).

Besides, spatial dimension is usually referred to the environmental variability/heterogeneity (geographical factors e.g. locations) at which food security is considered. Hoddinott (1999), suggested that it is possible to assess food security at the global (FAO, 2014), continental (WFP, 2013; UNDP, 2012; AGRA, 2014), national (WFP, 2009; World Bank, 2008; Bashir *et al.,* 2012), regional (Wiranthi, et al., 2014; Bashir et al., 2013), district (Tayebwa and Bashaasha 2005; Muhoyi *et al.,* 2014), village/community (Idrisa, Gwary and Shehu, 2008; Marchetta, 2011), and household or individual levels. The global, continental, national, regional, district and village levels food security is assessed when self-sufficient food production is guaranteed through own agricultural production or trade (import). Household is technically defined as food secure when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity, safety, and culturally acceptable), and when it is not at undue risk of losing such access (Smith, Alderman, and Aduayom 2006; WFP, 2012). In relation to the evolution of food security concept, several researchers have presently shifted their focus from the aggregate level to the nature and causes of households' food insecurity particularly in developing countries.

2.2 Causes of Household Food Insecurity in Developing Countries

Changes in household's consumption and expenditure behavior are not the same in general. All households within a specified location do not use the same approach in tackling their food consumption crisis caused by price hikes, crop failure, etc. Households are heterogeneous in consumption patterns that give rise to different welfare effects in different locations. According to Maxwell (2003), food crisis is the actual quantitative level of deprivation in the households due to inadequate food supply to meet individual demands as a result of inadequate resources. Individual household's food consumption varies depending on several factors including socioeconomic, physical resources, political, and environmental factors. These factors separately or jointly affect households' food security. For example, FAO and WFP, (2012) conducted a survey to analyze food security in the West Bank and Gaza Strip of Palestine. The study revealed that food insecurity situation in the area had increased to 34 percent compare to the previous year's result of 27 percent in 2011. The increased was associated with socioeconomic factors such as high unemployment rates, low and unstable wages coupled with the increasing cost of living, and large families. This challenge is observed to explicitly affect households' access to food in the study area. The study also evidenced that Palestinian households spent over 50 percent of their cash income on food indicating economic vulnerability. Osei, Aidoo andTuffour (2013) analyzed the causes of food security in the Sekyere-Afram Plains district of Volta Region in Ghana. The main focus was to assess the determinants of household food security among rural households in the study area. The study evidenced that socioeconomic variables as well as household resources were significantly associated with food security among the rural households in the study area.

In developing countries, certain factors including diseases (the high prevalence of HIV/AIDs, malaria, etc.) have contributed to the causes of food insecurity. For example, Sithole and Masuku (2009) examined the impact of HIV/AIDs on food security and household vulnerability in Swaziland. The study observed that farming households with HIV/AIDs members had to increase the sales of crops and livestock to finance funerals and healthcare. This resulted in a decrease in expenditure on agricultural inputs and an increase in expenditure on medical bills and funerals. In addition, a similar study analyzed the link between HIV/AIDs and food security using rural livelihoods approach (Gillespie *et al.,* 2001 cited in Sithole and Masuku, 2009). The study suggested that even though "drought has been more pronounced as the cause of food insecurity, affecting nutrition and agricultural production in many developing countries, the pandemic has

exacerbated the situation through its systematic impact" (Gillespie *et al.,* 2001). In addition, other factors including a wide range of risky events such as droughts, floods, earthquakes, adverse price trends, and civil conflict remain a major challenge (Ellis, 2003; WFP, 2013). FAO (2010), observed that annual droughts and flash floods during the rainy season in a province in Indonesia have disrupted agricultural productivity potential which affected household food security. Another evidenced is that in every year, a majority of the households living in Nusa Tengara Timur of Indonesia suffer food stress during the months approaching the main cereal harvest as a result of exceptional droughts, animal and crop pest and disease outbreaks, severe flooding typhoons, and earthquakes. A study by UNDP (2012) supports this view by revealing that the prevalence of food insecurity in sub-Sahara Africa is associated with conflict, drought prone and poverty regions. Other studies have also supported this view and reported that the root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty (Mwaniki, 2005; FAO 2010). Relatively, rural poor are mostly identified to be in the majority in terms of food insecurity (FAO, 2008), but the urban poor may also experience the most severe problem (Jrad *et al.,* 2010; Tetteh and Fredholm, 2011; Yusuf, Balogun and Falegbe 2015).

Agriculture sector remains underdeveloped in several countries in sub-Saharan Africa. The sector however, serves as a major source of livelihood especially, for the rural poor. The underdevelopment of the sector, which threatens food security is caused by several factors besides over reliance on rainfall (FAO, (2010). Poor and lack of irrigation system at the small-scale level minimize the potential of agricultural productivity (Timmer, 2004; AGRA, 2014). The declining soil fertility; lack of access to land by some potential producers; low commodity prices; reliance on traditional methods of production such as the use of unimproved seeds and animal breeds and use of local farm equipment including hand hoe, cutlass; and, poor extension services have contributed to the major causes of low agricultural production resulting in food insecurity (AGRA, 2014; Bahiigwa, 1999).

More so, lean season occurs during pre and post planting period which raises prices of staple crops as a result of low food supply. Lack of consistent access to food during lean periods pose challenges to food consumption in the household. Ironically, during this period farming households become more net buyers than net sellers. The World Bank report asserted that most analysts make a common error which comes from thinking that higher food prices inevitably benefit those who depend on farming as their primary source of income. In low-income countries,

most of the poor rely heavily on agriculture for their livelihood. Yet majority of farm households consume more food than they produce, satisfying the gap with transfers (food aid, gifts from family and friends) or purchases using off-farm and non-farm earnings. Since the poor do not have the capacity to increase nominal incomes quickly, rapid food price increases can seriously threaten their food security, including small-scale farmers (World Bank, 2008). These challenges faced by farming households in developing countries particularly in sub-Saharan Africa have resulted in measuring and determining the various factors influencing household's food security situation.

2.3 Measurement of Household Food Security

Measurement of household food insecurity is a complex one due to the absence of a single indicator that could capture the definition of food insecure households (Aiga and Dhur, 2006). The gathering of household food consumption data is observed as a hurdle to overcome especially when there are several income sources among adult members of the household and if some of the members are not willing to unravel what they earn to each other (Maxwell, 1995). Particularly, when the procurement of farm produce by farming households are also in piece by piece without proper or standard measurements (ibid). Smith and Subandoro, (2007) suggested that "past efforts have shown that, accurately estimating the amount of food people eat is costly in terms of time and money, and such measurements have thus been carried out mostly in small populations". Even though there has been some advancement in the measurement of household food insecurity. Studies have showed that other methods are preferred over others but the accurate measurement still remains a challenge (Coates, 2006 cited in Reichwage, 2010). In order to overcome some of these challenges, most of the studies in relation to household food security analyzes have relied on using food consumption for measurement (Maxwell, 1995). Bouis (1993) identified two common methods widely used for measuring household's food security although they are both subject to measurement challenges. These methods involve household food balance method and household food consumption method.

2.3.1 Household Food Balance Model (HFBM)

The HFBM takes into account two indicators: (i) total household production and purchase over a period of time, (ii) estimation of growth or depletion of food stocks held over the period of time. It is assumed that the food households possessed but could not be accounted for has been consumed. Several household studies have used HFBM to estimate food security status at the household level.

For example, Zakari, Ying and Song, (2014) conducted a study in Southern Niger to investigate the factors affecting household food security. Using 500 sampled households, the food security status of households was analyzed by the situation of the stock status. This was measured through the availability of sufficient daily rations for household members and the number of meals taken per day by households. The household food balance model showed that majority of the households were found to be food insecure. The empirical results from the logistic regression showed that gender of household head, diseases and pests, labor supply, flooding, poverty, access to market, the distance away from the main road and food aid were significant factors affecting the odds ratio of a household having enough daily rations. The study further showed that households headed by females were more vulnerable to food insecurity compared to male headed households.

In addition, Kidane, Alemu and Kundhlande (2005) also used HFBM to assess household food insecurity among Koredegaga peasant association, Oromiya zone in Ethiopia. The calorie intake of household was estimated by compiling a Food Balance Sheet for each sampled household. The sheet comprises of all grains coming into the household which included own production, purchased, received as gifts/remittances minus all those grains which left the household in terms of seeds, post-harvest losses, feeds, repayment of borrowed crops and those marketed. The food security status of the household was determined by comparing the difference between the actual calories available to the households and the recommended daily calorie requirement (2,100kcal). Household was classified as food insecure (0) when the available per capita calories were found below the recommended and food secure (1) when the available per capita calories were found above the recommended. This indicator has been used by other studies including (Ramakrishna and Assefa 2002; Shiferaw et al., 2004; Hail et al., 2005; Shumiye, 2007).

The application of HFBM however, is not without challenge. One of the disadvantage of using this method is that information gathering is mostly through key informant and focus group interviews, which may compromise representativeness. Thus, it requires high skills to avoid biased

information and undertakes the internal cross-checking for consistency that is integral to the method. Moreover, the application of HFBM also requires good judgement and considerable experience to quantify qualitative information, such as on coping strategies (Boudreau, 1999). These challenges have caused other empirical studies to use the food consumption data approach in order to minimize measurement errors and sample bias.

2.3.2 Food Consumption Approach (FCA)

There are various methods of measuring household food consumption but this approach is based on either primary or national level consumption data. The food consumption approach (FCA) takes into account either the household food consumption data or the food expenditure data. This is used to construct food security line in order to identify the food security status of a household. Food consumption approach does not only give information on household access to food but also the food acquisition and allocation behavior of a household (Pinstrup-Andersen, 2009). The FCA is mostly preferred to the HFBM because it has some special attributes such as: (i) the degree of flexibility afforded by individual food intake survey, (ii) the effective validation and standardization procedures, and (iii) the nature of information obtained (Ferro-Luzzi, 2003). The structure of the error of FCA is much better understood than for any other method used for assessing food security (ibid). The approach discloses intra-household food distribution and the understanding of what is consumed. According to Maxwell (1995), in spite of its uniqueness, it also has some flaws which involves; under reporting, respondent fatigue, the reference period is short and likely unpresentable. However, this method has the tendency of providing sufficient grounds for policy and decision making purposes (Ferro-Luzzi, 2003). The flaws can also be easily corrected and avoided.

The food consumption approach includes the use of Foster Greer and Thorbecke (FGT) poverty index (1986) and the Cost-of-Calorie (COC) method. The FGT poverty index has been used by several studies to identify household food insecurity. For examples:

Yusuf, Balogun and Falegbe (2015), examined the effect of urban household farming on food security status. The study addressed the problem that food insecurity, unemployment and poverty have become a major problem in urban areas of Nigeria. The **Foster Greer and Thorbecke (FGT)**

poverty index[7] developed by Greer *et al.,* (1984) was used to identify household food insecurity. Household food insecurity was estimated as the two-thirds of the mean per capita monthly food expenditure of all households. Food expenditure data for both primary and secondary data were used for the analysis. The study administered primary data in 110 urban farming households and observed that majority of the urban farming households were food insecure. To determine the factors influencing household's food security, the probit model was employed. The result of the probit model showed that gender, years of schooling, marital status, household size, access to an extension agent, hired labor and type of farming experience significantly affected household's food insecurity.

Welderufael (2014) examined the extent of household's vulnerability to food insecurity in urban and rural areas in one of the poverty prone areas in Ethiopia, Amahara regional. FGT and logit model were employed to identify household food insecurity and the determinants, respectively. The result showed that about 48 percent of the households were vulnerable to food insecurity with much higher in rural areas. Households with large family sizes; lower consumption expenditure, old age households, unemployed and male heads were more food insecure in urban areas. The determinants of rural household insecurity included livestock ownerships, farm inputs and farm size, shocks such as drought and illness.

More so, Mitiku, Fufa and Tadese (2012) examined the status and determinants of rural household' food security in Shahemene district of Oromia region in Ethiopia. The study used primary and secondary data based on a total of 100 household survey. FGT poverty index showed that 36 percent of the household were food insecure and the result of the logit model showed that family size, cultivated land size, total farm income, off-farm income and livestock ownership of household were the factors significantly influencing household food security. Aside family size, the rest of the factors positively and significantly improved household food security. A similar study was also conducted by Ibrahim, Al-feel and Ahmed (2014), to assess food security and poverty situation among rain-fed agricultural households' North Kordofan State in Sudan. The study used a stratified sampling technique to gather households' poverty and food security data.

[7] $F_\alpha = \frac{1}{N}\sum_{i=1}^{p}((F_L - C_i)/F_L)^\alpha \geq 0$: F_α= food insecurity level. $\alpha \geq 0$, it measures the incidences of food insecurity. P = Total number of individuals within a household. N = Total number of individuals in a household, F_L = Food security line, i.e the minimum recommended level of calorie intake for the individual. C_i= the calorie intake level of individual household member. When $\alpha = 0$, the formula becomes $F0 = P/N$.

By using FGT poverty index, it was revealed that the share of food spending amounted to 71 percent of the 205 households' total expenditure implying that households' in the study area has poor access to food and for that securing a minimum level of food becomes the top priority for the low income households. Several authors have also used FGT poverty index to assess food security (see Ojogho, 2010; Orewa and Iyangbe, 2010; Omotesho, Adewumi and Fadimula, 2007).

The use of FGT index in establishing household food security status could be misleading especially if the poverty axioms are incorrectly stated and if the factors considered affecting food insecurity are only within the poverty domain. This approach is mostly used to investigate the incidence and the degree of food insecurity in an already pre-conceived poverty prone areas. Motivated by this limitation, other studies have employed the Cost-of-Calorie (COC) approach for establishing household food security status. This can be analyzed in two ways which is based on either using household food expenditure in adult equivalent to establish food security line[8] or by using the caloric content of the food consumed by households in adult equivalent to establish food security index[9].

The following studies used COC approach using the **Household Food Expenditure** an indicator to establish food security status of household. Oluyole, Omonona and Adenegan (2009) examined food security among cocoa farming households of Ondo State, Nigeria. The study used primary data and 200 farming households were selected for the analysis. The COC using household food expenditure was employed in establishing household food security line which was ₦2,500.50 per month per adult equivalent. The study found that 43 percent of sampled households were found to be food secure while 57 percent were food insecure based on the food security line. The key determinants included farming experience of household head, output of roots and tubers crops, output of cereals and cocoa increases the probability of household to be food secure while household size and age-squared of household head decrease the probability of household to be food secure.

[8] $Inh = a + bC$, Where, h= food expenditure; C=calorie consumption (Kcal). From the COC function, the cost of minimum recommended energy level is Z calculated a: $Z = e^{(a+bL)}$ Where, L =recommended daily energy level (Kcal): a = is the intercept term; b =coefficient of calorie consumption.

[9] $Z_i = \frac{Y_i}{R_i}$: Where, Z_i= food security index of i^{th} household, Y_i= actual daily calories available to i^{th} households and R_i= the recommended daily calorie requirement of i^{th} household. $Z = e^{(a+bL)}$

Amaza, Umeh and Adejobi (2006) focused on identifying and analysing food security measures in Bomo State, Nigeria. The study also used this approach to determine household food security status. Based on the food insecurity line for the household's ₦ 23,700.12 per adult equivalent per year, the study found that over 58 percent of the sampled households (1,200) were food insecure. The logistic regression model was employed to determine the key factors influencing household food insecurity. Among these are household size, gender, educational level, farm size and the type of household farm enterprise. Several authors have also used Cost-of-Calorie using food expenditure approach to estimate household food security status (Omotesho *et al.,* 2006; Adenegan and Adewusi, 2007; Orewa and Iyangbe 2010; Sultana and Kiani, 2011; Asogwa and Umeh, 2012; Adeniyi and Ojo, 2013; Ifoema and Agwu, 2014).

