

**CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE**

**Faculty of Tropical AgriSciences**

**Department of Crop Science and Agroforestry**



Czech University of Life Sciences Prague  
**Faculty of Tropical  
AgriSciences**

**Assessment of Competitiveness of Maize Production and its Contribution to Food  
Security in Ghana**

**Master's thesis**

**Supervisor:**

Dr. Miroslava Bavorová

**Author:**

B.Ed Sarfo Kwaku, Obeng

**Prague, 2018**

## **DECLARATION**

I hereby declare that I have work on my thesis entitled “Assessment of Competitiveness of Maize Production and Its Contribution to Food Security in Ghana” independently and that all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references.

**22<sup>nd</sup> August, 2018.**

**Prague**

.....

**B.Ed Sarfo Kwaku, Obeng**

## **ACKNOWLEDGEMENTS**

I wish to express my profound gratitude to the Lord Almighty for his protection and guidance for my life throughout my education and more especially, in carrying out this thesis work successfully. I also offer my heartfelt gratitude to Dr. Miroslava Bavorová my supervisor for her tireless and selfless supervision of this research.

I will like to express my gratitude to my lovely wife Osiabour Ama Kyerewaa and my beloved son Sarfo Boakye-Yiadom Nkunim for their prayers and support. Also I will like to acknowledge my parents Mr. And Mrs. Obeng for their advice, support and prayers. Not forgetting Mr. and Mrs. Agoro Gyimah for their various support and advice to me throughout my education.

Lastly, I am very grateful to Mr. Adomako Enoch and his wife during the thesis data collection. I am most grateful to Ing. Samuel Ahado for his time spent on me during my data analysis and his guidance during my write-up. To all friends, thanks for your prayer and support during the challenging times. May the Good Lord shower His Blessings on you all!!

## **ABSTRACT**

The production of maize in Ghana is woefully inadequate to meet current domestic market demand. The motivation for ensuring food security in many developing economies depends primarily on enhanced agricultural productivity through efficient use of resources. This study applied the Domestic Resource Cost (DRC) ratio to assess the competitiveness of local maize production and its contribution to food security in Central Ghana (involving two regions: Ashanti and Brong-Ahafo regions). Scores related to some socio-economic factors of maize farmers were evaluated. A farm-level data size of 70, comprising of 50 maize farmers and 20 market/middlemen were sampled based on purposive and simple random sampling techniques. Respondents were interviewed using structured questionnaires to elicit all needed information. Findings from the research showed that the local maize production in the study area was not competitive and hence did not have the comparative advantage compared to other global producers in maize production. The DRC ratio of 3.46 implied that domestic resources usage was not efficient. The gross marketing margin along the maize supply chain at the farm gate and local market centres with the involvement of middlemen was 43.07 percent. Prioritising provision of linkage roads in rural areas to tackle inaccessibility would improve maize marketing and enhance the expansion of maize distribution across the country to guarantee food security. National policies should favour optimum allocation of productive resources by considering the drivers of competitiveness.

**Key words:** Competitiveness, maize production, efficiency, domestic resource cost ratio, marketing margin, Ghana

## TABLE OF CONTENT

<b>DECLARATION</b> .....	<b>i</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>ii</b>
<b>ABSTRACT</b> .....	<b>iii</b>
<b>TABLE OF CONTENT</b> .....	<b>iv</b>
<b>LIST OF FIGURES</b> .....	<b>vii</b>
<b>LIST OF TABLES</b> .....	<b>viii</b>
<b>LIST OF ACRONYMS</b> .....	<b>ix</b>
<b>1. INTRODUCTION</b> .....	<b>1</b>
<b>2. AIMS OF THE STUDY</b> .....	<b>4</b>
<b>3. LITERATURE REVIEW</b> .....	<b>6</b>
3.1 Maize Market in Ghana .....	6
3.1.2 Maize Expansion and Market Opportunities.....	7
3.2 Conceptual Framework .....	7
3.2.1 Maize Marketing Channels .....	7
3.2.2 Competitiveness of Production .....	8
3.3 Policy Environment of the Maize Sub-Sector .....	9
3.4 Maize Consumption .....	10
3.4.1 Poultry Feed Market .....	11
3.4.2 Industrial Maize Use .....	12
<b>4. METHODOLOGY</b> .....	<b>14</b>
4.1 Research Design.....	14
4.1.1 Geographical Characteristics.....	14
4.1.3 Climate and Vegetation .....	15
4.1.4 Agro-Ecological Zones: .....	15
4.2 Key Data Variables for the Study and their Measurement.....	16
4.3 Study Area .....	17
4.4 Data Sources .....	18
4.4.1. Secondary Data Sources.....	18
4.4.2. Primary Data Sources .....	18

4.4.3 Structured Questionnaire.....	19
4.4.4 Sampling Technique and Sample Size.....	20
4.5 Data Analysis .....	22
4.5.1 Empirical Model of the Domestic Resource Cost Ratio (DRC). .....	22
4.5.2 Marketing Margins .....	23
4.6 Limitations of the Study .....	23
<b>5. RESULTS .....</b>	<b>24</b>
5.1 Socio-Economic Characteristics of Respondents .....	24
5.2 Agricultural Indicators .....	26
5.2.1 Farm Labour Used by Respondents.....	26
5.2.3 Sources of Fund of Maize Farmers.....	28
5.2.4 Sources of Agricultural Extension Services.....	28
5.2.5 Maize Production Expansion in Central Ghana. ....	29
5.2.6 Technologies Applied by Maize Farmers .....	30
5.2.7 Sources of Irrigation by Maize Farmers .....	31
5.2.8 Access to Tractor.....	32
5.2.9 Varieties of Maize Cultivated by Farmers .....	33
5.2.10 Varieties of Maize Grown in Central Ghana.....	35
5.3 The Competitiveness of Maize Production in Central Ghana. ....	36
5.4 Marketing Margin of Maize Supply Chain.....	39
<b>6. DISCUSSION .....</b>	<b>40</b>
6.1 Socio-Economic Characteristics of Respondents .....	40
6.2 The Technology Adoption by Maize Farmers in Central Ghana.....	42
6.3 The Competitiveness of Maize Production in Central Ghana. ....	44
6.4 Marketing Margin of Maize Supply Chain .....	45
<b>7. CONCLUSION.....</b>	<b>47</b>
7.1 Policy Recommendations .....	47
7.2 Recommendations for Future Studies .....	48
<b>8. REFERENCES.....</b>	<b>49</b>
<b>APPENDICES .....</b>	<b>56</b>

List of Appendices .....	56
Appendix 1: Researcher Administering Questionnaires. ....	57
Appendix 2: Questionnaire for Maize Farmers.....	58
Appendix 3: Questionnaire for Middlemen/Market Sellers .....	65

## LIST OF FIGURES

Figure 1: The Agro-Ecological Zones in Ghana (FAO 2005 (Modified), RESPTA 2008). .....	16
Figure 2: Map of Ghana- (Wikimedia Modified).....	17
Figure 3: Education Status of Respondents .....	26
Figure 4: Type of Farm Labour Used.....	27
Figure 5: Access to Credit Facilities .....	27
Figure 6: Sources of Funds Available to Maize Farmers. ....	28
Figure 7: Sources of Agricultural Extension Services .....	29
Figure 8: Maize Expansion Possibility by Respondents .....	29
Figure 9: Sources of Market by Maize Farmers in Central Ghana .....	30
Figure 10: Application of Fertiliser by Respondents .....	31
Figure 11: Source of Irrigation by Respondents. ....	32
Figure 12: Maize Farmers' Access to Tractor .....	33
Figure 13: Source of Seeds for Planting (n=50).....	34
Figure 14: Maize Variety Preference (n=50) .....	34
Figure 15: Varieties of Maize (n=50).....	35



## LIST OF TABLES

Table 1: The estimated Ghana's Maize Market Composition (Gage et al. 2012).....	10
Table 2: Sample Distribution across Regions and Districts .....	21
Table 3: Socio-Economic Characteristics of Farmers and Middlemen.....	25
Table 4: Expansion of Maize Farm .....	30
Table 5: Access to Tractor .....	33
Table 6: Reasons for Variety of Maize Preferred by Farmers in Central Ghana .....	36
Table 7: Results of Domestic Resource Cost Ratio .....	38
Table 8: Marketing Margins in Marketing Channels of Maize (GH¢100kg).....	39

## LIST OF ACRONYMS

AAGDS	Accelerated Agricultural Growth and Development Strategy
AE	Allocative Efficiency
CGIAR	Consultative Group for International Agricultural Research
CIDA	Canadian International Development Agency
CRI	Crop Research Institute And
CSIR	Council for Scientific and Industrial Research
DAES	Department of Agricultural Extension Services
DRC	Domestic Resource Cost
ECOWAS	Economic Community of West African States
EDIF	Export Development and Investment Fund Levy
FAO	Food and Agriculture Organization
FAOSTAT	FAO Statistical Pocketbook
FASDEP I	Food and Agriculture Sector Development Policy I
FASDEP II	Food and Agriculture Sector Development Policy II
FRI	Food Research Institute
GABC	Ghana Agribusiness Center
GCNET	Ghana Customs Network
GDP	Gross Domestic Product
GDP	Gross Domestic Product
GGDP	Ghana Grains Development Project
GNA	Ghana News Agency
GoG	Government of Ghana
GSS	GSS Ghana Statistical Service
IFAD	International Fund for Agricultural Development
JHS	Junior High School
MDA	Millennium Development Authority
MoEST	Ministry Of Education Science and Technology
WPP	World Population Prospects
MoFA	Ministry Of Food and Agriculture
MTADP	Medium Term Agricultural Development Programme
MTADP	Medium Term Agriculture Sector Development Programme

NGOs	Non-GOVERNMENTAL Organizations
NHIL	National Health Insurance Levy
PAM)	Policy Analysis Matrix
RCC	Regional Coordinating Council
SARI	Savannah Research Institute
SCB	Social Benefit Cost
SHS	Senior High School
SPSS	Statistical Package for Social Sciences
SRID	Statistics Research and Information Directorate
TE	Technical Efficiency
USAID	United States Agency for International Development
VAT	Value Added Tax
WCA	Savanna of West and Central Africa
WFS	World Food Summit

## 1. INTRODUCTION

Ghana's economy is generally considered as agrarian, largely due to the contribution of the agriculture sector to labour absorption and foreign exchange earnings (GSS 2010b). Agriculture in the Ghanaian Economy forms a key sector which contributes a total of 41.5% of employment. It is reported that, 45.8% of all households in Ghana are agricultural households out of which a higher section is engaged in crop farming (95.1%) (GSS 2010a).

Maize (*Zea mays* L.) is one of the most important staple crops for Ghana's agricultural sector which represent the second largest commodity. Maize constitute more than 10% of all agricultural production and 15% of agricultural employment in Ghana (Khaliq et al. 2004) and it is one of the most important crops for Ghana's agricultural sector and for food security in the country after cocoa (VOTO 2015). Maize, being the most widely consumed staple food in Ghana and a major source of carbohydrate to a large proportion of people, is the most important cereal crop produced in Ghana for centuries with increasing production since 1965 (Morris et al. 1999; FAO 2008). Rondon and Ahitey, 2011 reported that, the average yearly production of maize between the years 2007 and 2010 was 1.5 million MT with an average yield of 1.7t/ha (SRID-Mofa, 2011). Maize accounts for over 50% of the total production of cereals in Ghana, and annual yields have been reported to be growing around 1.1% (IFPRI, 2014). With the increase in land, however, yield per unit area remains almost the same within the stipulated time, (Dapaah et al. 2004). Production of maize has sustained and continues to gain wider acceptability over other traditional cereal crops in sub-Saharan Africa, especially in the Savanna of West and Central Africa (WCA). Maize has high yield, and adaptable to extreme environmental condition. Also, maize has relative ease of cultivation, processing, storage and transportation which makes it appropriate for combating food security challenges posed by ever increasing population in WCA (CSIR 2011). Maize as a multipurpose crop also provides raw materials to industry and feed for livestock and poultry production as well.

The agricultural sector is believed to have the potential to grow at high rates as six percent (6%); regardless of this, there is rapid transition from the agricultural sector to an industry and service sector-led economy in recent times (VOTO 2015). Meanwhile, agriculture still plays a fundamental role in Ghana, (MOFA 2002). All things being equal, it is expected that, since the greater number of farmers in Ghana cultivate maize, higher output will be realised. However, domestic production of maize in the country is woefully inadequate (Ragasa et al. 2014), since the prime production is predominantly done under rain-fed conditions, by poor resourced smallholder farmers (SARI 1996). Thereby, creating supply insufficiencies which are only met through imports (Ragasa et al. 2014). Banson et al. (2014) found that in many African countries, cultivation and production of crops is done by smallholder farms with limited mechanisation and capacity, leading to high transaction cost and poor yields. In addition to the current shortfall in domestic maize supplies to fulfil demand, maize consumption is projected to grow at a compound annual growth rate of 2.6% based on population growth and increasing per capita income (MoFA 2013). Based on the most recent domestic production data, the shortfall between domestic production and domestic consumption would reach 267,000 metric tons by 2015.

Further, beyond these projected figures for household consumption, there is considerable unfulfilled demand for processed maize uses and for the growing as feed for the animal sector within Ghana. There are substantial opportunities for increased maize utilization for feed mills. Currently, less than 10% of maize supplies go into the poultry feed industry, although demand is much greater than this supply. In 2008, the government granted special import permits for more than 26,000 metric tons of yellow corn to supply the poultry feed industry. Limited supply of maize for feed production has led to constraints in the growth of the poultry industry, resulting in significant growth in imports of poultry and other meats for consumption (Addison et al. 2015). According to the publication investment opportunity in Ghana maize, soya and rice by the Millennium Development Authority (MiDA), estimated demand for maize for poultry feed is projected to grow from 73,000 metric tons in 2010 to 118,100 tons by 2015 (MoFA 2013). This however, is unavoidably the case as poor outputs are realised, since most maize production is done at subsistence level. Therefore, it becomes very difficult for

farmers to produce more maize for local consumption. It thus stands clear that maize, the highest yielding cereal crop in the world, is of topmost significant for countries like Ghana, where demand has outmatched supply (Memon et al. 2011; and Ullah et al. 2011; Memon et al. 2012) .

## **2. AIMS OF THE STUDY**

Increasing local maize production to meet the rapidly escalating national demand and reducing imports of staple foods (maize, rice etc.), has been of chief priority for the government of Ghana. Also, with food prices on the rise and food security challenges being faced by a number of developing regions, the question of how to feed growing populations is a key concern. Policy approaches over the years have been formulated to guide intervention in the growth and development of the agriculture sector in Ghana by the Ministry of Food and Agriculture, to include Accelerated Agricultural Growth and Development Strategy (AAGDS), Food and Agricultural Sector Development Policy I and II (FASDEP) and Medium Term Agriculture Sector Development Programme (MTADP). These policies are channelled in commitment to modernizing agriculture and structurally transforming the economy to encourage maize production to address food security (Akatey 2018). FASDEP II which is redefined sector development policy guidelines was strategized to cope with food insecurities and emergencies; by increasing production of top five staple crops: maize, rice, yam, cassava, and cowpeas.

