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The contribution of staple sector to reduction in food insecurity status in Ghana: Evidence of maize farmers in southern Ghana.

MASTER'S THESIS

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Declaration

I hereby declare that this thesis entitled "The **contribution of staple sector to reduction in food insecurity status in Ghana: Evidence of maize farmers in Southern Ghana**" is my own work, except referenced works which has been duly acknowledged by means of complete references.

6th August 2021 ……

Prague, Czech Republic BSc Godwin Yao Fenoo

Dedication

I dedicate this work to the FENOO AND GBEDEMAH family for their encouragement, prayers, and support, to see me progress to higher heights.

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Abstract

Food insecurity is a worldwide challenge, and a persistent problem and agricultural production plays an important role in achieving food security homes. The study estimated the food consumption score (FCS), ordinal logistic regression and Kendall's Coefficient of Concordance to assess the contribution of maize production to food insecurity status in southern Ghana. A farm-level data of 145 was obtained using stratified sampling technique, complemented by semi-structured questionnaire. The results show that majority of the households are in the borderline of FCS category with some a significant proportion in the poor FCS category. The results also show that socioeconomic and farm characteristics significantly affect the food security status of maize farmers. Major coping strategies adopted by maize farmers to offset food insecurity challenges are discussed. The study recommends agricultural index insurance as a protective cover for pro-poor farmers from production shocks. Policies that facilitate smallholder farmers access and acquisition to credit facilities will enhance food security and reduce poverty in rural areas.

Key words: Food consumption score, coping strategies, maize farmers, food insecurity, Ghana

Table of Contents

List of Tables

4 List of Figures

5 List of abbreviations

IFPRI	International Food Policy Research Institute
MoFA	Ministry of Food and Agriculture
FC	Food Security
FCS	Food Consumption Score
FAO	Food Agricultural Organizations
METASIP	Medium-Term Agriculture Sector Investment Plan
OECD	Organization for Economic Co-operation and Development
SAP	Structural Adjustment Programme
ISSER	Institute of Statistical, Social and Economic Research
UN	United Nations
HHS	Household Survey
FGD	Focus Group Discussions
OECD	Economic Co-operation and Development
WEAI	Women's Empowerment in Agriculture Index
CAADP	Comprehensive African Agriculture Development Programme
GHI	Global Hunger Index
PHL	Post Harvest Losses
PSF	Postharvest Service Focuses
NAFCO	National Food Buffer Stock Company
SDG	Sustainable Development Goals
5DE	Five Domain of empowerment
GPI	Gender Parity Index

1 INTRODUCTION

1.1 Background of the study

Majority of Africa's poor population depends on farming and fostering agricultural growth is central to development strategies aimed at reducing hunger and poverty in Africa (Thistle et al. 2003). Maize (*Zea mays* L.) is one of the basic staple foods of communities in the drought prone countries in sub-Saharan Africa (SSA) where over 650 million people currently consume annually an average of 43 kg of maize/person (FAOSTAT (2006). More than 50 % of SSA countries have assigned approximately over 50 % of their planted area to maize production (Abdoulaye et al. 2011).

Compared to other grains such as rice and wheat, maize is less expensive and has vital nutritional benefits. Maize is a major source of food and cash for smallholder farmers in West Africa (Abdoulaye et al. 2011). However, lack of access to high quality inputs, necessary know-how, pests and disease infestation and post-harvest challenges forms a continuous challenge to it production. It is reported that maize farmers in general encounters 14 and 36 % have post-harvest loss (Tefera 2012).

In Ghana, agriculture accounts for about 19.7 % of GDP with an annual growth rate of 4.8 %. It employs 38.3 % of the labour force (MoFA 2019). Maize is a very significant staple food in Ghana which accounts for more than 50 % of total cereal production in the country and grown in all agro-ecological zones (Akramov et al. 2012). The bulk of maize produced goes into food consumption and it is arguably that, the most important food security crop. Food insecurity as a condition is perceived not only as the inability of the agricultural sector to produce sufficient food at micro and macro level, but also as the inability of livelihoods to ensure access to sufficient and high-quality food at the household level (Devereux 2001).

1.2 Problem statement

Available evidence in Ghana suggests an increasing level of food sufficiency of some crops by an average of 1 % per annum (MoFA 2017). These figures do not reflect the food sufficiency situation of the population, especially in rural areas of the country (GSS 2014). Policy interventions has been made by successive governments, and other international organizations to address the food insecurity and rural poverty but the problem remains a major challenge in most parts of the country including the Volta Region. The Ghana Medium Term Agriculture Sector Investment Plan (METASIP 2010) seeks to modernize agriculture which will improve the economy and be evident in food security, employment opportunities and poverty reduction. Increasing the supply of food through increased production and improved market linkages will increase food availability to households and communities.

Consumption of maize is a lifestyle in the southern part of the country because it is versatile useful function in local foods such as kenkey, banku, tuozafi and akple (Amankwa 2009). The significance of maize is focused on the nutritional value compared with root and tuber crops (Agona et al. 2008). In the southern part of the country, the prevalence of undernourishment and food insecurity stands at 9.3 % and 6.1 % respectively (FAO et al. 2018). Between 2015 to 2017, about 2.2 million Ghanaians were confronted with food insecurity problems (FAO et al. 2018). Despite a significant share (58%) of the population of the Volta region in the agricultural sector (MoFA 2019), the region is still tagged among the regions with insecure food in the country. Against this background, the study provides a first attempt and seeks to assess the contribution of the staple sector (maize) to food security in the Volta Region of Ghana.

1.3 Organization of the study

The study is organized into six chapters. The next chapter entails related literature in terms of maize production in sub-Sahara Africa and the study country, Ghana. It also discusses the concept of food security and its dimensions as well as the determinants of food security status and coping strategies adapted by farming households in the study area, conceptual framework for household coping strategies and food insecurity food security status in Volta Region of Ghana, food insecurity in Africa, food insecurity situation in Ghana, causes of food insecurity, nutritional situation in Ghana, constraints facing maize farmers in Ghana, post-harvest handling and losses of maize, post-harvest storage methods, the power of empowerment of women in the area, women having access to how to use land in the rural area and contribution and information flow of women in the area. Chapter three contains the objectives and specific objectives of the

study. Chapter four contains the methods and the analytical framework. It discusses the study areas, data collection tools, method of data analysis and limitations of the study. The five chapter comprise of results and discussion of the findings while the conclusions and recommendations are presented in chapter six.

2 LITERATURE REVIEW

2. 1. 1 Concept of food security and its dimension

According to the FAO 1996, food security always refers to a situation where people, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary need and food preference for a healthy and active living. Barret (2002) perceives food insecurity as a situation of uncertainty by an individual or a household to access food in sufficient and reasonable quantities. Esonu (2009), also sees food security as the physical and monetary access to food that is inadequate as far as quality, amount and wellbeing is concern. Food insecurity and malnutrition are growing worldwide, from an estimated 777 million people in 2015 to 815 million people in 2016. This increase is a global challenge with a view to achieving the second sustainable development goal, which requires a commitment to end hunger, reduce food insecurity, and improve nutrition by 2030 (FAO 2017). According to the Ministry of Food and Agriculture (MoFA), food security in the Ghanaian context is described as quality nutritious food that is hygienically packaged, attractively presented, available in sufficient quantities and located at the right place at affordable prices throughout the year. The Ministry of Food and Agriculture of Ghana added another dimension to the definition of the concept of food security namely, "food and nutrition safety" and "stability of food supply".

The primary dimensions of food security include food availability, food accessibility, food utilisation and food stability (Lovendal 2005). The food availability aspect of food security implies that enough amount of food is obtainable on a regular basis. According to Kuwornu (2013), this dimension determines the physical existence of satisfactory quantity and quality of food in a household or an area. However, the FAO, IFAD, and WFP (2014) stated that the provision of sufficient food for a given population is a necessary condition, but not a sufficient condition to ensure adequate human access to food. Food accessibility refers to having enough financial resources to obtain proper foods for a healthy diet. The ability of an individual to access food largely depends on economic and physical factors (FAO, IFAD, and WFP 2013). The economic aspect determines the amount of personal income, distribution of and access to social support systems as well as prices of food whereas physical factor refers to the provision of appropriate infrastructures such as road and communication networks, food storage facilities and railways that enhances market viability (FAO 2013). Food utility also refers to the nourishment generated from the consumption food for a healthy life (FAO 2013). The final dimension of food security that is food stability refers to the stable supply of food or access to food by an individual or household.

2. 1. 2 The food security status in Ghana.

In Ghana, as in other countries in sub-Saharan Africa, food security continuous to remain a basic challenge and this is linked to the unstable levels of food production resulting in food insecurity (Wolter 2009). In the early 1980s, Ghana was severely affected by drought that made people to consume wild field crops due to the shortage of traditional Ghanaian foods (Kuwornu 2013). It is estimated that about 1.2 million Ghanaians (about 5 percent of the total population) continue to experience restricted access to adequate nutritious food (World Food Program 2009). According to Biederlack & Rivers (2009), lack of education, access to output markets and high dependency on agriculture are the basic factors for the food insecurity situation in the country.

The government of country Ghana is committed to the continental and global protocols for the achievement of overall sustainable development. The government, therefore, through the ex-president, His Excellency John Agyekum Kufour Foundation and with the support of the World Food Programme. WFP undertook a participatory process to ensure Zero Hunger Strategic Review for the purpose of charting a path to end hunger, food insecurity and all forms of malnutrition by 2030 in Ghana. To alleviate the situation, development of local capacity through community-based participatory actions are suggested as a means of improving program outcomes as well as promoting human rights of household food security (WFP 2017).