The application of COC using household expenditure as an indicator however, could introduce some bias. This method measures what households have spent on food which may not necessary be equivalent to what they actually consumed. Moreover, it does not provide an insight information on the amount of calorie intake by an individual or by a household as whole. There is a lack of knowledge of the type of foods on which the expenditures are made when using this method.
Due to this limitation several studies have used COC by using the caloric content of the actual food consumed by households in adult equivalent to establish food security index[10]. This method considers household or individual food consumption undertaking within the reference period of each food item with the caloric content being analyze. In this approach, the quantity of calories available in the respective food items consumed by households is computed. Household food security status is determined by the ratio between calorie availability and calorie requirement.

The following studies used COC approach using the **Caloric Intake** of the food consumed as an indicator by households to establish the food security status. In East-Africa, Tewodros and Tefera, (2014) focused on identifying factors influencing farming household food security. The study employed calorie intake and the logit model to establish food security status and the determinants, respectively. The food security index was established by estimating the calorie intake in adult

[10] $Z_i = \frac{Y_i}{R_i}$: Where, Z_i= food security index of i^{th} household, Y_i= actual daily calories available to i^{th} households and R_i= the recommended daily calorie requirement of i^{th} household. $Z = e^{(a+bL)}$

equivalent. The study observed that out of the 130 households selected, 62 percent of the households in the study area were food insecure. This implies that only 38 percent of the sampled households were meeting their daily recommended calorie requirement (2,100kcal). The study revealed that age of household head, level of education, household size, size of cultivated land, use of improved seed, number of contact with development agents, size of credit received, size of livestock owned, and off-farm income were the significant variables affecting food security at less than 10 percent probability level. Several authors in Ethiopia have used this approach in establishing household food security and some of these authors are Feleke, Kilmer and Gladwin, (2003); Meseret (2012).

In Kenya, Tayebwa and Bashaasha (2005) assessed the household food security status in the Food for Work (FfW) program area in Mwingi district. By using the same approach, the study found that 62 percent of the 125 households sampled were food secure. Participation in FfW program, household size, on-farm income, marital status of household head and educational level were the significant determinants of household food security.

Babatunde et al., (2007) analyzed the socioeconomic characteristics and food security status of farming households in Kwara State, North-Central Nigeria. The study obtained a sample of 94 farming households from twelve villages. Household food security status was determined by using calorie intake from the food available to household to construct food security index. The caloric content of the quantity of the respective food items consumed by household in the 7-day recall period was estimated. Per capita calorie intake was calculated by the family size after adjusting for adult equivalent using the consumption factors for age-sex categories. Household's calorie intake was divided by the seven-day period to get per capita daily calorie intake by household. Household with per daily capita calorie intake above the recommended daily requirement (2260kcal) was regarded as food secure and those who fell below was regarded as food insecure. Out of the 94 farming households considered, 36 percent and 64 percent were found to be food secure and insecure, respectively. Household income, household size, educational status of household's head and quantity of food obtained from own production were the major determinants of food security. An increase in household size decreased the probability of being food secure.

Similar study was also conducted by Ahungwa, Umeh and Muktar, (2013) in Benue State, Nigeria. The study used food consumption in a 7-day recall to estimate farming household's food security status. Based on the food security index constructed using 2,500kcal as the recommended, the

study found that 63.33 percent of the 180 sampled households were food insecure. In Nigeria, this approach has been employed by several authors including Adenegan and Adewusi, (2007); Oluyole *et al.,* (2009); Orewa and Iyangbe (2010); Asogwa and Umeh, (2012); Adeniyi and Ojo, (2013).

In Pakistan, Bashir et al., (2013) examined the regional sensitivity of rural household food security in three regions (South, Central and North) of the Punjab province. Primary data were collected from 1,152 households and the calorie intake approach was employed to analyze food security status. The result of the study showed that the Central region had about 31 percent of the sampled households to be food insecure compared to 13.5 percent and 15 percent households in South and North regions, respectively. The analysis of the logit model showed that livestock assets have a positive impact on food security across all the three regions while family size has a negative impact. Intermediate and graduation levels of education improve food security in North and Central regions, respectively but this was not the case in the South region. In the North region, the total number of income earners in the household also positively impacted food security while household heads' age has an inverse relationship with food security.

A subsequence study by the same author (Bashir *et al.,* 2012) was conducted but in this case, the study focused on the role of livestock for rural household food security of small farmers in the Punjab province of Pakistan. The study used a household level data and found that out of the 576 sampled smallholder farmers' households, only 19 percent of the sampled households were food insecure. Also monthly income, total earners in a household and educational level of graduation and above were identified to positively impact food security.

Additionally, Khatri-Chhatri and Maharian, (2006) analyzed the relationship between household's resource endowment and food security status in Nepal. The study employed calorie intake and logit model to identify household food security status and the key factors determining the situation, respectively. The study found that over 75 percent of the households were not producing enough food to meet the household's demand. The logit results showed that small landholders, fewer livestock holders, laborer and households with less consumption expenses were associated with household food insecurity. The study further observed that casual laboring, occupational work, selling of agricultural and livestock products, collection of wild foods, borrowing food or money, use of savings, seasonal migration to the places outside the district, within the country or in foreign

countries, small business, and use of pension were some of the coping strategies adopted by households.

More so, in South East Asia, a study conducted in Eastern and Western regions of Indonesia by Wiranthi, *et al.,* (2014) used a secondary data to investigate the determinants of household food security status. Household food security was identified using calorie intake approach. The study found that 41.76 percent of households in Indonesia were vulnerable to food insecurity. The further estimate was that households in the Eastern region were more food insecure (48.56percent) than those in Western region (41.76percent). The results of the logistic regression showed that increase in expenditure equivalent, age and educational level of household head, female household head, small household size, household head's occupation in non-agriculture and urban household would increase the probability of a household to become food secure in both regions. The study explained that the difference was in the factor of access to electricity in Eastern and access to safe drinking water and loan in Western region.

In Ghana, Kuwornu *et al.,* (2013) study focused on farming household's food security status in the Coastal and Forest belt of Central region. The study used household survey data with 120 farming households considered and employed the calorie intake approach to estimate the food security status. To model the relationship between household food security status and the socioeconomic factors, the logit model was employed. The result showed that majority of the farming households were food insecure (60percent). The logistic regression model also showed that a higher household's income, access to credit and the quantity of own farm produce positively and significantly were associated with food security. The study also observed that non-working members of households worsen food security status.

Frimpong and Asuming-Brempong (2013) also assessed the factors influencing food security in rural and urban households of Ashanti region, Ghana. The study employed the calorie intake approach and Tobit model to identify household food security status and the various determinants, respectively. The result showed that household size, expenditure on food, access to credit, total own production, remittances, number of income generating activities and land endowment were significantly influencing rural household's food security. Urban household's food security was affected by household size, migration, per capita food expenditure, own production and land endowment were the significant determinants of food security.

2.4 Conclusion from the literature

Several studies have been carried out on household food security status and its determinants in many different contexts (urban/rural) and levels (regional, national, local) using different variables and methodologies. In Ghana, general trends in food security have been documented however, only few studies so far have been identified in the literature using the Cost-of-Calorie specifically the calorie intake approach in investigating household food security status. In addition, no studies using this approach have analyzed household's food security between any two regions in the country.

The above reviews make it clear that both socio-economic and other factors such as climate related factors and household resources seem to have an impact on the food security status of households. But none of these reviewed studies have so far used the cutting down of trees by farming households as main cooking fuel in their analysis even though this practice is implicitly influencing food security through production potential (climate change).

Finally, the two reviewed articles on Ghana seem not to have checked multicollinearity that deserve attention while modelling relationships between variables. The implication of the several causes of food security listed in the literature relate to the facts that household food security is influenced by many factors, and have also showed that the dominance of one over the other is principally determined by area specific aspects. Therefore, before any policy interventions can be executed in an area, these factors in relation to food security need to be appropriately verified and addressed so that specific policies and programs can be properly implemented.

Chapter 3 METHODOLOGY

This chapter calculates the methodological framework for measuring households' food security status, the extent of their food security status by comparing the different between the indices in the two regions, and the econometric model employed for analysing factors determining the status of households' food security.

3.1 Measuring Household Food Security Status

The household food security status is obtained using food security index generated from the Cost-of-Calorie (COC) function. This was employed based on its simplicity and ease of computation. The food security index of household according to Fakiyesi, (2001), Babatunde *et al.,* 2007 and Adeniyi and Ojo, (2013), can be estimated as:

$$Z_i = \frac{Y_i}{R_i} \qquad (1)$$

Where, Z_i= food security index of i^{th} household, Y_i= actual daily calories available to i^{th} households and R_i= the recommended daily calorie requirement of i^{th} household. Household is food secure if $Z_i \geq 1$ and is food insecure if $Z_i < 1$. Estimation of this function gives the general household's daily calorie intake. The per household's daily calorie intake is obtained by dividing the calorie intake of household by the reference period (Omotsesho et al., 2006 and Ojogho, 2010). The per capita daily calorie intake of each household is estimated by dividing household daily calorie intake by its' household size (Babatunde *et al.,* 2007).

3.2 Extent of Household Food Security Status (Surplus/Shortfall)

Given the food security index estimated above, the extent of household's food security or insecurity is estimated by computing the food security indices including: Head Count Ratio (*HCR*), Food Insecurity Gap (FIG_i), Squared Food Insecurity ($SFIG_i$) and Surplus Index (*SI*).

The headcount ratio (HCR) is expressed as:

$$\frac{M}{N} * 100\% \qquad (2)$$

Where N is the number of households in the sample and M is the number of food insecure households. The mean food insecurity gap is expressed as:

$$FIGi = \frac{1}{M}\sum_{j=1}^{n} G_j \quad (3)$$

The mean squared food insecurity gap ($SFIG_i$) is expressed as:

$$SFIGi = \left(\frac{1}{M}\sum_{1}^{n} G_i\right)^2 \quad (4)$$

Where G_j is expressed as:

$$G_j = \frac{(Xi-L)}{L}$$

Where, G_j=calorie intake faced by household; X_i = per capita food consumption available to household; L = recommended daily per capita requirement; and N denotes number of households that are food secure (for surplus index) or food insecure (for shortfall index). The mean surplus index is expressed as:

$$\frac{1}{m}\sum_{i=1}^{n}\left(\frac{L-Y_i}{L}\right) \quad (5)$$

In comparing the food security indices of farming households in the two regions, the study separately estimated the food security indices (*HCR, FIG_i, $SFIG_i$, SI*) for farming households in Eastern and Northern regions. The mean food security indices were then compared using T-test. The indices were tested against the following hypotheses:

H_0: $\beta_i = 0$

H_A: $\beta i \neq 0 \quad \forall$ i where i = 1, 2…..

The study tests the null hypothesis that there is no significant difference between the head count ratio (HCR), food insecurity gap (FIG), squared food insecurity gap (SFIG) and the surplus index (SI) of farming households in Eastern region and farming households in Northern region. The alternative hypothesis tests that there is a significant difference between the indices of farming households in Eastern region and farming households in the Northern region. Therefore, if $t_{cal} > t_{crit}$ then the null hypothesis is rejected; however, if the $t_{cal} > t_{crit}$ then refuse to reject the null hypothesis.

3.3 Determinants of Household Food Security Status

There have been two major regression models used in data analyzes determining a response variable which is dichotomous in nature (the probability that an event will occur). These models are Probit and Logistic regressions. Following (Meseret, 2012), this study used logistic regression model. The aim of the analysis using logistic regression model is to find the best fitting and the most parsimonious model to interpret the relationship between response/dependent variable and predictor/explanatory variables. Logistic regression model has various advantages: (i) to predict a response variable on the basis of continuous, discrete, dichotomous, or a mix of any of these predictor variables; (ii) to determine the present of variance in the response variable explained by the predictor variables; (iii) to rank the relative importance of predictor variables; (iv) to assess interaction effects; and (v) to understand the impact of covariate control variables (Shumiye, 2007).

3.3.1 Analytical Model Specification

The logistic (logit) regression model is used as a result of the binary nature of the response variable and the ease of interpretation (Hailu, and Nigatu, 2007). The response variable relative to this study (food secure and insecure household), is a dichotomous variable which fit into the logistic regression model. The logit model assumes a linear relationship between the odds ratio and each explanatory variable. The advantage of using logit (logarithm of odds) is that it does not only solve the ground constraint of linear probability model but also enables the effect of each predictor variable on the logit of the odds (Getachew, 2000). The explanation of logit model can be considered as the collection of p-predictor variables denoted as $X_{nx(p+1)}$ of Y, where X is called regression matrix. The general function of logit model expressed by Bashir *et al.,* (2012) is:

$$Y_i = \alpha Xi + \mu_t \qquad (1)$$

Where

$$Y_i = \begin{cases} 1 \ if\ household\ is\ food\ secure \\ 0 \ if\ household\ is\ food\ insecure \end{cases}$$

'α' is the estimated coefficient of the respective parameter, and 'μ_t' is the error term. Y_i is a realization of a random variable that can take the values one and zero with probabilities π_i and

1-π_i. Then, the conditional probability that a household is food secure can be written as

$$\rho_i = \rho(Y_i = 1/X_i = x_i) \quad (2)$$

The logit model can therefore be expressed as:

$$\rho_i = F(Y_i = 1/X_i) = \rho[\alpha + \sum(\beta_i X_i)] = \frac{1}{1+e^{-(\alpha+\sum \beta_i X_i)}} \quad (3)$$

The log odds of the probability that an individual is food secure is expressed as:

$$log\left(\frac{P_i}{1-P_i}\right) = Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k \quad (4)$$

If the response variable Y_i=1 then the probability of a household being food secure is ρ and if is Y_i=0, then the probability of a household being food insecure is 1- ρ. The logarithmic transformation of equation (4) yields the Logit Regression Model. If the disturbance term (μ) is introduced, with Y_i= is a function of n explanatory variables (X), then the logit model is expressed as:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k + \mu \quad (5)$$

Thus, the household food security status (1=food secure & 0=food insecure) is expressed as a function of a linear combination of observable explanatory variables with some unknown parameters α & β and an error term μ. Equation (5) is the called Multiple Regression Model. The study is therefore modelled within the framework of this theory and the model behind is given below.

3.3.2 Econometric Modelling of the Determinants

Following from Bashir et al., (2013) the logit of the multiple empirical econometric modelling (Logit) of the factors affecting farming household food security is expressed as:

$$Y = \alpha + \beta_1 AGEHh + \beta_2 \text{GENDHh} + \beta_3 FARMHHSI + \beta_4 MARI - STAT + \beta_5\ H/h\,SIZE + \beta_6 OFF - FARM + \beta_7 MON - INC + \beta_8 YRS - EDUC + \beta_9 ACES - CRDT + \beta_{10} OWNEQUIP + \beta_{11} QTY - PROD + \beta_{12} FIRWOD - USE + \beta_{13} DEP - RATIO + \beta_{14} LIVST - OWN + \beta_{15} REMITT + \beta_{16} RELIG + \mu \quad (6)$$

Y = Dependent or response variable (Dichotomous)

α = intercept or constant term

$\beta_1 - \beta_{16}$ = are the slopes or the coefficients to be estimated

The 'a prior expectation of these coefficients to be estimated is provided in Table 3 below. These sixteen explanatory variables are assumed to have a close relationship with the response variable

Table 3.1: Variables Influencing Food Security Status of Farming Households

Variables	Description	Measurement	A priori Expectation
AGEHh	Age of household head	Continuous (Years)	+/-
GENDHh	Gender of household head	Dummy (Male=1, Female=0)	+
FARM	Farm	Continuous (hectares)	+
MARI-STAT	Marital status of household head	Dummy (1=married' otherwise=0)	+/-
H/h SIZE	Household seize	Continuous	-
OFF-FARM	Off-farm activities	Dummy (Yes=1, No=0)	+/-
MON-INC	Monthly income	Continuous (GHS₵)	+
YRS-EDUC	Years of education	Continuous (Years)	+
ACES-CRDIT	Access to credit	Dummy (Yes=1, No=0)	+
OWNEQUIP	Ownership of equipment	Dummy (Yes=1, No=0	+
QTY-PROD	Quantity of own produce	Continuous (Kg)	+
FIREWOOD	Firewood use as main fuel	Dummy (Yes=1, No=0)	
DEP-RATIO	Dependency ratio	Continuous (ratio years)	+/-
LIVST-OWN	Livestock ownership	Dummy (Yes=1, No=0)	+
REMITT	Remittance	Dummy (Yes=1, No=0)	+
RELIG	Religion	Dummy (Christian=1' otherwise= 0)	+

Logit model “accommodates a lot of variables (discrete and continuous), which can be ranked in a hierarchy to show which variables strongly affect the dependent variable and the association among the independent variables” (Adeniyi and Ojo, 2013). When the variables in the regression problem assume binary values (either 1 or 0), then fitting the general multiple linear regression model of a binary variable on a set of continuous and/or dichotomous regression confronts violations of some of the fundamental least square assumptions (Fernando, 2011). Unlike linear regression whereby the parameters are estimated using the method of least squares by minimizing the sum of squared deviations of predicted values from observed values, the logistic regression uses maximum likelihood estimators for the actual parameters. Probit Model is observed to have similar type of limitations and merits with logistic regression (Collect, 1991). Besides, the transformations of both models are quite similar to each other, but the logistic is observed to be more convenient during computation. The logistic transformation is preferred to other transformations in terms of its explicit interpretation of the logarithm of the odd in favor of a success. It is observed that the logistic regression model parameter estimates tend to be 1.6 to 1.8 times higher than the corresponding parameter estimates for the Probit model (Fernando, 2011). Again logit model is also linked to other models, such as the log-linear models; and its importance for retroactively collected data analysis (McCullar & Nelder, 1983). The logit model is known to be remarkably flexible (Hosmer-Lermeshow, 1989) and also to be less sensitive to outliers and easy to correct bias (Copas, 1988).