In spite of the numerous interventions made by the Ghana government for the crop sector, maize yield in Ghana is still lower than the African average yield and much lower than those achieved in regions in Asia and South America (GNA 2017). This situation creates supply insufficiencies and serves as a threat to food security. It is against this backdrop, that this study seeks to assess the competitiveness of local maize production and its contribution to food security in Ghana. In order to know the gap between the purchases of maize from farmers by middlemen at farm gate and how goods are sold in the market centres' marketing margin was estimated. Marketing margin is equilibrium entity of the differences between retail and farm gate prices (Wohgenant, 2001) or between market and farm gate prices as in this study. Marketing margins neither provides a measure of farmers' well-being nor of marketing firm's performance. However, they give the indications of the markets structure and efficiency (Tomek and Robinson 1990).

The main objective is to assess the competitiveness of maize production and its contribution to Central Ghana. The specific objectives are to:

1. Assess the competitiveness of maize production particularly in Central Ghana.
2. Estimate marketing margin along maize supply chain.



### 3. LITERATURE REVIEW

#### 3.1 Maize Market in Ghana

Maize is one of the most important crops in Ghana's agricultural sector. It represents the second largest commodity crop in the country after cocoa and contributes significantly to several consumer diets. It is the number one crop in terms of area planted and accounts for 50-60% of total cereal production. Maize is the second staple food apart from rice, consumed among many households in Ghana according to Alhassan (2008) and MOFA (2011); and it is traditionally grown throughout Ghana but the vast majority is concentrated in smallholder farms in rural arrears produced under rain fed conditions, leading to annual yield variations. Smallholder maize farms account for a significant (70%) production in Ghana (Khaliq et al. 2004). Maize production occurs in all the ten administrative regions in Ghana but more than 70% of maize comes from five regions which are Northern, Brong-Ahafo, Ashanti, Central and Eastern Regions (Amanor-Boadu, 2012). Under traditional production methods and rain fed conditions, maize yields in Ghana average approximately 1.7 metric tons per hectare. However, yields of 6 metric tons per hectare and higher have been realized by farmers using improved seeds (MoFA 2012). Various institutions and organizations are involved in the release, transfer and adoption of improved maize varieties in Ghana. Between 1979 and 1998, over twelve improved maize varieties were released to farmers by the Council for Scientific and Industrial Research (CSIR) under the Ghana Grains Development Project (GGDP) funded by the Government of Ghana (GoG) and the Canadian International Development Agency (CIDA). Some of the improved maize varieties released to farmers include "*Abeleehe*", "*Aburotia*", "*Dobidi*", "*Dorke*", "Golden Crystal", "*Mamaba*", "*Obatanpa*", "*Okomasa*" and "*Safita*" (Morris et al., 1999). Four improved varieties, including, "*Aziga*", "Golden Jubilee", "*Akposoe*" and "Etubi" were then released in 2007. Five hybrid varieties, including, "*Mamaba*", "*Cidaba*", "*Dadaba*", "*Etubi*", and "*Enibi*" were released by the Crop Research Institute (CRI) and Savannah Research Institute (SARI) in 2010. Another six varieties namely, "*Aseda*", "*Opeaburoo*", "*Tintim*", "*Nwanwa*", "*Odomfo*" and "*Honampa*" were released in 2012 (Ragasa et al 2013).

### **3.1.2 Maize Expansion and Market Opportunities**

It's been reported that the total quantity of maize marketed annually in Ghana is about one million metric tons. But out of this amount, a significant volume of maize produced by the locals remains as a primary staple food for households. Maize imports and exports are significantly low and assumed to have a net neutral effect on the market. Limited yellow maize is imported for the poultry feed industry and internal cross-border trade with the Sahel occurs, but has not been sufficiently studied and quantified.

The production of maize in Ghana largely meets current domestic market demand. The poultry feed industry imports limited quantity of yellow maize of approximately 50,000 MT. Traders do indicate some cross-border trade with the Sahel, particularly Burkina Faso, but it is a relatively small percentage of the market with no trader attempting to estimate actual volumes (USAID-EAT 2012).

## **3.2 Conceptual Framework**

This section explains the concepts of maize marketing channels and middlemen in the maize supply chain, production technologies in maize production and policy environment of the maize sub-sector. It also explains the concepts of both competitiveness of production and efficiency and how the two concepts help us to understand the relationship between inputs and output under a given production technology.

### **3.2.1 Maize Marketing Channels**

In order to improve the marketing arrangements for maize and other agricultural products, one needs to understand the channels that are currently used for trade. In fact, most small-scale farmers consume their produce largely within their household. The excesses are sold either to the local markets or to urban markets depending on the nature of the maize produce and/ or farmers' access to the market. Maize supply at the market is very limited and fluctuates according to the season. Maize farmers are inherently risk-averse and unlikely to produce more consistently if the market demonstrates uncertainty (Amanor-Boadu, 2012). The long distances from the maize farms to the urban markets makes smallholder maize farmers who cannot sell their produce at nearby local markets depend on middlemen who buy the maize for the urban markets (Eskola 2005). Mwangi

and Mdoe (2015) found that selling through middlemen cannot be avoided unless the smallholder farmers are directly linked with buyers at the terminal markets. The middleman trader exercises the essential entrepreneurial functions of exploring and creating market exchange opportunities and bears the risk entailed in this task. Middlemen operate in all the continents of the world to help the smallholder farmers' access customers and the customers to get the products (Weinberger and Lumpkin 2007).

These groups of people act as intermediary between the producers (farmers) and the consumers. In the process of letting food or other agricultural materials reach the final consumer (user), the price is marked up to cover transportation, storage and profit. Inefficient agricultural marketing system has been observed to have major drawbacks in the development of the agricultural sector (Mdoe et al. 2001). Many of the farms are located in relatively isolated areas, a considerable distance from improved roads making access to competitive markets difficult and costly (Massawe2007). Lack of bargaining power along with various credit bound relationships with the buyers has led to farmers being exploited during transaction (Eskola 2005). Food insecurity is one of the problems in sub Saharan Africa as a result of many environmental factors including human.

### **3.2.2 Competitiveness of Production**

Ghanaian maize competes favourably within the West African region. Production yields are on par with regional yields at 1.9 metric tons per hectare; similarly, domestic farm-gate prices, at \$384 per metric ton, are only 2.7% higher than regional averages. However, Ghana's maize has not yet achieved global competitiveness: global yields are approximately three times higher than domestic yields, while local farm-gate prices exceed global averages by 22%. There is potential to enhance global competitiveness through the use of improved seeds and fertilizers, which could result in yield improvements of over 23% and significantly reduce costs of production (GABC 2017).

International maize economy has undergone major changes over the past two decades in terms of production, utilization, trade as well as marketing structure. These changes were driven by a host of factors ranging from rapid advancements in seed and production technologies, changes in national policies and international trade, nearly uninterrupted

expansion of feed usage across the globe and more recently the sudden surge in demand for ethanol (Abdolreza 2006).

### **3.3 Policy Environment of the Maize Sub-Sector**

Adjao (2011) asserted that nations and economies can improve their competitiveness, and consequently their fortune, through policy reforms aiming at transforming a sub-sector in order to assume broad-based economic growth and increase productivity. In Ghana, improving productivity and competitiveness of the maize sub-sector through agricultural mechanisation, subsidisation of farm inputs like fertiliser, herbicides, tractors (Boansi et al. 2015), and enhancing commercial agriculture has been of key interest of government policies geared towards increasing maize production (Wienco Agriculture 2010). In the pursuit of enhancing agricultural productivity and narrowing the gap between domestic demand and supply of high quality maize, various government interventions have been rolled out since 2001 for the grain sub-sector to encourage production so that self-reliance and food security could be achieved (MoFA 2013).

Some of the policy interventions included the Medium Term Agricultural Development Programme (MTADP) which was developed in the early 2000s and was aimed at enhancing efficiency and effectiveness of the agricultural sector (MoFA 2002). Further, in 2002 the Ministry of Food and Agriculture (MoFA) drafted 'Food and Agriculture Sector Development Policy' (FASDEP I) with the aim of enhancing food security, reducing poverty, providing raw material base to industries so as to ensure sustainable contribution of the agricultural sector to Gross Domestic Product (GDP), foreign exchange and government revenues. It was also aim at revamping the maize sub-sector to discourage maize importation into the country (Brooks et al. 2007).

In 2008, Ministry of Food and Agriculture again developed the 'Food and Agriculture Sector Development Policy II (FASDEP II). The main objectives were to ensure food security, exigency awareness creation of five major staple food crops (namely maize, rice, cowpea, cassava and yam). And also to escalate competitiveness and increase synergy between domestic and international market as well as create employment opportunities, improve income levels and reduce poverty and also apply science and technology in food and agricultural development (Boansi et al. 2015).

### 3.4 Maize Consumption

Reports indicate that 90% of the world's calorific requirement is provided by only 30 crops, with wheat, rice, and maize alone providing about half the calories consumed globally (MA 2005b).

The consumption of maize in Ghana increase from 1750,000 MT in 2010/2011 to over 2,480,000 MT in 2016, MoFA 2017) and an estimated national consumption of 2,500,000 Mt in 2016 (SRID-MoFA 2017). One million metric tons of maize is reported to be marketed annually in Ghana. A very large quantity of maize grains produced (Table 1) remains within households of producers as a primary staple food (Gage et al 2012). The maize grain is consumed in different forms in various traditions and cultures and large proportion of the maize is used in the poultry industry as feed. Only about 20% to 25% of the total maize marketed is used for industrial processing and purposes. The wholesale price of maize is dependent on proximity to markets (location and transport), and the year's season, with prices generally high during the off seasons (Amanor-Boadu 2012).

**Table 1: The estimated Ghana's Maize Market Composition (Gage et al. 2012).**

<b>Variable</b>	<b>Quantity (MT)</b>	<b>% of Total Consumption</b>	<b>% of Marketed Maize</b>
Total maize consumption	1,785,000		
Subsistence consumption by Households & post-harvest losses	801,000	45	
Animal feed market (largely poultry)	410,000	23	42
Human consumption (informally traded)	328,000	18	33
Formally traded for processing (industrial & processed food)	246,000	14	25

Maize is cultivated worldwide and represents a staple food for a significant proportion of the world's population (International Food Biotechnology Council 1990). In sub-Saharan Africa, maize is a staple food for about 50% of the population and provides 50% of the basic calories. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals. Africans consume maize as a starchy base in a wide variety of porridges, pastes, grits, and beer. Green maize (fresh on the cob) is eaten parched, baked, roasted or boiled and plays an important role in filling the hunger gap after the dry season (Hussan et al 2003; SRID-MoFA 2007).

Maize grains have great nutritional value as they contain 72 % starch, 10 % protein, 4.8 % oil, 0.5 % fibre, 3.0 % sugar and 1.7 % ash (Chaudhary 1983). *Zea mays* is the most important cereal fodder and grain crop under both irrigated and rainfed agricultural systems in the semi-arid and arid tropics (Hussan et al 2003). The per capital consumption of maize in Ghana in 2000 was estimated at 42.5 kg (MoFA 2000) and an estimated national consumption of 943000 Mt in 2006 (SRID 2007).

The total quantity of maize sold annually in Ghana stands at about one million metric tons. A significant volume of Ghanaian-produced maize remains within producer households as a primary staple food (SRID-MoFA 2007). Maize, specifically white maize, is an important staple food in Ghana, particularly for the approximately 1 million households involved in primary production of maize. Many consumers though are showing an increased preference for rice over maize due to ease of rice preparation. This trend is more pronounced in urban areas, and is significantly less apparent in rural maize-producing areas. Considering that annual population growth has been between 2 percent and 3.5 percent since 1980, any decline in per-capita human consumption of maize due to changing consumer preferences is likely to have been offset by overall population growth. This results in essentially stagnant overall human consumption of maize (Gage et al. 2012).

### **3.4.1 Poultry Feed Market**

Poultry consumes about 400,000 MT of maize annually (approximately 40 percent of the maize marketed). The volume of high-quality yellow maize going into

commercial poultry feed is about 200,000 MT. Roughly 150,000 MT of this is produced in Ghana, primarily in the Northern Region. Imports represent the balance of about 50,000 MT. The remaining 175 to 200,000 MT of maize required for feed is locally produced white maize (Gage et al. 2012). White maize remains more widely produced and thus more available in the market, but the poultry industry prefers yellow maize. The poultry industry is dominated by layers, and yellow maize contributes to a more pronounced yolk colour. Commercial poultry feed producers and large integrated poultry companies use an additive in feed produced with white maize to compensate for the yolk colour impact. Small-scale poultry producers do not, and the eggs produced are significantly paler.

Maize accounts for about 60 percent of the average poultry feed ration. Commercial poultry production is struggling to compete with cheap broiler imports from Brazil, which is one explanation for why the industry is dominated by layers for table egg production. Most poultry operations mix their own feed, buying ration components from various sources. The white maize is mostly purchased from traders and in the local informal markets, while the yellow maize is more often purchased by the few large, formal final feed millers and the largest integrated poultry operations (Koney 2004).

### **3.4.2 Industrial Maize Use**

Industrial maize buyers estimate that processing and utilization of maize represents up to 20 to 25 percent of the total maize marketed. Breweries are a small but interesting player in the Ghana maize market (Koney 2004). Sorghum is preferred to maize in brewing, but breweries will substitute maize if attainable at a competitive price. According to one key industry player, the general rule of thumb is that a maize grits price of US\$0.80/kg is the highest amount at which brewers consider substituting grits for sorghum.

Breweries and beverage manufacturers have also done trials with corn syrup as a substitute for sugar and are eager about the possibilities for using corn syrup due to unique fermentation properties. Some processors use maize for ready-made or processed traditional foods (such as banku), which meet with mixed consumer reviews. While some prefer the convenience of “quick prepare” products, many perceive these products as lower quality and are unwilling to pay a premium. These products largely target the small export market for Ghanaians living abroad whom show a higher rate of adoption and acceptance.



## **4. METHODOLOGY**

### **4.1 Research Design**

The research design employed for the study was a quantitative research approach. This design is considered suitable because it has the ability to cover large geographical area and a tendency to give relevant information to describe situations (Best and Kahn, 2005). The quantitative research design is concerned with phenomena that exist, the direction, effects that are evident or trends that are developing among variables.

#### **4.1.2 Geographical Characteristics**

Ghana lies on the south central coast of West Africa between latitudes 4.5<sup>0</sup>N and 11.5<sup>0</sup>N and longitude 3.5<sup>0</sup>W and 1.3<sup>0</sup>E. It shares a common border with the Republic of Togo on the east, Burkina Faso on the north and la Cote d'Ivoire on the west respectively. Ghana covers an average area of 238,539square kilometres (MoFA 2012). Extensive water bodies including the Lakes Volta and Bosomtwe occupy 3,275 square kilometres while seasonally flooded lakes occupy another 23,350 square kilometres. The territorial waters extend 200 nautical miles out to sea. All the major rivers in Ghana flow into the sea. The only area of internal drainage is found around Lake Bosomtwe, where only streams flow from the surrounding highlands into the lake. The river valleys show diverse characteristics. The valleys of all the major rivers are bordered by terraces showing the former width and height of the rivers. Whilst some of the valleys are guided in their direction by relief or by structure. The two main sources of water supply for the rivers are rainfall and spring. In areas with single rainfall maximum as in the north, the rivers are intermittent. However, in areas with high and well distributed rainfall within the year, the rivers flow throughout the year.