2. 1. 3 Food security has four main dimensions.

- **Availability of food**: This is the extent to which enough quantity and quality of food is physically present in an area and this includes food found in markets, food produced by farmers themselves locally or home gardens and food provided as food aid or gifts.
- **Access to food**: Even when food is available, some people may not have the money or not always be able to access it at the marketplaces. Food access is ensured when communities, households and all individuals have enough resources to obtain sufficient food for a nutritious diet through a combination of home production, stocks, purchase, barter, gifts, borrowing or food aid.
- **Utilization of food**: Utilization refers to an individual's ability to obtain energy and nutrients from food to live a healthy life. Proper childcare practices, a diet with sufficient energy and nutritional value, safe drinking water, adequate sanitation, knowledge of food storage and processing, general health and basic nutrition are essential to achieving adequate food utilization.

- **Stability**: The fourth component of food security, which refer to both availability and access is stability. For households to be food secure they need to always have access to food and should not be at risk of becoming food insecure because of shocks or cyclical events, such as seasonal food shortages. Even if a household has enough food consumption at one point in time, the household can still be food insecure if the food is not continuously available or access to the food is limited.

2. 1. 4 Food security status in Volta Region of Ghana.

Cowpea is one of the crops thus does well and commonly plant in Ohawu in Ketu North District of Volta Region. The field for planting this cowpea populations was at Ohawu in the Ketu North District of the Volta Region because of the soil and pattern of rainfall there. (Kenneth Fafa Egbadzor 2015) The vegetation was normally cleared in the first season of June followed by ploughing and sowing of the beans or cowpea. Normally, the planting was done on the third week of June every year with the spacing of 60 cm by 80 cm. The field was rain-fed, giving different rainfall predictions in the fall. They used hoe to weed which was done in the 3rd and 5th week of planting and followed immediately with insecticide application. This insecticide used was cymethoate and it was applied at 1.5 L/ha. Harvesting was done as and when different individual plants had dried pods from the various populations from the 15th of August after the participatory selection is done (Kenneth Fafa Egbadzor 2015)

Selections of the cowpea were made from six different populations. Line selection was made from F3 population of CB27/ Gh3710. Selection from the other five F3 populations, four of which had Bambey21 as the female parent and the males as, Gbode, Nhyira, Tona and UCR779 were based on single plants. The fifth population was UCR779/CB27. Individual farmers indicated their three best lines from the five other populations of 58 days after planting by placing cards under them (Kenneth Fafa Egbadzor 2015).

2. 1. 5 The determinants of food security status of maize farmers

Several studies (Kidane et al. 2005; Babatunde et al. 2007; Kuwornu et al. 2013; Arene &

Anyaeji 2010) have shown that the age of the household, educational status, household size, gender of the household, farm size, access to farm credit and income earned among others are important factors that influence the food security status of an individual or household. Kidane et al. (2005) found that older households are more food secured compared to younger ones since most of the farmlands are owned by older households. Maxwell et al. (2010) also argued that female households are less likely to be food secured due to their dependence on male headed

households. Kuwornu and Demi (2013) also posited that well-educated households are better informed about the household food production, nutrition, and dietary diversification for a healthy life and as such are less prone to food insecurity issues. In addition, educated household heads can explore better employment avenues to increase household income, augment purchasing power and afford knowledge on dietary diversity to enhance food and nutrition safety (Hoddinott & Yohannes 2002). The size of the household is another important factor that significantly impact household food security. Large household size burdens the household consumption rather than increase household labour force (Tsegay (2009). In another study, Jayne et al. (2005) found a positive correlation between farm size, improvement income and food security. Households with larger farm size are expected to increase production levels and increase household food access.

2. 1. 6 Food insecurity in Africa.

There was a report on global food outlook which revealed that chronic hunger had increased significantly in Africa between the period of 1990 to 2007. Persistent and prolonged drought in the Sahel belt caused the poverty situation of millions of people in the continent (UNEP 2007) and became worsened due to higher food prices during the global financial crises over the 2008-2009 period (FAO 2011). The world food security situation has not seen any remarkable improvement from 2011 to 2012 in Africa, but the implementation and performance of sound agricultural and food security related policies lead to a declaration of food security in Ghana and Malawi although the state of food security in many African countries were still the same or had even worsened (FAO, IFAD and WFP 2013).

An earlier observation of the United Nations Economic and Social Council (UNESC 2012) noted that in the last decade there has been an impressive performance in many countries in terms of improved economic growth rates, but in Africa, much progress has not been seen in overcoming its key challenges such as food insecurity, poverty, and youth unemployment.

In view of this, many countries in Africa have since 2008 reinforced their commitment to align strategies and policies with the CAADP to consolidate its implementation vis-a-vis their respective national agricultural strategies which prioritize food security for policy support and investment (UNESC 2012). Worsening food insecurity situation on the African continent has become complicated due to unstable political regimes, civil wars, adverse weather conditions and scanty supply of incentives and inputs required to transform the agricultural sector (UNESC 2012). Poor growth in agricultural productivity and production levels except for few countries

like Malawi and Rwanda, lack of knowledge on diversification and entrepreneurship are factors that are exacerbating food insecurity in Africa (ibid).

Politically induced civil war and uprisings in parts of West Africa and North Africa has affected many economies, caused the displacement of thousands of people, and has caused household food insecurity in Africa (UNESC 2012). Following the above report, sustainable and strategic policies ought to be intensified to curb the adverse effect of climate change and increasing population growth. The scale of hunger of a population is measured by an indicator called Global Hunger Index (GHI). The GHI blends three estimated indices in one index number, and these indices are:

(a) proportion of undernourished within the population

(b) occurrence of underweight among children under five

(c) rate of mortality in children below five years (IFPRI, GHI 2011).

A GHI report in 2011 on 122 countries indicated that over the period of 1990-2011, sub-Saharan Africa dropped on the GHI rating by 18%. This was below the score in East and North Africa (39%) and South Asia (25%). In Africa, about 16 countries had improved their GHI score during that period, but out of the top 10 best performers Ghana was the only country in sub–Saharan Africa to be part. The hunger situation in about 83% sub-Sahara African countries worsened during the same period (IFPRI, GHI 2011). Available evidence shows that many developing countries especially those within sub-Saharan Africa are faced with the challenge of meeting the food requirements of households, owing to adverse effects of global climate change such as drought and famine (Rosenzweig et al. 2001); low levels of agricultural productivity (Haile 2005) prevailing conflicts and poverty (Misselhorn 2005; Oldewage Theron et al. 2006); deforestation and other forms of environmental degradation (Baro and Deubel 2006) and growing demand for biofuels leading to hikes in food prices (Trostle 2008) among other limiting factors to food access.

2. 1. 7 Food insecurity situation in Ghana.

The Comprehensive Food Security and Vulnerability Assessment (CFSVA), Survey (2009), was the first ever nationwide mentioned food security analysis which was carried in Ghana. The survey was carried out by the World Food Programme (WFP) in collaboration with the Ghana Statistical Service (GSS), the Ministry of Food and Agriculture (MOFA) and the Ministry of Health (MOFA/SRID 2013)

Based on the assessment of households' food consumption in Ghana, the survey found that 7% of the population in that year had about 1.2 million people have very small access to sufficient and nutritious food for active and healthy life and are defined as food insure. The survey further found that there was a wide regional disparity in the number of food insecure people. Food insecurity is concentrated in the poorest regions of the country. These are areas prone to adverse weather conditions and natural disasters such as flood and drought (FAO 1983).

The CFSVA further identified fifteen distinct livelihood groups as food insecure and vulnerable. Five of those livelihoods have a large share of food insecure and vulnerable households in specific areas of the country. According to the survey, one of the most common characteristic to all five is the importance of agriculture as livelihoods source of households' income. Together, households engaged in these five livelihoods make up 55% of all the food insecure (CFSVA 2012).

2. 1. 8 Causes of food insecurity.

Common factors that cause food insecurity are great and vary from one place to another but in this literature, the following major causes are population growth, natural disaster, and socio-economic factors. The debate goes on with the causes of food insecurity that have waged on for a long because of the dynamism of these factors from one location to the others. It has brought about divergent views it has on this note that, Marquette (1997) espoused the population growth concept that is two competing theories regarding population growth and food insecurity. Mankind increases in a geometric progression while food production increases in an arithmetic way. Therefore, unless the population increase is controlled, it tends to go more than food production and starvation set in at the household level. Thus, Malthus's development of the theory of rapid population is a cause of food shortage. The "theory of Malthus" is a serious theory that disagrees with the basis that it failed to consider the innovation improvements in agriculture which will increase productivity (Marquette 1997).

Additionally, age is a demographic factor that finds household food security, which means households that have youthful people are more likely to be more food secure than households with old age. The age of a household head affects the food security status of a household by way of his/her labor efforts that he/she in productivity (Kuwornu et al. 2013). As it is stated, young men and energetic household heads can do more farm work and would usually put more farmland under cultivation as well as seek and obtain non-farm or off-farm jobs more than older and weaker ones. Educated households were proved by Shaikh (Kuwornu et al. 2013) generally to be better positioned to manage farm-related issues than households without education.

The results of population growth are shown on farm size, and it moves to high land splitting into small sizes, thereby small landholdings finally reduce productivity. On the other hand, some authors try to argue that small landholding does not put anything on any country's economy, for example, China's people's landholding is even lower than Ghana but their economy growing much than Ghana.