Chapter 4 STUDY AREA AND DATA DESCRIPTION

This chapter presents the description of the sources of data and the study area, procedure for obtaining the response variable (measuring household food security) and the various hypotheses underlying the independent variables.

4.1 Data Description

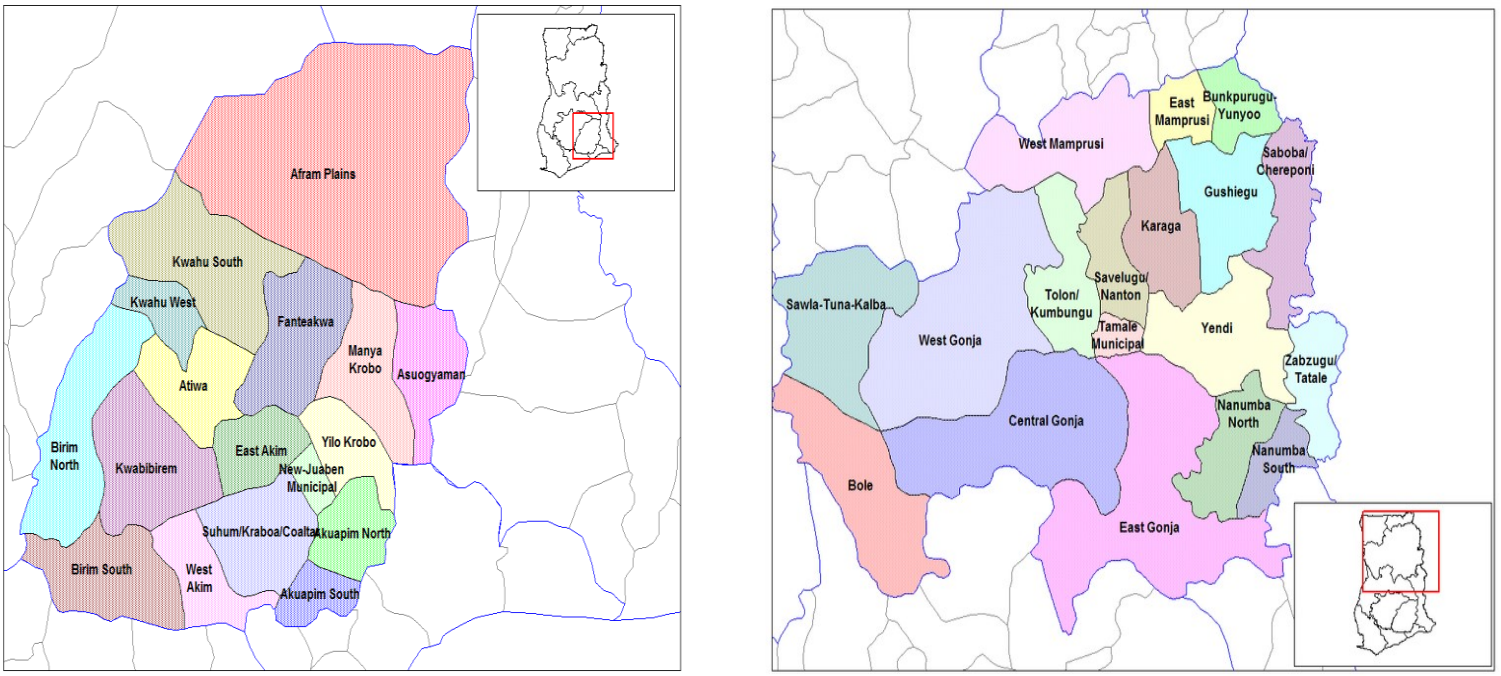
Data for this work is obtained from the 2012/2013 Ghana Living Standard Survey. The Ghana Living Standards Survey (GLSS) is a nationally representative sample survey undertaken by Ghana Statistical Service (GSS) to measure the living conditions and welfare of the population. The current GLSS is the sixth round which was initiated in October 2012 and completed in October 2013. Interviews were conducted among 18,000 households in 1,200 enumeration areas selected across the entire country. Out of the 18,000 households selected for the survey, 16,772 were successfully interviewed. The survey covered all household members who have not been away from their usual residence for more than six months. This survey was administered by trained enumerators and it includes questionnaires on demographic characteristics of the population, education, health, employment and time use, migration, housing conditions and household agriculture. This study used sample drawn from the survey's agricultural and household questionnaires. It contains sample of farmer's food availability and accessibility.

4.2 Description of study area

The study was conducted in the Eastern and Northern regions of Ghana. Eastern region is located in southern Ghana and has an area of 19,323 km^2, which is the sixth largest region in the country. It constitutes 8.1 per cent of the total land area of Ghana. The total population of Eastern region as at 2012 was 2,633,154 representing 10.7 percent of the country. It lies between latitudes 6^o and 7^o N and longitudes 1.30^o W and latitudes 0.17^o E. The main vegetation in the region is mostly secondary forest with savannah grassland found in some parts of the region. The topography of the region is quite diverse with low lying areas around the valley of the Volta River and Lake. The region is well drained with the Volta Lake covering large stretches of the land. By it, transportation is made possible between the southern and northern parts of the country. The vegetation of the

region is tropical and the rainfall pattern is the double maxima with dry and wet seasons. The cultivation of several food crops and cocoa as well as animal rearing have been major agricultural activities in the region.

Northern region climatically, religiously, linguistically, and culturally differs greatly from the politically and economically dominating regions of central and southern Ghana. In relation to land coverage, the Northern region is the largest region in Ghana. It occupies an area of 70,384 km^2 which represents 29.5 percent of the total land area of Ghana. It shares boundaries with two neighbouring countries, the Republic of Togo to the east, and La Cote d' Ivoire to the west. The land is mostly low lying except in the north-eastern corner with the Gambaga escarpment and along the western corridor. The region is drained by the Black and white Volta and their tributaries, Rivers Nasia, Daka. It is also characterised by an average annual rainfall of less than 1,200 mm, falling within the single rainy season stretching from April/May to October/November[11]. The recent population of the region is 2,479,461 representing 10.1 percent of Ghana's population. Figure 4.1 shows the map of the two administrative regions (Eastern on the left and Northern on the right) of Ghana.



Map of Ghana showing the two study areas, Eastern and Northern regions (districts)

[11] Minia, 2008.

4.3 Variables Measure

This section describes the various measures used in this study to investigate household food security status and the variables carried out in the logistic regression analysis.

4.3.1 Measuring Household Food Security Status (Dependent Variable)

Following Kuwornu *et al.,* (2013) the daily recommended food energy intake of each farming household was determined using the given threshold which was provided by Ghana Statistical Service (GSS) and the International Food Policy Research Institute [IFPRI] (2000). The standard of 2,900 Kilocalorie is the recommended daily calorie intake for a moderately active Ghanaian person and a safe minimum daily intake should not fall below 80percent of 2,900kcal. This mean that the minimum intake should be about 2,320kcal. The study uses this recommended standard (2,900kcal) because is it the mostly widely used by researchers in the country (Kuwornu *et al.,* 2013; (Pappoe, 2011 and Quainoo, 2010 cited in Kuwornu *et al.,* 2013). The household members were first adjusted for adult equivalence due to the fact that different age groups have different calorie requirements. Even though certain groups of persons such as sick individual, lactation mothers and pregnant women have different requirements for the adult equivalent, the aforementioned studies show that no such requirements have yet been developed in Ghana (GSS, 2000). Table 3.2 below provides the requirement for daily energy intake of the household various composition and adult equivalent scale for the age category.

Table 4.1: Recommended Daily Energy Intake and Equivalent Scale

Age category (years)	Average energy allowance per day	Equivalent Scale
Children (<6)	1150	0.4
Children (6-18)	2250	0.7
Adults (>18)	2900	1.0

Source: Adopted from Kuwornu et al., (2013)

According to Kuwornu *et al.,* (2013) the total calorie intake by a household is computed by counting the total number of adults in every household multiplied by their recommended calorie intake (i.e total number of adults*2900 Kcal). A similar principle is used for the different age

groups in each household but in this case with different recommended daily calories requirement (Table 3.2). All the different age group is converted to adult equivalent with conversion factors presented in table 3.2. An individual households' daily calorie requirement is obtained by summing up the requirement for the three age groups estimated. The source of households' daily food consumption (Daily Energy Intake) is acquired from own quantity produced, purchase food as a supplement and those received as gifts if any. Moreover, the main staple foods consumed by each household over the preference period is converted into kilograms. Table 3.3 shows the energy content for the actual staple foods consume by each household over the reference period.

Table 4.2: Cereal and Other Food Crop Equivalent Conversion Ratios

Food crop	Calorie/kg	Milling ratio	Maize equivalent ratio
Maize	3,590	0.85	1.00
Rice	3,640	0.65	0.92
Cassava	1,490	−	0.40
Plantain	1,350	−	−

Source: Adopted from Kuwornu et al., (2013)

The energy content of each of the food item consumed is multiplied by the total quantity of each of that food consumed. For example, the total kilogram of cassava consumed per week *1,490 Kcal = total Kilocalories of cassava consumed (Kuwornu *et al.,* 2013). A similar precept would be estimated for the rest of the main foods consumed by each household. Maize and rice go through processing and grinding which lead to losses of the total energy contained in the food, hence the quantity of Maize and rice acquired is multiplied by the energy content given in table 3.3 and the milling ratio of 0.85 (ibid). To obtain the actual daily calorie intake, each household's total kilocalories of maize, cassava, rice and plantain will be summed up and divided by the preference period (7days).

4.3.2 Independent Variables

This section describes the various explanatory variables assumed to influence household food security status based on the published literature which is specified in Table 3.1 (chapter three). The following explanatory variables were hypothesized to have an influence on household food security status. The following are the reasons behind the use of these explanatory variables

4.3.2.1 Farmers Socio-Demographic Variables

Age of household heads: This variable is measured in years which is represented by the variable AGEHh and is a continuous variable. It is included in the logistic regression because it is the only variable that explained the effect of life experience to households' food security. The number of years that a person is exposed to several life experiences help a person increases the knowledge of minimizing risk by adopting certain coping strategies. Older household's head minimizes risk and avoid the chances of becoming food insecure. This variable is considered because older household heads are also less likely to adopt new technology which can negatively influence food security vis-à-vis agricultural production. Additionally, younger household's heads are also sometimes observed to have relatively poorer experiences of the socio-physical environments and farming than older household heads.

Gender of household head: The household head in this study is the person recognized by the members of the household as the one who cares for their well-being and manages the affair of the households and is also revered by the household members. In Ghana, male household heads are seen to have a merit to their counterpart 'female' because of their entitlement to lands and other household resources in the society. In the developing countries, females have a lot of disadvantages in the society and are mostly vulnerable to factors undermining household food security. This is included because gender inequality in Ghana challenged household food security status.

***Household size*:** In this study, household size is the total number of members living and consuming from the same households which is expressed in adult equivalent. This variable is included in the logistic regression because when the household size increases, the number of mouths to feed also increases with the available limited resources. Larger household size with limited household resources reduce the probability of becoming food security, ceteris paribus. The

rationale for using this variable is that most farming households in the study areas engage family members as labors for planting and harvesting activities on the farm. Moreover, in Ghana the family unit involve more than just the nuclear members of the household head. The household unit is some complex extended family units which include other relatives.

Dependency ratio: This is expressed by dividing the number of unproductive family labors (age <15 and >65) by productive family labors (aged between 15 and 65) within the household. The reason for including this variable in the logistic regression is that most of the households in both regions at the time of the survey had some members within the age range of 15 and below, 65 and above particularly, in Northern region. A household with more non-members, is expected to be food insecure. This is because the number of mouths to feed increase and this puts more pressure on household food consumption. This in turn, negatively affect household food security. Besides, the income earned by the working members could also influence household productivity. It should be taking noted that; it is possible for all the household members to be working but their overall incomes may not be enough for the households' needs. This could also affect household food security.

4.3.2.2 Economic, Institutional and Agricultural Factors

Monthly household income: Monthly income refers to the total amount of money household receives per month from diverse sources such as on-farm activities, regular jobs etc. In this study household expenditure is used as a proxy for monthly household income. This variable is highly relevant to household food consumption pattern because an increase in income leads to an increase in demands, all things being equal. Income in this study is measured in the local currency (Ghana cedi, ¢).

Remittances: This is the amount of money received from migrants of farming households. The remittances received from migrants have been identified to positively influence the food security and economic development status of several poor households in rural areas (FAO, 2011). According to WFP, (2013), the remittances received by household globally have had significant impacts on the reduction of poverty and food insecurity. The reason for using this variable is that there is a high need of cash by farming households to improve agricultural production in Ghana. The high need of cash by farming households has lingered the increase in a multifaceted

phenomenon of migration (World Bank, 2011). The popular form of migration in the northern part of the country is the rural-to-rural seasonal migration where some members in the household labor in other farms. Migration trend in the south however, is rather rural-urban where migrants seek regular jobs other than farming. It is also suggested that the impact of migration and the resultant remittances on agriculture as well as rural development and employment depend directly on the relative number of migrants and the volume of remittances both financially and in-kind (IFAD, 2007b).

Off-farm activity: This is when farming household diversified their portfolio and sourced their income from elsewhere other than agriculture. Off-farm job opportunities are diversification strategies adopted by farming household in order to minimize external shocks and also to improve their livelihoods. This variable was involved in the analysis because the opportunity cost of spending more time outside the farm is expected to reduce total yield especially when the income acquired from other activities is lower than the farm income. However, when the off-farm income is higher than on-farm income, then the opportunity cost of spending more time outside the farm is expected to improve household food security. The income acquired could be invested into purchasing agricultural inputs such as fertilizers, improved seeds, appropriate farm equipment etc. This in turn helps boost productivity hence, improving food security in the household.

Access to credit: Access to credit is very essential factor for household's consumptions. When farming households have access to credit, they are able to expand production by buying improved inputs or technology to increase household income. Studies have shown that farming households with access to credit are able to invest in farm and non-farm activities to generate income for the household. This does not only help to over come poverty but also to achieve food security. It is therefore, reasonable to include this variable in the logistic regression as a relevant determinant of household food security status.

Farm size: In this study, farm size refers to the total farmland within the twelve months' period of the data survey operated by the household and measured in hectares. For any farming household, land is an imperative resource which have an impact on food security as larger land size corresponds to higher productivity all things being equal. This is included in the logistic regression because studies that assessed farm size on food security status of farming households suggest that the size of farm has a significant relationship with food security.