### **4.1.3 Climate and Vegetation**

Ghana is considered as a fairly mild tropical climate with season divided into two different categories, the cold or the wet season and the hot or the dry season. The southern part of Ghana experiences the wet season from the start of April until the middle of the month of November where as that of northern Ghana begins around March and prevails until the end of November. From December through to the month of March, dry wind blows in north-eastern Ghana, which abruptly reduces the humidity in the climate, making the days hot and the nights cool in the northern part of Ghana. The humidity levels vary from about 77% - 78% but has the mean temperature range of about 21<sup>0</sup>C to 28<sup>0</sup>C (70 to 82F) dominating the weather of Ghana (MoEST 2000; WPP 2017). Generally, rainfall in Ghana decreases from south to north. The wettest area is the extreme south-west where annual rainfall is about 2000mm. In the extreme north, the annual rainfall is less than 1100mm. The driest area is the wedge-like strip from east of Sekondi-Takoradi, extending eastward up to 40km where the annual rainfall is about 750mm. The dry conditions in the south eastern coastal strip are anomalous and are the cause of important differences in ecology and land use from the rest of the country (MoEST 2000; MoFA 2012).

### **4.1.4 Agro-Ecological Zones:**

There are 5 main agro-ecological zones (fig. 3.2) defined on the basis of climate, reflected by the natural vegetation and influenced by the soils. These are Rain Forest, Deciduous Forest, Transitional Zone, Coastal Savanna and Northern Savanna (Guinea and Sudan Savanna) (MoFA 2012).



**Figure 1: The Agro-Ecological Zones in Ghana (FAO 2005 (Modified), RESPTA 2008).**

#### **4.2 Key Data Variables for the Study and their Measurement**

Variables are experiential factor or condition that takes different values or categories. The main data variables for the research are farm size (in hectares), types of inputs used, sources of labour, access to finance, maize varieties cultivated, cropping systems, land preparation method, fertilizer usage harvesting method for the purpose of some agricultural indicators in the study area. Farm gate and market prices of maize for the calculation of marketing margin. Other key variables obtained were farmers' sources of extension services and marketing of maize as well as middlemen involvement in the maize supply chain.

Two measurement scales were used to measure these variables. They are the nominal and interval scales. The nominal scale was used to measure the socio-economic characteristics of the sampled maize farmers such as level of education, gender, types of inputs used, farm preparation techniques and systems, fertiliser usage and access to credits and markets. The interval scale was used to measure the variables related to the

farmers' land holdings (for instance; farm size), years of farming, household size; quantities of agrochemicals used and farm output.

### 4.3 Study Area

The study was carried out in the middle belt of Ghana, including Ashanti and Brong-Ahafo regions (fig. 1).



**Figure 2: Map of Ghana- (Wikimedia Modified)**

Ashanti region is located between longitude 0.15 - 2.25 West and latitude 5.50–7.46 North. The region is bounded to the North, West, South and East by Brong-Ahafo region, Western region, Central region, and Eastern & Volta regions respectively. The total land area of Ashanti region is 24,389square kilometre out of which 60% are arable. Nonetheless, only 81% of the 1,463,340 hectares arable lands are cultivated. It is reported that about 706,888 are engaged in agriculture (GSS 2010; MoFA 2015).

Brong-Ahafo region is the second largest region in Ghana with a land area of 39,558 km<sup>2</sup> and covers 16.6% of the country's total land. The region lies within longitude 0° 15' E-3° W and latitude 8° 45' N-7° 30' S in the west central part of Ghana. It shares boundary with Ashanti and Western regions to its North, to the west by Republic of Cote d'Ivoire, to its south-east lies the Eastern region and to its south by Volta region. Arable land area in the region is 23,734 km<sup>2</sup> out of which 46% are cultivation dominated by crop production (GSS 2010; MoFA 2015).

#### **4.4 Data Sources**

Both secondary and primary data were used for the study. Secondary data were used largely for reviewing related literature and in the calculation of the Domestic Cost Ratio (DCR). The primary data collected from small-scale maize farmers and middlemen for the calculation of marketing margin.

##### **4.4.1. Secondary Data Sources**

The secondary data was mainly from Premium Foods Limited for the competitiveness (DRC) while others were assembled from articles, academic journals and books, research projects, reports and database of World Bank, IMF, and UNDP.

##### **4.4.2. Primary Data Sources**

The Primary data collected for the study involved the socio-economic and demographic characteristics of the small-scale maize farmers and middlemen in the maize production and marketing systems in central Ghana.

The data collection methods used in obtaining more precise information was varied. It included structured questionnaires with the local maize farmers and middlemen. The farmers and middlemen were sampled from three districts in each of the two regions in Central Ghana, comprising Mampong Municipal, Ejura-Sekyeredumase and Asante Akim South districts in Ashanti Region; and in the Brong-Ahafo of Ghana, Kintampo North Municipal, Techiman North and Nkoranza South districts. Appendix 1 shows photo-documentation the researcher administering questionnaires.

#### 4.4.3 Structured Questionnaire

Questionnaires are essential tool and are in a form of written interviews which enable the researcher to attain significantly low level of involvement for information from numerous participants within the shortest possible time (McLeod 2014). A set of close and open ended questions were used for interviewing respondents. These questions comprised of information on the bio data and socio-economic characteristics of maize farmers and middlemen in study areas. More importantly, information on farming and production system of maize cultivation were obtained using this tool, also the economics of production involving cost of inputs and other operational expenses; and the quantity of harvested maize and producer price from both the local market and farm gate were sought. Likewise, production technologies and financial support encountered by the local maize producers were included in the semi-structured questionnaires. Ultimately, constraints in local maize farming that always pop up in production; as well as the marketing challenges that rare it ugly heads on maize market sellers were also included.

The main data tool for the collection of primary data was chosen structured questionnaire. It was accounted as the most appropriate research instrument for data collection due to short period of time allowed for gathering information from small-scale farmers and middlemen. Two different set of questionnaire were constructed for each group of respondents in English language but were elaborated in local Vernacular for the illiterate farmers and middlemen/marketers respondents to respond appropriately.

- The questionnaire for the maize farmers involved 59 questions of various forms: single response with nominal categories, multiple choice responses and scaled questions (see Appendix 2). It contained sections about:
  - i. Personal data of the respondents: gender, age, family status, level of completed education, region and household composition.
  - ii. The experience of the farmer in maize production: year into production, total area of cultivated land, average expenditure per hector of cropping,

type of irrigation system, utilization of fertilizers/agricultural equipment, access to a loan and quantity/price of cultivated crops, the farming system used, type/variety of seeds used, fertilizer usage, farm machinery used.

- iii. Harvesting techniques: time and method of harvesting, tools in harvesting, season of harvesting, yield per hectare harvest etc.
  - iv. Maize processing and storage: chemical usage, time of storage etc.
  - v. Marketing of maize: sales of produce, market features, problems in sales
  - vi. Role of government and organization/ funding: extension services, funding/assistance, credit facilities.
- The questionnaire for the maize middlemen/marketers involved 20 questions of various forms (See Appendix 3) containing sections about:
1. The personal data of the maize marketers/sellers
  2. Experience as a Maize Seller: The years being in marketing/selling maize business, source of acquiring the maize produce, system of selling price determination, time of maize demand, purchasing class, storage point and market centre distance farm gate, main problems marketing of maize produce, etc.

#### **4.4.4 Sampling Technique and Sample Size**

A Simple Random Sampling technique was used to select the various respondents for the survey, comprising registered maize farmers who are recognized by various district offices of the Ministry of Food and Agriculture, registered maize sellers in the various markets by market authorities while the extension officials were sampled from the staff of the various district MoFA offices.

The population for the purpose of this research entailed the total number of maize farms in the four districts and the two Municipalities. The total farmers obtained from all districts were 94. Hanlon and Larget (2011) define population as, a group of people that share the same characteristics that is of interest to the researcher. It is therefore impracticable if not impossible to study an entire population before making

generalisation (Best and Khan 2013) cited in (Mbangani 2016). It would have therefore been expensive to study the entire population due to the limited time the researcher had to conduct this study.

A sample of 63 respondents were interviewed but scaled to the sample size of 50 after screening for purposes of quality data since some respondents failed to answer some vital questions. A sample can therefore be seen as a percentage of the entire population selected for a study from which valid and reliable inferences can be made of the population (Hanlon and Larget, 2011). The researcher however purposively selected the 20 middlemen whose names were frequently mentioned by the farmers during the questionnaire administration, and are recognized by the market Queens (authorities).

**Table 2: Sample Distribution across Regions and Districts**

<b>Regions</b>	<b>Districts</b>	<b>Farmers</b>	<b>Middlemen</b>
Ashanti	Mampong Municipal	9	4
	Ejura-Sekyeredumase	8	3
	Asante-Akim South	8	3
Brong-Ahafo	Kintampo-North Municipal	9	4
	Techiman-North	8	3
	Nkoranza-South	8	3
<b>Total</b>		<b>50</b>	<b>20</b>

The data were collected between 7<sup>th</sup> June 2016 and 20<sup>th</sup> September 2016 in the two separate regions in central Ghana- Ashanti and Brong-Ahafo regions (fig. 1) for the 2015/2016 cropping season. Three (3) districts were randomly selected from each region; comprising one (1) municipal district and two (2) ordinary districts. From each district, eight (8) maize farmers were randomly sampled whilst nine (9) farmers from the municipal districts were sampled to obtain a total of 25 respondents for each region. Hence, 50 maize farmers were sampled for survey from all the



districts. Furthermore, the survey on the middlemen composed of three (3) intermediaries randomly sampled from the ordinary districts and four (4) from the municipal districts of each region. Thus, making a total of 20 at the market level.

#### **4.5 Data Analysis**

In assessing the competitiveness of domestic rice production in Uganda, Kikuchi et al. (2016) employed the Domestic Resource Cost (DRC) Ratio, to evaluate the comparative advantage of Uganda's rice sub-sector relative to rice imported from Pakistan. In another study, Ogbe et al. (2011) assessed the competitiveness of Nigerian rice and maize production ecologies using the policy analysis matrix (PAM).

In the same way, this study used the DRC ratio to assess the competitiveness of local maize production in central Ghana (Ashanti and Brong-Ahafo regions).

##### **4.5.1 Empirical Model of the Domestic Resource Cost Ratio (DRC).**

The DRC ratio is estimated as the ratio of the economic value of “domestic resources” used in production relative to the economic value-added created by the production process. Considering Salinger (2001) the domestic resource costs earned or saved by producing product  $j$  is defined as:

$$DRC = \frac{\sum_s f_{s,j} P_s^*}{P_j^* - \sum_i a_{i,j} P_i^*}$$

Where:  $f_{s,j}$ : quantity of factor of production ‘s’ used to produce one unit of product ‘j’

$P_s^*$ : international reference price of factor of production s

$P_j^*$ : international reference price of product j

$a_{i,j}$ : quantity of tradable input i used to produce one unit of product j

$P_i^*$ : international reference prices of input i

The DRC thus represents the cost of domestic resources spent in order to gain or save a unit of foreign exchange. In order to see whether a country is efficient in the production

of product  $j$ , the DRC should be compared to the shadow exchange rate which reflects the scarcity value of the foreign exchange for the entire economy, which is the reference exchange rate (Salinger 2001). A DRC coefficient which is greater than 1.00 suggests that the firm is using more value in domestic resources than it is gaining in tradable value-added. A DRC coefficient which is less than 1.00 suggests the opposite; that is the firm is gaining more in terms of tradable value-added than it is using in domestic factors of production. In the latter scenario, the firm is said to be competitive and demonstrates a comparative advantage, relative to other global producers, in the production of that good.

The DRC ratio provides a primary scale of the opportunity cost and competitiveness for initial examinations (Siggel 2006).

#### **4.5.2 Marketing Margins**

Marketing margin is defined as the difference between the price paid by consumers and that obtained by producers. It is also called the ‘Farm-Retail Price Spread’. Margins can be calculated all along the market chain and each margin reflects the value added at that level of the market chain (FEWS NET 2009).

The Percent Marketing Margin (MM) according to Hussain et al. (2013) can be

calculated as: 
$$MM = \frac{Ps}{Sp} \times 100$$

Where:

$MM =$  Marketing Margin

$Ps =$  Price spread,

$Sp =$  Sale price

$Ps =$  Sale price – Purchase price

#### **4.6 Limitations of the Study**

The main limitation encountered by researcher was poor or no records keeping by respondents (farmers and middlemen) in the study area. As a result, responds were not always able to give accurate responds pertaining to purchases of inputs for their production and marketing prices.

## **5. RESULTS**

### **5.1 Socio-Economic Characteristics of Respondents**

This section entails the social and economic characteristics of respondents (maize farmers, middlemen and extension officers) in the study area. Educational status, sex, gender, age, marital status, household size, and work experience of the respondents were some of the issues discussed. Table 3 below shows the Socio-economic characteristics of the respondents in the study.

Results from Table 3 revealed that, majority (58%) of the maize farmers were males, just as the middlemen (55%), whilst female form the minority (42% and 45%) in both cases respectively.

Also, maize farmers were mainly in the age bracket of 41-55years with minority (14%) falling within the age brackets of 26-40years. However, the maize middlemen were mostly (45%) within the ages of 41-55 while only few (10%) were those who are 56 years and above are involved in the selling business.

On the level of education attained by the respondents, most of the maize farmers had either primary (22%) or secondary (12%) education, but not tertiary education as is found in the middlemen. However, 32% of 50 farmers and 25% of 30 marketers were found to be illiterate and could neither read nor write (figure 3).

The household sizes of the farmers were mostly (42%) from 6-10. While that of middlemen (45%) The respondents marital status were found to be majority (38%) single farmers, majority married (55%) marketers. It was evident only few respondents were divorced or widowed.

Moreover, the findings revealed that 32% of the 50 farmers have 11-15 years of practical maize farming experience just as 60% of the marketers had been actively engaged in the maize marketing business for 16 years and above.

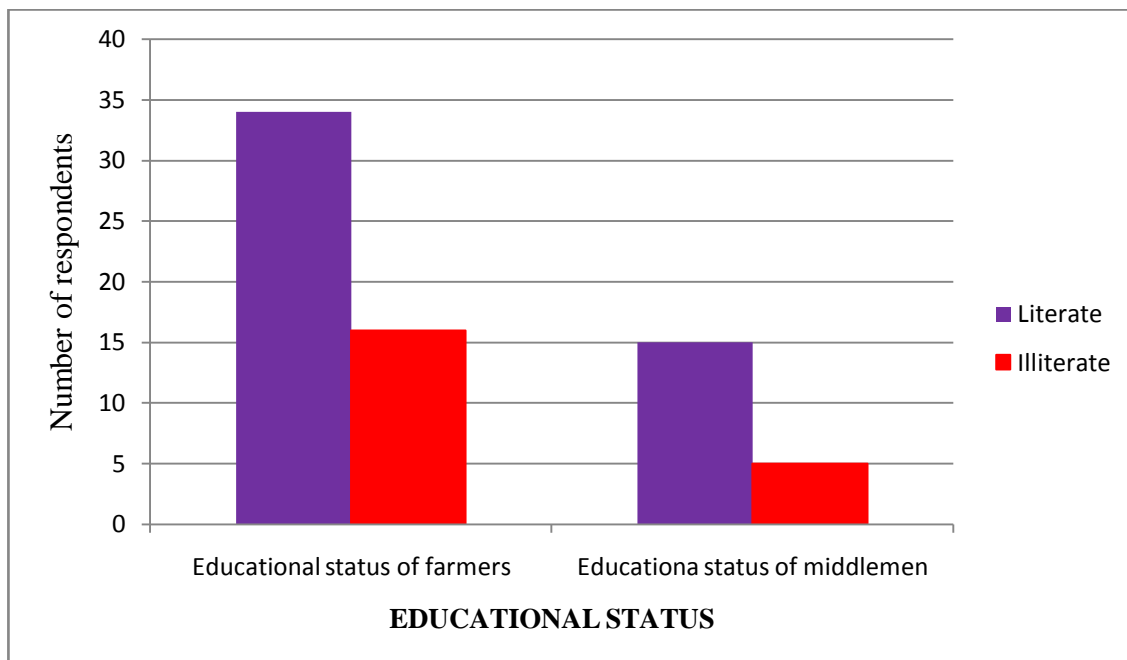
The study found majority of respondents frequently use maize in their households. From Table 2, 52% of farmers, and 93.3% of middlemen use maize grains frequently at home. Whiles 26% of farmers, 6.7% of middlemen consume maize food once a week.