2. 1. 9 Nutritional situation in Ghana.

With the economic situation in the country, a significant regional disparities exist in the nutrition and food security situation in Ghana. The prevalence of stunting chronic malnutrition or low height for age is 19 % nationally but rises to 33 % in Northern region. The prevalence of acute malnutrition wasting, or weight-for-height is much higher in the northern regions, and at 9 %, is highest in Upper East region. Central region also has high levels of both stunting and wasting, at 22 % and 8 %, respectively (GSS, GHS, & ICF International 2015; World Health Organization 2017). Disparities in stunting levels could be generated according to maternal education and wealth levels only 16 % of children whose mothers have secondary education are stunted, while the rate rises to 26 % for children whose mothers had no formal education. Similarly, 9 % of children in the highest wealth quintile are stunted, while 25 % of children in the lowest wealth quintile are stunted (GSS, GHS, & ICF International 2015).

Given birth started early in Ghana. By age 19 years, 36.1 % of adolescents had begun childbearing in the year 2014, which increased from 28.9 % in 2008 (GSS, GHS, & ICF International 2015). This has serious implications because, relative to older mothers, adolescent girls are more likely to be malnourished and have a low-birth-weight baby who is more likely to become malnourished and be at increased risk of illness and death than those born to older mothers (GSS, GHS, & ICF International 2015). The problem of stunting is 33 % higher among first-born children of girls under 18 years in sub-Saharan Africa, and as such, early motherhood is a key driver of malnutrition (Fink et al. 2014). Anemia, giving low blood, particularly in children under 5 years, is also an important public health problem. Although, the rates of anemia have falling from 78 % in 2008 to 66 % in 2014, but the rate is still far above the threshold 40 % WHO (GSS, GHS, & ICF International 2015; de Benoist et al. 2008).

Food insecurity contributes a major factor to the poor nutritional status of the population in Ghana. The following regions are of greater concern are Upper East, Upper West, Northern, Brong Ahafo, and Volta, 16 % of households are considered food insecure. Food insecurity is connected to the inability of households to produce enough staples to meet their food needs,

due to poor soil quality, unfavourable weather conditions, constrained access to inputs, and limited financial resources to expand production (World Food Programme 2016a).

Ghana is one of the developing countries which experience the double burden of malnutrition, with high prevalence of both undernutrition and overweight/obesity. The rates of overweight/obesity have increased from 139 % over a period of 15 years from 1993 to 2008, and with a period of increased wealth in the country. The trend in Ghana is continuous with other developing countries that had experienced rapid economic growth, which led to lifestyle changes that included the increased consumption pattern of refined foods. The rates of overweight/obesity are higher among those with higher socio-economic status in Ghana, older urban women, 40–44 years of age are of particular concern (Doku D & Neupane S 2015). This rise in overweight/obesity needs to be confronted, as it can lead to increases in noncommunicable diseases such as diabetes, hypertension, and cardiovascular conditions among the people in the country. The figures below show a list of plant-based protein and animals-based protein that are required to be taken as daily food to prevent the problems above.

Plant-based protein and animal-based protein.

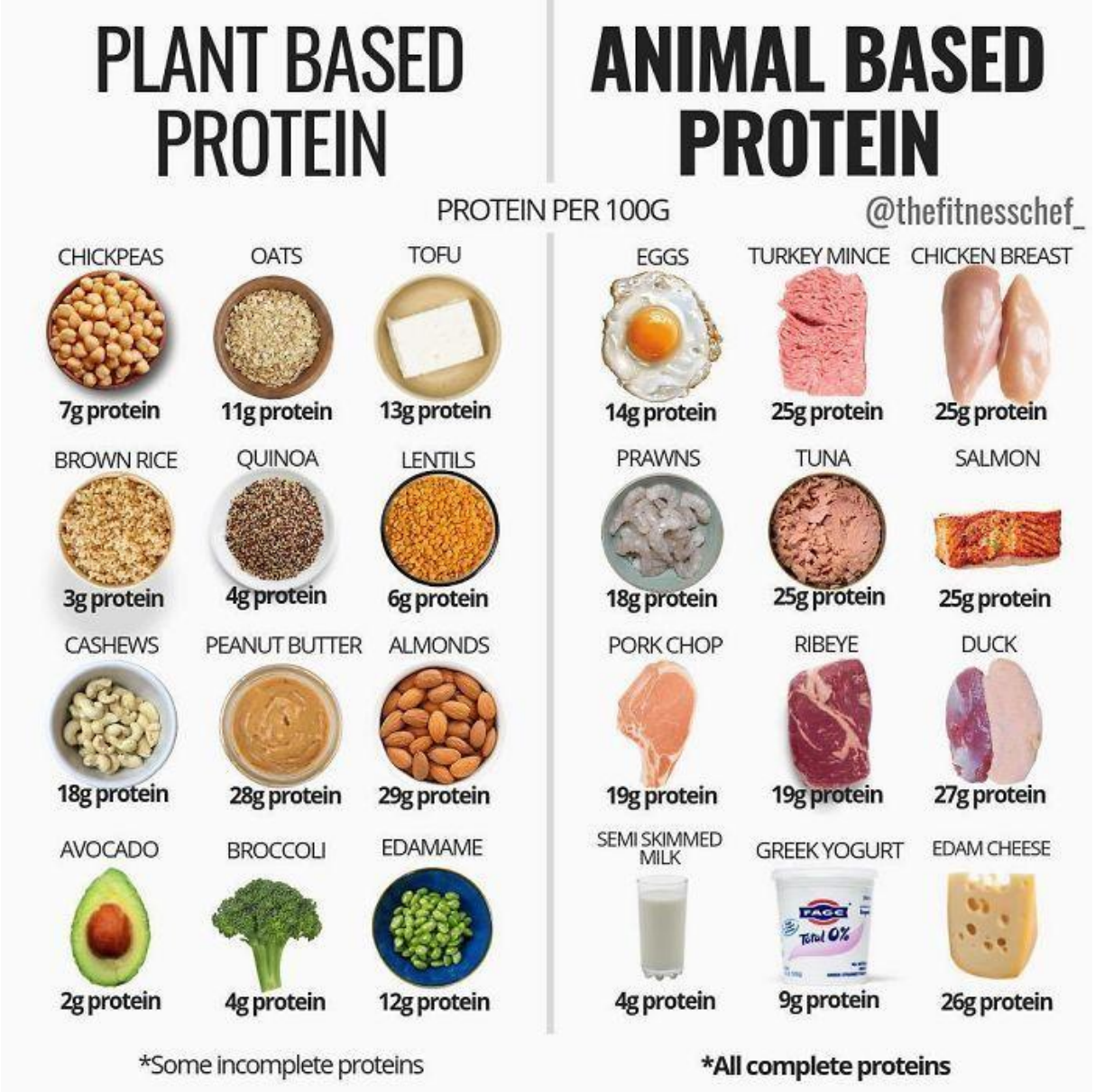

Figure 1: Plant based and Animal based Proteins

Source: By plant based & animal based proteins, pinterest.com.

2. 1. 10 Constraints facing maize farmers in Ghana

Maize farmers faced a lot of problems which increase the risk and uncertainty they met during maize farming and this act as disincentives to increased maize production. Van Rooyen et al. (1987) assert that if the technical and economic constraints face by smallscale farmers in traditional agriculture are removed, they will be easy to make balanced cost-effective decisions. Generally, maize farmers in developing countries, such as Ghana, are faced with major problems such as land inaccessibility, lack of general infrastructure, financial problems for production inputs, poor mechanization facility, transport, and not enough extension services. These problems maize farmers faced can be classified into two classes, namely internal and external challenges.

Internal problems affect the farmers‟ strength to work effectively. These include shortage of labour, lack of experience and education. External problems on the other hand came from the bigger agricultural setting and are principally not in the control as a single farmer. These include meagre availability of inputs, credit, mechanization, problems associated with land tenure and poor institutional and infrastructural support. Farmers will allocate resources reasonably to increase productivity if these problems are taken off their way.

2. 2. 1 Food insecurity and households coping strategies

Coping strategies may refer to the mechanisms adopted by an individual or household to offset food security challenges. Devereux (2001) defined coping strategies as a response mechanism to survive shocks and adverse events. From a broader perspective, Snel and Staring (2001), perceive coping strategies as actions taken by an individual/household to restrict expenditure or earn additional income to acquire basic household necessities (e.g., food, clothing, and shelter) to meet societal welfare needs and aspirations. Among the coping strategies, a household may rely on less preferred/inexpensive food, borrow food from friends, or rely on help from friends or relatives, gathering wild food (Mjonono et al. 2009).

2.2.2 Conceptual framework for household coping strategies and food insecurity.

The conceptual framework (see Figure 2) below is used in this study and based on the World Food Program’s (2006) ‘Household Food Consumption Approach model’ that is utilised for food sustainability throughout the year, thus the amount of harvest, dietary diversity, food frequency and food sources as a proxy indicators of household food insecurity to estimate the severity or status of household food insecurity. These measurement goes with other variables like, food sufficiency in terms of the number of grains produced and store for a year, having a

large livestock herd, farmland size, and types of crops cultivated, food insecure months, drought and flood occurrence, food aid and coping strategies as indicated in Figure 2 below. The reason for picking this conceptual model in Figure 2 is that the issues of major causes of food insecurity and coping strategies were not clearly stated into the framework. Thus, this study sees to integrate, the major causes of food insecurity, when they get food from household food security status and diverse coping strategies for a serious analysis of the variables in terms of their interplays. In household food security assessments and conceptualisation, the strength of households to give enough food for the needs of all members is the focus. Emphasis is laid and shifts from production of enough stocks, capacity to get food when needed to availability of asserts and other resources that can be turned into household capacities to acquire food (Maxwell & Smith 1992; Maxwell 1996; Pinstrup-Andersen 2009).