Total quantity of farm production: This is the total yield produced from own farm for home consumption. This is measured in kilogram and is included in the analysis because most of the farming households in the study areas produce mainly for home consumption and sell the surpluses. The surpluses are sold, especially during the bumper harvest due to poor or lack of appropriate and affordable post-harvest technology at the household level. During the time of the survey, most of the households had no or depleting food stocks. The respondents complained that lack of storage facility compiled them to sell their surpluses at a cheaper price immediately after harvest so as to prevent the spoilage of the perishable foods. This costs farming households to have limited income to cater for other household needs.

***Livestock ownership*:** Livestock in farming household is an asset which helps rural people to accumulate wealth, a case contrary to most urban farming households. In this study livestock owned refers to the total number of animals such as goats, sheep, cattle, rabbits, and fowls reared by most smallholder's farmers which can either be sold or served as a meal. Households with larger number of livestock are able to balance or reduce their vulnerability to food insecurity when there is a reduction in food crop production. This was assessed as dummy '1' for those who say they own livestock and '0' for otherwise.

Firewood use as main source of cooking fuel: This is the trees and shrubs cut down by most farming households living in rural areas used as another source of income and also for domestic activities such as cooking fuel. This variable is included in the analysis because this practice has led to a reduction in forest resources and other ecological factors (bees, insects and other organisms) which existence contribute to agricultural production. An increase in the cutting down of trees and shrubs is expected to reduce soil fertility which in turn dwindle overall yields. This is a dummy variable which take the form 1=yes if household use firewood cooking energy and 0=otherwise. Thus, if a household does this practice, then the coefficient of the parameter is expected to be negative and is likely for such a household to be food insecure.

4.3.3 Hypotheses of the Variables

A systematic relation or association between each explanatory variable with the dependent variable was made prior the final model. The following sets of hypotheses are tested, where H_0 is the null and H_A is the alternate:

H_0: off-farm income activities have no effect on the food security status of farming household

H_A: off-farm income activities has an effect on the food security status of farming household

H_0: farm size has no relationship with the food security status of farming household

H_A: farm size has a relationship with the food security status of farming household

These hypotheses are repeated for the rest of the explanatory variables considered in the analysis

4.3.4 Validation of Hypothesis

The null hypothesis for this test is assume as: all the k explanatory variables considered together do not explain the variation in the responses. Thus

H_0: $\beta_1 = \beta_2 = \ldots. = \beta_k = 0$

Hence, to test this hypothesis the chi-square test (χ^2) and the log likelihood ratio (LR) test statistics is estimated. LR test has a chi-square distribution with k degrees of freedom under H_0. Likelihood ratio test is expressed as:

$$\chi^2_{LR} = 2\left[InL\left(\hat{\beta}\right) - InL(0)\right]$$

The log likelihood ratio indicates that the explanatory variables included in the model jointly explain household's food security status. The chi-square indicates that farmer's socioeconomic characteristics and resources are relevant in explaining the dependent variable.

4.3.5 Testing for Multicollinearity

In logistic regression, the result of multicollinearity is due to strong correlations between independent variables. A study explained that high inter-correlations among the predictor variables by themselves need not necessarily cause any problems in deduction (Maddala, 1997). The

magnitude of the error variance and the variables of the predictor variables will determine whether or not this is a problem. This is observed to occur when there is poor sampling method, misspecification and overfitting of a model as well as improper use of dummy variables. Inspecting off-diagonal elements of the Kendall's tau correlation bivariate correlation matrix of the explanatory variables; variance inflation factors (VIFs), tolerance and condition number or indices are some of the statistical techniques that have been provided for detecting multicollinearity among categorical predictor variables. But some of these tests have shortfalls and others are superior to another. To help detect high multicollinearity, the study examined the Kendall's tau bivariate correlations between the predictors (e.g. x_i and x_j for $i \neq j$) to detect "large" values of r_{ij} equals 0.8 and above. The study also employed the VIFs to further investigate potential multicollinearity problems. Marqurdt (1970) described that variance inflation factors are probably superior to the analysis based on the bivariate correlations. This is given as

$VIF(\hat{\beta}_j) = \frac{1}{1-R_j^2}$; where R_j^2 is the coefficient of determination obtained when X_j is regressed on the remaining $\rho - 1$ predictors. The VIF for each term in the model measures the combined effect of the dependencies among the predictors on the variance of that term. Multicollinearity is detected if any of the VIFs exceeds 5 or 10, this is the given common rule of thumb (Meseret, 2012). Another way of addressing this is by taking the inverse of VIF termed as tolerance linked with a predictor and when the tolerance is small say less than 0.01 then, the variable with the smallest tolerance is easy to be eliminated. A small multicollinearity implies that the tolerance is closed to 1 but when the value is closed to zero, then multicollinearity becomes a threat.

Chapter 5 RESULTS AND DISCUSSIONS

In this chapter results of the findings from the two selected regions are provided together in comparison with the respective issue of interest discussed. This chapter includes the descriptive analysis, which discusses the socioeconomic characteristics of the respondents for both Eastern and Northern regions. The food security status of farming households and the extent of calorie intake are addressed. The results of the econometric (logistic) analysis for the determinants of farming household's food security status is provided. This is presented by first discussing the logistic results of the determinants for the two regions. Afterwards, the discussion of the determinants for Eastern and Northern regions are also presented.

A total of 1,004 respondents in the Ghana living Standard Survey (2012/2013) that fulfilled the interests of the research for this thesis in relation to the variables were examined. The observations of this study were taking from two regions of Ghana: one region from the south (Eastern region) and the other from the north (Northern region). The sample size for Eastern region was 501 while that of Northern region was 503. Analysing these two regions by comparison helps to understand the differences existing within the country as regional disparity plays a vital role in the Ghanaian economy.

5.1 Descriptive Analysis: Demographic and Socioeconomic characteristics of respondents for both regions

A comparative analysis of the demographic characteristics of the sampled respondents in the selected regions are presented in this sub-section. In this study the demographic characteristics of the respondents for both regions are provided in table 5.1. These include gender, age, household size, marital status, educational level, and area of residence.

Table 5.1 presents distribution of the respondent's general household characteristics. Male household heads constituted majority of the respondents in Eastern (77.2%) and Northern regions (95.2%). Majority of the respondents are aged between 52 and 62 years in Eastern region while in Northern region most of the respondents fall within 31 and 40 years, indicating that a typical farmer in the Northern was more economically active than in Eastern. As high as 81.2% of total farming households considered in Northern had more than 4 members indicating that the average household

in the region had a large household size, similar to farming households in Eastern (70.7%). Those who were married accounted for more than half of the entire population for both Eastern (59.3%) and Northern (59.7%). Besides, multiple marriages which is the state of having more than one spouse or marriage partner at one time were observed to be higher in Northern (25.6%) than in Eastern (0.4%). Those who were divorced/widowed (23.4%) accounted for approximately less than a quarter of the total respondent in Eastern. A very small percentage (6.8%) of divorced/widowed accounted for the total respondents in Northern.

Table 5.1: Distribution by household's characteristics for both regions

Household characteristics	**Eastern Region**		**Northern Region**	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender				
Male	387	77.2	480	95.24
Female	114	22.8	24	4.76
Age (years)				
19-29	24	4.8	63	12.5
30-40	110	22.0	165	32.7
41-51	127	25.3	119	23.6
52-62	123	24.6	63	12.5
63-73	69	13.8	64	12.7
>73	48	9.6	30	6.0
Household Size				
1-3	147	29.34	95	18.86
4-6	251	50.10	207	41.08
7-9	87	17.37	107	21.23
10-12	13	2.59	56	11.11
>12	3	0.60	39	7.75
Marital status				
Single	13	2.59	13	2.58
Married monogamous	297	59.28	301	59.72
Married polygamous	2	0.40	129	25.60
Common law	72	14.37	27	5.36
Divorced	51	10.18	14	2.78
Widowed	66	13.17	20	3.97
Educational levels				
No Education	76	15.17	362	71.83
Primary	156	31.14	69	13.70
JHS	211	42.12	27	5.36
SHS/O/A-level	37	7.39	43	8.53
Tertiary	21	4.19	3	0.60
Area of Residence				
Rural	385	76.85	455	90.28
Per-urban	116	23.15	49	9.72

Of all the farming household heads in Eastern, there were more respondents (42.1%) who had attained junior high school than primary education (31.1%), no education (15.2%), senior high School/O/A-level (7.4%) and tertiary (4.2%). In the Northern, the majority of the respondents had no education (71.8%) relative to those who had attained some levels of education (28.2%). Most of the farming households dwell in rural areas than in peri-urban areas for both regions. However, the majority of the farming households in Northern (90.3%) region reside in rural areas than in Eastern region (76.9%).

The socioeconomic characteristics presented (Table 5.2) in this section are incomes of households, own farm production, the size of farms owned by households, off-farm activity (respondents engaged in other income generating activities aside farming), livestock ownership, access to credit, farm equipment ownership, and owned fridge.

The mean of monthly income was higher for farming households in Eastern (¢644.11) than in Northern (¢518.25). The mean of total monthly food expenditure (¢323.81) in Eastern was less than Northern (¢330.46). Even though both regions spend more than 50% of their total monthly income on food, Northern region spent a higher proportion of their monthly income (63.76%) on food than in Eastern (50.27%). According to Engel's law, lower income households spend a greater proportion of their available income on food than middle or higher income households. In this study, it can be inferred that farming households in both regions belong to lower income group. Moreover, USAID (2013) asserted that changes in access to food can be analyzed through the calculation of food expenditure to total household income. Thus, the amount spent on any representative food basket can be compared with monthly income. It was explained that if the amount spent on food is over 50 percent of per capita income, the evident is that household has food security problem. This indicates that a spike in food prices in the regions may trigger food insecurity, particularly, in Northern region.

Furthermore, farming households in Eastern received a higher mean monthly remittances (¢22.0) from their out-migrants than in Northern (¢3.8). Even though, the remittances received by farming households in both regions were not significant relative to their monthly income. This was observed to also serves as an additional source of household income.

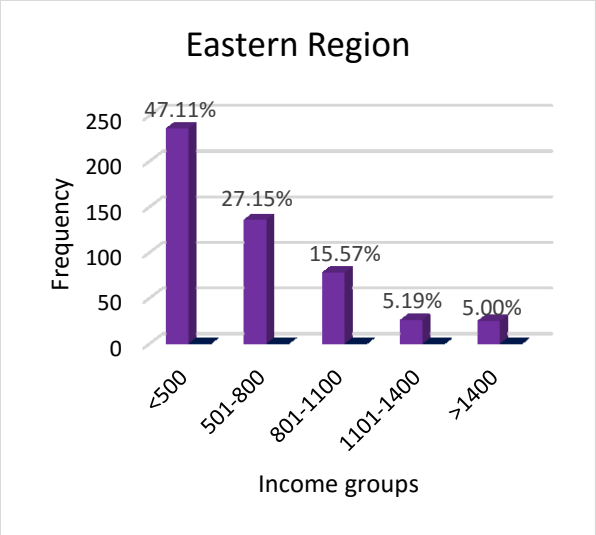
Table 5.2: Distribution of household incomes and quantity of own farm production

Variables	Eastern Region			Northern Region		
	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.
Monthly income (GH¢)	644.11	21.81	488.09	518.25	17.34	389.38
Monthly food expenditure (GH¢)	323.82	10.48	234.64	330.46	12.26	275.24
Monthly remit-received (GH¢)	22.00	2.56	57.95	3.82	0.63	14.12
Quantity of farm production (kg)	42.79	1.32	29.55	29.01	1.12	25.14

Source: GSS survey, 2012/13.

Figure 5.1 and 5.2 below give a detail distribution of household income for farming household in both regions. The figures provide the percentage of total household income and food expenditure, respectively, for both regions. Even though the monthly income for Eastern region seem to be a little higher than Northern region, majority of the respondents belong to low income groups. Figure 5.1 provides farming household's income categorized into five income groups: less than or equal to ¢500; ¢501 to ¢800; ¢801 to ¢1100; ¢1101 to ¢1400 and greater than ¢1400. Low income groups were those with income less than or equal to ¢500 while high income groups were those with income equal to or greater than ¢1400. Middle income groups include incomes starting from ¢501 up to ¢1101.

More so, there were some levels of similarities in the distribution of monthly household food expenditure for both regions. Majority of the respondents have monthly household food expenditure between ¢101 and ¢300 income groups (figure 5.2). However, respondents with food expenditure over ¢800 were higher in Northern (5.95%) than Eastern (2.79%).



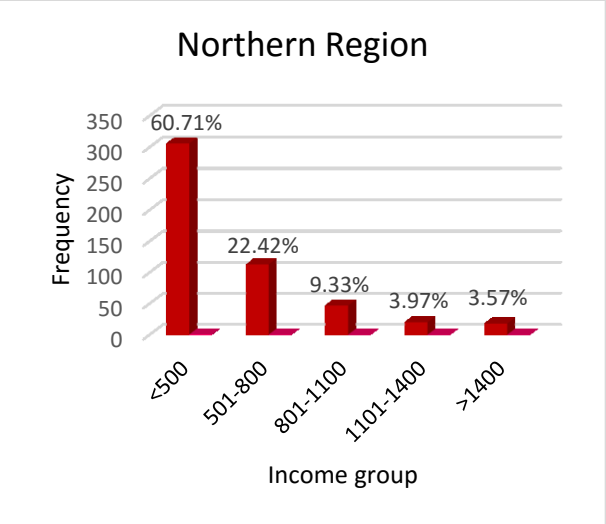
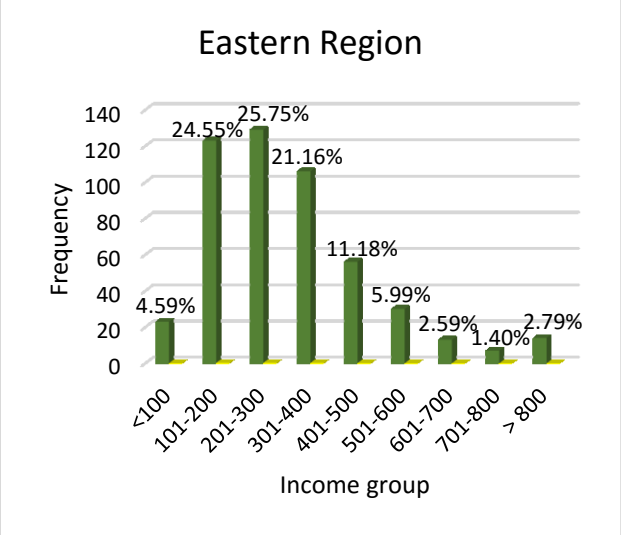


Figure 5.1: Distribution of total monthly household income for Eastern & Northern region



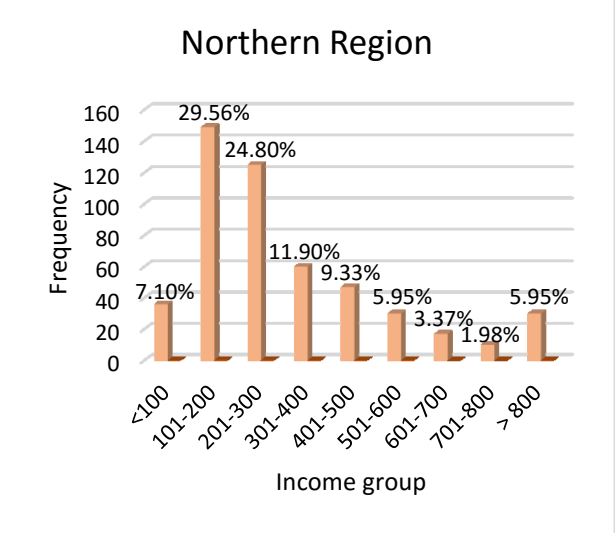


Figure 5.2 : Distribution of monthly household food expenditure for Eastern & Northern Region

Source: GSS survey, 2012/13

The following tables 5.3 and 5.4 provide the economic, financial and agricultural factors of the households for both Eastern and Northern regions.