**Table 3: Socio-Economic Characteristics of Farmers and Middlemen**

Respondents	Characteristics	Farmers n(50)		Middlemen n(20)	
		n	%	n	%
Gender	<i>Male</i>	29	58	11	55
	<i>Female</i>	21	42	9	45
Age (years)	<i>18-25</i>	14	28	3	15
	<i>26-40</i>	7	14	6	30
	<i>41-55</i>	17	34	9	45
	<i>56 above</i>	12	24	2	10
	<i>Mean</i>	38.75		45.67	
Level of Education	<i>Primary/JHS</i>	22	44	12	60
	<i>Secondary</i>	12	24	2	10
	<i>Tertiary</i>	0	0	1	5
	<i>None</i>	16	32	5	25
Marital status	<i>Single</i>	19	38	1	5
	<i>Married</i>	15	30	11	55
	<i>Divorce</i>	6	12	6	30
	<i>Widow</i>	10	20	2	10
Household size (persons)	<i>0-5</i>	17	34	9	45
	<i>6-10</i>	21	42	6	30
	<i>11-15</i>	3	6	3	15
	<i>16 above</i>	9	18	2	10
	<i>Mean</i>	6.63		6.5	
Work experience (years)	<i>1-5 years</i>	9	18	0	0
	<i>6-10 years</i>	12	24	2	10
	<i>11-15 years</i>	16	32	6	30

	<i>16 above</i>	13	26	12	60
	<i>Mean</i>	<i>10.25</i>		<i>8.67</i>	
Family use of maize	<i>Once a week</i>	13	26	1	6.7
	<i>Twice a week</i>	5	10	0	0
	<i>Not frequent</i>	6	12	0	0
	<i>Frequent</i>	26	52	14	93.3

Source: Field Survey, 2016

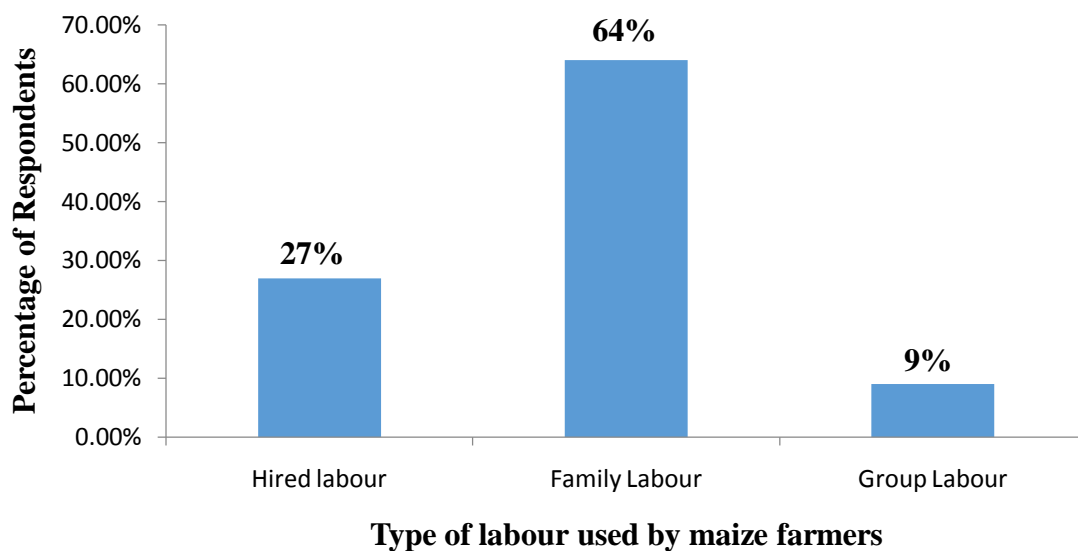


**Figure 3: Education Status of Respondents**

## 5.2 Agricultural Indicators

### 5.2.1 Farm Labour Used by Respondents

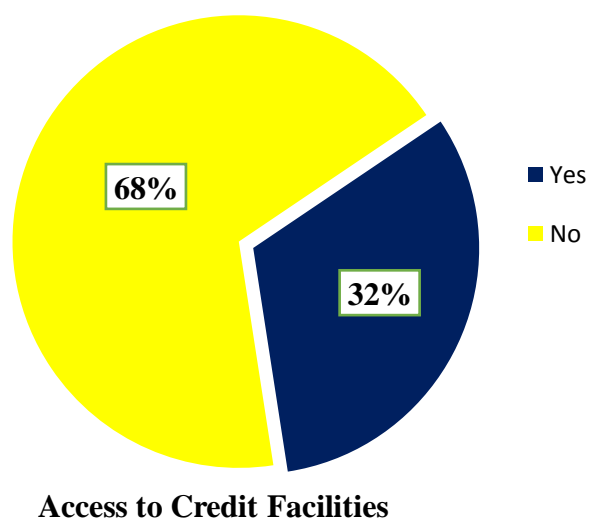
From figure 4, majority (64%) of farm labour used were sourced from household labour. Followed by hired labour, which are sought to augment farm work force representing 27%. However, few (9%) of the farmers rely on group labour (Nnoboa) during the harvesting period.



**Figure 4: Type of Farm Labour Used**

### 5.2.2 Access to Credit Support

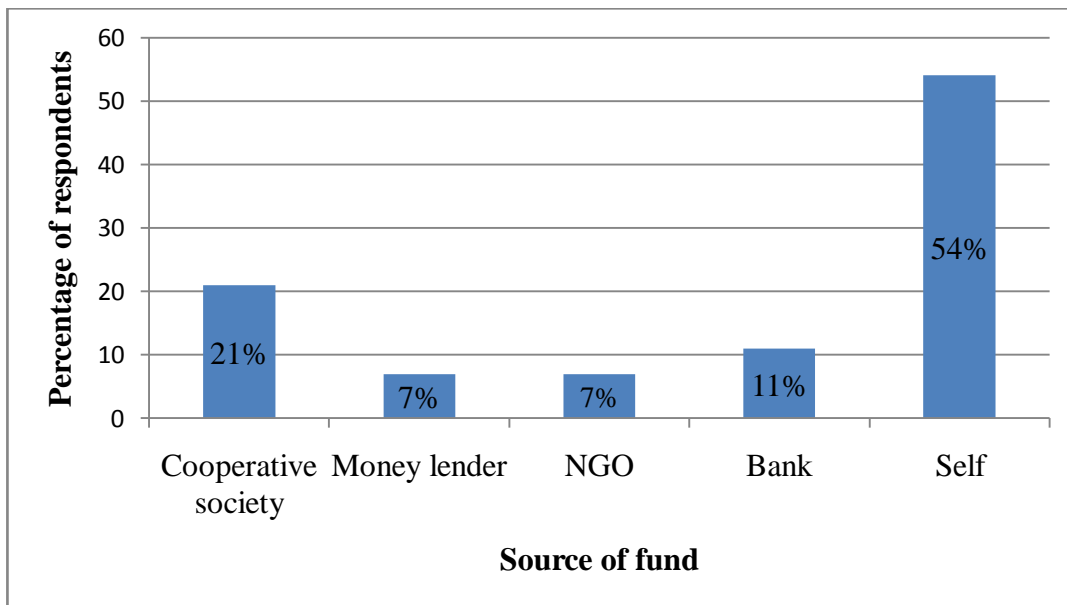
From the survey,, 34 farmers representing 68% did not have access to credit facility to enable them purchase farm inputs such as improved seed, fertilizers and pesticides to facilitate the maximization of maize output. Only32% of the farmers had access to credit support as illustrated in figure 5 below.



**Figure 5: Access to Credit Facilities**

### 5.2.3 Sources of Fund of Maize Farmers

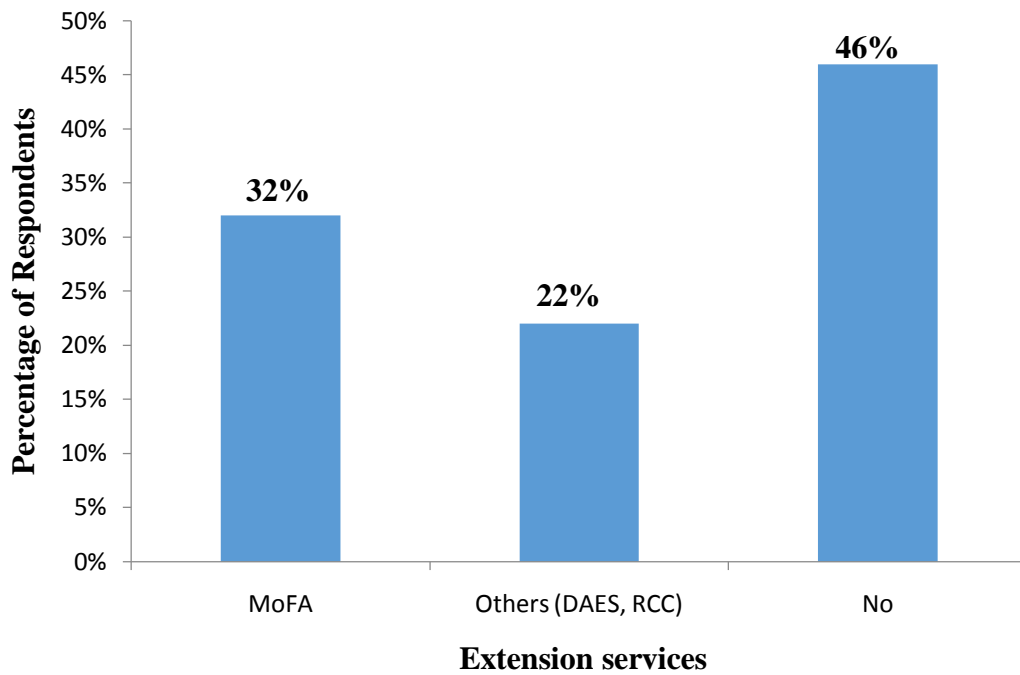
Most farmers (54%) in the study area self-finance their farming activities on their own. However, other sources of fund available for maize farmers in Central Ghana are funds from Cooperative society (21%) due to low amount of interest rates charged on amount borrowed. then, moneys sourced from banks (11%) and NGO's (7%) as well as money lenders (7%). This is due to lack of availability of funds and high interest rates charges (Fig. 6)



**Figure 6: Sources of Funds Available to Maize Farmers.**

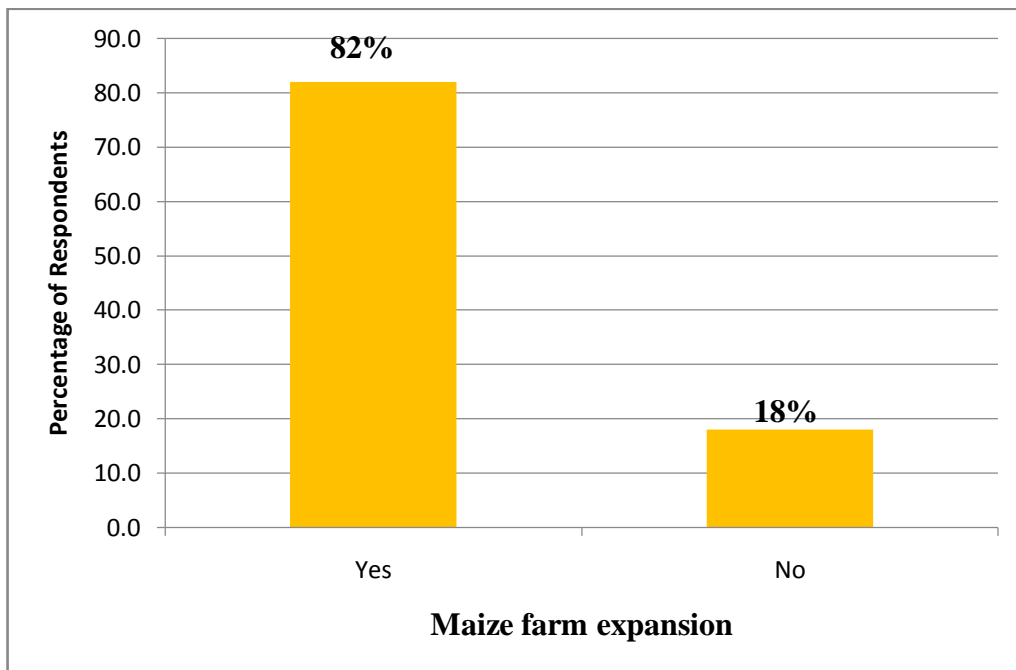
### 5.2.4 Sources of Agricultural Extension Services

From figure 7, majority of maize farmers (46%) stated that they do not have access to any form of extension services. However, the few (32%) who had received it from the government extension officers of the Ministry of Food and Agricultural (MoFA). Other sources of agricultural extension services available to 22% of maize farmers are either from Department of Agricultural Extension Services (DAES) or Regional Coordinating Council (RCC) or Food Research Institute (FRI) or Crops Research Institute (CRI).