This household food insecurity situation does not happen in a vacuum, this is due to the differential impact of climate and non-climatic factors that comes and play with small-scale farming households. These major factors include natural occurrences, rainfall and temperature, variability, population growth, and socio-economic conditions. The adverse impact or the reverse on livestock and crop production tend to affect the availability of food, access to food and utilization. The resultant effect is household food security, vulnerability to food insecurity and finally managing households into condition of food insecurity. The situation where households are not able to access enough food for nutritional balance and the general wellbeing of the family gives threats to food insecurity, hence households look for complex coping strategies such as, reducing expenditure, crop modification, and change in the rate at which food consumption take place among the farmers.

Conceptual framework for household coping strategies and food insecurity

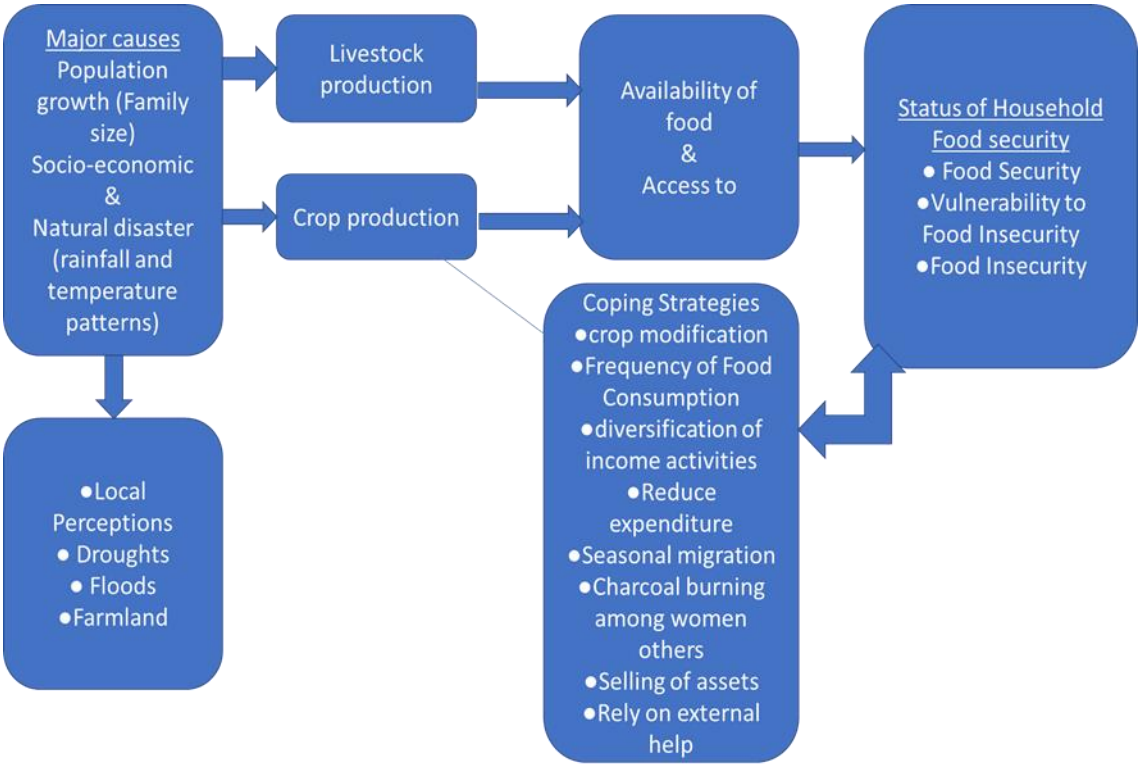

Figure 2 A Conceptual Framework Illustrating Household Coping Strategies and Food Insecurity Source, Adapted from: WFP. (2006).

2. 2. 3 Conceptual framework

Food consumption score approach comprises of dietary diversity, food frequency and nutritional value as proxy indicators to estimate household food security.

Describes the relationship between household food consumption

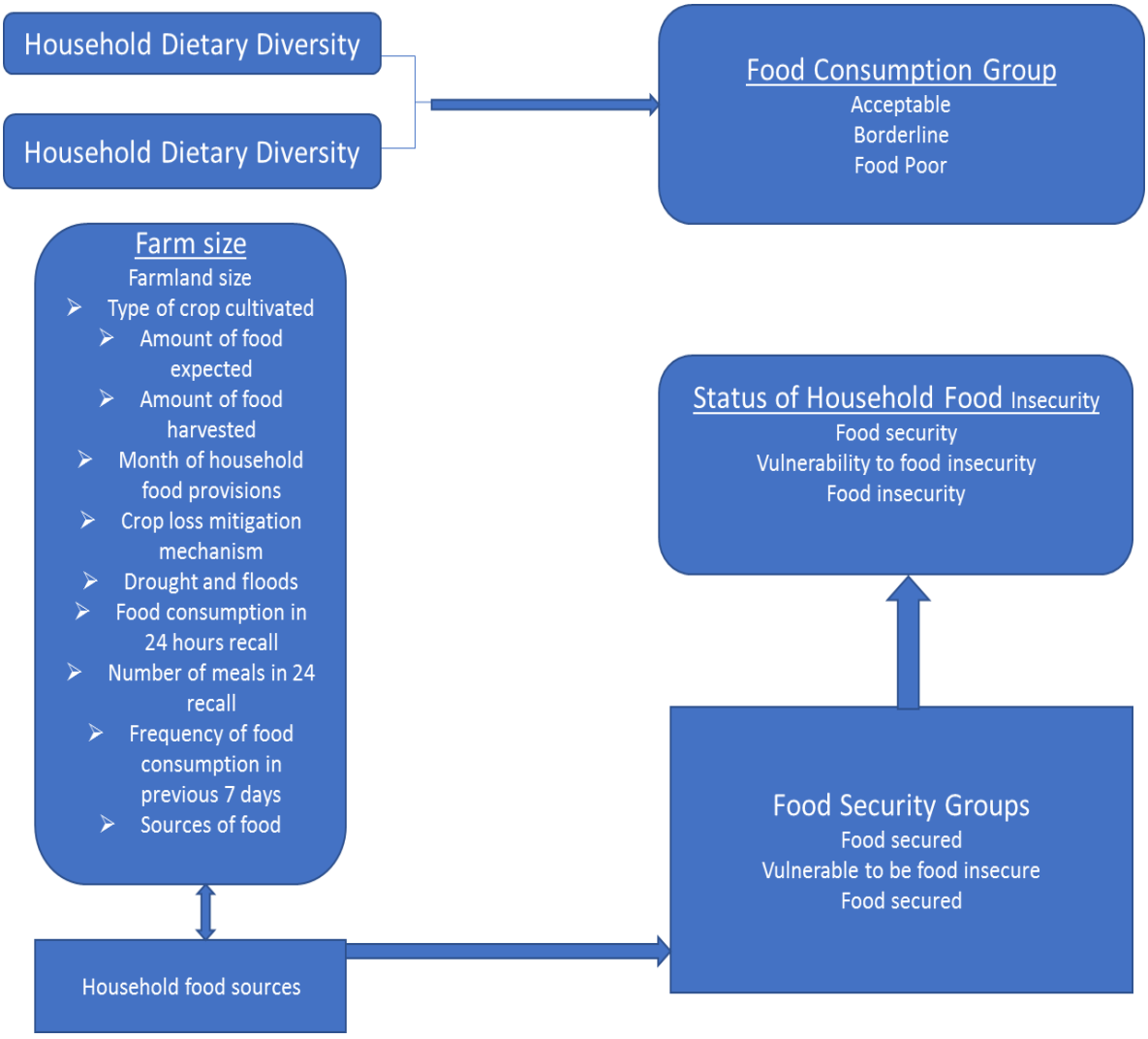

Figure 3. A Conceptual framework illustrating household food consumption approach

Source: Adapted from WFP (2006)

2. 2. 4 Postharvest handling and losses of maize.

The quality of maize produced cannot be understated in the agricultural production chain, and post-reap/harvest treatment of produce is a basic factor in deciding principles and quality. Post-reap/harvest includes the administration of produce before preparation which includes drying,

storage, assurance against vermin, and moisture guideline. This progression significantly requires quality control process in food production sector and key in serious product promoting/marketing which Ghanaians like doing in the south. There has been the use of traditional strategies since days of years to save produce until the rise of current and advance post-collect methods. The advantages of current post-harvest taking care of maize are many, and most farmers in Ghana value these procedures.

Ragasa et al. (2014) stated that maize represents half of the absolute grain production in Ghana and supposedly has postharvest misfortunes of somewhere in the range of 5 and 70 % (FAOSTAT/FAO Statistical Division 2012). To improve food security must be a decrease in post-harvest losses (PHL). Since misfortunes increase cost of produce and accordingly decreasing buyers' buying power, occupy salary out of farmers' pockets, and impede food accessibility (Opit 2014). This report shows that the measure of grain put into distribution centers in Ghana is quickly expanding and various private and open segment associations have framed Postharvest Service Focuses (PSF) to expand farming activities, food quality and diminish PHL. The grains held by PSF are put into a stockroom and are basically not given insurance from bugs and bothers, and climatic air.

