

**UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE**

**FACTORS INFLUENCING THE ADOPTION OF IMPROVED MAIZE FARMING  
TECHNOLOGIES IN YENDI MUNICIPALITY, NORTHERN REGION**

**GAZALI BABA MOHAMMED**

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TECHNOLOGIES IN YENDI MUNICIPALITY, NORTHERN REGION**

**BY**

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**THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL  
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DEGREE IN INNOVATION COMMUNICATION**

**FEBRUARY, 2018**



## DECLARATION

I hereby declare that this thesis is the result of my own original research work except for citations and quotations which have been duly acknowledged. I also declare that no part of it has been previously and concurrently presented for another degree in this University or elsewhere.

Candidate's Signature..... Date.....

**Gazali Baba Mohammed**

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

Supervisor's Signature ..... Date.....

**Dr. Hamza Adam**



## ABSTRACT

Low technology adoption remains a challenge to maize production in Ghana, including Yendi Municipality, which is one of the popular maize growing areas of Northern Region of Ghana. The study examined factors influencing the adoption of improved maize farming technologies in Yendi Municipality. Data was collected from 154 randomly selected farmers in the Municipality using questionnaires, Focus Group Discussions (FGD) and in depth interviews were used to collect data. Descriptive statistics, Poisson regression model and Kendall's coefficient of concordance were used to analyse quantitative data. Qualitative data was analysed based on themes and relationships. The study revealed that, the levels of adoption of improved maize farming technologies in the area were generally low. However, few of the technologies such as line spacing, seed per hole, as well as early harvesting recorded high adoption levels. The study also revealed that about 59% of the maize farmers had no contact with agricultural extension agents, which can negatively affect adoption of improved maize farming technologies. The Poisson regression analysis showed that education, farm size, credit access and extension contact significantly influenced the adoption of improved maize farming technologies in the area. The cost of the technology, complex nature of the technology, lack of skills to adopt the technology, risk and uncertainty of the technology and lack of productive resources were identified as challenges inhibiting the adoption of improved maize farming technologies in the area. The study recommends that Ministry of Food and Agriculture and other development partners should intensify training on the technologies to enable farmers understand their full benefits before they can fully adopt them.



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## DEDICATION

This thesis is dedicated to Almighty Allah, my beloved parents and well-wishers.



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## LIST OF ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
DIVA	Diffusion of Improved Crop Varieties in Africa
DOI	Diffusion of Innovation
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agricultural Organization Statistics
GFFSN	Global Forum on Food Security and Nutrition
GSS	Ghana Statistical Service
IFPI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ISSER	Institute of Statistical Social and Economic Research
MoFA	Ministry of Food and Agriculture
NB	Negative Binomial
NGO	Non-Governmental Organization
SARI	Savannah Agricultural Research Institute
SPSS	Statistical Package for Social Sciences
SSS	Sub- Saharan Africa
USAID	United States Agency for International Development
ZIM	Zero Inflated Model



## CHAPTER ONE

### INTRODUCTION

#### 1.0 Introduction:

The chapter discusses the background to the study, the problem statement, the research questions and objectives the study sought to achieve. The justification as well as the organization of the study is also discussed in this chapter.

#### 1.1 Background

In sub-Saharan Africa, maize is the widely-grown staple food crop with annual coverage of more than 33 million ha (FAOSTAT, 2015). It covers an estimated 200 million ha of cultivated land in Sub-Saharan Africa thus nearly 17%, and is grown in diverse agricultural fields and consumed by people that have different socio-economic backgrounds and food preferences (FAOSTAT, 2015). Maize is also the most widely consumed staple food in Ghana with increasing production since 1965 (FAO, 2013). It is grown in many parts of Ghana with an estimated of 15% production in Northern Ghana. Maize produced in Ghana on average has recorded an increase of 13.3% in 2012.

However, production has been fluctuating for the past two decades, which affects household incomes sources and threatens food security (MoFA-SRID, 2009). The low maize yields is probably due to multiples of traditional farming practices that include the use of low-yielding varieties, low plant population, poor soil fertility and inadequate and improper application of fertilisers and Improper weed control (Bidzakin *et al.*,





2014). The major staple crops and livestock low production remain a key challenge in realising food security in Africa. This has led to high food and nutrition insecurity, malnutrition and poverty, especially for the resource-constrained smallholder farmers, mostly rural farmers, practicing rain-fed agriculture (Gurney *et al.*, 2006; World Bank, 2007). To reverse the low productivity in maize production the utilisation of new maize farming technologies is paramount.

However, crop farmers seem to have relatively low rates of adoption of modern crop varieties and other agricultural technologies associated with increased crop yields (Peterman *et al.*, 2010). The adoption of improved maize farming technologies is important for boosting maize production and improving on household livelihood and food security in Ghana and Africa as a whole. It is evident as several studies conducted in Sub-Saharan Africa has proven that adoption of improved maize technologies adds to raising productivity which improves the household income and food security (Simtowe, 2011). The adoption of improved farming technologies influences the increasing rate of agricultural output. It also regulates how the increase in farming output impacts on the poverty levels and degradation of the environment (Meinzen-Dick *et al.*, 2002).