**Figure 7: Sources of Agricultural Extension Services**

**5.2.5 Maize Production Expansion in Central Ghana.**

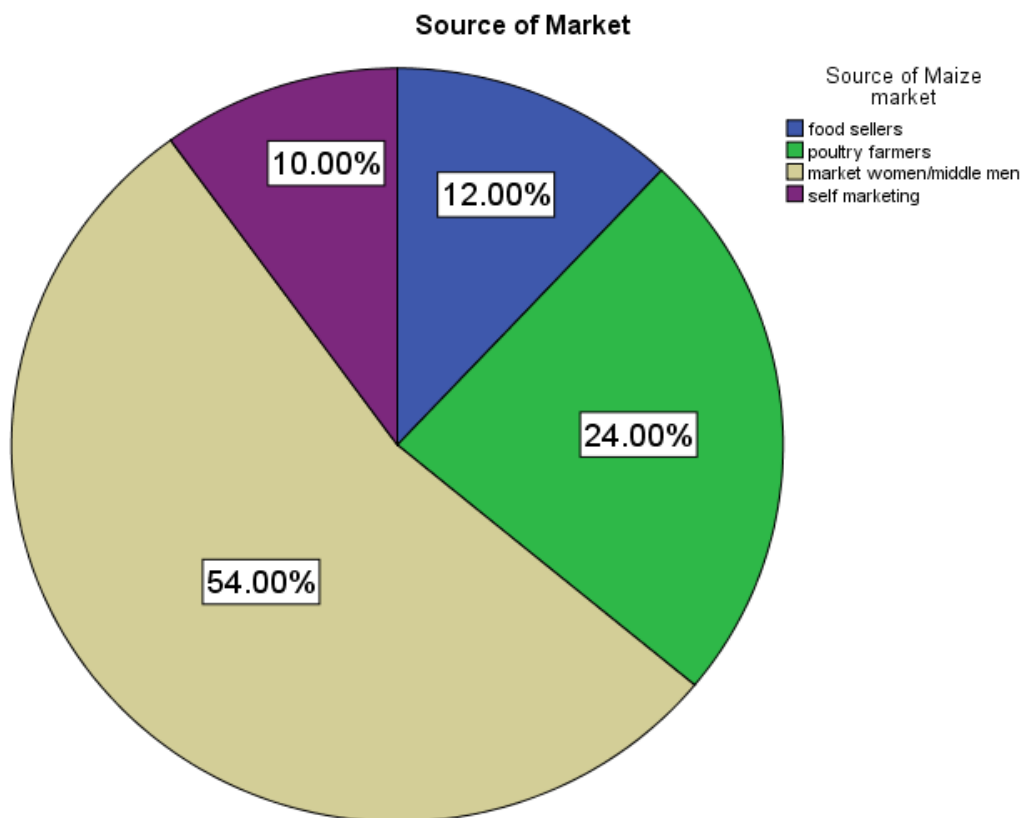


**Figure 8: Maize Expansion Possibility by Respondents**



**Table 4: Expansion of Maize Farm**

Maize Farm expansion	Frequency	Percentage (%)
Access to financial assistance	8	16
Reduction of input prices	10	20
High price of maize produce	9	18
Availability of ready market	12	24
Develop high-yield maize	4	8
Availability of irrigation system	7	14
Total	50	100

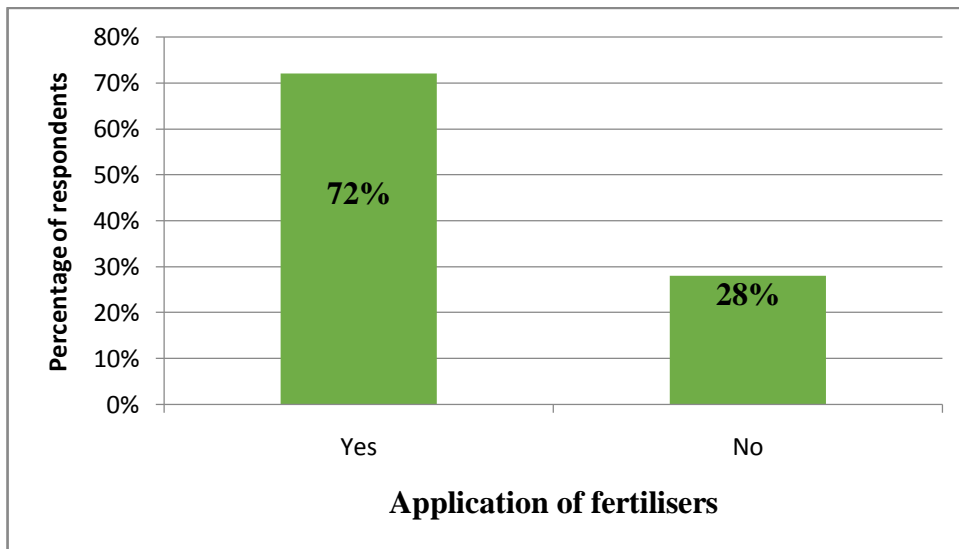


**Figure 9: Sources of Market by Maize Farmers in Central Ghana**

### 5.2.6 Technologies Applied by Maize Farmers

It was observed that, most (72%) of the farmers in central of Ghana do apply fertiliser in the cultivation of maize in order to improve the yield levels. Meanwhile a few (28%) of them affirmed that, they do not apply fertiliser on their production (Figure 10).

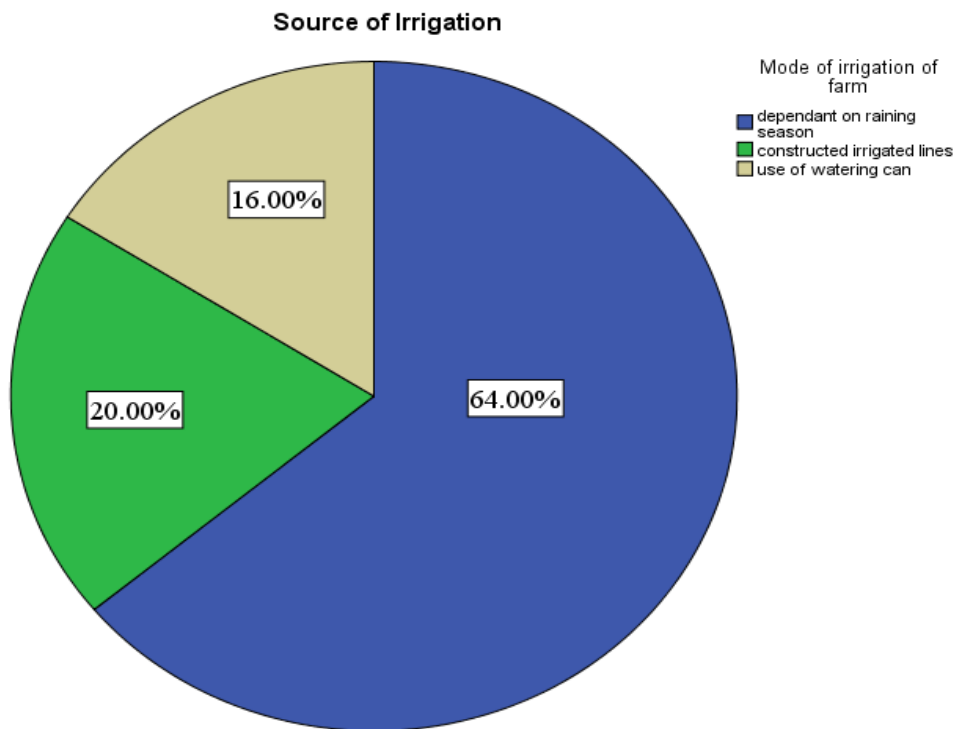
Moreover, some farmers were of the view that application of fertiliser change the quality and taste of the maize and as such reduce the market value.



**Figure 10: Application of Fertiliser by Respondents**

#### **5.2.7 Sources of Irrigation by Maize Farmers**

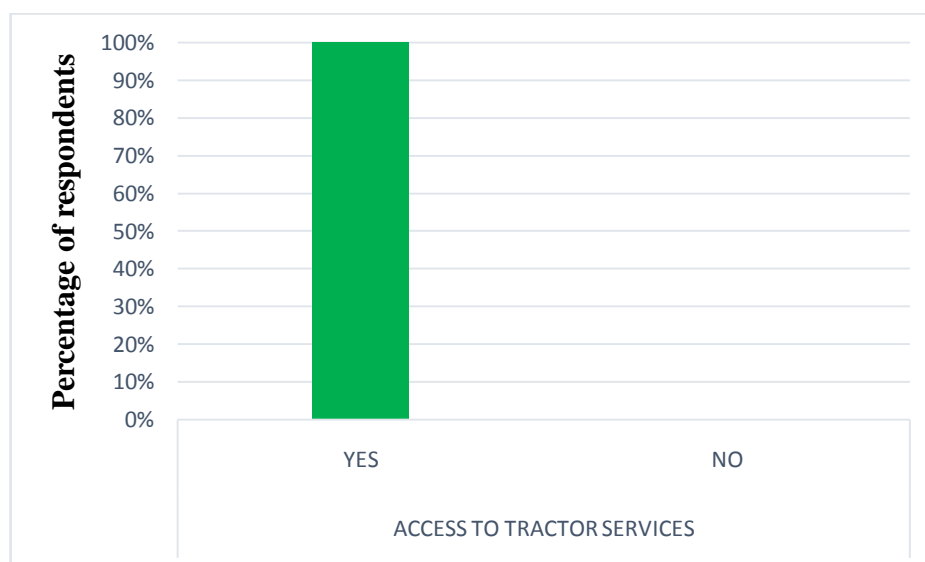
Most of the respondents (64%) depend on rain fall for their maize cultivation. Only 10 respondents representing 20% constructed irrigated channels which serve as the source of irrigation on their farm. Others (16%) sourced water their farm produce by the use of watering cans as illustrated by figure 11 below.



**Figure 11: Source of Irrigation by Respondents.**

### **5.2.8 Access to Tractor**

Majority (36%) of respondents had access to tractor for threshing of grains after harvest. Also (24%) of respondents had access to tractor for ploughing and harrowing of their farm lands which thereby help them in the expansion of the area of cultivation of their farm land. Harrowing and carrying of farm produce recorded 10% of respondents whiles planting of seeds had 12% by the use of tractor.



**Figure 12: Maize Farmers' Access to Tractor**

**Table 5: Access to Tractor**

Tractor access	Frequency	Percentage
Ploughing and harrowing	12	24
Harrowing and carrying farm produce	5	10
Planting of seeds	6	12
Harvesting	9	18
Threshing of grains	18	36
Total	50	100.0

Source: Filed data, 2016

### 5.2.9 Varieties of Maize Cultivated by Farmers

In modern and productive agriculture, improved and quality seeds are major source of ingredient for crop cultivation. Cultivation of maize in Central Ghana is no exception of the need of quality and improved seeds. However, some respondents (16%) still grow some local variety (*obatanpa*) due to the quality of taste and high market preference of it. Golden jubilee (34%) which was developed to commemorate the Ghana Golden Jubilee was mostly cultivated by respondents. Other varieties such as Aziga (big egg) and Etuto-pibi (fathers' child) also used by respondents recorded 26% and 24% respectively.

### SOURCE OF SEEDS FOR PLANTING

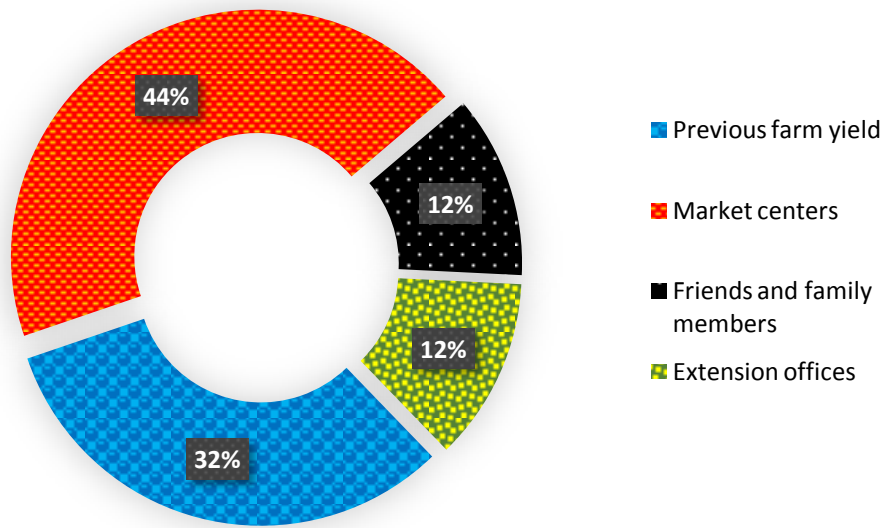


Figure 13: Source of Seeds for Planting (n=50)

### MAIZE VARIETY PREFERENCE

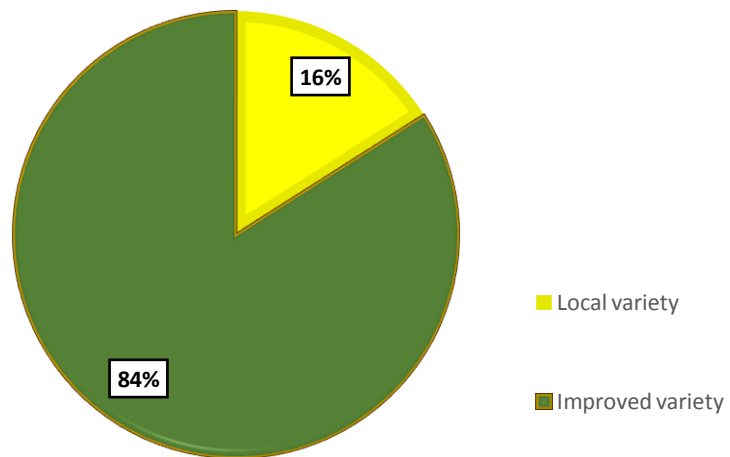
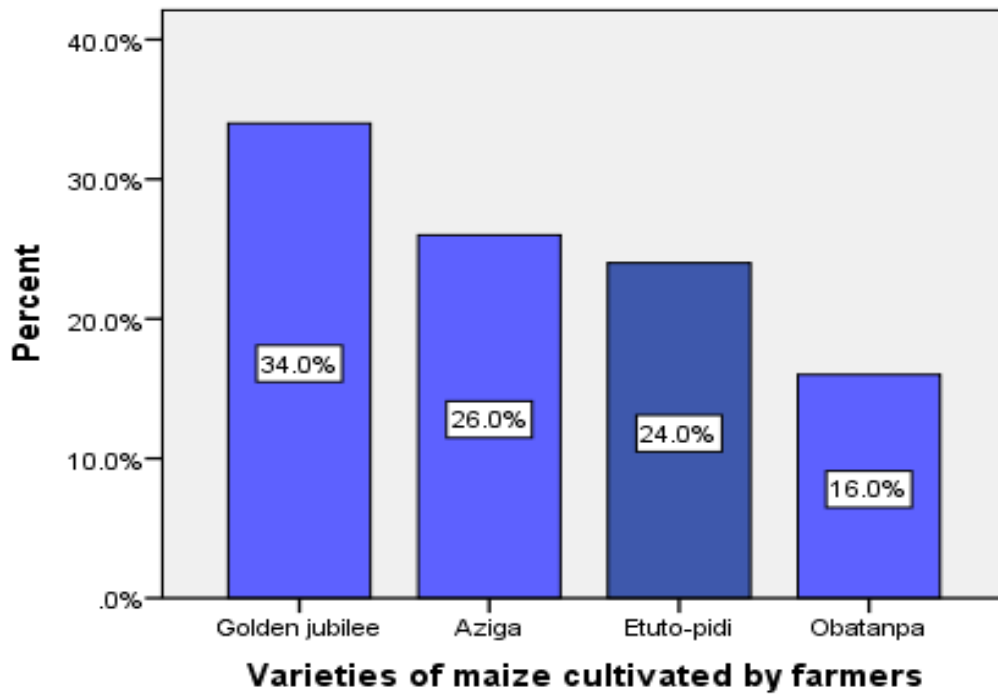


Figure 14: Maize Variety Preference (n=50)



**Figure 15: Varieties of Maize (n=50)**

#### **5.2.10 Varieties of Maize Grown in Central Ghana**

Table 7 shows the reasons why farmers cultivate local and improved maize varieties and the source of planting materials. 84% of the maize farmers in used improved seeds for planting while 16% plants local variety of maize. Source of planting are mostly from recognized shops or market centres (44%) whiles others used seeds from previous farm yield (32%).