The National Food Buffer Stock Company (NAFCO) deliberately made by Ghana's Government was to decrease post-reap misfortunes, guarantee value solidness, and build up crisis grain saves (Rondon & Ashitey 2011). NAFCO is a state-possessed organisation that undertake purchases, stores, sells and conveys overabundance maize in stockrooms across the nation. Africa and Ghana cannot stand to encounter 20 % or more grain PHL (World Bank 2011).

2. 2. 5 Postharvest storage methods.

Some of the maize grown which has been kept for future used has be attacked by different insects, pests, including the maize weevil, *Sitophilus zeamais* (Mots.) (Coleoptera, Curculionidae) and the bigger grain borer (LGB), *Prostephanus truncatus* (Horn) (Coleoptera Bostrichidae). It has been accounted that 90 % of postharvest misfortunes are because of creepy crawlies and parasite invasion and in this way the need to control them (Vachanth et al. 2010). Owusu-Akyaw (1991) detailed that about 20 % of maize and cowpea produced every year were lost to S. zeamais. (Kabir et al. 2011). There are different new conventional methods and current day procedures utilized for putting away the maize grains or cobs in Ghana.

2. 2. 5. 1 Traditional ways of technique. Maize drying is one of the ways and done to make way for smooth air, relatively less humid and dry air takes away the moisture from the grain. These are the olden days methods that has been used by farmers in Ghana, seriously practiced in the southern part of the country.

2. 2. 5. 2 In-field drying. The cobs are stacked or 'stoked' in the field to have further drying. More losses are likely to happen due to more spreading of the maize, and exposure to pests and insects.

2. 2. 5. 3 On-platform drying. Threshing of the grain is mostly preceded by further drying in farms places to allow air and sun to blow through. The maize cobs are put on racks or placed on constructed platforms (Figure 3). This method has a lot of advantages as compared to the in-field drying but the percentage of grain loss is relatively high.

Figure 4. Different platforms to dry maize (Hodges 2001).

2. 2. 5. 4 Bagging of maize. Bagging of maize is another traditional way of practice for most farmers in Africa. Bagging is the most helpful method of keeping grain, yet the bags ought to be put away on the platform to keep moisture absorption from the ground (Agona 2008). The sacks serve as container where the maize produce is kept prior to being sent into the proper storage structures. The bags give some type of security to the grains, make simple handling and transportation easy and serve as unit of measurement during trading (Kaaya et al. 2006). However, Thamaga-Chitja et al. (2004) announced that putting maize seeds in sacks gave little protection against bugs and maize store in this way absorbed moisture. The efficacy of storage in bags generally relies upon where they are kept. If they are open to the rain or not sealed well, water and insets can enter them causing damage to them. (Rochat & Guenat 2013). The presentation of PIC bags by Purdu University has brought great chance to farmers who put maize in bags to store. Baoua et al. (2014) announced that PIC bagscan was useful for maize storage, even in regions with prevalence of *P. truncatus* however, storage should be soon after

harvest and University of Ghana. PICS sacks capture the development of insect's pests (Baoua et al. 2014), which can spread the mode through the container, as detailed by Hell et al. (2000). Grain that had been put in PICS bag were less contaminated than that of the control sacks, because of the hypoxia & hypercarbia (IFPRI 2010) made com with hermetic storage hinders that cause the growth of the pathogen.

The PICS innovation vows to be helpful for storage of dry maize, causing broad mortality of the two fundamental pests, *P. truncatus* and *S. oryza* (Baoua et al. 2014).

2. 2. 5. 5 On-ground drying. In this way, the grains are spread-out on the ground floor to make drying in (Figure 4). The grains which may be on the bare floor absorb moisture from the floor and full of dirt and foreign materials and is exposed to rains, insects, pests, livestock, and birds. In recent days, Ghanaians are easily drying maize on plastic sheets or mats in their houses. This type of ground floor drying is a problem because of the following reasons.

- Must be watching it all the time to keep the grains in order from rain and not allowing any animals to eat them etc.
- Grains can be washed away when there is a sudden down pour or be brought under shelter at night or when it is about to rain, which is a big work.
- There is a higher risk of contamination and dust, soil, stones, animal toilets and insect infested them. Losses from poultry and domestic animals.
- The method is very expensive and time-consuming and is labour intensive when the harvest is huge. Unfortunately, this method is practiced most by farmers in Ghana.

Figure 5. On-the ground maize drying (World Bank 2011)

2. 2. 5. 6 Modernized techniques. The modern technology which helps farmers save and gets more income in their farming activities in their farming community in southern Ghana are as follows.

2. 2. 5. 7 The use of metal silos. Ghanaian farmers now used metal silos to store grains relatively in affordable metal silos (Figure 5). These metal silos reduce to a larger extent the exposure of pests and the weather conditions and help keep food security in the country (Proctor 1994).

Figure 6. Metal silos for maize storage (CGIAR 2013)

The high costs of the metal silos are a problem, and the smallholder farmers consider it as expensive to buy now it as an individual person (FAO 2008).

2. 2. 5. 8 The use of chemical

Ghana farmers sometimes must turn to the use of chemical control methods despite the associated health problems or issues concerning its uses.

2. 2. 5. 9 The use of fumigants and contact insecticides

Gaseous fumigants are also used commonly to prevent insects in stored grains (White 1995; Obeng-Ofori 2007 & 2011). The dried grains are fumigated and then packed into bags for storage for safe keeping. Fumigants are said not to have a residual effect but can go through the stacks or bulk product killing all live animals in stages of insects. The major problem in the use

of fumigants is that they do not protect against the grain infestations, they are extremely dangerous and can result in death if not well-handled by the farmers (Danilo 2003).

2. 3 The power of empowerment of women in the area

The extent to which maize farmers in the study area are food secure is as follows. The study was put down by the women's empowerment framework developed by Naila Kabeer (2001). Such empowerment is a process and stage of placement where those who have been refused the ability to make choices themselves acquire such an ability to make their own choice. The ability to make by the household or women in the area can be thought of in terms of making changes in three individual life dimensions of power, which give a choice, resource, agency, and achievement. The resources they have form the conditions under which choices are made, the agency is at the heart of the process by which choices are made, achievements come after the outcomes of choices are made. These resources are divided into three main stages, which are economic resources, human resources, and social resources (Kabeer 2001).

The human resources are put into the individual hands and encompass his or her knowledge, skills, creativity, and imagination to utilise. Social resources are made up of claims, obligations and expectations that made up relationship building, such as networks which made households to improve their life and life chances that they would be possible of making it themselves through their individual efforts. Agency is the ability to define one's goals and act upon such goals (Kabeer 2001) It is about more than observable action and encompasses the meaning of motivation and ideas which individuals bring to their work, their sense of agency, or the power within them. Agency can have both positive and negative understandings as the dimension of power enrolled. In the positive way of power, agency is the strength of people to define the choice of their own lives and pursue their own goals. A negative sense of agency is the ability of actors of overriding the work of others, for instance, through violence, coercion, and threat. Resources and agency work together to form the potentials that people must achieve the value of being and living (Kabeer 2001).

Based on this framework, women are empowered through the five dimensions of the WEAI which are summarized into three dimensions of Kabeer's framework. Through resources, the study looked at the level of women's decision-making in economic resources such as land use, the decision on assets and the impact of their decision making on household income as well as credits. Human and social resources were taken in two ways among the 5 Domains of Empowerment (5DE), leadership and time. The study showed how women participate in the three community groups, which reflects their social-economic network and personal skills

through leadership. Through Kabeer's dimension of achievement, the study looked at how women's empowerment in agriculture affects household farms in survey and how they commercialize their produce. (Kabeer 2001)

2. 3. 1 Women having access to how to use land in the rural area.

The proof is that the usual promises of jobs, the gendered nature of some tasks and models of farming, skill requirement, and other conditions may not necessarily increase incomes and open windows of job (Gyapong 2019; Hall et al. 2017). Even though Fonjong et al. (2007) & Fold (2008) discovered significant integration of rural jobs on some plantations in Cameroon and Ghana, respectively, they also emphasised the differentiated terms of incorporation and unequal opportunities of different social groups based on gender and access to land, they additionally underscored the separated terms of joining and inconsistent freedoms of various gatherings of people dependent on sex and access to land. As a result, setting matters, and as we show in the subsequent sections, the food security implication in the area were so good and are strongly connected with both the accumulation logic of capitalist production put in place and policy of each town. This condition made the underlying gendered nature of local resources ownership and cropping systems that define production and food security (Fonjong & Gyapong 2020).

The study takes two broad, interrelated issues of gender relations in the communities affected by plantation land deals and how domestic and capitalist relations of production structure taken place, this reinforces inequalities in access to and control over land and labour, consequently the implications for food security in these three communities, Akatsi, Abor and Ohawu respectively were very ok. The study discusses issues and contributes to critical debates of how woman and men should come together and work on with the complexities and gender differentiated impacts of the global rush in rural African communities. The emphasis on women's experiences in securing their households food security among the increasing revenue enclosures for plantations, contribute to knowledge, alternative policy pathways and in the light of the Sustainable Development Goals (SDGs) which calls for reduced inequalities between men and women in the access to resources like land and how to control and utilize them properly (Fonjong & Gyapong 2020).