Therefore, the focus of many recent researches has been on coming out with better agricultural practices. For farmers to gain from research technologies, they need to proceed to implement the technologies on their farms (Meinzen-Dick *et al.*, 2002). The increase in agricultural productivity, rates of technology adoption, food security and nutrition of household can be accomplished through expansion of rural financial

markets, improved agricultural practices, increased capital and equipment ownership by the rural households and research development and extension linkages (von Braun, 1999; Katengeza *et al.*, 2012; Mason and Smale, 2013; Bezu *et al.*, 2014).

The use of improved maize based technologies in on-farm demonstration fields have resulted in yields of 4-5 tonnes per hectare (Bidzakin *et al.*, 2014). This indicates that improvements can be realised if farmers resort to the use of improved seeds, fertiliser and improved production practices and proper technologies (Bidzakin *et al.*, 2014). This makes the improvement in agricultural production and sustainability largely dependent on farmer's willingness and access to new technologies. The production and income can be increased extensively through the adoption and utilisation of modern technology by maize farmers in the Yendi Municipality or in many parts of the country. However, there are barriers to adoption of improved maize technologies which include: unavailability of credit, inadequate capacity of seed companies impeding product delivery at large scale, lack of awareness, inadequate availability of improved maize seed, and unaffordable seed price (Tahirou *et al.*, 2009; Fisher *et al.*, 2015).

Kakwani (2005) posited that technology adoption is pro-poor if it benefits the poor relatively more than non-poor. Clearly, such innovation or technology must be affordable to the poor in the society. Furthermore, its benefit must also be significant relative to its cost (including the adoption risks it involves). Although the benefits and determinants of adopting new farm technologies are stressed in the literature, the impact of these new technologies on poverty reduction is not well articulated. Partly,



agricultural extension and advisory services seem to be crucial in addressing the low maize productivity by providing and encouraging farmers to adopt improved maize farming technologies to boost their productivity.

According to (USAID, 2012), extension advisory services and programmes forge to strengthen the farmer's capacity to innovate by providing access to useful knowledge and information. However, the failure in the delivery of these extension services has a major influence in the adoption of improved maize technologies. This study therefore sought to assess the factors influencing the adoption of improved maize farming technologies in the Yendi Municipality.

## **1.2 Problem Statement**

Maize is a major staple crop for most Ghanaians and is usually used as a substitute for other major cereals that are in short supply. In spite of the increase in maize production in Sub-Sahara Africa over the years, Ghana has a supply deficit of maize to make up for this shortage through imports (Codjoe, 2007). This is not surprising as the ever increasing demand for maize for various domestic and industrial purposes keep growing, due to high population and low productivity of maize. This deficit can easily be addressed with increase in production, as there is enormous potential for maize cultivation in Ghana (Codjoe, 2007).





Undoubtedly, the maize subsector is mainly small-scale and is overwhelmed with usage of local technology, inadequate extension services, no or insufficient application of vital inputs (for example fertiliser and improved planting material), lack of support for credit and inputs provision, extension and research services and agro-management practices (MoFA, 2009). These factors hamper maize productivity in Ghana to which the Yendi municipality is no exception. However, previous studies have revealed that, low maize productivity growth in Ghana is mainly caused by low adoption of improved technologies, improved varieties, agronomic practices, and inadequate usage of purchased inputs (MoFA, 2011). It is therefore indisputable that the adoption of improved technologies for maize production is an important means to increase the productivity of smallholder agriculture in Africa that will lead to economic growth and improvement of the welfare of many poor households (Kassie *et al.*, 2011; Asfaw *et al.*, 2012).

Yet, in African countries especially Ghana and its countryside there exists paucity of information on adoption of improved maize farming technologies used by crop farmers (Merrill *et al.*, 2009). This is common because most African governments do not pay much attention to the collection of useful data (Doss *et al.*, 2003). It is always difficult to formulate policies for increasing agricultural productivity, without basic reliable descriptive information on who adopts technologies and who does not (Doss *et al.*, 2003).



However, most African governments to which Ghana government is no exception are committed to strengthening the provision of extension services over decades. Although, the role of extension today goes beyond technology transfer to facilitation and beyond training to learning; as access and adoption of technology are the most essential enablers for crop farmers to improve productivity (Zhou, 2010). The adoption of technology pattern and crop farmers' perceptions has remained unclear in most developing countries especially Ghana. The perceptions of crop farmers are mostly considered subjective but have direct influence on decisions to adopt improved technologies and are therefore very important in economic modeling (D'Antoni *et al.*, 2012).

Over the years several improved technologies have been developed by SARI/CSIR to enhance the production of maize in the Northern region of Ghana including the study area, due to the huge potential of its production in the area. According to the Municipal agricultural directorate in the Yendi Municipality maize technologies which have been promoted in the municipality over the past two decades includes; early fertilizer application, line spacing, the use of improved seeds, seed per hole, early harvesting and many others. However, since the introduction of these technologies they have not been an independent extensive research conducted to assess the levels of adoption of improved maize technologies and to determine the factors that influence the adoption of these technologies. The study therefore sought to assess the factors influencing the adoption of improved maize farming technologies in the Yendi Municipality.



## **1.3 Research Questions**

### **1.3.1 Main Research Question**

What factors influence the adoption of improved maize farming technologies among farmers in Yendi Municipality?