**Table 6: Reasons for Variety of Maize Preferred by Farmers in Central Ghana**

<b>Variable</b>	<b>Reason</b>	<b>n(50)</b>	<b>%</b>
Local variety	<i>Seed availability</i>	3	6
	<i>Taste quality</i>	2	4
	<i>High market preference</i>	2	4
	<i>High yield</i>	1	2
		8	16
Improved variety	<i>Early maturing</i>	24	48
	<i>Drought resistance</i>	18	36
		42	100

Source: Field Survey, 2016

### 5.3 The Competitiveness of Maize Production in Central Ghana.

The International Reference Price (CIF) of maize according to importing and exporting company (Premium Foods Limited) was \$250/Mt from Argentina. Due to high amount of maize import from Argentine (75%) by importers to Ghana, maize imported from Argentina among that of the South Africa, Turkey, United States and Senegal was chosen for the calculation of the DRC ratio. Maize imports attract the following duties and levies: 10 % Import duty, 17.5 % Value Added Tax (VAT), 2.5% National Health Insurance Levy (NHIL) to be collected by the VAT Secretariat, 0.5% Export Development and Investment Fund Levy (EDIF), 1% Inspection fee, 0.5% ECOWAS Levy, and 0.4% Ghana Customs Network (GCNET). Due to the above duties, \$250/Mt of imported maize will attract \$25 as import duty, \$43.75 as VAT, \$6.25 as NHIL, \$1.25 as EDIF, \$2.5 as Inspection fee, \$1.25 as ECOWAS levy and \$1.0 as GCNET. Therefore, maize imported from Argentina, international reference price is \$331/Mt, which will yield GH¢ 1,304.14 as applied to the exchange rate.

In this study, the operating capital required by farmers was considered to be the expenses on inputs purchased or rented. The Interest on operating capital was calculated using the formula proposed by Mia et al (2013) given by equation

$$IOC = AI i t$$

Where

IOC = Interest on operating capital

i= rate of interest, on the average, 11.52 percent was the amount of loan borrowed by farmers either from formal and informal sources

AI= Total investment/2, GH¢ 487.63 is the average of amount of capital borrowed

t= total time period of a cycle. The period of repayment of loan is 6 months

Therefore:  $IOC = 487.63/2 \times 0.1152 \times 6 = GH¢168.52$

For the depreciation of farm land which is the fixed capital, the double declining balanced method was used. Lands are mostly family owned and cash is paid by those who rent them for farming.

An average of GH¢262.5 per hectare is charged by owners of land, which is equivalent to 1.75 bags (100kg) of maize market price of GH¢150.

An average of three (3) years according to the study was the lifespan of land as fallow period for the land to regain its fertility.

The depreciation rate is given as:  $= \frac{100}{3} \times 2 = 66.67\%$ , so the depreciation value of the land is 66.67% of 262.5=GH¢175.01

The DRC ration

$$DRC = \frac{\sum_s f_{s,j} P_s^*}{P_j^* - \sum_i a_{i,j} P_i^*}$$

$$= \frac{(431.94+168.52+175.01+52)}{1,304.14 - (178.64+522.49+363.60)} = \frac{(827.47)}{(239.41)} = 3.46$$



**Table 7: Results of Domestic Resource Cost Ratio**

Tradable inputs				Non-tradable inputs		
Item	Unit	Price/unit (GH¢)	Cost/ha (GH¢)	Item	Unit	Cost (GH¢)
Certified seeds	Kg	4	178.64	Labour	Md/ha	431.94
NPK	Kg	121.51	522.49	Capital	GH¢	168.52
Herbicides	litre	20	363.60	Land	Ha	175.01
				Other expenses	GH¢	52
Total (a)			1,064.73			827.47 (c)
Int. price of maize (b)		1,304.14				
DRC = (c)/(b-a)			<u>3.46</u>			

*Exchange rate of 1USD=GH¢ 3.94 (Bank of Ghana as at June 2016)*

$$(a) = \sum i a_{i,j} P_i^*$$

$$(b) = P_j^*$$

$$(c) = \sum S f_{s,j} P_s^*$$

Other expenses made by the middlemen include the average cost of transportation of maize (GH¢6.5/100 kg) from farm-gate to various houses of middlemen and to market centres and cost of maize sacks (GH¢4/bag). This is base of average yield of the study. Capital is the interest on operating capital (interest on the average amount of credit obtained either from formal or informal sources for maize farming).

#### 5.4 Marketing Margin of Maize Supply Chain.

The Percent Marketing Margin (MM) according to Hussain et al. (2013) can be

calculated as:  $MM = \frac{Ps}{Sp} \times 100$

Where:

$MM = \text{Marketing Margin}$

$Ps = \text{Price spread,}$

$Sp = \text{Sale price}$

But;  $Ps = \text{Sale price} - \text{Purchase price}$

This implies that the gross marketing margin between farm gate price (farmers) and market price (middlemen/sellers) is

$$Ps = 150 - 85.4 = 64.6$$

$$MM = \frac{64.6}{150} \times 100$$

Therefore Percentage Marketing Margin = 43.07%

Transport cost of maize to market (GH¢/100 kg) = 6.5

Net profit of middlemen/sellers (GH¢/100 kg) = 64.6 - 6.5 = 58.1

Net profit of middlemen/sellers as percentage of margin = 58.1/64.6 x100 = 89.94%

Net profit of sellers as a percentage of sale price = 58.1/150 x 100 = 38.73%

**Table 8: Marketing Margins in Marketing Channels of Maize (GH¢100kg)**

Parameter	Item	
	Maize GH¢/100 kg	Percentage %
Average farm gate price	85.4	
Average market price	150	
Gross margin	64.6	43.07
Average transport cost	6.5	10.06
Net profit margin	58.1	89.94
Net profit as % of sale price		38.73

Source: Field data, 2016 (n=20)

## **6. DISCUSSION**

### **6.1 Socio-Economic Characteristics of Respondents**

The study revealed 58% males as maize farmers and 55% male as middlemen whilst female form the minority (42% and 45%) in both cases. This suggests that less female farmers were engaged in maize production compared to their male counterparts. Women are often disadvantaged and face greater constraints in agricultural production than men (Meinzen-Dick et al.2011; World Bank, FAO and IFAD, 2008). Rural women are consistently less likely than men to own land or livestock, adopt new technologies, access credit or other financial services, or receive education or extension advice (FAO 2011). Women make up the most of the world's small-scale maize farmers. As such they are important agents for agricultural development and change (CGIAR 2015). In the same way, women are more constrained than their male counterparts' interms of access to information and technology, inputs, credits etc. In agriculture, men are generally presumed to be the chief actors and, as such, are often the main participants in and/ or recipients of support related programmes. The findings agree with report by Farnworth and Mahama (2012) that, women are less prominent in the share of Labour Force force including preservation and marketing of crops in Brong Ahafo Region. Meanwhile, the extension officers in the study area were mainly (60%) females; and all extension officers are educated.

Also, majority 68% and 75% farmers and middlepersons respectively were found to have had some form of education (primary and SHS level). Meanwhile, only 32% farmers and 25% marketers have had no education hence illiterate, and could neither read nor write. Asadullah et al. (2005) asserted that, human resource is a significant asset for sustainable agricultural development. Therefore, education plays a pivotal role in decision making and the ability to absorb modern agricultural technology. This in effect has a bearing on agricultural productivity (Kibaara 2005). Furthermore; education enables farmers to comprehend the socio-economic factors used to sustain their farming activities (Shamsudeen et al. 2013).

Maize production expansion has been of key interest to most importing countries around the globe in order to meet national demand and hence supply deficits. It was observed from the study that majority of the maize farmers (82%) had motivation of expanding their maize farming while 18% of them thought otherwise. In the report of FAOSTAT (2015), the acreage of maize and grain production in Ghana among other 20 countries have increased significantly across regions in Sub-Saharan Africa since 1961. The prime motive for the expansion of maize farming according to respondents are mostly (24%) the “availability of ready market”, “reduction of input prices (20%)”, “high price of maize produce (18%)”, “access to financial assistance (16%)”, and the “availability of irrigation systems (14%)”, with the development of “high-yielding maize (4%)” being the least motivation factor for maize farmers to expand their production. A focus group discussion with the maize farmers emphasised that, the prevailing price structure of maize discourages most farmer from venturing into maize production and hence expand their maize field production capacity. They stressed that measures should be put in place to regulate the maize price, so as to encourage larger maize cultivation in the area; since, higher maize production in the country emanate from the Centre, Transitional Zone, which has two harvest seasons (USAID 2012).

The study also revealed that, majority (54%) of maize farmers in Central Ghana would have to sell their produce to market intermediaries (middlemen) on their farms at farm-gate prices due to their inability to cater for costs such as storage and transportation to the market centres. Thus, market intermediaries (middlemen) would have to move from farm to farm in order to purchase maize produce at typically lower prices, compared to the amount they would have purchased (market price) the same unit if farmers had sent them to the market centres. Hence, it is evident from the reports that wholesale maize prices were found to be ranged depending on nearness to district/regional markets and time of year. Therefore Farm gate prices decrease as distance to major market locations which causes transport costs to increase as the findings agrees with (USAID 2012). Other maize farmers (24%) sell their maize

produce to poultry farmers. Just as reported that 40 percent of marketed maize (white cultivars) is mostly purchased from traders and in the local informal markets for consumption by poultry industry. While some other maize farmers in the study area would opt for sales to the local food vendor/sellers (12%) for meal preparation. Only a few (10%) maize produced in central Ghana are sold directly in the market centres by farmers on active market days (figure 9), with prices generally high during the off seasons (Amanor-Boadu, 2012). This phenomenon thus creates minimal imports and exports and it's believed to have a net neutral effect on the market (USAID 2012).

## **6.2 The Technology Adoption by Maize Farmers in Central Ghana**

The possible factors affecting the efficiencies and productivities of maize in Ghana may be the use of inputs such as fertiliser, certified seed etc. and the adoption of improved maize variety (Owusu 2016). Yusuf and Malomo (2007) also argued that a farmer's efficient use of available technology may be influenced by non-physical inputs such as experience, information asymmetry among other socio-economic factors. Obviously, fertilizer application in maize production in the research area is a major factor adopted in production activities. The survey on maize farmers' technological activities adoption in maize farming in Central Ghana indicated that, 72% use fertilisers in their maize cultivation; for increased yields. Whereas only a few (28%) of them do not apply fertiliser in their cultivation. Farmers in the forest zone and transitional zones do sometimes may presumed that their soils are fertile; only to observe lower productivity in the end. This is evident in the reports that, the highest proportions of fertiliser use in maize production occur in the Savannah and Transitional zones compared to the Forest zone of Ghana (Ragasa et al. 2013). The maize yield response to fertiliser application is higher in Ghana than in other African countries (Chapoto and Ragasa 2013).

Moreover, it is estimated from the study results that, all maize farmers in the central Ghana have access to tractor services (fig. 12) as 36% of the farmers had access to tractors for threshing of grains services after harvest. Followed by 24% farmers who had access to tractor for farm lands ploughing and harrowing services to enable them

cultivate a larger area of land, 12% farmers who use tractors for seeds planting services. But only a few (10%) of them use tractors for Harrowing and carrying of farm produce (Table 6).

Improved and quality seeds are major source of ingredient for efficient crop production.. Study result indicated that about 16% of maize farmers still grow some local variety (*obatanpa*) probably due to a number of reasons such as the taste, availability and its high market preference or that they are not made sufficiently available to farmers through an effective seed system (Ragasa et al. 2014). Nonetheless, a significantly higher (84%) farmers adopt the use of improved maize seed variety primarily due to reasons like early maturing (48%) and drought resistance (36%). Golden jubilee which was developed to commemorate the Ghana Golden Jubilee was mostly (34%) cultivated maize variety by the farmers. Other varieties such as *Aziga* (big egg) and *Etuto-pibi* (fathers' child) maize varieties were also used by 26% and 24% farmers respectively. Just as reported by Morris et al. (1998) that, modern maize varieties were planted on 61 percent of Ghana's maize fields.

The sources of seeds for cultivation in the study area were noticed to be higher for farmers who obtain their seed from seed sales point in the market centres (44%). Adoption of improved maize varieties is linked to farmer's productivity and real incomes (Langyintuo and Mekuria 2008). Followed closely to the seed sales point in the markets are those who get their seeds from the yields of the previous harvest. Then, family and friends as well as extension officers who fall as the minor (12%) sources where maize farmers obtain seed cultivars. Table 4.5 shows the reason why farmers cultivate local or improved varieties and their source of planting materials. 84% of respondents of maize farmers in central Ghana used improved seeds for planting while 16% plants local variety of maize. Source of planting are mostly from recognized shops or market centres (44%) while others used seeds from previous farm yield (32%). The adoption of improved crop varieties and improvement in resource-use efficiency in agricultural production have been widely advocated as

policy measures required to improve the productivity levels, increase the overall food production and contribute to reducing hunger and malnutrition in Ghana (Doss 2006). Improved maize crop varieties have high yielding and disease or pest resistant (or tolerant), and have high nutritional quality and low input requirements. The Council for Scientific and Industrial Research (CSIR) and its affiliate institutions such as the Food Research Institute (FRI) and the Crop Research Institute (CRI) develop and release improved crop varieties to farmers in Ghana, with the aim of improving the yields and household food security of the farmers (Ragasa et al. 2013). However, low yields generally happen because of too low input use and poor adoption of technologies (FAO 2005).

Most of the respondents (64%) depend on rainfall as their main source of irrigation on their farms. Nonetheless, 20% maize farmers had a constructed irrigated channel which serves as the source of irrigation on their farm. Others (16%) sought to water their farm produce by the use of watering cans. This confirms the report that until today, in Africa the use of modern technologies such as the use of irrigation is considerably low (Cudjoe et al. 2010).

### **6.3 The Competitiveness of Maize Production in Central Ghana.**

The most valuable crops grown in Ghana for the international market are cocoa, fruit and horticulture products. Cocoa alone contributed to 32% of the total foreign exchange earned in 2009. Even though Ghana is exporting a substantial amount of food products, agricultural imports are far rising at the same time. The import bills of imported maize raised from 10million US dollars in 2004 to 21million in 2008, with a peak of 25 million US dollars in 2006, according to FAO (FAOSTAT 2008). The locally produced maize in Ghana is subjected to competition from maize imports from countries such as Brazil, Argentina and South Africa. The International Reference Price (CIF) of maize according to importing and exporting company (Premium Foods Limited) was \$250/Mt from Argentina.

Due to high amount of maize import from Argentina (75%) by importers to Ghana, maize imported from Argentina among that of the South Africa, Turkey, United States and Senegal was chosen for the calculation of the DRC ratio. Maize imports attract the following duties and levies: 10 % Import duty, 17.5% Value Added Tax (VAT), 2.5% National Health Insurance Levy (NHIL) to be collected by the VAT Secretariat, 0.5% Export Development and Investment Fund Levy (EDIF), 1% Inspection fee, 0.5% ECOWAS Levy, and 0.4% Ghana Customs Network (GCNET). Due to the above duties, \$250/Mt of imported maize will attract \$25 as import duty, \$43.75 as VAT, \$6.25 as NHIL, \$1.25 as EDIF, \$2.5 as Inspection fee, \$1.25 as ECOWAS levy and \$1.0 as GCNET. Therefore, maize imported from Argentina, international reference price is \$331/Mt, which will yield GH¢ 1,304.14 as applied to the exchange rate.

It was evident from the study that, The Interest on operating capital (IOC) calculated from the formula proposed by Mia et al. (2013) is GH¢168.52.