The women in the area are empowered in agriculture and it reflects the strength in women to access, control and utilize productive resources such as land, livestock, labour, education, extension, financial services, and technology (Quisumbing et al. 2015). It is measured by the Women's Empowerment in Agriculture Index (WEAI) which is a new survey-based index designed to measure empowerment of women in the rural areas, agency, and the involvement

of female in the agricultural sector. The WEAI is a total addition of indexes, that is utilised to give in a country, regional and district levels, based on individual-level data collected by interviewing men and women within the same households. The WEAI comprises two sub-indices. The first index examination of took the degree of women who are empowered into five main domain of empowerment (5DE) into agriculture. It reflects the percentage of women who are empowered and those who are not. It also gives the proportion of homes in which women enjoy adequate greatness. These domains are:

(1) decisions about agricultural production

(2) having access to resources and decision process towards productive resources ventures

(3) control of the use of income

(4) leadership in the community and

(5) time allocation. The second sub-index, thus the (Gender Parity Index [GPI) measures gender parities. The GPI shows the proportion of women who are helped and achievements that they had which are at least as high as those of men in their households (Alkire et al. 2013).

Despite the gender mainstreaming efforts of Rwanda, the farming system remains subsistence-oriented, additionally, research results showed that women are more engaged in the production of consumption-oriented crops rather than the production of sales or market-oriented produce (MINECOFIN 2013; Ingabire et al. 2017). Furthermore, it has been observed that there is gender competitive model between more commercialized crops and food crops. Women are traditionally considered to be engaged in food crop production. Therefore, women remain in subsistence agriculture and hence the continued persistence of subsistence farming (MINAGRI 2010). Similar evidence come from the Northern part of Rwanda has revealed that women were more engaged in beans transactions than men, while men highly participated in transactions of potatoes. Ironically, potatoes are more commercialize than beans in northern Rwanda (Ingabire et al. 2017). It has been shown that men of these days tend to take control of crops when an opportunity for their commercialization emerges (Fischer & Qaim 2012; Quisumbing & Pandolfelli 2010). However, it was only a few studies have been made on the relationship between agricultural commercialization and women's empowerment in agriculture (Gupta 2017). This study determined the friendship between women's engagement in agriculture studies and agricultural commercialization industry in Rwanda across 252 households from Musanze and Burera districts in the Northern Province of Rwanda. In the same household, both

female and male primary decision-makers were interviewed. A survey based on the Women's Empowerment in Agriculture Index (WEAI) was used (Alkire et al. 2013).

2. 3. 2 Contribution and information flow of women in the area

Information is one of the main human needs after air, water, food, and shelter, it is one of the main things of life (Stanley 1990). Agricultural information can is said to be of published or unpublished knowledge given on all aspects of agriculture and is mostly generated through various aspects (Aina 1995). These aspects include agricultural institutes, Universities of Agriculture, Faculties of Agriculture, agro-based industries, and service institutions. Not one person can claim to know all the information needed of farmers, especially in all information sectors like agriculture where there are new and serious problems of farmers every day. It is safe to say that the information needs of Ghanaians small-scale farmers go around the country such as pest hazards, weed control, soil fertility, farm credit, soil erosion (Ozowa 1995). Agricultural extension methods traditionally have ideas on increasing production of cash crops by providing men and women with training, information and access to inputs and services (Ayoade 2012). This male bias problem is shown in farmers training centers which have been established to give residential training on special subjects. According to Ozowa (1995), small-scale farmers are among the potential people of agricultural credit in Ghana, but because they are not educated, they are mostly not aware of the presence of loan facilities in their area. This problem became serious that women in extension agents, especially in a society where cultural and religious issues make it not possible for male extension workers to go with women farmers who are greater than male small farmers. Despite this, the women have been found to play vital roles in all aspects of life. Their involvement in agriculture covers all places such as production, processing, storage, marketing and distribution of crops and Livestock. Out of the 95% of small-scale farmers in Ghana who feed the nation, 55 % of them were women (Ozowa 1995).

Despite the valuable contributions of women to agriculture, they do not have access to extensive information in Ghana. An explanation of credit scheme in five African countries, including Ghana, where women-controlled food production shows that, women receive less than 10 % of the total credit directed to agriculture (FAO 1996). The implication is that women receive less, but they tried to multiply the inputs recommended by extension agents. Foster (1986) says that women farmers farm more than 80 % of the food in sub-Sahara Africa FAO (1996), in validating this assertion, noted that women farmers are cable of 100 % processing of basic food stuff and 80 % food storage and transportation to the market centre.

3 AIMS OF THE THESIS.

The main objective of the study is to examine the contribution of the staple sector (maize) to reducing food insecurity in the country. The specific objectives are to:

(i) Determine the factors that influence food security of maize farmers in southern Ghana.

(ii) Find out and rank the coping strategies used by maize farmers to solve food insecurity problems

(iii) Examine the extent to which maize farmers in the study area are food secure.

4 METHODOLOGY

4 . 1 The study area.

The study was conducted in Akatsi District, Abor, and Ohawu in the Volta Region of Ghana. The Akatsi is in the South-Eastern part of the Volta Region. It has a total land area of about 960.445 sq. km, the total land. Akatsi is the administrative capital. The district is bounded to the south by the Keta Municipal, to the east by the Ketu North Municipal, to the north-by-North Tongu Districts to the west. The population of the district according to 2010 population and housing census stands at 95,426 of which 44,039 are males and 51,387 being females. Agriculture is the main occupation in the area. Some of crops cultivated include maize, soybeans, ground nuts and the animal they reared too are goats, sheep, poultry, cattle, and others.

Abor (Abaw, Abɔ) is a town in the Keta Municipal District of the Volta Region in Southeast Ghana. Abor lies east of the Volta River and north to the Keta Lagoon. Agriculture is the main occupation in the district. The population of district is about 147,618 in 2014 and had land area of 575 kilometres.

Ohawu in the Ketu North District: Ohawu is a town in Ketu North Municipal District of Volta Region in southeast part of Ghana. Ohawu city is in Ghana and here you will see this place is situated in Dzoze, Volta and Ghana. The district is covered with land area of 754 kilometres square with a projected populace of 98,571 in 2010.

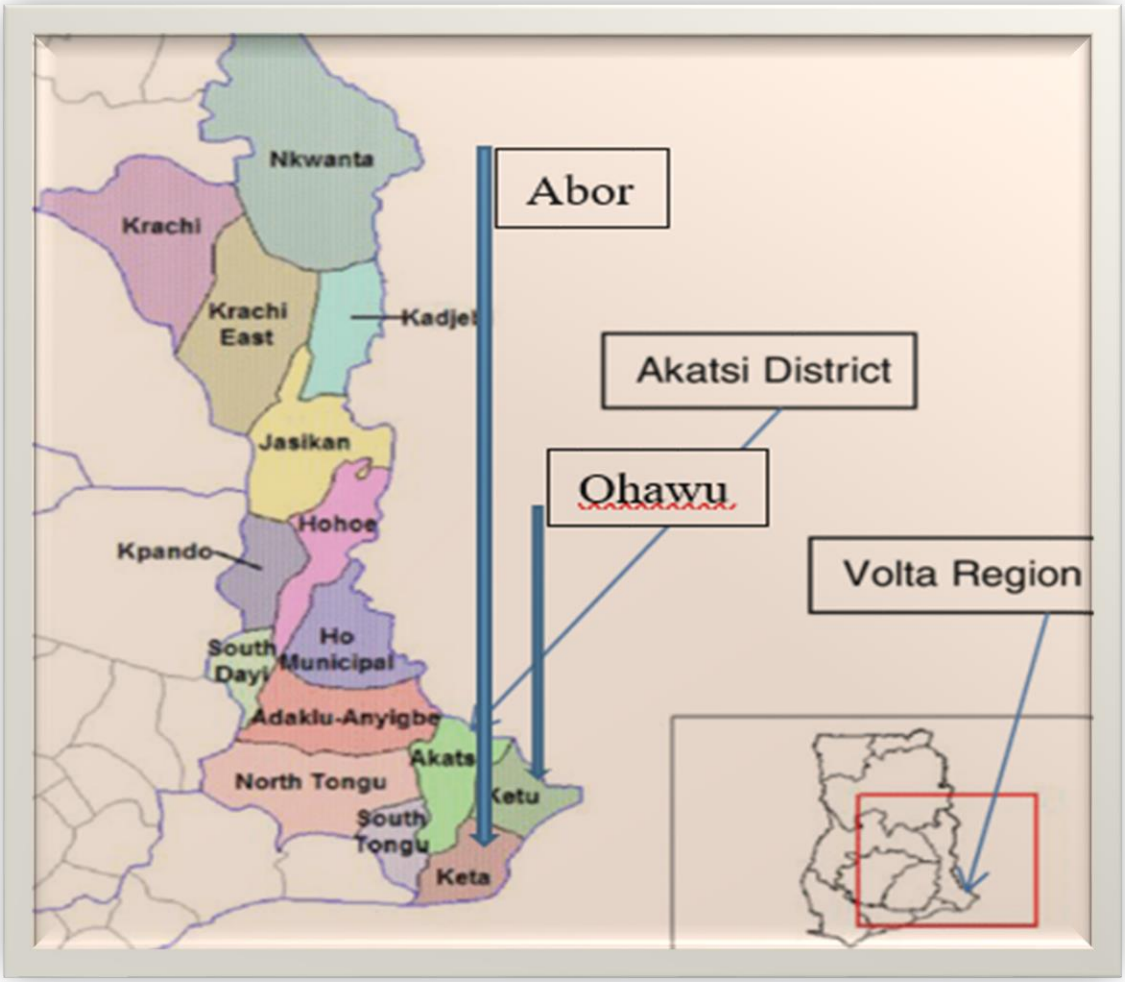

Figure 7. A map of Ghana indicating the study area.