The means, standard deviation and the standard errors of farm size for both regions are presented (Table 5.3). This is also detailed in a graph below. The mean of farm size (1.44ha) in Eastern region was observed to be smaller compare to the mean of farm size (4.60ha) in Northern region.

Thus, the size of farm owned by farming households in Northern region was larger than that of Eastern region. This result supports the finding of Chamberlin (2007) and IFPRI (2008). The detail of the distribution of farm size is provided in figures 5.3.

Table 5.3: The means of the farm size of farming households for both regions

Observation	Mean	Std. Err.	Std. Dev.
Eastern Region	1.44	0.11	2.53
Northern Region	4.60	0.21	4.66

Source: GSS survey, 2012/13

The distribution of farm size for Eastern and Northern regions is provided in Figure 5.3. The proportion of the respondents without farm lands were higher in Eastern region (43.31%) than in Northern (3.80%) region. The proportion of the respondents with farm size between 1 to 2 hectares for Northern region was higher (37.60%) than in the Eastern region (24.35%). The proportion of the respondents with farm size above 6 hectares was also higher in Northern (16.50%) than in Eastern (3.60%). Overall, the result shows that farming households in Northern region have more access to farm land compare to those in Eastern region. Thus, the livelihoods of respondents in Northern region are more agriculture based than those in Eastern region.

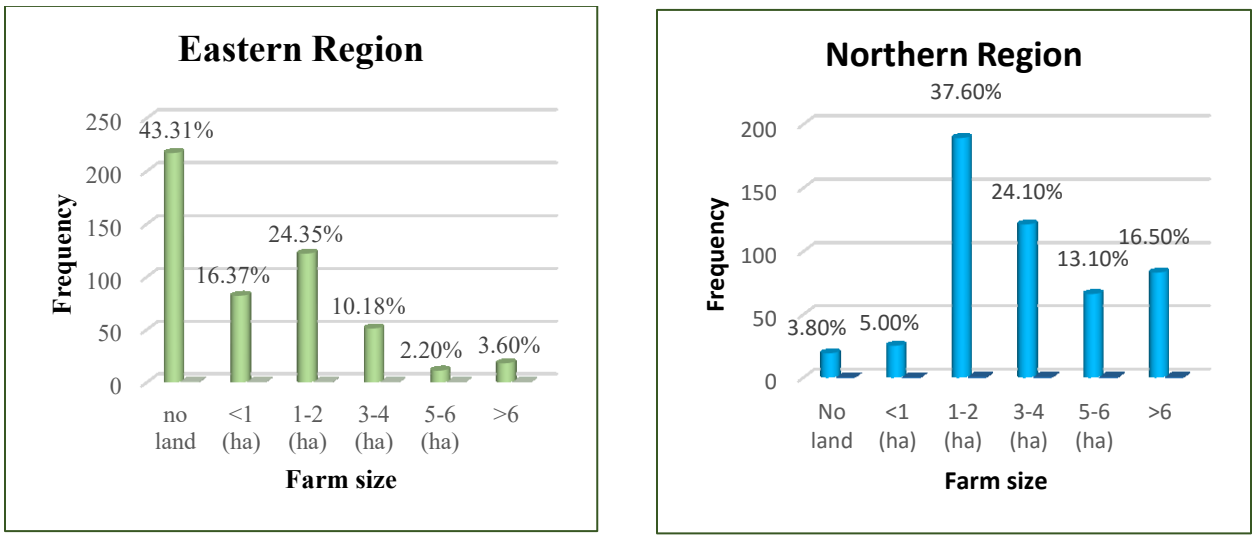


Figure 5.3 :The percentage of farm size in Eastern and Northern regions

Source: GSS survey, 2012/13

The capital and physical assets of farming households are presented (Table 5.4). These include off-farm activity, ownership of farm equipment, access to credit, livestock ownership and owned fridge. The variables are presented in dummy (i.e. yes =1, otherwise = 0). Accordingly, the proportion of respondents engaged in off-farm income generating activities[12] were higher in Eastern (45.31%) than in Northern (31.94%). Respondents without own farm equipment were higher for both Eastern (58.08%) and Northern (63.89%). Of the sampled farming households considered, only 34.53% and 9.52% have access to credit in Eastern and Northern regions, respectively. Majority of the respondents owned livestock in Northern region (95.63%) compared to those in Eastern region (65.27%). Livestock rearing in the northern part of Ghana has been observed to serve as relevant source of income for most households (Aasoglenang and Bonye, 2013). Besides, the income gained from livestock sales are generally noted for the men/husbands and they determined how to spend it. Nevertheless, livestock is observed to be used as a sale during the lean season to buy additional foodstuffs. Further, the proportion of farming households that did not own fridge were higher for both Eastern (83.83%) and Northern (97.22%) regions.

Table 5.4: Distribution of resources/assets of farming households in dummy

Variables		**Eastern Region**		**Northern Region**	
	Score	Frequency	%	Frequency	%
Off-farm activity	Yes =1	227	45.31	161	31.94
	No = 0	274	54.69	343	68.06
Farm equipment ownership	Yes =1	210	41.92	182	36.11
	No = 0	291	58.08	322	63.89
Access to credit	Yes =1	173	34.53	48	9.52
	No = 0	328	65.47	456	90.48
Livestock ownership	Yes =1	327	65.27	482	95.63
	No = 0	174	34.73	22	4.37
Own fridge	Yes =1	81	16.17	14	2.78
	No = 0	420	83.83	490	97.22

Source: GSS survey, 2012/13

[12] Off-farm activities are the various kind of work farmers engaged in so as to diversify their income. These works include daily laborers such as construction, petty trading, artisans, carpenters, weavers etc.

The description of other socioeconomic characteristics of farming households in this section includes the main sources of household drinking water, toilet facility[13], cooking fuel, and the religious beliefs of respondents. The description of these variables helps to understand the differences existing in the social values of respondents and also how these can implicate the value of food households consumed. This aspect is particularly important in areas with low income households. However, these variables except religion and main source of cooking fuel were not included in the logistic regression. Due to some limitations in the data which can lead to type I error in the significant test for each coefficient in the model. Type I error occurs when the model exhibits some significant explanatory variables in relation to the response variable when they are actually supposed to be non-significant. It can also result in high correlation with other variables.

The main sources of cooking fuel utilized by farming households for cooking food as well as other home cooking activities are also presented in table 5.5. Firewood was the main cooking fuel used by farming households for both Eastern (83.4%) and Northern (93.3%) regions. Charcoal production was another source of cooking energy which is generated from dry woods. It has been observed that most farming households living in rural areas generate income from charcoal production to improve livelihoods including food security (Fousseni *et al.,* 2012). Majority of the respondents (86.5%) in Eastern region were Christians (Catholic, Protestant, Pentecostal & other Christian) while majority of the respondents (70.1%) in Northern region were Islamic (Islam and Ahmadiya). The percentages of the Christians and Islamic categorizes are indicated in the appendix 3

[13] Table 5.5 shows the main sources of household water, toilet facilities and cooking energy. The sources of water considered in this study were those collected purposely for home consumption such as drinking and cooking. Majority of the respondents in Eastern (50.1%) and Northern (56.5%) regions sourced their water from protected wells. Few of the respondents in Eastern used surface water (23.4%), public standpipe (11.2%), borehole (11.0%), rain water (1.8%), own tap (1.4%) and unprotected well (1.2%), similar to those in Northern region. Most of the respondents in Eastern used unimproved latrine (44.7%) as their main source of toilet facility with only 2.0% using flush toilet facility. While in Northern, only 1.8% used unimproved latrine with 0.6% using flush toilet facility. Majority of the respondents (89.3%) had no toilet facility in Northern compare to only 7.9% in Eastern region. The value of food consumed by household can be distorted due to inappropriate health and sanitation services observed in their sources of drinking water and toilet facility (Herwig, (2000); USAID, 1992 cited in Tewodro & Tefera, 2014).

Apparently, the descriptive statistics show that farming households in the Eastern region have a better economic conditions than those living in the Northern region. With regards to their socioeconomic profiles and access to resources, there are some disparities existing between farmers in the two regions. Regional disparity exists in income, education, access to credit, engagement in off-farm activity and religion of the respondents. Farming households in Eastern region seem to be ahead in terms of the economic welfare relative to farming households in Northern region.

Table 5.5: Other socioeconomic characterisers of respondents

Variables	Eastern Region		Northern Region	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Main sources of water				
Pipe (own tap)	7	1.4	4	0.8
Public standpipe	56	11.2	45	8.9
Borehole	55	11.0	4	0.8
Wells (protected)	251	50.1	285	56.5
Wells (unprotected)	6	1.2	2	0.4
Surface water	117	23.4	160	31.7
Rain water	9	1.8	4	0.8
Main toilet facility				
Flush toilet	10	2.0	3	0.6
Improve pit latrine	59	11.8	6	1.2
Unimproved pit latrine	224	44.7	9	1.8
No toilet facility	40	7.9	449	89.3
Other	168	33.5	36	7.2
Main sources of cooking fuel				
Firewood	418	83.4	471	93.3
Kerosene	1	0.2	1	0.2
Charcoal	64	12.8	33	6.5
Electricity	-	-	-	-
Gas	18	3.6	-	-
Religion of respondents				
No religion	44	8.8	38	7.5
Catholic	27	5.4	49	9.7
Protestant	112	22.4	13	2.6
Pentecostal	200	39.9	42	8.3
Other Christian	94	18.8	9	1.8
Islamic	24	4.8	353	70.1

Source: GSS survey, 2012/13

5.2 Food Security Status of Farming Households in Eastern and Northern Region

Table 5.6 presents the food security status of farming households using the recommended daily calorie intake of 2,900kcal for both regions. The result shows that in Eastern region, 57.29% of the sampled farming households were food secure while in the Northern region, 53.97% were found to be food secure. The proportion of food insecure households in Eastern was 42.71% while 46.03% were food insecure in Northern region. Apparently, the percentage of food secure households was higher in Northern region than in Eastern region. The proportion of farming households found to be food insecure for both regions is alarmingly high compare to the national average of 5% estimated by WFP, (2012).

Table 5.6: Food Secure and Insecure Farming Households

	Eastern region		**Northern region**	
Observations	Frequency	Percentage (%)	Frequency	Percentage (%)
Food secure	287	57.29	272	53.97
Food insecure	214	42.71	232	46.03
Total	501	100.00	504	100.00

Source: GSS survey, 2012/13.

The food security status of farming household across the area of residence is presented in table 5.7.

Of the estimated food secure farming households (57.3%) in Eastern region, 78.0% lived in rural areas while 22.0% lived in peri-urban areas. Of the estimated food secure farming households (54.0%) in Northern region, 89.3% lived in rural areas while 10.7% lived in peri-urban areas. Furthermore, among the food insecure households (42.7%) in Eastern region, 75.2% lived in rural areas while 24.8% lived in peri-urban areas. Among the food insecure farming households (46.0%) in Northern region, 91.4% lived in rural areas while 8.6% lived in peri-urban areas.

This finding is line with FAO observation which explained that most farming households in sub-Saharan Africa countries mainly dwell in rural places. According to FAO, (2015) majority of the poor and most of the hungry live in rural areas, where family farming and smallholder agriculture is prevailing. The following section presents the calorie intake of farming households in both regions.

Table 5.7: Food Security Status Across Area of Residence

	Eastern Region				Northern Region			
Area of residence	Food secure % (frequency)		Food insecure % (frequency)		Food secure % (frequency)		Food insecure % (frequency)	
Rural	78.0	(224)	75.2	(161)	89.3	(243)	91.4	(212)
Peri-urban	22.0	(63)	24.8	(53)	10.7	(29)	8.6	(20)
Total	100.0	(287)	100.0	(214)	100.0	(272)	100.0	(232)

Source: GSS survey, 2012/13

The summary of the weighted averages of household daily calorie requirement, household daily calorie consumption, household per capita calorie consumption, the food security index and the regional average calorie intake are presented (Table 5.8, estimated in chapter three). The means of food security index of households found to be food secure were 1.48 and 1.49 in Eastern and Northern, respectively (above the threshold 1). While the means of food insecurity index for Eastern and Northern were 0.65 and 0.60, respectively (below the threshold of 1). The calorie intake exceeded the requirement by 48% and 49% in Eastern and Northern, respectively. While the deficit in the calorie intake for food insecure households were 35% and 40% in Eastern and Northern, respectively.

Based on the 2,900kcal requirement, the average daily per capita calorie consumption for food secure farming households in Eastern was 3,569.43kcal and that of the food insecure household was 1,544.07kcal. This finding is similar to the finding of Omotesho et al (2006). The authors observed that the average per capita calorie consumption for food secure farming households in Kwara State of Nigeria was 3,963.97kcal and that of food insecure household was 1,504.24kcal. The regional average per capita calorie intake for all farming households in Eastern was estimated to be 2,704.29kcal which is below the national average of 2,849kcal[14]. However, this value is higher than what Kuwornu et al., (2013), found in the Central region of Ghana. In the case of Northern region, the average daily per capita calorie consumption for food secure farming households was 3,356.70kcal and that of the food insecure household was 1,368.68kcal. The regional average per capita calorie intake for all farming households in Northern was estimated to

[14] www.faoghana.org

be 2,441.58kcal which is also below the national average of 2,849kcal. From the data, the calorie requirement by food insecure households was observed to be higher than food secure households in both regions. This is because food insecure households had larger household sizes (Table 3 in appendices) and also had more adult members (653) than food secure households (498) for Eastern region. Similar to that of Northern region, the adult members for food insecure households (706) were also higher than food secure households (670). The average household daily calorie requirement for the food insecure is higher than the food secure households due to the difference also in the age group (Table 4 in appendices). This finding also agrees with Omotesho *et al.,* (2006).

Table 5.8: Amount of calorie intake by farming households in adult equivalent

Variables	Eastern Region		Northern Region	
	Food secure	Food insecure	Food secure	Food insecure
Household daily calorie requirement (kilocal)	10,722.93	11,849.35	12,910.33	16,103.75
Household daily calorie consumption (kilocal)	15,752.91	7,746.45	19,071.32	9,543.12
Average household per capita calorie consumption (kilocal)	3,569.43	1,544.07	3,356.70	1,368.68
Mean FSI (Z)	1.48	0.65	1.49	0.60
Regional average calorie intake	2,704.29		2,441.58	

Source: GSS Survey, 2012/13

5.3 Comparing the Food Security Indices among Farming Households in Eastern and Northern Regions

The various food security indices estimated in chapter three are presented (in Table 5.9). These indices measure the extent of deviation from the food security line which explains the extent of food security status among farming households in the two regions. The food security indices of farming households in both Eastern and Northern Regions were computed and the difference of means were tested using T-test. The mean differences in these variables for the two regions are examined using the statistical t-test. The 2-tailed p-value gives the statistical significant which test the hypothesis that the means of the variables for the two groups are not different from each other. Coefficients of a parameter having p-value equal or less than 0.05 are statistically significant at 95% confident interval. This would indicate that there are differences in the means for the two regions. For example, testing the null hypothesis that the mean of household income for Eastern region is not different from the mean of household income for Northern region. Against the alternative that the mean of household income for Eastern region is different from the mean of household income in Northern region. The indices which were tested include head count ratio (HCR), mean food insecurity gap (FIG), mean surplus index (SI), mean squared food insecurity gap (SFIG).

The head count ratio measures the percentage of the households which were food insecure and the result shows that majority of the respondents in Northern region (63%) as against 52% of the respondents in Eastern region were food insecure. The t-test result shows that HCR was significant at 1% level. The result of the t-test confirms that farming households in the Eastern region are more food secure than farming households in the Northern region. FIG measures the depth/extent of food insecurity of food insecure household. This helps to understand the percentage of calories needed to raise those who fall below the given threshold in order to meet food security. The p-value (0.009) of the t-test confirms that there is a statistically significant difference in the depth of household food insecurity in Eastern and Northern regions. The result of the FIG indicates that on the average, food insecure households in Eastern needed an additional 34% of what they consumed to meet the food security threshold. While households in Northern region requires an additional 40% of what they consumed to meet the food security threshold.