### **1.3.2 Specific Research Questions**

1. What are the levels of awareness of improved maize farming technologies in the study area?
2. What are the rates of adoption of improved maize farming technologies in the study area?
3. What socio-economic and institutional factors influence the adoption of improved maize farming technologies?
4. What challenges affect the adoption of improved maize farming technologies in the study area?

## **1.4 Research Objectives**

### **1.4.1 Main Research Objectives**

To examine the factors influencing the adoption of improved maize farming technologies among farmers in the Yendi Municipality.



### **1.4.2 Specific Objectives**

1. To determine the levels of awareness of improved maize farming technologies in the study area?
2. To assess the rate of adoption of improved maize farming technologies in the study area.
3. To determine the socio-economic and institutional factors influencing the adoption of improved maize farming technologies.
4. To investigate the challenges affecting the adoption of improved maize farming technologies in the study area

### **1.5 Justification of the study**

Ghana is not self-sufficient in maize production and as significant quantity or tonnes is imported to meet domestic demand. There is urgent need to improve small-scale maize producers' capacity to increase their production, to fully engage in farming as employment that will help reduce poverty and minimise the rural-urban migration in rural settings. Hence, any research that focuses on identifying the factors influencing the adoption of improved maize technologies that has the potential to boost production is quite commendable.

This study was appropriate and strategic as it provides empirical evidence on the levels and factors influencing the adoption of improved maize technologies. Particularly, empirical evidence on socio-economic factors influencing the adoption of improved technology. Findings of this research can be used by government, researchers, policy

makers, extension agents, organisations and other stakeholders to design programmes, strategies and projects that will help increase productivity as well as enhance the food security and producers' welfare. Moreover, this study will contribute to scientific knowledge that will serve as a trigger for possible interventions and policy formulation in the maize sector.

### **1.6 Definition of Key Terms and Concepts as used in this thesis**

**Adoption:** It is acceptance and use of new agricultural technologies by the farmers. According to Feder *et al.*, (1985), at the individual level, it is the degree to which a new technology is used in the long- run equilibrium when the farmer becomes fully awareness about the technology.

**Technology:** New innovations developed by the researchers, that are intended to improve agricultural productivity for high quality and quantity yield gains. Loevinsohn *et al.*, 2012), posits that technology is the means and methods of goods and services as well as production that included methods of organisation along with physical technique.

**Socio-Economic:** These are social, cultural, and financial aspects guiding maize farmers' decision on the adoption of improved maize farming technologies.

**Improved Technologies:** These are innovative agricultural practices that help at enhancing agricultural production.



## 1.7 Organisation of the Study

This study comprises of five chapters. Chapter one covers the study background, research problem investigated, objectives, justification and organisation of the study. Chapter two composes of related literature that are of relevant to this study. Chapter three highlights the research methodology, which describes the theoretical underpinnings and its empirical application; data analysis techniques used; the sampling technique, type of data collected and a brief description of the study area. Chapter four is dedicated to results, discussions and interpretation. Chapter five presents the summary, conclusions and policy recommendations and directions for future research.



## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

The chapter reviewed relevant literature on the key concepts of the study. The main areas discussed include the concept of adoption, definition of technology maize production, utilization and technology as well as proven and exploitable technologies on maize. The study discussed the factors that influence agricultural productivity, links between maize farming technologies and productivity as well as the role of technology in addressing the agrarian crisis. The study also discussed measurement of adoption and the empirical application of adoption analysis as well as reviewed relevant literature on adoption of improved technology, factors that are associated with farmers adoption decision, farmers perception on the characteristics of improved technologies, determinants or factors that influence farmers adoption of modern technologies as well as studies conducted on adoption of agricultural technologies. The study presents an empirical review of the study and ends with the conceptual framework of the study.

#### 2.2 Concept of Adoption

Adoption can be defined as an act of accepting a new technology with approval (Namara *et al.*, 2007). It is also defined as the integration of an improved technology into current practice and is usually preceded by a period of ‘trying’ and certain degree of adaptation (Loevinsohn *et al.*, 2012). In agriculture the adoption process often involves a series of stages that the farmers passes through, from an awareness stage





(first hearing about the technology), the evaluation stage (to collecting information on the expected benefit of the technology's in terms of its ease of operation and profitability) the trial stage and the final full-scale adoption stage of the new technology (with available and adequate information and positive evaluation, the farmer will experiment with the new technology) (Feder *et al.*, 1985).

Adoption of technology is influenced by numerous cultural, economic, social, technical and institutional factors. The rate of adoption can be measured by the number of individuals who adopted the idea for a specified period, for instance one year. Whilst the intensity of adoption could mean the adoption level of the improved technology (Nkonya *et al.*, 1997). Adoption intensity can also be measured based on the number of adopted technologies to the number of farmers adopting them. Kaguougo *et al.* (2012) and Nkonya *et al.* (1997) determined the factors that affect intensity by investigating their influence on areas cropped with the new improved technology by using the Tobit model.

### **2.3 Definition of Technology**

Basically, technology in agricultural perspective means different things largely depends on the predisposition of the contributor as it can be defined to ensemble individual and or organization's aims and objectives. According to Nelson and Phelps (2006) technology can be defined as all improved methods, materials, techniques, tools among others aimed at agricultural modernisations. These include fertiliser, improved seeds,



improved tools, insecticides, irrigation facilities, new implements, pesticides, storage facilities among others.