The DRC ratio of 3.46 suggest that the local maize production in the study area is not competitive and domestic resources are not efficiently used hence the sector does not have comparative advantage with other global maize producers.

#### **6.4 Marketing Margin of Maize Supply Chain**

Maize yield and production increases are necessary to attract investment by commercial maize buyers. Use of improved seeds, proper fertilizer application, use of best practices in production, and production promotion all contribute to yield increases in different ways, depending on growing conditions and how new technologies are combined.

In practice, the flow of agricultural commodities usually starting at the farm, (sometimes passed through a storage phase) and/or goes directly to rural (tertiary) markets for stored or passed to secondary markets where intermediaries (middlemen)



and wholesalers start purchase of sizable stocks and convey it to primary or main markets and/or to depot. The gross marketing margin between the farm gate price and the market price is calculated as Percent Marketing Margin according to Hussain et al. (2013) is 43.07%; which is wider enough to mean that the maize farmers only obtain a smaller share of the retail price. This study found the transport cost of a 100kg maize to market GH¢ 6.50, and that distance from maize production centres to markets are longer and challenge with bad roads. This conforms to the report that bad roads increased the size of the marketing margins. Also, marketing margins are said to be influenced by a number of factors, primarily shifts in retail demand, farm supply, the costs of transformation across time, space and form (e.g., transport and storage costs, processing costs in many cases, transaction costs associated with exchange, the quality of products and risk associated with the transactions) and potentially non-competitive behaviour in the markets (Wohlgenant 2001). The net profit of middlemen/sellers was GH¢ 58.1, then the net profit as percentage of margin GH¢89.94%, while the net profit as a percentage of sale price was 38.73%. Hence, marketing margins affected by a number of factors including transport cost to market centres and others.

## **7. CONCLUSION**

DRC ratio of 3.46 suggests that the local maize production in the study area was not competitive and domestic resources were not used efficiently. Therefore, the sector does not have comparative advantage with other global maize producers.

The gross margin between the farm gate price and the local market centres in the study was 43.07%; depicting that the maize farmers only obtain a smaller portion of the retail price. This primarily is due to the distance from maize production centres to markets being longer and confronted with bad roads: As reports indicate that bad roads increased the size of the marketing margins and are also influenced by factors like shifts in retail demand, farm supply, the costs of transformation across time, space and form (e.g., transport and storage costs, processing costs in many cases, transaction costs associated with exchange, the quality of products and risk associated with the transactions) and potentially non-competitive behaviour in the markets.

### **7.1 Policy Recommendations**

Based on the findings of this study, the following recommendations are proposed.

Prioritising the provision of linkage roads in rural areas to tackle inaccessibility would improve local maize marketing and therefore reduce the marketing margin of farmers and enhance the expansion of maize distribution across the country to ensure food security.

National policies should favour optimum allocation of productive resources by considering the drivers of competitiveness.

Furthermore, maize farmers should organise themselves into farmer groups in order to have bargaining power in the marketing channels of their produce.

Policy makers would need to focus more on farmers' training and extension programmes to reduce technical inefficiency in maize production. Appropriate crop management practices for the area should be determined and provided to maize farmers efficiently to increase productivity.

## **7.2 Recommendations for Future Studies**

This study focused mainly on efficient use of domestic resources to ensure food security through a competitive production.

Further studies may examine competitiveness under irrigated, non-irrigated and combined schemes among maize farming households in the study area.

There are five maize producing regions in Ghana. Inclusive studies in these other regions would serve to verify and improve the findings of this study.

Studies on a much larger scale than the scope of this research, may involve measurements of production of other crops cultivated by the farmers and evaluating the effects of these on production efficiency and competitiveness of maize production in the central Ghana.

## 8. REFERENCES

- Abdolreza A. 2006. Maize International Market Profile-Competitive Commercial Agriculture in Sub-Saharan Africa (CCAA) Study, Trade and Markets Division Food and Agriculture Organization of the United Nations. Washington DC.
- Abdulai A. and Huffman W. 2000. Structure Adjustment and Economic Efficiency of Rice Farmers in Northern Ghana. *Economic Development and Cultural Change*, 50:3519.
- Adjao RT. 2011. Analysis of the Competitiveness of the Rice Sub-sector in Mali: The Case of Gravitational Irrigation and Bas-fond Production Systems. Afriat, S.N. (1972). Efficiency Estimation of Production Functions. *International Economic Review*, 13, pp. 568-598.
- Ahado S. 2017. Assessment of Competitiveness of Local Rice Production and its Contribution to Food Security in the Northern Region of Ghana.(MSc Thesis). Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Prague.
- Akatey NK. 2018. Report on the Ghana policy hub action programme for stakeholders at its final workshop MoFA; Article: Nelson Kofi Akatey ghana.gov.gh
- Al-hassan Seidu 2008. "Technical Efficiency of Rice Farmers in Northern Ghana", African Economic Research Consortium Research Paper 178, www.ccsenet.org/jas, Vol. 4, No. 1; 2012.
- Amanor-Boadu V. 2012. Maize Price Trends in Ghana (2007-2011), Monitoring, Evaluation and Technical Support Services (METSS) USAID ([http://www.agmanager.info/agribus/METSS/MaizeTrends\\_01-2012\\_Vincent.pdf](http://www.agmanager.info/agribus/METSS/MaizeTrends_01-2012_Vincent.pdf))
- Asadullah MN, and Rahman S. 2005. Farm productivity and efficiency in rural Bangladesh; The role of education revisited. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006. Available at <http://ageconsearch.umn.edu/bitstream/25482/1/cp060135.pdf>: (accessed on 2018-01-15).

- Boansi David and Mawuena Rita Favour. 2015: Why the Persistent Increase in Ghana's Rice Imports? Prescriptions for Future Rice Policy. *Asian Journal of Agricultural Extension, Economics & Sociology* 7 (4): 1-21, 2015; Article no. AJAEES.18834 ISSN, pp. 2320-7027.
- Brooks J, Croppenstedt A, Aggrey-Fynn E. Distortions to agricultural incentives in Ghana. Main report. *Agricultural Distortions Working Paper No. 47*, December 2007 Washington, DC: World Bank; Available at <http://documents.worldbank.org/curated/en/218091468031782881/pdf/560370NWP0GH0v101PUBLIC10Ghana10708.pdf>: (accessed 2016-12-10).
- CGAR Research Program on MAIZE 2015. CRP MAIZE Gender Strategy. Available at: <http://maize.org/wp-content/uploads/sites/5/2015/04/MAIZE-gender-strategy-2015-Web.pdf> (Accessed on 23/04/2018).
- Chapoto, A., and C. Ragasa. 2013. Moving in the right direction? Maize productivity and fertilizer use and use intensity in Ghana. IFPRI Discussion Paper 01314. Washington, DC: IFPRI.
- Council for Scientific and Industrial Research. 2011. *Savana Agricultural Research Institute Annual Report, 2011*, CSIR-INSTI
- Creswell JW, and Garrett AL. 2008. The "movement" of mixed methods research and the role of educators. *South African Journal of Education* volume 28: 321-333.
- Cudjoe G., Breisinger, C. and Diao, X., 2010. Local impacts of a global crisis: Food price transmission, consumer welfare and poverty in Ghana. *Food Policy*, pp. 294-302. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0306919210000266> [Accessed 14/4/18].
- Eskola E. 2005. *Agricultural Marketing and Supply Chain Management in Tanzania: A Case Study*. Working Paper No.16
- Esonu BO. 2010. Unconventional feed resources for livestock development and food security: paradigms for Nigeria livestock Industry. 14th Inaugural Lecture of Federal University of Technology, Owerri, pp 51.
- FAO 2008. *An Introduction to the Basic Concepts of Food Security, Food Security Information for Action Practical Guides*. The EC - FAO Food Security Programme available online at: [www.foodsec.org/docs/concepts\\_guide.pdf](http://www.foodsec.org/docs/concepts_guide.pdf)

- FAO 2011. The State of Food and Agriculture 2010–11. Women in Agriculture: Closing the Gender Gap for Development. FAO, Rome.
- FAO, IFAD, WFP. 2014. The State of Food Insecurity in the World 2014. Strengthening the enabling environment for food security and nutrition. Rome 2014. Available at <http://www.fao.org/3/a-i4030e.pdf>: Accessed 2017-09-12.
- FAO 2005. Fertilizer use by crop in Ghana. FAO.
- FAO 2008. Statistical Databases. FAOSTAT: Agriculture Data. Available online: <http://faostat.fao.org> (accessed 2017-11-17).
- FAOSTAT. 2015. FAO Statistical Pocketbook, world food and agriculture. Food and Agriculture Organization of the United Nations, Rome, ISBN 978-92-5-108802-9. Available at: <http://www.fao.org/3/a-i4691e.pdf>: (accessed on 10/04/18)
- Farnworth C. and Mahama A. 2012. Gender Analysis of the Maize Value Chain, Ghana For GIZ MOAP, Ghana, and BMZ. Available from <http://static1.squarespace.com/static/551bb3ade4b0404100c31678/t/558c0086e4b0c093c661bc2c/1435238534464/Farnworth+%26+Mahama++Maize+Value+Chain+Ghana+GIZ++2012.pdf> (accessed on 23/04/18).
- Farrell M. 1957. The measurement of productivity efficiency. Journal of Royal Statistical Society, 120, pp. 253-290.
- FEWS NET. 2009. Commodity Market Maps and Price Bulletins: Tools for Food Security Analysis and Reporting FEWS NET Markets Guidance, No 4. July 2009. FEWS NET Washington 1717 H St NW Washington DC 20006 [info@fewsn.net](mailto:info@fewsn.net)
- GABC–Ghana Agribusiness Center 2017. Latest agribusiness new. Available at <http://www.agribusinessghana.com/news>. Online Sites (accessed 2017-11-06).
- Gage D, Bangnikon , Abeka-Afari H, Hanif C, Addaquay J, Antwi V, & Hale A. 2012. The Market for Maize, Rice, Soy, and Warehousing in Northern Ghana. This report was produced by USAID’s Enabling Agricultural Trade (EAT) Project, January, 2012.
- Ghana News Agency 2017. Maize production is threatened in Ghana –ISSER, ENA Ghana. Available from <https://enaghana.com/2017/12/12/maize-production-is-threatened-in-ghanaisser/> (accessed on 14/4/2018)

- Ghana Statistical Service 2010b. Population and Housing Census, National Analytical Report, May 2013.
- Hanlon B, Larget B. 2011. Sex and older women samples and populations the scientific literature. *Statistics Wisconsin University Journal* 8:1–6.
- IFPRI (2014). International Food Policy Research Institute (Ghana Strategy Support Program, GSSP). Ghana Agricultural News Digest – September 8, 2014. New GSSP policy note prepared by Arhin, B.G.
- International Food Biotechnology Council. 1990. Biotechnologies and food: assuring the safety of foods produced by genetic modification. *Regulatory Toxicology and Pharmacology* 12: S1-S196.
- Khaliq T, Mahmood T, and Masood A. 2004. Effectiveness of farmyard manure, poultry manure and nitrogen for corn (Zeamays) productivity. *Int. J. Agric. Biol.* 2: 260-263.
- Kibaara, B.W. 2005. Technical Efficiency in Kenyan's Maize Production; An Application of the Stochastic Frontier Approach. An MPhil Thesis, Colorado State University. Available at: [http://fsg.afre.msu.edu/kenya/o\\_papers/tech\\_eff\\_maize.pdf](http://fsg.afre.msu.edu/kenya/o_papers/tech_eff_maize.pdf): (accessed 2016-11-20).
- Koney EBM. 2004. Poultry Health and Production. (3<sup>rd</sup> Edition) Advent Press, Accra. Pp 50 -52.b
- Langyintuo, A. and Mekuria, M. 2008. Assessing the Influence of Neighborhood Effects on the Adoption of Improved Agricultural Technologies in Developing Agriculture. *African Journal of Agricultural and Resource Economics* 2:151-169. DOI: <http://purl.umn.edu/56960>
- Massawe S. 2007. Assessment of Food market Structure and their implication to household food security in Rufiji District. Unpublished MSc Dissertation, Sokoine University of agriculture, Tanzania
- Mayes, D., Harris, C., Lansbury, M. 1994. Inefficiency in industry. New York: Harvester Wheat sheaf.
- Mbangani D. 2016. Development Analysis of Market Parameters for Groundnuts in Mazowe District, Zimbabwe [MSc.]. Prague: Czech University of Life Sciences Prague. 55p.

- McLeod SA. 2014. Questionnaire. Retrieved from [www.simplepsychology.org/questionnaire.hotml](http://www.simplepsychology.org/questionnaire.hotml) (accessed 2016-08-06).
- Mdoe NS, Isinika AC, Mutabazi KD, Phillip D, Mnenwa KR. 2001. Information and communication technologies: Challenges, possibilities and the way forward for agricultural Sector. In Proceedings of the 5th Scientific conference of The Agricultural Economic Society of Tanzania
- Meinzen-Dick R., Quisumbing, A., Behrmann, J., Biermayr-Jenzano, P., Wilde, V., Noordeloos, M., Ragasa, C., Beintema, N. (2011) Engendering agricultural research, development and extension. International Food Policy Research Institute, Washington, D.C.
- Memon SQ, Mirjat MS, Mughal AQ, Amjad N. 2012. Evaluation of inputs and outputs energy for maize grain yield. *Sarhad J. Agric.* 28(3):387-394
- Memon SQ, Zakria M, Mari GR, Nawaz MH, and Khan MZ. 2011. Effect of Tillage Methods and Fertilizer Levels on Maize Production. *Pak. J. Agri. Sci.*, Vol. 48(2), 115-117; 2011
- Mia MAM., Hossain, TMB., Matin, A., Hossain, S., Moniruzzaman, and Kumar, R. 2013. Assessments of the Maize Situation, Outlook and Investment Opportunities to Ensure Food Security in Bangladesh. MAIZE CGIAR Research Programme (CRP). International Maize and Wheat Improvement Centre (CIMMYT).
- Ministry of Food and Agriculture 2012. Agriculture in Ghana: Facts and Figures, Statistics, Research and Information Directorate (SRID), August, 2013.
- MoEST, Ministry of Environment, Science and Technology 2000. Climate change vulnerability assessment studies, The Environmental Protection Agency (EPA), Ghana.
- MoFA 2013. Agriculture in Ghana: Facts and Figures. Statistical, Research and Information Division (SRID). Available at [http://mofa.gov.gh/site/?page\\_id=6032](http://mofa.gov.gh/site/?page_id=6032). (accessed 2016-12-20).
- MOFA. 2002. Food and Agriculture Sector Development Policy. Accra: Government of Ghana, MOFA: 47. Ghana Statistical Service, Census (2010a) Summary Results of Final Report, May, 2012



- Morris ML, Tripp R. and Dankyi AA. 1999. Adoption and Impacts of Improved Maize Production Technology. A Case Study of the Ghana Grains Development Project, Economics Program Paper 99-01. Mexico, D.F., CIMMYT. Available online: [http://www.cimmyt.org/Research/economics/map/research\\_results/program\\_papers/pdf/EPP%2099\\_01.pdf](http://www.cimmyt.org/Research/economics/map/research_results/program_papers/pdf/EPP%2099_01.pdf)(accessed 2017-10-08).
- Mwagike L. and Mdoe N. 2015. The role of middlemen in fresh tomato supply chain in Kilolo district, Tanzania. *International Journal of Agricultural Marketing*, 2(3): 046-056.
- Ogbe AO, Okoruwa OV, Saka OJ. 2011. Competitiveness of Nigerian Rice and Maize Production Ecologies: A Policy Analysis Approach. *Tropical and Subtropical Agroecosystems*, 14 (2011): 493- 500
- Owusu, V. 2016. Technical Efficiency of Technology Adoption by Maize Farmers in three Agro-Ecological Zones of Ghana. *Review of Agricultural and Applied Economics*. 19(2) 39-50, doi: 10.15414/raae.2016.19.02.39-50
- Ragasa, C., Chapoto, A., and Kolavalli, S. (2014). Maize Productivity in Ghana, Policy Note #5, August, International Food Policy Research Institute (IFPRI).
- Ragasa, C., Dankyi, A., Acheampong, P., Wiredu, A.N., Chapoto, A., Asamoah, M., Tripp, R. (2013). Patterns of Adoption of Improved Maize Technologies in Ghana. Ghana Strategy Support Program, Working Paper 36. International Food Policy Research Institute (IFPRI).
- Rondon M. and Ashitey E. (2011). Grain and Feed Annual Report: Assessments of Commodity and Trade Issues in Ghana. USDA Foreign Agricultural Service, GAIN Report, April 15, 2011
- Shamsudeen, A., Nkegbe, P.K., and Donkoh, S.A. 2013. Technical efficiency of maize production in Northern Ghana. *African Journal of Agricultural Research*, 8(43), Pp. 5251-5259.
- Ullah RKH, Khan QS, Safi F, Gul 2011. Profitability of maize production in District Charsadda: A comparison of conventional and hybrid varieties. *Int. J Latest Trends Agric. Food Sci.* 1: 9-12.
- USAID. 2012. The Market for Maize, rice, Soy, and Warehouse in northern Ghana, The EAT project, Fintrac Inc.