Table 5.9 Comparing the food security indices among farming households in Eastern and Northern regions

	Eastern Region	**Northern Region**				
Indices	Mean	Mean	T-test	df	Sig (2-tailed)	Decision
HCR	0.52	0.63	3.29	1003	0.001	Reject
FIG_i	-0.34	-0.40	-2.61	444	0.009	Reject
$SFIG_i$	0.16	0.22	3.23	444	0.001	Reject
SI	0.48	0.49	-0.80	557	0.420	Accept

Source: GSS, Survey 2012/2013

The squared food insecurity gap measures the severity of food insecurity. This was significant at 1% using t-test which shows that the severity of food insecurity is lower in Eastern region than in Northern region. The null hypotheses of the t-test were that there were no significant differences between head count ratio, food insecurity gap and squared food insecurity gap among farming households in Eastern region and in Northern region. The null hypotheses based on the p-values for these three indices were rejected in favor of the alternative hypotheses which stated that there were significant differences between head ratio, food insecurity gap and squared food insecurity gap. However, the surplus index (SI) was not statistically significant at 10% probability (p-value = 0.42). This indicates that there is no significant difference in the extent by which food secure households exceeded the food security threshold in Eastern and Northern regions. Surplus index measures the excess of calories consumed. Therefore, the null hypothesis which stated that there is no significant difference between surplus index of food secure farming households in Eastern and Northern regions failed to be rejected. The lack of significance was not expected as Northern is observed to lag behind Eastern with regards to their socioeconomic characteristics. However, the status of farming in areas characterized by a better economy does not guarantee a better livelihood. Implying that farming households in the Eastern region with access to better economy are not different from farming households in the Northern region who also experience better farming activities (e.g. access to good land, seeds and other farm inputs).

5.4 Logistic Regression Results

The results of the determinants of farming household's food security status are presented (Table 5.11, 5.12 and 5.13). The results of the hypothesized variables were presented using logistic regression. This model was employed to identify potential explanatory variables affecting household food security status through the odd ratio (OR) estimates. The odd ratio represents the odds that an outcome will occur when given a particular exposure, compared to the odds of the outcome occurring in the absence of the exposure (Szumilas, 2010). In logistic model, the changes in the coefficients (slopes) can be interpreted as an effect on the odds. That is every unit increase in the explanatory variable results in a multiplicative effect of e^{β} on the odd ratio (Fernando, 2011).

Prior to the analysis, it was essential to diagnose the existence of multicollinearity among the variables. The results of the Kendall's correlation (explained in chapter 4) matrix which is provided (appendix 5), showed that none of the bivariate correlations between any two explanatory variables exceeded 0.8 indicating that multicollinearity was not a serious problem among the categorical and continuous variables included in the analysis. Further, table 5.10 shows the result of the variance inflation factors (VIF) explained in chapter 4. The values show that for all the continuous explanatory variable, the VIF was less than 5 implying that multicollinearity may not be a threat.

In order to test the goodness of fit of the specified logistic regression model, the study considered the regression's chi-square statistic and the log likelihood ratio. The p-values presented (in Table 5.11, Table 5.12 and Table 5.13) which is less than 0.01 imply that the nine, six and four significant variables in the respective tables included in the logistic regression model have a significant joint influence on the outcome variables. The model Chi-square distribution in the logistic regression model indicates that farmer's socioeconomic characteristics are relevant in explaining the dependent variables. This can be used to assess the significant of the model which presents the normal significant test for a logistic model. The likelihood ratio tests the null hypothesis that none of the explanatory variables are linearly related to the log odds of the response variable. But it is an overall test which does not assure every explanatory variable is significant. The p-value was less than 1% probability level indicating that the null hypothesis is rejected. The log likelihood ratio indicates that the explanatory variables included in the model jointly explain the probability of household food security status.

Table 5.10: Variance inflation factor for continuous variables

Variable	VIF	1/VIF
Household size	1.58	0.63
Years of education	1.52	0.66
Total quantity of own production	1.41	0.71
Farm size	1.31	0.76
Monthly income	1.30	0.77
Dependency ratio	1.15	0.87
Monthly remittances	1.09	0.92
Age	1.08	0.92
Mean VIF	1.30	

The first regression was fitted by determining the overall factors affecting food security status of farming households for the two regions. Table 5.11 provides the results of the parameter estimates for the logistic regression model for the regions were joined. Among the seventeen variables entered in the model, nine were found to statistically and significantly influence household food security status. These variables included marital status of household head, years of education, household size, farm size, which make up household characteristics. The socioeconomic characteristics included off-farm activity, monthly income, total own farm production, and other socioeconomic factors such as the use of firewood as the main source of cooking fuel and region. Most of the signs of the regression coefficients of the final model (Table 5.11) fulfilled the underlying assumption except years of education.

The following socioeconomic characteristics were found to significantly influence household food security status:

Marital Status of Respondent: The variable **MARI-STAT** represents the marital status of the respondents in this study. This finding is in line with the hypothesis and is also consistent with a prior expectation. This was significant at 10% which indicates that there is a relevant difference between the food security status of married and unmarried household heads. The negative

coefficient indicates that households headed by unmarried people are more likely to be food secure than those headed by married people. The odds ratio in favor of food security decreases by the factor 0.612 when the head of a household is married. In terms of percentage, the odds for married household heads being food secure is 39%, less than the odds for unmarried household heads. This could possibly be that married household heads have larger household size and so would have to take care of many people than unmarried household heads. This is also reasonable due to the practice of multiple marriages (polygamous marriage) particularly in the Northern region (Aasoglenang and Bonye, 2013). This outcome disagrees with the findings by Kaloi et al. (2005) in Uganda, Haliu *et al.,* (2007) and Yusuf *et al,* (2015) in Ethiopia. However, it is in accordance with Osei *et al.*, (2013) and (Aasoglenang and Bonye, 2013) in Ghana.

Household size: The variable **HH-SIZE** represents the total number of members that live together under the same roof and share and eat from the same pot. This was significant at less than 1% probability level and had a negative relationship with household food security status. This means that large size households are more likely to be food insecure than smaller size households. That is the larger the household size the higher the demand for food consumption. The odds ratio in favor of food security decreases by the factor 0.605 when the size of household increases by one person. In terms of percentage change, the odds for large household size being food secure is 39%, less than the odds for small household size. If all things remain equal, an increase in the number of household implies more mouths to feed which leads to low average food, per capita expenditure and per household food consumption. This result supports the hypothesis that larger household size is likely to be food insecure than smaller household size. This finding is consistent with several studies such as Babatunde *et al.,* (2007) conducted in Nigeria, Sikwela, (2008) cited in Osei et al., (2013) in Zimbabwe, Muche *et al.,* (2014) in Ethiopia. However, it disagrees with Yusuf *et al.,* (2015) who explained that the greater the number of persons in household, the more the hands can be used as family labor.

Years of Education of Household Heads: The variable years of education (YRSEDU**)** represents the number of years the respondent had spent in school. The outcome of this variable was surprising because it contradicted the hypothesis presumed before the analysis. It was expected that when a person spends more years in education, the knowledge and skills acquired should perhaps improve household food security. This is because a literate farmer is expected to be able

to disseminate agricultural information's advertised in the newspapers and magazines as well as media sources (the internet) relative to an illiterate farmer. Inconsistent with the hypothesis, years of education by household heads had a negative influence on food security status and is significant at 10% probability level. The odds ratio in favor of food security decreases by the factor 0.966 when the household head spends more years in education than on the farm. In terms of percentage change, the result indicates that the odds for the household heads with more years of education being food secure is 3%, less than the odds for household heads with few years of education. Thus, household heads who spend more years on the farm are likely to be food secure than household heads who spend most of the years in education. However, this unexpected result is in line with Garrett and Ruel, (1999) cited in Beyene & Muche, (2010); Yusuf *et al.,* (2015) in Ethiopia. According to Yusuf *et al.,* (2015), educated household heads might not have the chance to apply their knowledge towards the attainment of household food security. For instance, they explained that "in the situation where farmers spend most of their time searching for more lucrative jobs in the city because of an additional certificate instead of being more serious with their farm work sometimes increase their vulnerability to food insecurity" (ibid). In contrast, Nyako (2013) observed that educational attainment of the household head has a negative relationship with the food insecurity status in rural Nigeria. The author realized that household heads with basic formal education were less likely to be food insecure than household heads without any formal education.

Farm size: In this study, the land owned and operated by farming households is represented by the variable **FARMSIZ**. The variable was significant at less than 1% probability level and show a positive relationship in explaining the status of household food security. This result supports the hypothesis that farming households with larger farm size are likely to be food secure than those with smaller farm size. The result shows that the odds ratio in favor of food security increases by the factor of 1.094 when the area of land under cultivation increases by one hectare. In term of percentage change, the odds for larger farm size of households being food secure is 9%, more than the odds for smaller farm size households. This finding agrees with the research conducted by Bogale (2009) and Muche *et al.,* (2014) in Ethiopia and Osei et al., (2011) in Ghana which indicated that the size of a land owned by farming household had a positive relationship with an improvement in household food security status. However, it does not agree with the finding by

Sikwela (2008) in Zimbabwe who realized a negative and significant relationship of farm size to food security status.

Off-farm activity: The variable **OFFAR-ACT** represents the participation of the respondents in other income generating activities aside farming. This variable was significant at less than 1% probability level and showed a positive relationship in explaining the status of household food security. This result supports the hypothesis that farming households that engaged in off-farm activities were likely to be food secure than those who did not engaged in any off-farm activity. Household diversified their sources of income by working on other jobs other than farm activities. Thus, farmers who did not participate in off-farm activities and mainly rely on the farm had inadequate sources of income to enable them afford inputs and also fulfill their family needs, hence were likely to be food insecure. The odds ratio in favor of food security increases by a factor of 1.705 when farmers diversified their sources of income. In terms of percentage change, the odds for off-farm activity of household heads being food secure is 71%, more than the odds for household heads who do not engage in off-farm activity. This finding is similar to the finding of (Babatunde et al., 2007; Beyene & Muche, 2010; Osei *et al.,* 2013) who explained that off-farm activity has the tendency to increase farming household's portfolio as they do not only source their income from the farm.

Monthly household income: In this study, the variable **MONTH-INC** represents the total monthly household expenditure which is a proxy of household monthly income. This was significant at less than 1% probability level and has a positive influence on the status of household food security. Which means that an increase in income improves the level of household's food security. All things being equal, an increase in income of farming households has the probability of increasing household's food security. The odds ratio in favor of food security increases by the factor of 1.003 when income increases by one cedi. In terms of percentage change, the odds for higher monthly income of households being food secure is 0.3%, more than the odds of households with lower monthly income. The outcome underpins the hypothesis that a unit increase in income of farming household, increases food security ceteris paribus. This finding agrees with Omotesho et al., (2006); Adenega and Adewusi, (2007); Bashir *et al.,* (2010); Mitiku, *et al.,* (2012); Kuwornu *et al.,* (2013).

Quantity of farm production: The variable **QTY-PROD** represents the quantity of own farm production. This variable was also found to be significant at less than 1% probability level. It had a positive relationship with the food security status of farming households. Obviously, when the total quantity of yields increases as the number of mouth to feed remains constant, there is a high tendency of an increase in farming households' food security. More so, the sale of the surplus increases household income which can be invested back on the farm to boost production. The odds ratio in favour of food security increases by a factor of 1.069 when the quantity of farm production increases by 1kg. In term of percentage change, the result shows that the odds for higher quantity of own farm production of households being food secure is 6.9%, more than household with lower quantity of own farm production. This result supports the hypothesis that 1kg increase of farm yields, increases the level of farming household's food security. The finding is in line with Omotesho *et al.,* (2006); Smith and Subandoro, (2007); Beyene & Muche, (2010); Osei *et al.,* (2013).

The model also indicates that the outcomes of the following variables were not statistically significant for the combined regions (Eastern and Northern regions together) in explaining household food security status at 10% probability level. These variables include age, access to credit, ownership of livestock, dependency ratio, remittances received, and farm equipment.

The variable representing **Age** (AGE) is a farmer characteristic that did not have a significant (Table 5.11) impact on household food security status. The coefficient for the age variable has a positive relationship with food security status. Age of respondent was expected to be significant because from the published literature, old age comes with some experiences and acquisition of knowledge. This variable is observed to give some less complications when faced with different kinds of risks in life (e.g. food insecurity).

The variable representing **Access to Credit** (ACCES-CRDT) was not significant (Table 5.11) in determining household food security stats. The coefficient of access to credit variable was positive although it was not significant. This is surprising because it was expected to have a significant impact on food security. This is by the fact credit to farmers help to acquire technologies such as improved seeds, machinery and agricultural inputs (fertilizer). Osei *et al.,* (2013) suggested that access to credit by farming households help to build their capacity to produce more through the use of improved seeds and the adoption of improved technologies. The fact that it was not

significant suggests that farmers who have access to credit are indifferent from those who have access to credit in relation to food security.

The variable **Livestock Ownership** (OWN-LIVST) was not significant (Table 5.11) in determining the food security status of farming household. Even though the coefficient of the variable, ownership of livestock meets a prior expectation (positive). This is also surprising given the fact that livestock owned contributes heavily to the livelihoods of poor households. It was therefore, expected that households having livestock would be more food secure than households having no livestock. The possible explanation to the non-significant relationship could that, the income gained from selling livestock have no impact on household food security. Livestock owned by poor households are assets that generate income to provide other household needs (medication, school fees etc.) other than food needs households (Beyene & Muche, 2010; Kuwenyi *et al.,* 2014).

The variable **Ownership of Farm Equipment (**OWNEQUIP) was not significant (Table 5.11) in determining household's food security status. The possible explanation to the negative relationship could be that, owning farm equipment might come with a cost since they require maintenance and repairs. The non-significant effect suggests that the ownership of farm equipment by farming household does not differ between food secure and insecure households. Farmer's wealth in the literature is sometimes defined as their total assets which include physical capital such as farm equipment (Kaliba *et al*., 2001). It was expected that owned farm equipment will have a significant impact of food security status of farming households. Thus, farmers with their farm equipment will avoid the risk of late planting as this could dwindle total yields. Farmers who borrow tools and equipment from their neighbors for planting and harvesting are mostly observed to be delayed in productivity. This implicitly affect their food security vis-à-vis production and consumption.

The variable **Dependency Ratio** (DEP-RATIO) was non-significant (Table 5.11) to household food security status. This variable was expected to negatively and significantly influence household food security status. Given that every household has productive age groups (members between 15-65 ages) and unproductive age groups (age under 15 and above 65 age range). It was expected that an increase in the number of non-working members in the households will decrease the odds ratio in favor of food security. Though the coefficient was positive, this was not significant in explaining household food security status. The possible explanation for the non-significant relationship could be that the addition of unproductive person into the household does not make any profound changes to the productivity of farming households. Thus, an increase in the non-

working members make no significant change to farming household food security status when the regions are combined.

The variable **Gender of Household Head** (GENDHh) was not significant (Table 5.11) in determining household' food security status. The coefficient for the gender of household head met a prior expectation but it had no significant relationship with household food security status. The positive relationship of this variable to food security status suggests that household headed by males were likely to be food secure than household headed by their female's counterparts. The non-significant effect suggests that the status of household food security does not differ between men and women.

The variable representing **Monthly Remittances** (MONTH-REM) was not significant (Table 5.11) in determining household food security status. The monthly remittances received by farming households had a positive coefficient but not significant food security. The positive effect could be that the amount received as a remittance by farming households could be used to cater for other household needs. However, the proportion of the amount of remittances received from the out-migrants to farming household monthly income had no relevant impact on their food security. This outcome is in line with the finding of Marchetta, (2011) who suggested that the remittances were in normally used to supplement the basic consumption needs which involve food, health service, clothes, school expenditure, and inputs for farming but this was consider not to be enough to set up a new economic activity.