Technology is defined as the means and methods of goods and services as well as production that included methods of organisation along with physical technique (Loevinsohn *et al.*, 2012). It is the knowledge or information that stimulates the tasks to be accomplished very easily, some service to be executed or the manufacture of a particular product (Lavison, 2013). Technology can also be defined as those forces that lead to increase in farm output with a given dollar/cedi volume of the production inputs (labour, farmland and purchased inputs) with new and improved inputs and variations in farm management practices, specialisation, and agricultural related institutions (Tweeten, 2007).

To improve livelihood of most rural farmers the development and promotion of adoption of high yielding crop varieties should be done in a sustainable manner (Asfaw *et al.*, 2012). The adoption of improved technologies for maize production is essential and crucial to increase productivity of smallholder farmers in Ghana to which Yendi Municipality is no exception. This ultimately will foster the economic growth and welfare of many households that are mostly poor.



## **2.4 Maize Production, Utilisation and Technology**

### **2.4.1 Maize Sector in Africa**

Maize produced in the world is 785 million tonnes of which 6.5 % are produced from Africa with Nigeria being the largest producer of nearly 8 million tonnes, followed by South Africa. In Africa, the importation of maize required from countries is about 28% outside the continent (IITA, 2016). Taking into consideration these projections and earlier one thus increase in annual maize demand in Africa reaching 52 million tonnes by 2020 (IFPRI, 2000).

The maize yield gaps are persistent among all African smallholder farmers to which maize farmers in the Yendi Municipality are no exception. The total maize production in SSA account for 96% coming from top 20 countries that include Angola, Burkina Faso, Benin, Cameroon, Cote D'Ivoire, DRC, Ethiopia, Ghana, Malawi, Mozambique, Mali, Nigeria, Kenya, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe (FAOSTAT, 2015). Since 1961 land use for the cultivation of maize has increased considerably across regions in the sub-Saharan Africa (FAOSTAT, 2015).

Maize basically forms the uppermost percentage of calorie consumption in the national diet in 22 countries in the world out of which 16 are in Africa (Nuss and Tanumihardjo, 2011). In Eastern and Southern Africa, maize contributes to almost half of the total calories and consumed, and in West Africa it accounts for about one-fifth of the calories protein consumed. Regional maize average yields are as high as 1.7 t/ha in the West



Africa, 1.5 t/ha in the East Africa and 1.1 t/ha in the Southern Africa (Smale *et al.*, 2011).

Many drought tolerant and nitrogen use efficient varieties of maize are being scaled-up in Eastern, Southern and West African countries that has significant present-day and potential impacts (Alene *et al.*, 2009; Kostandini *et al.*, 2015).

Some of the technologies or projects developed have improved on the crop management practices such as cereal-legume rotation to Striga control and to soil fertility improvement (Kamara *et al.*, 2008). However, the low level of effective adoption of these novel technologies hamper maize productivity in many countryside of Africa nations to which Yendi is no exception.

#### **2.4.2 Maize Sector in Ghana**

The cultivation of maize in Ghana has been more than several hundred years. It was introduced in the late 16<sup>th</sup> century, and became the most important staple food crop in Southern Ghana (Morris *et al.*, 1999). It is the most important cereal crop grown and consumed by most rural farmers and their households in Ghana. It is the second most essential staple food in the country aside cassava. Ghana is a major producer of maize in sub-Saharan Africa as the production accounts for about 9% of total acreage among the surveyed countries in the Diffusion of Improved Crop Varieties in Africa (DIVA) project, and 7% of the total acreage in Central and West Africa (Alene and Mwalughali, 2012).



Maize production at the national level averages 1.7 metric tonnes / hectare (MoFA, 1993 2011). Meanwhile, data from different on-farm and on-station trials suggest that the yield on average is around 4 to 6 tonnes / hectare for maize which is below the achievable yield (MoFA/CRI/SARI, 2005). Maize is the largest staple crop and is the mainstay of the diet of the majority of Ghanaians, since it is the base for several traditional food preparations such as banku, tuozafo, and kenkey (Morris *et al.*, 1999). Furthermore, maize is the second largest commodity crop in the country, aside cocoa (ISSER, 2012). Maize is also the main constituent for poultry and livestock feed. Maize accounts for about 50–60% of the total cereal production in Ghana (ISSER, 2012). Total maize annual production in Ghana between 2007 and 2012 average 1.5 million MT (MoFA, 2012).

Maize farmers have no clear understanding of climate change, though they are among the first in reacting and perceiving to environmental changes. It has been established that the effects of declining rainfall, with emphasis on changes in the regularity, intensity, length and timing of rainfall; increasing sunshine intensity, increasing air temperature and seasonal changes in rainfall pattern hamper profitable maize production (Kluste *et al.*, 2013). The onset and cessation of rain changes have had a destructive impact on production of maize and which threatens household food security since maize is a staple food of majority of Ghanaians. Maize farmers are also aware of the interaction effect between changes in climate and bad management practices.