- USAID- EAT. 2012. Market Assessment: The Market for Maize, rice, Soy, and Warehousing in northern Ghana- January, 2012, Fintrac Inc.
- VOTO 2015. A Complete Curriculum and Guide to Maize Production in Ghana. [WWW.VOTOMOBILE.ORG](http://WWW.VOTOMOBILE.ORG) Accessed: 08/09/17
- Weinberger K. Lumpkin TA. 2007. “Diversification into Horticulture and Poverty Reduction: A Research Agenda” *World Development* 35 (8):1464–1480.
- Wienco Agriculture. 2010. Products and Services. Accessed at: [http://www.wienco.com/pages/product\\_content/7](http://www.wienco.com/pages/product_content/7) (Retrieved Jan 19, 2018).
- Wohlgenant, M. K. 2001. Marketing Margins: Empirical Analysis. *Handbook of Agricultural Economics* 1:933-970.
- World Food Summit 1996a. On Food Security at Rome Italy. Available at <http://www.fao.org/wfs/>: Accessed 2017-04-20.
- World Bank, FAO, IFAD. 2008. Gender in Agriculture Sourcebook. World Bank, Washington, D.C. 29
- World Population Prospects 2017 Revision. United Nations population estimates and projections, United Nations DESA / Population Division. <http://worldpopulationreview.com/countries/ghana-population/> (Accessed: 20/02/18).
- Yuba NL. 2007. Agriculture, food security and poverty alleviation. Available at <http://www.groundreport.com/agriculture-food-security-and-poverty-alleviation/>: (accessed 2017-10-22).
- Yusuf, S.A. and O. Malomo, (2007). Technical efficiency of poultry egg production in Ogun state: A Data Envelopment Analysis (DEA) approach. *International Journal of Poultry Science*, 6, pp. 622-629

## **APPENDICES**

### **List of Appendices**

Appendix 1: Researcher Administering Questionnaires

Appendix 2: Questionnaire for Maize Farmers

Appendix 3: Questionnaire for Extension Officers

Appendix 4: Questionnaire for Maize Market Sellers

**Appendix 1: Researcher Administering Questionnaires.**



## Appendix 2: Questionnaire for Maize Farmers

*My name is Obeng Sarfo Kwaku a Ghanaian and a student from Czech University of Life Sciences in Prague, Czech Republic. This survey is to help me in writing of my diploma thesis for BSc degree in Tropical Crop Management and Ecology. The main objective of my master thesis is to assess the competitiveness of maize production and its contribution to food security in Ghana. This questionnaire is anonymous and all the answers will be used only for my personal research.*

### Personal Data

Please tick (✓) in the appropriate boxes.

1. Gender: (A) Male  (B) Female
2. Age: (A) 18-25 years  (C) 41-55 years   
(B) 26-40 years  (D) 56 years and above   
Specify age: .....
3. Level of education: (A) Primary/JHS  (C) Tertiary   
(B) Secondary  (D) None
4. Marital status (A) Single  (C) Divorce   
(B) Married  (D) Widow
5. Main occupation (A) Farming  (C) Trading   
(B) Civil/Public Servant  (D) Other (specify) .....
6. Minor occupation .....
7. Number of family members in your household:  
(A) 0-5  (B) 6-10  (C) 11-15  (D) 15 and above   
Specify number: .....
8. How often does your family use/eat maize meal at home?  
(A) Once a week  (C) not frequent   
(B) Twice a week  (D) frequently
9. What is your average monthly household income (GH¢): .....

***Experience as Maize Farmer***

10. How did you acquire your farm land? (A) Own/Family  (B) Rent

11. How many years have you been cultivating maize?.....

12. What is your mode of irrigation of your cultivated maize?

(A) Dependant on raining season  (C) use of watering can

(B) Constructed irrigated lines  (D) source of pipe born water

13. What is the average farm land size in hectares for your maize production annually?.....

14. What is your estimated cost (GH¢) of per hectare of your farm?.....

15. What varieties of maize do you cultivate:.....

16. How do you obtain your maize seeds for planting?

(A) From previous farm yields  (B) buy from market centre

(C) From friends or family members  (D) from extension service

17. Do you buy improved maize varieties for planting? (A) Yes  (B) No

18. If “Yes” why do you plant improved varieties?

(A) Early maturity  (B) drought resistance

(C) Pest resistance  (D) High seed weight

19. If “No” why do you cultivate local maize seeds?

(A) Taste quality  (B) high yield

(C) High market preference  (D) seeds availability

20. What other crops do you cultivate?

Crop	Acreage (ha)

21. Which cropping systems do you use for your maize farming?

(A) monocropping  (C) mixed-cropping

(B) Intercropping  (D) Agroforestry

22. What planting activities or method do you use?

(A) random planting  (B) row planting

23. Do you apply fertilizer on your farm? (A) Yes  (B) No

24. What type of fertilizer do you use

(A) Organic fertilizers  (B) Inorganic fertilizers

25. What is the name of the fertilizer normally used by you?  
 (A) Manure or compost  (C) Other (specify):.....  
 (B) NPK
26. If you do apply fertilizers, why do you apply the fertilizer?  
 (A) plump grain  (C) fast growth   
 (B) Heavier yield  (D) loss of soil fertility
27. If you do not apply fertilizer why?  
 (A) expensive  (C) change in taste   
 (B) Scarcity  (D) high fertility
28. How many years do you cultivate on piece of land before moving on to another?.....
29. How many times do you carry out weed control exercise after planting before harvesting? .....

### Economics of Production

Input	Quantity Used	Unit Cost GH¢	Total Cost GH¢
Local seeds (kg/ha)			
Improved/Certified seeds (kg/ha)			
Ploughing (per ha)			
Harrowing (per ha)			
Herbicides (litres/ha)			
Organic fertilizer			
Inorganic fertilizer			
NPK			
Urea			
Family Labour (person-day/ha)			
Hired Labour (person-day/ha)			
Planting			
Transport			
Harvesting			
Threshing			

Please, indicate the total number of bags of maize you harvested and the price per 100kg bag during the last farming season (2015/2016).

Maize plot	No. of bags	Price per bag GH¢		Total Revenue	
		Farm gate	Local market	Rev. farm gate	Rev. local market

**Harvesting**

30. At what time do you do harvesting?  
 (A) At maturity-wet  (B) maturity-dry
31. What method do you use to harvest your maize cobs?  
 (A) Manually  (C) others (specify).....  
 (B) with combine harvester
32. If manually, how many people do you involve in the harvesting per acreage of farm?.....
33. How long (hours) does it take to harvest per acreage of maize farm? .....

**Maize Processing and Storage.**

34. In what condition do you process the maize for drying?  
 (A) shelled  (C) undehusked   
 (B) dehusked  (D) others(specify).....
35. Which of these problems do you encounter most in the storage periods of maize?  
 (A) insects (weevils)  (C) birds   
 (B) Rats  (D) theft
36. Do you apply chemical to the maize before storage? (A)Yes  (B)No
37. If “Yes”, how do you apply the chemical?  
 (A) undehusked and spray  (C) fumigants   
 (B) Shelled and sprayed  (D) others (specify).....
38. If you do not use chemical treatment, how do you store the maize?  
 (A) silos  (C) in sacks   
 (B) cribs  (D) others(specify).....



39. For how long do you store your maize?  
 (A) one month  (C) up to six months   
 (B) up to three months  (D) Seven or more
40. How often do you inspect the stored maize?  
 (A) once month  (C) thrice in a month   
 (B) twice a month  (D) more than necessary

### **Marketing**

41. At what time in the year do you sell your produce?  
 (A) Immediately after harvest  (C) whenever prices are high   
 (B) during the planting season  (D) during Easter
42. Who normally purchase your maize?  
 (A) food sellers  (C) market women/middle men   
 (B) poultry farmers  (D) self marketing
43. Mention the main reasons why you sell at this time .....
- (A) lack of storage facility  (C) lack of transportation   
 (B) Good price/better income  (D) others (specify) .....
44. What is the distance from your farm land to the market?  
 (A) 1 -50km  (C) 101-150km   
 (B) 51-100km  (D) 151km or above
45. What main problems do you encounter in the marketing of maize?  
 (A) low initial prices  (C) transportation   
 (B) varietal discrimination  (D) price determination by buyers
46. Do you have problem when transporting your goods or products?  
 (A) Yes  (B) No
47. What kind of problem do you encounter?  
 (A) bad roads  (C) High cost of transportation   
 (B) Lack of vehicle  (D) others (specify).....
48. Is there any possibility to increase your acreage? [1] Yes [2] No  
 (i) If yes what motivate you to increase your acreage. ....  
 (ii) What is the cost involved in expanding your acreage? .....  
 (iii) If no possibility to expand maize farm why? .....

***Role of Government and Various Organizations /Funding***

49. Do you have visits from extension service personnel?

(A) Yes  (B) No  (C) Not frequent

50. How does their visits contribute meaningfully towards the success of your maize farming operations, assess them by ticking the following?

(A) excellent  (C) good   
(B) very good  (D) fair  (E) poor

51. What is the source of funding of your maize farming activity?

(A) Self  (C) NGO   
(B) bank  (D) money lenders  p-operative society

52. Have you received any assistance from any governmental or Non-Governmental Organization? (A) Yes  (B) No

53. What was the form of the assistance?

(A) maize seed  (C) financial assistance   
(B) Fertilizer  (D) others (specify) .....

54. When was the assistance given?

(A) before planting  (C) during harvesting   
(B) After planting  (D) before harvesting

55. Do you normally get credit facility promptly when needed?

(A) Yes  (B) No

56. Do you belong to a farmer association? (A) Yes  (B) No

57. What benefits do you derive from the group as a member?  
.....

58. Has the fertilizer subsidy programme informed your decision to cultivate maize?

(A) Yes  (B) No

59. Do you have access to tractor services for farm operations such as ploughing, carrying farm produce, harvesting, threshing etc. (as proxy to level of agric. mechanization)? (A) Yes  (B) No

Please, indicate any credit source(s), amount, interest rate and payment schedule.

Credit source	Amount GH¢	Interest Rate	Payment schedule	Ability to repay

60. What do you normally do during the off season period?

(A) Preparation of land for next season

(C) Civil servant

(B) Trading/self employment

(D) Any other .....

### Appendix 3: Questionnaire for Middlemen/Market Sellers

*My name is Obeng Sarfo Kwaku a Ghanaian and a student from Czech University of Life Sciences in Prague, Czech Republic. This survey is to help me in writing of my diploma thesis for BSc degree in Tropical Crop Management and Ecology. The main objective of my master thesis is to assess the competitiveness of maize production and its contribution to food security in Ghana. This questionnaire is anonymous and all the answers will be used only for my personal research.*

#### **Personal Data**

Please tick (✓) in the appropriate boxes.

1. Gender: (A) Male  (B) Female
2. Age: (A) 18-25 years  (C) 41-55 years   
(B) 26-40 years  (D) 56 years and above   
Specify age: .....
3. Level of education: (A) Primary/JHS  (C) Tertiary   
(B) Secondary  (D) None
4. Marital status (A) Single  (C) Divorce   
(B) Married  (D) Widow
5. Main occupation (A) Farming  (C) Trading   
(B) Civil/Public Servant  (D) Other (specify) .....
6. Minor occupation .....
7. Number of family members in your household:  
(B) 0-5  (B) 6-10  (C) 11-15  (D) 15 and above   
Specify number: .....
8. How often does your family use/eat maize meal at home?  
(C) Once a week  (C) not frequent   
(D) Twice a week  (D) frequently
9. What is your average monthly household income (GH¢): .....

### Marketing relationship with maize farmers

10. What is the general attitude of maize farmers to price changes in the area?.....
11. Are the maize farmers will to sell their rmaizeto you at farm gate price? [1] Yes  
[2] No (i) If no why.....
12. How many middlepersons serve the area? .....
13. How many years have you been selling maize?  
(A) 1-5 years  (B) 6-10years   
(C) 11-15years  (D) 16 and above
14. How do you acquire your produce to sell?  
(A) From farmers  (C) Personal farm produce   
(B) From middle men  (D) storage houses
15. Who determine the selling price of your product?  
(A) Myself  (C) market leaders   
(B) Government  (D) Demand of the produce (market force)
16. At what time of the year is maize demand very high?  
(A) All year round  (C) Rainy season   
(B) Dry season  (D) during festivities
17. Which group of people normally purchase your maize?  
(C) food sellers  (C) direct consumers   
(D) poultry farmers  (D) exporters
18. What is the distance from your house or storage point to the market center?  
(C) 1 -50km  (C) 101-150km   
(D) 51-100km  (D) 151km or above
19. What is the distance from farm to the storage point?  
(A) 1 -100km  (C) 201-300km   
(B) 101-200km  (D) 301km or above
20. What main problems do you encounter during marketing of maize?  
(C) low prices  (C) transportation   
(D) varietal discrimination  (D) variation of prices
21. What kind of problem do you encounter during transportation of maize to market?  
(C) bad roads  (C) High cost of transportation

(D) Lack of vehicle  (D) improper handling

22. What is the average number of maize bags do you sell in a market day?

(A) 1-5 bags  (C) 11-15 bags   
(B) 6-10 bags  (D) 16 bags and above

23. How do you store your produce left after marketing?

		YES	NO
A	Storage facilities (own /hired)		
B	Use of Fumigant		
C	In Sacks		
D	In Silos		

24. Which of these methods do you apply to combat the problems in the storage of maize? (A) Poison baits  (B) traps

25. Do you give assistance to farmers?

(A) Yes  (B) No

26. What form of assistance do you normally give to farmers?

(A) maize seed  (C) financial assistance   
(B) fertilizer  (D) advice