The variable **Religion** (RELIG) was not significant (Table 5.11) in determining household's food security status. The positive coefficient met a prior expectation which indicates that Christians farming households were more likely to be food secure than other religion. Although the relationship between religion and household food security status remains a big gap in the literature, a study revealed that religion together with culture and traditional knowledge "affect food and nutrition security by shaping a community's diet, food preferences, intra-household food distribution patterns, and child feeding practices, food processing and preparation techniques, health and sanitation practices" (Alonso, 2015).

5.4.1 Other determinants

The following other socioeconomic characteristics of respondents were found to be significantly associated with household food security status:

The use of firewood: In this study, the variable **FIREWO-USE** (Dummy; yes=1, otherwise=0) represents the cutting down of trees as a main source of cooking fuel. This is consistent with the hypothesis that an increase in the cutting down of trees and shrubs as a source of cooking fuel negatively and significantly (at 5% probability) influence household food security. The possible explanation to the negative coefficient indicates that the trees which are being cut down by farming households for home activities such as cooking and for sale were implicitly affecting household's food security vis-à-vis total production. This is reasonable because in the long run, the increase in the number of trees and shrubs cut down without replacement add to climate change and induce the occurrence of drought and flood in the country. The dry up of trees and shrubs are increasingly cut down and being used as a source of cooking energy and income particularly in the northern parts of Ghana (Yaro, 2006; Marchetta, 2011). This practice also reduces forest zones and land vegetation resulting in soil erosion which also reduce the fertility of the soil (decreases micro-and macro-organisms). Ghanaian Environmental Protection Agency revealed that the Sahara Desert for every year, extends southwards into the forest reservations (northern to southern Ghana) by an estimate of 0.8 kilometer due to climate change (Dorurugu, 2010). The implication is the result of low total farm outputs hence increasing vulnerability to food insecurity among farming households. Moreover, most farming households are increasing the cutting down of trees and shrubs as a source income generating activities in order to minimize the impact of poverty to their livelihoods. This finding agrees with Meseret (2012) in Ethiopia who realized that a significant proportion of the respondent households engaged in forests in search of natural resources so that they can make money from the sale. However, this practice led to the contribution of food insecurity in the study area. Similar finding was also observed by Fousseni *et al.,* (2012) in northern Togo.

Region: This variable significantly affects household food security at less than 1% probability level. The variable **REGION** (dummy) takes the value of 1 if farmer lives in Eastern region and 0 otherwise. The odds ratio value of 0.272 indicates that the probability of Eastern region to be food secure is 0.272 times lower than the probability of Northern region to be food secure. In term of percentage change, the result indicates that the odds for farming households in Eastern region being food secure is 73%, less than the odds for farming households in Northern region. This could possibly be explained by the fact that even though farming households in Eastern have better access to economic conditions, the standard of living is higher in regards to these conditions than

those in Northern region. The effect of regional disparity to food security was also observed by a study conducted in Indonesia (Wiranthi *et al.,* 2013) and also in Pakistan, Punjab province (Bashir *et al.,* 2013). This regional effect signifies that food insecurity among farming households is also worsening in the southern part of the country. Thus, the continuous negligent of policies in relation to food security in southern Ghana has over shadowed the challenges encountered in these areas.

Table 5.11: Logistic Regression Estimates for determinants of food security status of farming households for both regions

FSSHH	Odds Ratio	Std. Err.	Z	P>|Z|
GENDHh	1.142	0.322	0.47	0.638
AGEHh	1.005	0.005	1.03	0.305
DEP-RATIO	1.065	0.100	0.67	0.503
MARI-STAT	0.612	0.156	-1.92	0.054*
YRSEDU	0.966	0.020	-1.69	0.091*
FARMSIZ	1.094	0.031	3.12	0.002***
HH-SIZE	0.605	0.026	-11.79	0.000***
OWN-LIVST	1.103	0.250	0.43	0.666
OWNEQUIP	0.915	0.159	-0.51	0.609
OFFAR-ACT	1.705	0.301	3.02	0.003***
ACCESS-CRDT	1.230	0.274	0.93	0.354
FIREWO-USE	0.286	0.167	-2.14	0.032**
RELIG	1.094	0.244	0.40	0.689
MONTH-REM	1.002	0.002	1.18	0.238
MONTH-INC	1.003	0.001	5.18	0.000***
QTY-PROD	1.069	0.006	11.88	0.000***
REGION	0.272	0.082	-4.34	0.000***
_CONS	4.468	3.436	1.95	0.052
Number of observations	= 1004			
Likelihood Ratio (18)	= 408.02			
Probability > chi2	= 0.0000			
Pseudo R2	= 0.2958			
Log likelihood	= -485.64778			

Source: GSS Survey, 2012/13. *** Significant at less than 1% probability level; ** Significant at less than 5% probability level; * Significant at less than 10% probability level.

5.5 Logistic Regression Results for individual region (Eastern and Northern regions separately)

In order to separately determine the factors influencing food security status for each region (Eastern and Northern regions), the logistic regression model was again employed for the estimates. The results of the factors influencing the status of farming household's food security for each region are presented (Table 5.12 and 5.13). The results show that household size, off-farm activity, monthly household expenditure and total own farm production significantly affected food security status in Eastern region (Table 5.12). Similar observations were observed in Northern region however; off-farm activity was not significant. Besides, dependency ratio, years of education and farm size were observed to significantly influence food security status in Northern region. The relationship between household food security status and the variables: household size, off-farm activity, monthly household income, total own farm production, years of education and farm size for the regions specific are similar to the observations presented in table 5.11 (when the regions are jointly analyzed).

However, dependency ratio was observed to have a negative and significant relationship with food security status in Northern region (Table 5.13). This was not significant in Eastern region and also when the two regions were jointly analyzed. The possible explanation to this could be that family labors in the Northern region are an imperative resources vis-à-vis agricultural production. The odds ratio in favor of food security decreases by a factor of 0.366 as the number of non-working members in the household increase holding other things constant. In term of percentage change, the odds for high dependency ratio of households being food secure is 37%, less than the odds for low dependency ratio. This finding agrees with other studies such as Kuwornu *et al.,* (2013); Etim and Patrick, (2010); Ojogho, (2010). The authors observed that an increase in the proportion of non-working members in the household without a corresponding increase in income and productivity decreases food security.

The logistic regression for the individual region shows that the following number of variables do not have a significant impact on farming household food security status. Age, gender, marital status, access to credit, religion, livestock ownership, ownership of farm equipment, and monthly remittances were not significant at 10% probability level in explaining households' food security for both Eastern and Northern regions. Unlike Northern region (Table 5.13), dependency ratio was not significant in determining household food security status in Eastern region (Table 5.12).

The results of the logistic regression indicate that nine significant variables determined household food security status for the combined regions. These variables included: marital status of respondents, years of education, household size, the use of firewood as main source of cooking fuel, off-farm activity, farm size, monthly household income, quantity of own farm production and region. For the individual analysis, the logistic regression shows that monthly household income, household size and quantity of own farm production were the three significant variables influencing food security status in both case.

Table 5.12: Logistic Results for Eastern Region

Variables	Odds Ratio	Std. Err.	Z	P>|Z|
gend	1.066	0.359	0.19	0.850
age	1.008	0.008	0.99	0.323
depRatio	0.916	0.123	-0.65	0.513
marry	0.637	0.208	-1.38	0.168
yrsedu	0.976	0.029	-0.79	0.428
farmsiz	1.086	0.063	1.43	0.152
hh_size	0.492	0.041	-8.44	0.000***
ownlivst	1.319	0.366	1.00	0.318
ownequip	1.154	0.297	0.56	0.579
offm_act	2.668	0.735	3.56	0.000***
access_cr	1.267	0.360	0.94	0.349
firewo_u	0.571	0.376	-0.85	0.395
relig	1.225	0.675	0.37	0.713
month_re	1.003	0.002	1.46	0.144
mohh_inc	1.003	0.001	3.86	0.000***
total_qt	1.066	0.007	9.06	0.000***
_cons	0.672	0.764	-0.35	0.727

Number of observations	= 501
Likelihood Ratio chi2 (17)	= 232.66
Probability > chi2	= 0.0000
Pseudo R2	= 0.3402
Log likelihood	= -225.60032

Table 5.13 Logistic Results for Northern Region

Variables	Odds Ratio	Std. Err.	Z	P>|Z|
gend	1.489	0.883	0.67	0.502
age	1.004	0.008	0.47	0.635
depRatio	0.366	0.202	-2.11	0.034**
marry	0.544	0.251	-1.32	0.187
yrsedu	0.945	0.029	-1.85	0.064*
hh_size	0.593	0.034	-9.01	0.000***
farmsiz	1.092	0.039	2.44	0.015**
ownlivst	0.569	0.309	-1.04	0.300
ownequip	0.719	0.182	-1.30	0.192
offm_act	0.973	0.244	-0.11	0.913
acces_cr	1.016	0.439	0.04	0.971
relig	1.101	0.279	0.38	0.704
month_re	0.985	0.010	-1.55	0.122
mohh_inc	1.003	0.001	4.04	0.000***
total_qt	1.100	0.013	8.29	0.000***
_cons	2.005	1.856	0.75	0.453

Number of observations	= 503
Likelihood Ratio (16)	= 219.97
Probability>Chi2	= 0.0000
Pseudo R2	= 0.3376
Log likelihood	= -237.15583

Source: GSS Survey, 2012/13. *** Significant at less than 1% probability level; ** Significant at less than 5% probability level; *Significant at less than 10% probability level

Chapter 6 GENERAL CONCLUSION AND RECOMMENDATIONS

6.1 General Summary

Currently, the proportion of people exhibiting undernourishment worldwide stands at 795 million including 780 million in the developing regions (FAO, 2015: pp.4). The factors associated with the high prevalence of food insecurity in these parts of the world are mainly conflicts and natural disasters together with unsustainable livelihoods, ineffective governance and some scarce resources. Most countries in sub-Saharan Africa (SSA) where a relevant proportion of its populations are faced with the problem of achieving food needs are constrained mainly by a combination of several factors. These include socioeconomic and environmental factors as well as physical resources making food security issues a top priority in policy making for this region. According to the World Food Program, over 2 million people were most vulnerable of becoming food insecure throughout Ghana in 2012. Undernourishment due to insufficient calorie intake in certain parts of Eastern and Northern regions of the country are recently increasing. The problem is predominantly among farming households already trapped in poverty and lack the resources for acquiring basic needs. Throughout the country, the highest number of households that have more than 30 percent of their income sourced from agriculture are located in the Eastern and Northern regions. The issues of food security in northern Ghana have gained a top priority in many areas of policy making. However, the prevalence of food inadequacy as a result of insufficient resources to access food among individual household has led to increasing food insecurity throughout the country. The study therefore aimed at analysing food security status across farming households in Eastern region and compare it to the Northern region of Ghana given that certain factors influence their food security status.

In order to identify the food security status of farming households, the food security index for the study area was computed using a recommended daily calories intake of 2,900kcal. This was provided by Ghana Statistical Service (GSS) and the International Food Policy Research Institute [IFPRI] (2000). The extent of food security status among farming households in the two regions was conducted using food security indices. The t-test was employed in order to test for the statistical differences between the two regions. The food security indices used included: head count

ratio (HCR), food insecurity gap (FIG), squared food insecurity gap (SFIG) and surplus index (SI). The logistic regression model was adopted to determine factors influencing farming household food security status. This model was adopted because it has been identified as the most appropriate functional framework to analyze determinants of household's food security status.

The description of household characteristics shows that the majority of the farming households in both regions dwell in rural areas than in peri-urban areas. Majority of farming households in both regions were headed by males. Analysis of the educational status of respondents indicated that majority of the respondents in Eastern region had some levels of formal education relative to those without any form of education. In contrast, the majority of the respondents in Northern region had no formal education, only 28% of the respondents had at least attained primary education. The socioeconomic factors of the respondents were also described. The data shows that access to credit was a major constrained to respondents as most of the farmers in Eastern and Northern were unable to receive any credit at all. Moreover, the percentage of farmers who engaged in other income generating activities other than agricultural production were observed to be higher in Eastern region than in Northern region. Overall, farmers in Eastern region were identified to have a better economic conditions in regards to their socioeconomic profiles than farmers in Northern region.

The result of the food security index indicates that 57% and 54% of farming households were food secure in Eastern and Northern regions, respectively. The result of the head count ratio shows that food insecurity was higher (63%) in Northern region than in Eastern region (52%). The extent of food insecurity which was measured by using food insecurity gap indicates that farming households in Eastern region, consumed 34% less than their daily calorie requirement while farming households in Northern region consumed 40% less than their daily calorie requirement. The t-test shows that differences of the means for head count ratio (*HCR*), food insecurity gap (FIG_i) and squared food insecurity gap ($SFIG_i$) were statistically significant at 1% between the two regions. Test of difference of the means for the surplus index (*SI*) was observed to be statistically non-significant.

Overall, sixteen explanatory variables were considered for both regions. These variables included household characteristics and their socioeconomic factors. First, the analysis carried out the determinants of household's food security status for the two regions combined. Further, the

determinants for the individual region were separately carried out. Marital status of respondents, years of education, household size, and the use of firewood as main source of cooking fuel were the negative determinants of household food security. While off-farm activity, farm size, monthly household income, and quantity of own farm production positively determine household's food security status when the regions were combined. In Eastern region, household size was the only negative determinants. The variables off-farm activity, monthly household income and quantity of own farm production were the positive determinants of household's food security in Eastern region. In Northern region, household size, dependency ratio, and years of education were the negative factors affecting household's food security. However, monthly household expenditure, total quantity of own farm productions and farm size positively impacted household food security. Marital status of respondents as well as the use of firewood as the main source of cooking fuel in the household were not significant in determining food security status when the individual region was analyzed. All things being equal, an increase in income of farming households has the probability of increasing household's food security. More so, the model indicates that sale of farm surpluses increase households' income which can be invested back on the farm to boost production. However, an increase in the number of households implies more members to feed which leads to low per capita expenditure and low per household food consumption.

6.2 Study's Conclusions

In investigating farming household's food security status in Eastern region and comparing to Northern region, it was observed that almost half of farming households in both study areas were food insecure. Overall, majority of the farming households lived in rural areas. The proportion of food insecure farming households living in peri-urban areas are more in Eastern region than in Northern region. Farming households living in peri-urban areas were mostly food insecure in Eastern region. This is the opposite in the case of farming households living in peri-urban areas in Northern region.

These seven significant variables: farm size, off-farm activity, monthly household income, quantity of own farm production, years of education, dependency ratio, and household size were the key determinants of food security in the regions. The logistic regression shows that an increase in monthly household income and the quantity of own farm production increase the odds ratio in

favor food security in both regions. Off-farm activity was significant in Eastern region but not in the case of Northern region. Thus, engagement of household heads in other source of income generating activities improve household food security in Eastern region. Farm size is particularly, important in regard to farming household's food security in Northern region. The result shows that large farm sizes positively and significantly impact farming household food security status. The result shows that dependency ratio in Northern region negatively and significantly impact household's food security status. This indicates that increasing the number of non-working members in the household decreases the odds ratio in favor of food security. Thus, farming households that increase the number of unproductive members are prone to food insecurity in Northern region. Surprisingly, the result indicates that human capital development (years of education) does not support food security of farming households in Northern region. This could possibly be that educated household heads might not have the chance to apply their knowledge towards the attainment of household's food security.

6.3 RECOMMENDATIONS

The Ghanaian government policies aimed at improving food security has focused on aggregate food availability through sustainable management of land and environment, science and technology applied in food and agriculture, and school feeding programs. However, to address the issue of food insecurity in the study areas and to also ensure that farming households have enough access to food, the study suggests further improvement in the following pivotal policy areas:

1. Off-farm activity according to Babatunde and Qaim (2010) has proven to be a relevant sources of income generation which can contribute to reducing food insecurity in poor households. Improving poor households' access to off-farm activity would improve rural development and also contribute to household's food security. Promotion of off-farm activity in a pro-poor way could minimize food insecurity especially, in periods of high food prices. Agriculture operation on marginal lands and limited resources among farming households are recently increasing in the country. The study recommends that government policy and non-governmental strategies that underpin off-farm income diversification should implement their interventions in areas where agriculture service as the main source of livelihoods. In this way farmers do not necessarily have to rely solely on agriculture for

their needs. It is also observed that expansion of industrial services benefits economic development through the increase of incomes for both rural and urban poor in Africa (UNIDO, 2000). Hence, acceleration of industrial opportunities among the rural and urban poor farming households will explicitly enhance food security particularly, in Eastern region.