### 2.4.3 Maize Situational Analysis

Maize is a staple in most Ghanaian diets, and is more affordable food in the local market. Domestically, maize production appears to be meeting the human consumption thus the local demand (Obeng-Ofori *et al.*, 2014). In Ghana maize supply has been increasing progressively over the past few years with an average supply of 1.4 million MT over the period of 2005 to 2010 (Obeng-Ofori *et al.*, 2014). Though, human consumption is contending with the poultry production sector and to a lesser extent the livestock sector. Whilst there is no dependable data for maize used as animal feed, the Government of Ghana estimates that 85% of all maize grown in Ghana is intended for human consumption and 15% is used for the feeding of animal thus mainly poultry (Obeng-Ofori *et al.*, 2014).

Furthermore, maize as a source of biodiesel is being studied worldwide including Ghana with the advancement of the renewable sources of energy, and may soon increase local demand when crop farmers try to sell to fuel companies (Obeng-Ofori *et al.*, 2014). White maize consumption is estimated to increase owing to population growth and growing per capita income. Based on the domestic production figures, the shortfall between domestic production and domestic consumption were estimated to reach 267 000 Mt in 2015 if there is no substantial productivity improvement (MoFA, 2011). This deficit will mostly affect consumers particularly those in urban areas and the poultry sector.





Undoubtedly, Ghana has great potential to produce maize as a major export agricultural commodity (William *et al.*, (2009). The soils and climate in all the 10 regions of Ghana are appropriate for maize production sector. Also, many technologies along the maize value chain have been advanced by research institutions in Ghana to boost productivity. However, the average yield of maize per hectare produced by small scale farmers is very low and postharvest losses at farm level and during storage are enormously high averaging 30 to 50% (William *et al.*, 2009).

#### **2.4.4 Increasing Maize Production through Science and Technology**

Maize is a key staple crop in the diet of Ghanaians. It is therefore necessary that, level of production is increased to meet the ever increasing population in the country. The fast population growth has put extensive pressure on accessible arable land fields as these land fields are increasingly being used for social infrastructural development, human habitation and some economic activities for instance mining (Obeng-Ofori *et al.*, 2014). Accordingly, new technologies that will boost or increase yield per hectare need to be recognised and disseminated to crop farmers to meet the ever growing demand. Also, due to large mainstream of Ghanaian farmers being small scale farmers with limited educational background, most of them will not willingly seek and adopt new agricultural technologies (Obeng-Ofori *et al.*, 2014).

Technology plays a vital role in agricultural production and influences the lives of crop farmers worldwide. Technical innovations that include irrigation, ploughing, milling, and other improved agricultural practices have expedited to achieve food security in the history of mankind. In recent time, technologies are freely available and innovations



thrive (Obeng-Ofori *et al.*, 2014). However, these technologies are with some unknown risks when employed indiscriminately without good assessment. Mostly, crop farmers and other stakeholders trust demonstrated technologies which have been used and adapted for particular settings.

However, new technologies can track the risk of being used only by the people who are rich in the society to increase their incomes rather than safeguarding food security. This practice can hinder the acceptance by small holder farmers that are traditionally known for avoidance of risks (Global Forum on Food Security and Nutrition, 2010). Some factors have been noted for affecting the integration and adoption of new improved agricultural technologies in Ghana. Some of these include, age, access to information, educational level, access to technology, farm size, land ownership, availability of funds, level of farm income and infrastructure (Obisesan, 2014).

To have a progressive and long term impact for broad acceptance and on food security by stakeholders, technologies need to be introduced with proper care and be freely adaptable to the demands of a particular setting, and should be easily understood and used. Likewise, technologies need to take into consideration the socio-economic conditions of the community and/or current agricultural practices and their instant benefits (Obeng-Ofori *et al.*, 2014).

To successfully disseminate recognised appropriate technologies, the following procedures would be followed: Several stakeholders in the maize value chain (for example extension agents, small scale farmers, policy makers, researchers, processors among others) would be recognised and interviewed to determine what technologies

they are currently using; Selection of actual available suitable technologies that are not being widely utilised by crop farmers in the area through stakeholder workshop; Validate and educate target farmers on the use of the selected suitable technologies through field experimentation with main stakeholders and; Monitor and collect data on the impact of these suitable technologies on the output of the farms.

## **2.5 Proven and Exploitable Technologies on Maize**

### **2.5.1 Maize Varieties**

The Crop Research Institute of the Council for Scientific and Industrial Research (CSIR) has developed numerous varieties of maize seeds in Ghana. The full season of 115 to 120 days and the medium maturing of 105 to 110 days varieties normally give the highest yields, followed by the early maturing of 90 to 95 days and extra-early of 75 to 80 days maturing varieties (Obeng-Ofori *et al.*, 2014).

About twenty-seven improved maize varieties had been released since the 1960s, varietal improvement and testing conducted by CRI and SARI focused on high yield, protein content, Striga resistance, tolerance to pests and disease and early maturity (Ragasa *et al.*, 2014). Obaatanpa is the most popular maize variety which was released as a medium-maturing open-pollinated variety in 1992, nevertheless it is still by extension the most popular variety. It was adapted to the rising conditions in the lowland tropics and has been adopted widely in Ghana and many other African countries (Sallah *et al.*, 2003).