Source: https://www.ghanamissionun.org/map-regions-in-ghana

4. 2 Research design

The study adopted mixed model method involving both qualitative and quantitative techniques. The study used both primary and secondary data to collect it. The primary data collected through semi-structured questionnaire included costs and production information of maize production as well as household and socio-economic characteristics of farmers. The qualitative data comprised of interviews with officials of the Ministry of food and Agriculture and focus group discussion with farmers to understand their challenges and adaptation strategies to food insecurity in the locality. The discussions focused on issues of livelihood activities, understanding of food insecurity, how they manage to sustain their home food, causes and

coping strategies in times of food insecurity in all. At least nine farmers from each district were used for the focus group discussions.

4. 3 Sampling technique and sample size

Stratified sampling technique was used for the study. First, purposive sampling technique was used to select the three districts due to many of the maize farmers in the area and the significant contribution of maize to the region. At least a community in each district was randomly selected of which about 40-50 maize famers were randomly sampled. In total 145 maize farmers were used for the study (see Table 1).

Table 1. Sample distribution across the towns in the districts

District	Towns/communities	Farmers
Akatsi	Akatsi	49
Keta Municipal.	Abor	46
Keta North	Ohawu	50
Total		**145**

4. 4 Method of data analysis

4. 4. 1 The food security status of maize farmers

The food consumption score (FCS) measures the frequency of weighted dietary score (Leroy et al. 2015). Several studies (Mason et al. 2015; Nkomoki 2018) have applied the FCS in different African countries. The FCS consist of three elements, namely the dietary diversity, the food frequency, and the nutritional value of the food groups (World Food Programme 2012). The dietary diversity consists of the number of different types of food consumed by the household over a reference period. The food frequency indicates the count of a particular food group consumed by the household. The FCS consist of eight food groups including sugar, oil, fruits, milk, meat/fish/eggs, staples, pulses, and vegetables. The nutritional value uses standard food group weights. The weights of the nutritional values in ascending order of the various food groups include sugar and oils (0.5), vegetables and fruits (1), cereals (2), pulses (3) and meat, fish, and milk (4) having the highest values (Leroy et al. 2015; Nkomoki 2018). The food group score is computed within each food group by adding the consumption frequencies. The

respective group score obtained is multiplied by its weight. The results are then summed up to obtain and generate FCS of the household (Carollete et al. 2013; Nkomoki 2018).

Inspired by Jones et al. (2013) and Nkomoki (2018), the FCS can be expressed as:

$$FCS = X_1Y_1 + X_2Y_2 + X_3Y_3 + \cdots X_8Y_8 \quad (1)$$

where X is the frequency of one week recall threshold, 1-8 refers to the various food groups and Y is the weight of the various food groups (sugar and oils =0.5, vegetables and fruits =1, cereals =2, pulses =3 and meat, fish, and milk =4).

Following the standard threshold intervals defined by the World Food Programme, the FCS is classified into three categories namely: poor (< 21.5), borderline (21.5-35) and acceptable (> 35).

4. 4. 2 The determinants of food security status of maize farmers

In the estimation of a dichotomous dependent variable as in this study, a discrete choice modelling (probit or logit) is usually applied instead of the linear regression model. The study employed the ordinal logistic regression to analyse the factors that affect food security status of maize farmers. From the binary logistic model specified below:

$$\text{Logit(K)} = Ln\left[\frac{k_i}{1-k_i}\right] = x_i\beta + \varepsilon_i \quad (2)$$

K measures the probability that a household could be food secured, x_i is the vector of explanatory variables (including the age of the household, gender, household size, marital status of household head, educational status of the household head, farm size, access to credit, extension contact, flood, storage problems and road network), β is the regression coefficient and ε_i is the error term. Following the framework of Chen et al. (2016), the empirical specification of the ordinal logistic model is given as:

$$In(\gamma_i) = \alpha_i - (\boldsymbol{x}_i\beta' + \varepsilon_i) \quad (3)$$

where refers to the parameters to be estimated; x_i is defined as previously, α is the intercept term and u denotes the random disturbance term.

4. 4. 3 Coping strategies to food insecurity

We operationalized this objective in threefold. First, a few coping strategies were adopted from literature and the respondents were made to confirm the coping strategies that were widely applied in the locality in the order of frequency of use. Second, the various coping strategies were weighted based on the frequency scores of the household. Finally, Kendall's coefficient of concordance was used to rank farmers 'the coping strategies when the household is challenged by food insecurity problems in the area. The Kendall's coefficient of concordance (W) was used because of its ability to assess the two or more levels of agreement among respondents and their respective rankings. Following Taahir Namaa (2017), the Kendall's coefficient of concordance is specified as:

$$W = \frac{12S}{K(n3 - n) - KT} \quad (4)$$

where $R =$ total rank for the ith strategy

S= $\sum_{i=1}^{n}(R_i - R^-)$

$R^- =$ Average value for each total rank strategy

$K =$ Number of respondents

$n =$ Number of strategies to be ranked

$T =$ Correction ties factor

When the test statistic (W) is equal to unity, it indicates that the household have a common trend in terms of the order of coping strategies adopted. When the value of the test statistic (W) is zero, it indicates a random response of the trend of coping strategies adopted. A value between zero and one suggests varying degrees of agreement with the coping strategies adopted by the household.

4.4 Tools for data analysis

The food security index and the Kendall's Coefficient of Concordance were estimated using MS Excel. The descriptive statistics and ordinal logistic regression were done using STATA version 14.

4.5 Limitations of the study

The study used only the food consumption score to measure the food security status due to farmers 'inability to recall incomes and production information during the interview period. The relatively small sample size of the study is due to the absence of farmers during the interview, as most travelled to funerals and others in search of greener pastures abroad.

4.6 Description of variables used in the ordinal logistic regression model

Table 2 lists the variables that were used in the ordinal logistic regression. It can be observed that the majority (65 %) of the farm head were males compared to 35 % of females. The average age of the sampled farmers was 48 years. This suggests that majority of the household head is in the economic active age bracket. In terms of education, most farmers have spent at least 13 years in formal schooling, suggesting that they have at least secondary education. The average household size was recorded at 4.83. It can also be observed that very few (25 %) of the farmers had access to credit to support their farming activities. Regarding the farmer's relationship to extension, 36 % of the farmers had contact with government paid extension agents in the farming season.

Table **2** shows, 34 % of farmers were affected by floods during the last crop season. Also, 30 % of households indicated that the road network from their farms to the house was in poor condition.

Table 2

Descriptive statistics of variables used in the ordinal logistic regression

Variable	Description	Mean
Gender	1 if household head is male, 0 for female	0.65 (0.48)
Age	Age of household head in years	47.95 (12.64)
Education	Number of years of formal education	12.90 (4.45)
Household size	Number of people in the household	4.83 (2.37)
Farm size	Area of land under cultivation in hectares	2.65 (1.14)

Access to credit	1 if farmer has access to credit, 0 otherwise	0.25 (0.43)
Access to extension	1 if farmer has access to extension agent, 0 otherwise.	0.36 (0.48)
Flood	1 if farmer was hit by flood in the last farming season	0.34 (0.47)
Road status	1 if road network from the farm to the farmer's house is bad, 0 otherwise	0.30 (0.46)
Akatsi	1 if farmer is located in Akatsi District, 0 otherwise	0.34 (0.47)
Ohawu	1 if farmer is located in Ohawu District, 0 otherwise	0.34 (0.48)
Abor	1 if farmer is located Abor District, 0 otherwise	0.32 (0.47)

Notes: Standard deviations in parenthesis.

5. RESULTS

5.1 Food security status of maize farmers

Error! Reference source not found. presents the results of food security status estimated by the FCS approach. Households in Akatsi account for 8 % of acceptable FCS, followed by Ohawu (6 %) and 4 % for Abor. The difference between the scores is statistically significant at the 1% level. It can also be observed that most (43 %) of households in Akatsi District recorded poor FCS, followed by 41 % in Abor. Although, a significant share of the households was captured as poor by the respective scores in the three districts, the chunk of the households in all three districts fell into the FCS borderline category. This generally suggests that farmers in the study area, are not far from the acceptable FCS category. A further analysis of the factors affecting farmers' food security situation will provide insights into bottlenecks and provide information on policies to improve their economic condition.

Table 3 Estimates of food consumption score (%).

District/indicator	Poor	Borderline	Acceptable	ANOVA
Akatsi	43	49	8	106.10***
Ohawu	36	58	6	72.43***
Abor	41	54	4	93.92***

Notes: *** denotes significance at 1 % level.

5.2 The determinants of food security status of maize farmers

The estimates of factors affecting the food security status of maize farmers are presented in Table 4. Marginal effects are reported for better interpretations. The parameter estimates jointly influence food security status at the 5 % level of significance, as indicated by the chi-square test statistics ($\chi^2(11) = 19.830$). The results show that households with access to credit are 17 % more likely to be in borderline FCS category and 20 % less likely to be in acceptable FCS category. A similar finding was reported by Kuwornu et al. (2013), in their analysis of food security status in the Central Region of Ghana. Households that were affected by flood were 14.4 % less likely to be in borderline FCS category, 17.2 % more likely to be in acceptable FCS category. Similarly, farmers who reported bad road networks were 12.6 % less likely to be in borderline FCS category,15.1 % more likely to be in acceptable FCS category.