2. The study's result indicates that large household size decrease food security in both regions. Government policy that prioritize family planning programs such as CHPS, FP etc. should be adequately promoted. Thus, family planning programs should be made effectively in order to minimize the pace of fertility to reduce population growth. Further, increasing in the proportion of non-working members affect food security particularly, in Northern region. The study recommend that food security related programs should integrate family planning awareness raising programs so as to minimize the pressure on the limited resources available to households in the region.
3. Policies which aim at reducing tree cutting and promoting forest conservation strategies should create desertification awareness programs and its implication on food security among farming areas in the country. Programs such pricing or valuing the forest (e.g. afforestation) and the benefits from their services to livelihoods should be promoted in order to reduce the rate of destructions due to ignorance at the side of the farmers. Although it is generally argued that communal rights insecurity could prevent investment in the abatement of forest degradation. Based on United Nations Program on Reducing Emissions from Deforestation and Forest degradation (UN-REDD Program) suggestions, the supposition of higher returns in the future could generate an incentive to invest in forest conservation (UNDP, 2008).
4. The quantity of own farm production had proven to be a significant factor in improving household food security. The study suggests that food insecurity would be reduced through increasing the productivity of major cereals, tubers and roots crops in both regions. This can be implemented through the use of improved farm inputs such as improved seeds, fertilizers, access to irrigation and storage facilities, and proper post-harvest management. Government should provide loans to farmers in terms of seeds, fertilizers and cash to serve as an incentive to increase agricultural productivity. Moreover, an improvement in land quality through soil nutrients management and practices should be promoted to boost

agricultural production. The current population growth has caused most farms to be operated on marginal lands which result in low productivity. Hence, leading to an increase in food insecurity in the regions. Policy measures should be directed towards the provision of agricultural technologies that would possibly have an insignificant impact on the quality of land. This will indirectly help farmers in Northern region to improve food security in the long run.

5. The benefits of human capital development do not improve food security status of farming households in both regions. The kind of education attain by farming household heads does not relate to agricultural production which obviously could be the reason why education was not significant variable to household food security. Possibly, the number of years spent in formal education does not dealt with special agricultural training that could be beneficial to farmers to apply on their farm activities. There should be some proper measures that may help educate household heads to improve their food security. More specifically, the measures including water conservation practices, improvement of soil nutrients and structures, knowledge on weather forecasting and crop insurance as well as the advantages of modernizing agriculture by means of technological inputs should be advocated. The study thus recommends that education in these regions would be modified to include special agricultural training that will sustain agricultural production. So that farmers can utilize whatever knowledge or skills acquired in their production activities to achieve food security in the future.

In general, the study recommends that the knowledge about the deficit or surplus provides an information to the government in order to ensure the improvement of internal trade between regions in the country. The government through the Ministry of Food and Agriculture (MoFA) in Ghana should use this knowledge to provide the relevant inputs in policy making and perhaps use the information in planning location and format changes in interventions.

According to WFP, (2012), Ghana is moderately food secure at country level. It is worth noting that Ghana has met the first Millennium Development Goal by halving it poverty rate from 51.7% in 1991/92 to 24.2% in 2012/13. However, an important indicator for this achievement is whether this is reflected in meeting household food security at all time. The study's result shows that almost half of the sampled households in Eastern (43%) and Norther (46%) regions were food insecure

even though this is based on secondary data. This indicates that the achievement is not evenly distributed across geographical areas in the country. Despite the keen attentions given to income poverty reduction, majority of Ghanaians are still faced with food insecurity challenges. Previous researches and other studies have indicated that the problem dominates the northern part of the country however, the outcome of the study indicates that food insecurity continue to remain a crucial problem among farming households living in the country. The finding agrees with Kuwornu et al., (2013) and Frimpong and Asuming-Brempong (2013). This finding provides information for UN stakeholders in the country in relation to the progress of the country's achievement for the Millennium Development Goal (MDG). This shows that some of the programs towards food insecurity reduction need to be change or redirected. The study advice that measures towards the goal of reducing the number of hungry people needs to be prioritized and reconsidered. Finally, it is also recommended that UN stakeholders in the country would tackle this problem based on the identification of relevant factors undermining their efforts.

6.4 LIMITATIONS AND FURTHER RESEACH

Certain limitations will always occur as far as research is concerned. In this study, the following limitations were observed. In identifying the available calorie consumption by households, the study only considered major staple foods (maize, rice, plantain and cassava) as a representative food basket. It is therefore, important to note that, the calories of the food items presented here are representative food baskets and do not make up a nutritionally optimal diet. The study did not include other food items such as oil, vegetable, fish, meat etc.

Additionally, the study only focused on identifying some of the variables that were expected to determine household food security status from the limited database. However, other factors which could highly explain food security determinants were not included due to the limited number of observations. The study could not incorporate some essential factors such as access to subsidized fertilizers, improved seeds, topography, climate and ecological conditions, political factors etc. Further, it would have been essential to examine those who belong to farmer's organization such as members of cooperative and also institutional factors such as access to consumption credit, extension officers and insurance.

The study therefore, focused on two dimensions of food security namely, food availability and access in analyzing the determinants of food security status in the study. Other food security dimensions such as food utilization as well as nutritional safety were not considered. However, nutritional benefit is an important aspect of food security. Further research is required to re-assess this area to improve human development in the country.

Further researches and studies also need to consider the following limitations. For instance, the study only used a representative food basket (four main staple crops) for the analysis which does not address all the dietary needs. The study also focused on farming households who only consumed their own farm produce and purchased the deficit from the market (supplement). The study suggests that further research will re-assess this by including other sources of food items and also using other indicators mentioned in the literature.

In addition, the proportion of farmers living in peri-urban areas in this study was small but those considered to be food insecure were more than those found to be food secure, particularly in Eastern region. Since the study could not separately address factors influencing their food security status, further research should thoroughly re-assess this outcome.

Finally, one limitation of the study is the fact that it's based on secondary data collected at the national level. A combination of both primary and secondary data could help provide an effective information about the relative factors influencing farming household's food security status. For e.g., interviewers (primary data) could consider taking along with them a standard bowls or containers to the various households to be visited. This is to make measurement of the different quantity of food more accurate and less bias as well as to minimize measurement errors and variations in quantity under score.

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Appendices

Appendix 1: ***Socioeconomic characteristics of farming households for food secure and insecure households in both regions***

Table 2: Household characteristics for food secure and insecure				
Variables	**Eastern Region**		**Northern Region**	
	Food secure (%)	Food insecure (%)	Food secure (%)	Food insecure (%)
Age of HH (years)				
≤30	8.0	6.6	21.2	12
31-40	16.6	23.7	25.2	31.5
41-50	20.6	27.6	22.1	23.7
51-60	27.8	19.1	11	13.3
>60	27.0	21.5	19.4	21
Marital status				
Never married	3.1	1.9	3.3	1.7
Married monogamy	60.3	57.9	58.1	61.6
Married polygamy	0.3	0.5	23.2	28.4
Common law	11.8	17.8	7.7	2.6
Divorced	10.1	10.3	4.0	1.3
Widowed	14.3	11.7	3.7	4.3
Educational level of HH				
No Education	13.2	17.8	75.4	67.7
Primary	31.3	30.8	13.6	13.8
Secondary	47.8	48.7	11.0	17.3
Post-secondary technical	4.5	2.8	0	0.4
Tertiary	0.7	0.0	0	0.9
Religion of HH				
No religion	8.7	8.9	8.1	6.9
Catholic	5.6	5.1	6.6	13.4
Protestant	24.0	20.1	2.9	2.2
Pentecostal	43.6	35.0	8.5	8.2
Other Christian	13.9	25.2	2.2	1.3
Islam	2.8	3.7	42.6	45.7
Ahmadiya	1.4	1.9	29.0	22.4
Household size				
1-3	35.9	20.4	25.3	11.2
4-6	46.3	55.1	43.7	37.9
7-9	15.0	20.5	16.1	27.2
10-12	2.0	3.2	14.6	14.6
>12	0.7	0.5	9.1	12.5

Appendix 2: ***Economic and Farm characteristics of farming households for food secure and insecure households in both regions***

Table 2: Distribution of household resources for food secure and insecure households					
Variables	Score	**Eastern Region**		**Northern Region**	
		Food secure	**Food insecure**	**Food secure**	**Food insecure**
		%	%	%	%
Sex of HH	1=male	77.0	77.6	95.2	95.3
	2=female	23.0	22.4	4.8	4.7
Owner of refrigerator	Yes=1	18.1	13.6	1.8	3.9
	No=2	81.9	86.4	98.2	96.1
Off-farm activity	Yes=1	50.5	38.3	31.2	32.8
	No=2	49.5	61.7	68.8	67.2
Access to credit	Yes=1	38.7	29.0	9.2	9.9
	No=2	61.3	71.0	90.8	90.1
Ownership of farm equipment	Yes=1	43.9	39.3	36.1	35.3
	No=2	56.1	60.7	63.2	64.7
Ownership of livestock	Yes=1	70.0	58.9	95.6	95.7
	No=2	30.0	41.1	4.4	4.3

Appendix 3: Other socioeconomic characteristic

Table 3*: Distribution of other socioeconomic characteristics*				
Variables	**Eastern Region**		**Northern Region**	
	Food secure (%)	Food insecure (%)	Food secure (%)	Food insecure (%)
Main sources of water				
Pipe (own tap)	1.7	0.9	0.4	1.3
Public standpipe	13.2	8.9	8.8	9.1
Borehole	9.8	12.1	1.1	0.4
Wells (protected)	51.9	47.7	53.7	59.9
Wells (unprotected)	0.7	1.9	0.7	0.0
Surface water	20.2	27.6	35.3	27.6
Rain water	0.9	2.4	0.0	0.4
Main toilet facility				
Flush toilet	1.7	2.3	0.0	1.3
Improve pit latrine	13.2	9.8	1.8	0.4
Unimproved pit latrine	44.3	45.3	0.4	3.4
No toilet facility	6.3	10.3	93.0	84.5
Other	34.5	32.2	4.8	10.3

Continuation of table 3				
Main sources of cooking energy				
Firewood	82.6	84.6	93.4	93.5
Kerosene	0.3	0.0	0.4	0.0
Charcoal	12.9	12.6	4.0	57.7
Gas	4.2	2.8	2.2	0.0

Appendix 4: Main sources of food items

Table 4*: Distribution of main sources of food items*					
Food type	The share of each food item in total food consume (%)	**Main sources of food items (%)**			
		Own production (%)	Market (%)	Foods receive as gift	Food transfer
Eastern Region					
Maize	37.15	21.49	24.04	-	-
Rice	10.45	-	45.04	-	-
Cassava	22.06	42.14	10.44	-	-
Plantain	30.34	36.37	20.48	-	-
Northern Region					
Maize	54.80	61.80	38.01	-	-
Rice	15.54	3.93	43.43	-	-
Cassava	20.57	11.13	4.17	-	-
Millet	9.08	23.15	14.39	-	-

Figure 1: Share of each food type to total quantity for food secure households

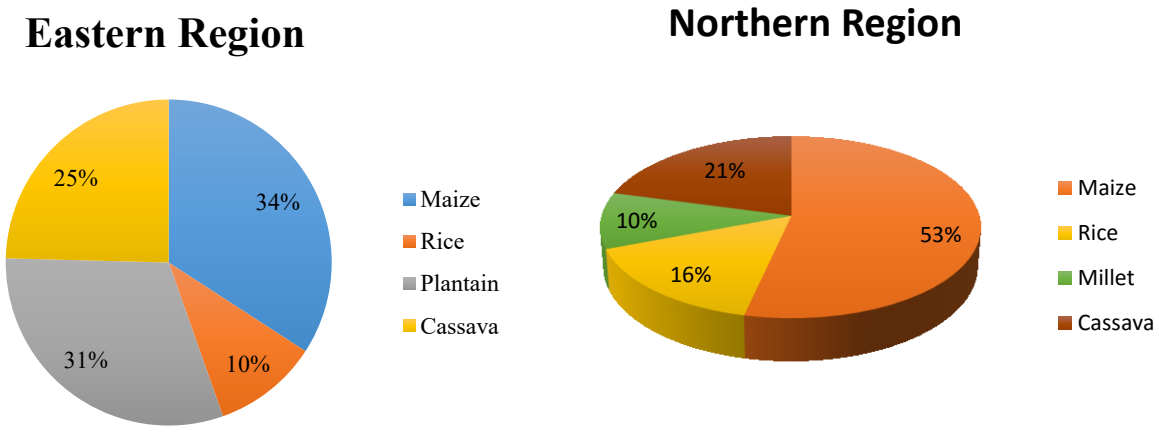
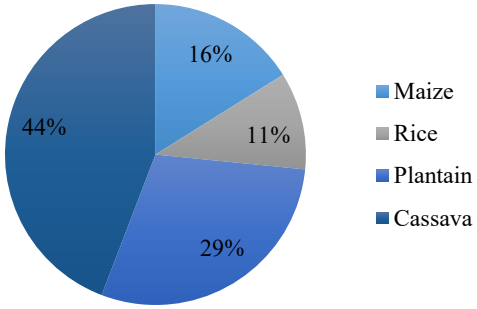
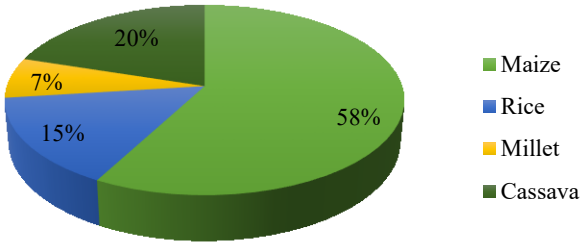


Figure 2: share of each food type to total quantity for food insecure households

Eastern Region



Northern Region



Appendix 5: Correlation Matrix

e (v)	Gend	Age	DepRatio	Marry	Yrs_educ	Farmsiz	Hh_size	Ownlivst	Ownequip	Offm_activ	Acces_cred	Firewo_use	Relig
Gend	1.00												
Age	-0.14	1.00											
DepRatio	-0.04	0.01	1.00										
Marry	0.43	-0.12	0.06	1.00									
Yrs_educ	0.29	-0.19	-0.10	0.19	1.00								
Farmsiz	0.12	0.13	-0.04	0.07	0.10	1.00							
Hh_size	-0.18	-0.01	0.29	0.30	0.09	0.14	1.00						
Ownlivst	0.04	0.07	0.07	0.14	0.05	-0.02	0.25	1.00					
Ownequip	0.13	0.02	0.03	0.15	0.10	0.09	0.19	0.24	1.00				
Offm_activ	0.07	-0.12	-0.03	0.18	0.26	-0.07	0.17	0.16	0.09	1.00			
Acces_cred	0.11	-0.09	-0.07	0.18	0.26	0.04	0.13	0.15	0.17	0.26	1.00		
Firewo_use	-0.06	0.02	0.09	-0.07	-0.17	0.07	0.04	0.05	-0.02	-0.11	-0.19	1.00	
Relig	0.02	-0.03	0.04	-0.06	0.09	0.06	-0.05	-0.10	0.06	0.01	0.04	-0.05	1.00
Mon_remitt	0.10	0.05	0.02	0.00	0.07	-0.02	-0.00	0.09	-0.11	0.11	0.04	0.02	-0.07
Mon_inc	0.10	0.12	0.10	0.17	0.21	0.29	0.39	0.20	0.08	0.21	0.16	-0.05	0.06
Total_qty	0.37	0.13	0.09	0.16	0.09	0.20	0.49	0.21	0.15	0.02	0.09	0.07	-0.02

	Mon_remitt	Mon_inc	Total_qty
Mon_remitt	1.00		
Mon_inc	0.03	1.00	
Total_qty	-0.01	0.36	1.00