### 2.5.2 Planting Patterns

The recommended planting dates are based on the rains establishment in each agro-ecological zone. Though, the experience of farmers in each area seems to be the best guide. Experience over the years shows that, planting as early as potential after the rains have the following merits: Highest yield; Benefit from higher soil fertility; Lower incidence of birds and rodent damage; Lower incidence of streak virus disease and; more days of sunlight (Obeng-Ofori *et al.*, 2014). Locally, planting stick, farmers use a cutlass or hoe to plant, making 5 to 7 cm deep holes in the soil. Deep planting and firming soil stop seed removal by rodents and birds. In soils or clay soils that crust easily, planting is done by making 2 to 3 cm deep holes in the soil. Farmers ensure that the seeds are in good contact with the soil. Approximately 20 kg of seeds are used to plant one hectare (or 8 kg for 1 acre). Inorganic fertilisers are the most widely used after planting (Obeng-Ofori *et al.*, 2014).

### 2.5.3 Fertiliser Application

Inorganic fertiliser, NPK is used in almost every area planted with maize in Ghana. On average, 270 kg of fertiliser is used per hectare. This amount contains 47 kg of nitrogen (N), 20 kg of phosphorus (P), and 20 kg of potassium (K) (Ragasa *et al.*, 2014). Experts recommend, and many of the farmers interviewed also admitted to adapting crop rotation practices on the maize farms. Sulfate of ammonia (N21 S24) is also recommended as a side-dress applied four to five weeks after planting at the soil surface. Many farmers planted groundnuts, cowpea, or yams in alternate years in place of maize on their farms. This ensures that the legumes replenish the nitrogen content in

the soil and thus keep the fertility relatively higher for a longer period of time (Ragasa *et al.*, 2014).

#### **2.5.4 Weed Control**

Herbicide glyphosate is used to control weeds before planting, and 2-4 D weedicides are used to control post planting weeds. Most of the small scale farmers also control weeds by thrashing with hoes and cutlass (Obeng-Ofori *et al.*, 2014). Apparently, costs of farm labour have been soaring in all regions, these has compelled farmers to use weedicides as a cheaper alternative to hoeing or additional manual weeding methods, which is their favoured choice of weed control (Obeng-Ofori *et al.*, 2014).

The most tarnished weed in maize production is striga. Striga are parasitic weeds that attack largely cereals like maize, these weed produces various tiny seeds and the seeds usually are dispersed by livestock, man, water, wind, and contaminated crop seeds (Ragasa *et al.*, 2014). Once shed, the seeds can stay viable in the soil for up to 20 years. Seemingly the seeds naturally germinate only in response to chemical stimulants radiated by the host roots and once germinated, the weed establishes parasitic attachments with the root of the host and starts deriving all nutrients from the host (Ragasa *et al.*, 2014).

#### **2.5.5 Pests and Diseases**

Maize streak virus disease is the most serious disease affecting maize production in Ghana. Generally, it occurs in late plantings in the main season and during the



negligible season. Early disease symptoms consist of round, very small and scattered spots in the leaves of youngest crop (Obeng-Ofori *et al.*, 2014). The best control measure for streak is to plant the suggested improved varieties that are all resistant to the disease (Obeng-Ofori *et al.*, 2014).

### **2.5.6 Threshing**

Hand threshing using tarpaulin, sticks or bare ground, and bam-bam boxes are common. Adding value through processing to increase shelf life of maize is done traditionally to minimise post-harvest losses. Lately, mobile threshing machines have been introduced and are hired out to maize farmers by co-operative maize farmers' groups (Obeng-Ofori *et al.*, 2014).

### **2.5.7 Maize Drying and Storage**

As a dry cereal, when maize correctly dried, treated and stored, can last for numerous months. The development of mould cause by the presence of extra moisture in the maize crop is one of the most serious post-harvest difficulty maize farmers' faces (Obeng-Ofori *et al.*, 2014). Numerous types of open air cribs, solar dryers and wood cribs are accessible and in use by farmers in Ghana. However, the poor peasant farmer is often incapable to afford quality crib and storage. Hence, are compelled to sell their farm produce cheaply and quickly to prevent post-harvest losses. The maize protein infused varieties like Obatanpa are predominantly susceptible to weevils and some pests after harvest (Obeng-Ofori *et al.*, 2014).



There are two options in the storage thus maize are shelled and stored in poly propylene or jute sacks or can be stored in undehusked or dehusked ears. Some traditional storage facilities include: granaries, open area storage, barns, pots, pits, baskets, cribs, platforms, jars, bags and gourds. Modern facilities include: metallic silos, warehouses, improved barns, triple bags (PICS), supper grain bags, narrow cribs and zero fly bags. Numerous maize drying technologies are used by maize farmers (Obeng-Ofori *et al.*, 2014).

## **2.6 Factors that Influence Agricultural Productivity**

In developed countries, productivity growth is largely depended on improved technologies and organisational changes (Brynjolfsson and Hitt, 2003). In developing economies there exist a gap of technological and organisational change to keep pace with ever increasing population and demand for consumable goods due to high cost of technological development and adoption of the innovation. In Ghana especially rural areas to which Yendi Municipality is no exception, multiple factors influence maize productivity that include agricultural research and extension, education of producer, market access and availability of credit, input use, technology, and relative output and input prices.