Table 4 The determinants of food security status of maize farmers: An ordinal logistic regression

Variables	Coefficient	Food Consumption Score		
		Poor	Borderline	Acceptable
Gender	0.333 (0.433)	-0.011 (0.016)	-0.054 (0.069)	0.065 (0.084)
Age	0.017 (0.016)	-0.001 (0.001)	-0.003 (0.002)	0.003 (0.003)
Education	-0.086 (0.070)	0.003 (0.002)	0.014 (0.011)	-0.017 (0.014)
Household size	0.025 (0.075)	-0.001 (0.002)	-0.004 (0.012)	0.005 (0.014)
Farm size	0.267 (0.192)	-0.008 (0.007)	-0.044 (0.031)	0.052 (0.036)
Access to Credit	-1.046 (0.50)**	0.033 (0.021)	0.170 (0.077)**	-0.204 (0.092)**
Access to extension	-0.465 (0.514)	0.015 (0.016)	0.076 (0.085)	-0.090 (0.010)
Flood	0.884 (0.450)**	-0.028 (0.020)	-0.144 (0.068)**	0.172 (0.083)**
Road status	0.775 (0.429)*	-0.025 (0.018)	-0.126 (0.066)*	0.151 (0.081)*
Akatsi	-0.124 (0.489)	0.004 (0.016)	0.020 (0.080)	-0.024 (0.095)
Abor	-0.302 (0.456)	0.010 (0.015)	0.049 (0.075)	-0.059 (0.089)
Cut 1	-2.904 (1.528)			
Cut 2	-0.068 (1.407)			
$\chi^2(11)$	(19.83)**			
Sample size	145			

Notes: *, ** denote significance at 10 % and 5 % levels: Robust standard errors in parenthesis. The reference district is Ohawu.

5.3 Coping strategies to food insecurity.

The results of the coping mechanisms to food insecurity by the Kendall's Coefficient of Concordance are presented in Table 5. The chi-square statistic (χ^2) is greater than the critical/table value (9.487) at 5 % and 4 degrees of freedom and therefore we reject the null hypothesis and infer that households essentially apply the same standard in ranking coping strategies to mitigate food insecurity in the locality. Thus, there is significant agreement in ranking by different households at 5 % level. As shown, the most important coping strategy adopted and ranked the ultimate is the reduction of household expenditure. As expected, the households have no better option than to reduce especially food expenses when for example the price of food stuffs are high. A shift to less preferred foods, also show as another important coping mechanism to food insecurity problems in the study area. Similarly, reducing adult consumption at the household level to augment children consumption is one of the coping strategies that most households in the study area implement. This is reasonable, as in difficult situations, parents can stay without food and use the little at their disposal to cater for the children. In the Ghanaian society, parents who are unable to put food on the table for their children are ridicule and marked as irresponsible.

Table 5 Food security coping strategies results

Coping mechanism	Average	Rank
Reduce household expenditure	2.42	1st
Shift to less preferred foods	2.86	2nd
Reduce adult consumption	3.00	3rd
Borrow food from friends and relatives	3.61	5th
Sale of household assets	3.11	4th
Model diagnosis		
Kendall's W = 0.074		
χ^2 = 43.075***		
Degrees of freedom = 4		
Sample size = 145		

Notes: *** indicate 1% significant level

6 DISCUSSION

Table 3 presents the results of food security status estimated by the FCS approach. Households in Akatsi account for 8 % of acceptable FCS, followed by Ohawu (6 %) and 4 % for Abor. The difference between the scores is statistically significant at the 1% level. It can also observed that most (43 %) of households in Akatsi District recorded poor FCS, followed by 41 % in Abor. Although, a significant share of the households was captured as poor by the respective scores in the three districts, the chunk of the households in all three districts fell into the FCS borderline category. This generally suggests that farmers in the study area, are not far from the acceptable FCS category. A further analysis of the factors affecting farmers' food security situation will provide insights into bottlenecks and provide information on policies to improve their economic condition.

It is also consistent with literature that Kuwornu et al. (2013) found that the majority (60%) of smallholder households in the central region of Ghana were food insecure. Households that were affected by the flood were 14.4 % less likely to be in the borderline FCS category, 17.2 % more likely to be in the acceptable FCS category. Similarly, farmers who reported bad road networks were 12.6 % less likely to be in the borderline FCS category,15.1 % more likely to be in the acceptable FCS category. Babatunde et al. (2007) also indicated that 64% of smallholder households in Nigeria were food insecure. The result also confirmed that, the assertion of Wiggins & Keats (2013) who reported that about 67% of the world's food insecure population can be traced to smallholder farming households because smallholder farmers are net buyers of food than the seller of same.

The results of the coping strategies to food insecurity by the Kendall's Coefficient of Concordance are presented in Table 5 above, shows that, the chi-square statistic (x2) is greater than the critical/table value of (9.487) at 5 % and 4 degrees of freedom and therefore we reject the null hypothesis and infer that households essentially apply the same strategies in ranking coping methods to reduce food insecurity in the locality. Thus, there is significant agreement in ranking by different households at 5 % level. As shown, the most important coping strategy adopted and ranked the ultimate food shortage is the reduction of household expenditure.

It was in also consistent with literature (Frank 2000). It was found that the coping strategies are similar to that of Snel and Staring (2001) which gave similar judgement of corcodance.

7 CONCLUSION AND RECOMMENDATIONS

The study assessed the contribution of maize production and food security status in southern Ghana using farm-level data from 145 maize farmers. It uses the food consumption score, ordinal logistic regression, and Kendall's Coefficient of Concordance to estimate the food security status, determinants of food security and coping mechanisms to food insecurity.

The empirical results show that majority of the households are in the borderline FCS category with some a significant proportion in the poor FCS category. The results also show that socioeconomic and farm characteristics such as access to credit, road network and flood affect the food security status of maize farmers. Regarding the coping strategies to food insecurity challenges, it was observed that reduction in household expenditure, shifting to less preferred foods and reduction adult consumption were among the most important strategies adopted by households to mitigate food insecurity problems in the locality.

The findings of this study suggest the need for the government of Ghana to institute agricultural index insurance to protect pro-poor farmers from shocks. Prioritising improving rural infrastructures such as roads will improve smallholder farmers accessibility to capital markets and reduce post-harvest losses and food spoilage. Mechanisms and policies that facilitate smallholder farmers credit reach and acquisition should be put in place to enhance food security and reduce poverty in rural areas.

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APPENDICES

List of the Appendices:

Appendix 1: Questionnaire for maize farmers

Appendix 2: A snapshot showing questionnaire administration between the researcher and respondents at Ohawu Agriculture College at the study area, **Ohawu**.

Appendix 1

QUESTIONNAIRE

These questionnaires have been designed to execute a research purposely for academic work. The researcher is Godwin Yao Fenoo, a student pursuing master's degree in International Development and Agricultural Economics at the Czech University of Life Sciences, Prague. All information provided will be used solely and exclusively for academic purpose and would be treated with the necessary confidentiality it deserves.

PART A: Farmer biodata

1. What is your gender? [a] Male, [b] Female
2. Marital Status [a] Single, [b] Married, [c] Divorced, [d] Widow, [e] Widower
3. Age of respondent?.....
4. What is your level of education? [a] No Formal Education, [b] JHS, [c] College, [d] Undergraduate [e] SHS/Secondary /Vocational, [f] Tertiary
5. What is your occupation. [a] Farming [b] Trading [c] Artisan [d]Public Servant [e] Student [f] Others (Specify)……

PART B: Farm level characteristics

6. How do you get your farmland? [a] Own/Family [b] Rent [c] Squatter
7. What is the size of your maize farm in acres/hectares……?
8. How many years have you been into maize farming?.....?
9. What is the size of your household……?
10. What is the number of HH members who work on your farm ……..?
11. What cropping systems do you use in producing your maize on the farm? [a] Mono cropping [b] Mixed cropping [c]Other specify…….
12. What do you use to prepare your land before cultivating the maize? [a] Tractor Service [b] Bullock Service [c] Hoe/ Cutlass [d] Weedicides [e] Other (specify)
13. What type of storage facility do you use/have? [a] Traditional wood/thatch structure [b] Concrete structure [c] Metallic structure.
14. Do you encounter any storage problems for your maize? [a] Yes [b] No
15. Have you experienced shortage of food in your household before? [a] Yes [b] No
16. Do you keep enough food to fight the lean season in your home? [a] Yes [b] No
17. Do you have a mobile phone? [a] Yes [b] No
18. Did you have access to any credit in the last cropping season? [a] Yes [b] No

19. Have you ever been affected by flood on your maize farm in the last crop season? [a] Yes [b]No
20. Do you have proper road network to from your farm to the house? [a] Yes [b] No
21. **Food consumption score questions**

Food items	Number of times eaten in the last seven days
Maize	
Rice	
Millet	
Wheat	
Beans	
Groundnut	
Cassava	
Potatoes	
Fruits	
Meat	
Fish	
Milk	
Eggs	
Sugar	

22. In the past two weeks, if there have been times when you did not have enough food or money to buy food, did your household.

Coping Strategies.	Yes	No	Frequency	Rank
Shift to less preferred food				
Borrow food from relatives, friends or neighbors				
Reduce expenditure of household to buy food				
Reduce adult's food consumption to secure food for children				
Sale of farm or household assets to buy food				

Appendix 2: A snapshot showing a picture of researcher and respondents

Appendix 2: A snapshot showing interview between the researcher and respondents