Additionally, agricultural policies, weather, land tenure system, inadequate involvement of farmers in decision-making, insecurity, legal and regulatory environmental issues are also factors influencing productivity (Odhiambo and Nyangito, 2003). Brynjolfsson and Hitt (2003) reported that productivity across countries differ due to difference in time

factors in the levels of multiple factors such as fertiliser, land, labour, livestock, mechanisation and tractors that influence production in developing countries.

## **2.7 Links between Maize Farming Technologies and Productivity**

Improved maize farming technologies has the potential to reduce poverty through increased in rural incomes, reduction in food prices due to abundance, food security, boost the beverage industries among others. The poverty reduction potential of maize farming and various transmission mechanisms is largely dependent on ability of farmers to increase maize productivity on annual bases. Agricultural technology or innovation can have major direct and indirect influence on poverty. Maize productivity gains obtained by the farmers as a result of adoption of technology are the direct effects of technology on poverty reduction, this usually comes in a form of higher farm profits. Whilst the indirect effects are the productivity-induced benefits distributed onto other farmers by their counterparts that are innovating. These may include lower food prices, increased in consumption for all farmers or higher non-farm employment levels. The dominance of these effects is largely dependent on the speed at which farmers adopt improved maize farming technologies and also the household's status either net food buyers or sellers. In spite of the higher productivity of improved seed, fertiliser relative to other agronomic practices, maize farmers are seen to be slow in adoption of the technologies. Many attempts have been made to examine the causes for the partial adoption, but few studies have the subsequent impacts of the packaged multiple technologies (Nyangena and Juma, 2014).



## 2.8 Role of Technology in Addressing the Agrarian Crisis

There is an existing gap between what the farmer gets and what is actually feasible with the improved technology in sub-Saharan Africa. In searching for solutions on what has gone wrong, a basic issue of concern recounts to the improved technologies and institutional arrangements that are promoted by existing governments in Africa to increase productivity (Mkandawire, 1993). The adoption of improved farming technologies influences the increasing rate of agricultural output. It also regulates how the increase in farming output impacts on the poverty levels and degradation of the environment (Meinzen-Dick *et al.*, 2002).

The increase in agricultural productivity, rates of technology adoption, and food security and nutrition of household can be accomplished through expansion of rural financial markets, improved agricultural practices, increased capital and equipment ownership by the rural households and research development and extension linkages (von Braun, 1999).

The increase in technology development and adoption can increase agricultural output, therefore improve household food intake (Kennedy and Bouis, 1993). The experience and evidence from nations within and around sub-Saharan African region shows that returns to development of agricultural technology can be very high and far reaching. This can transform the smallholder sector and also in the whole national economies of countries in Africa (Mazonde, 1993).



## 2.9 Measurement of Adoption

Adoption measurement is purely based on measuring choices. Measurement of adoption can be through the estimation of the intensity and rate of utilisation of the improved new technology being examined depending on the type or nature of the data thus be it qualitative or quantitative (Bonabana-Wabbi, 2002). For example, Alene *et al.* (2000) employed Tobit model to study quantitative and qualitative data for the investigation of the determinants of adoption and intensity of use of improved maize varieties in the Ethiopia.

The adoption decision involves choice of how many resources such as crop field allocated for the new improved and old technologies, if the technology is not divisible. Equally, if the technology has divisibility (for example agronomic practices, fertiliser, herbicide and improved seed), the decision process involves cropped area allocations in addition to levels of use or the rate of application (Feder *et al.*, 1985). Undoubtedly, the process of adoption decision involves simultaneous choice of whether to adopt a new technology or not, and use and rate of its intensity.

Moreover, before adoption choices are made a farmer makes a set of numerous interdependent decisions (Hassan *et al.*, 1998). In measuring adoption, it is essential to differentiate between technologies that are divisible and others that are not. Adoption intensity of divisible technologies could be measured at the farmer or individual level within a given period of time by sharing farm area used for the new improved technology or quantity of input invested per hectare (Feder *et al.*, 1985).





Similarly, the measurement can be used to examine the aggregate level of adoption. Aggregate adoption is estimated by the aggregate level of use of a particular improved technology within a population or a geographic location. However, the adoption intensity of non-divisible technologies of agriculture that include tractors and combine harvesters at farm level within a given period of time is usually used or not used (dichotomous), whilst the continuous is an aggregate measure.

## **2.10 Empirical Applications of Adoption Analysis**

Previous economic studies on technology adoption revealed that credit, farm size, human capital, labour availability, land tenure, risk and uncertainty and complementary input availability are major factors that affect agricultural technologies adoption (Feder *et al.*, 1985). In Tanzania, Kaliba *et al.* (2000) reported factors that influence adoption of improved maize technologies (maize seeds and inorganic fertiliser) by producers or farmers. The results revealed that on-farm field trials, availability of extension services, rainfall and variety characteristics were the major essential factors that influenced the adoption intensity of improved technologies.

Probit and Tobit models were employed to identify the factors that influenced improved maize varieties adoption. Nchinda *et al.* (2010) suggests that if the intensity and factors influencing the adoption are to be examined simultaneously (adoption and intensity decisions are assumed to be taken at the same time), the Tobit model is appropriate. When compared to the other dichotomous models grounded on the assumption that no selection is bias. Moreover, it offers both the influence of exogenous factors on the



probability of adoption and its intensity in addition to the estimation of marginal effects of the factors (Chukwuji and Ogisi, 2006).

## 2.11 Adoption of Improved Technology

The production and diffusion of high maize yielding technology is the only possible means of achieving high agricultural productivity (Asfaw *et al.*, 2011). Adoption of improved maize technology is very essential as masses of the population are poor and draw their household livelihood from agricultural production (Feder *et al.*, 1985). The production and income can be increased extensively through the adoption and utilisation of modern technology by maize farmers in the Yendi Municipality or in many parts of the country.

Barriers to adoption of improved maize technologies include: unavailability of credit, inadequate capacity of seed companies impeding product delivery at large scale, lack of awareness, inadequate availability of improved maize seed, and unaffordable seed price (Tahirou *et al.*, 2009; Fisher *et al.*, 2015). Technology adoption is a pro-poor if it benefits the poor relatively more than non-poor (Kakwani, 2005). Clearly, such innovation or technology must be affordable to the poor in the society. Furthermore, its benefit must be significant relative to its cost (including the adoption risks it involves). Although the benefits and determinants of adopting new farm technologies are stressed in the literature, the impact of these new technologies on poverty reduction is not well articulated.





## 2.12 Factors Associated with Farmers Adoption Decision

Farmers' decisions to adopt technologies are fundamentally dynamic, farmers do not simply decide to forever adopt a new technology. Rather, before adopting an improved agricultural technology, a series of questions are asked by farmers that include: what resources (thus land and capital) are needed for the allocation to support the use of the new technology? Is there any other technology (for example other improved variety) that is higher-yielding? (Doss, 2003). Farmers' adoption of technological behaviour is associated with multiple factors. In a study of the adoption of technologies by smallholder in the tropical areas, Pattanayak *et al.* (2003), classify factors associated with adoption of technologies into four categories: biophysical factors, market incentives, preferences and resource endowments, and risk and uncertainty.

Doss *et al.* (2003) studied the adoption of maize and wheat technologies in eastern Africa and propose a similar frame work. They classify factors associated with farmers' adoption decisions into four categories: economic attributes, farmers' socio-demographic characteristics, farmers' perception about the characteristics of technologies, and institutional factors.

## 2.13 Factors that Affect Farmers' Access and Use of Agricultural Information and Technologies

Maize farming forms part of the back bone of agricultural production in Ghana and most African countries. Historically, the production of maize and others has been beleaguered with many structural and policy issues that have resulted in low yields



(MOFA, 2005). In the context of this research access can be defined as the availability or possible use of improved maize information at the individual level, household level, or community level. The farmer socio-economic characteristics that include level of education, farm size and farming experience influence the adoption of improved technologies (Hudson and Hite, 2003).

The decision made by farmers regarding adoption of agricultural technology that is new to the old technologies will largely depends on multiple factors that include access to institutional services and the input supply markets (Khan *et al.*, 2008). The age of the adopter influences the levels of information access and farming experience. Older farmers might have engaged in concurrent receiving and provision of information as they are often confronted with communication barriers (Katungi, 2006). Gender also influences the adoption of technologies as it affects sourcing of agricultural information and use. Female farmers are more risk loath (Croson and Gneezy, 2008) and perceptions that females or women are not supposed to be farmers also limit their accessibility to agricultural information sources (Doss, 2001). However, due to male farmers' geographically dispersed and socially networks nature they usually stand a greater chance in accessing agricultural information (Haddad and Maluccio, 2003).

Marital status also influences access to agricultural information by the farmer. The desire to increase in productivity for family consumption and income is high among farmers who are married than their counterparts who are not married (Opara, 2008). As the desire increases in maize production it will stimulate them to search for more and reliable agricultural information for use. The household size of a farmer is also a major factor that influences their agricultural information access and use. Kacharo (2007)

reported that higher number of households (family members) leads to high exposure to acquire agricultural information.

Access to agricultural information is influenced by the farmer's level of education. Farmers with formal education stand high chance of adopting a new technology to increase productive. Education gives the farmer ability to derive, decode and evaluate useful agricultural information for production (Ani, 1998). In developing countries such as Ghana most farmers are found in rural areas and are not or less educated. The level or status of farmer resource affects his or her decision to adopt an improved agricultural technology (Khan *et al.*, 2008). Land size is an indicator of wealth and proxy for social status which has influence on farmers in the Yendi Municipality and in the country as a whole. Farmers with big farm sizes are better informed, richer and keener in searching for improved technologies information (Okwu and Iorkaa, 2011).

The farmer whose farm lands are secured in land tenure system gives him or her incentive and authority to easily adopt improved maize technologies. The nature or lack of secure property rights disturbs the household investment (Samuel, 2001). The ability of farmers to adapt improved technologies requires financing to improve productivity. Other economic activities that provide ready cash for farmers can be used to purchase inputs and also provide other household needs. Gundu (2006) reported that rural farmers lack the economic ability to access and use relevant agricultural information. Social networking gives the farmers ability to observe and learn suitable and profitable improved agricultural production methods.





The networks are particularly essential as they assess the worthiness of new technologies and suitability to their conditions (Minja *et al.*, 2004). Social capital is measured basically by five indicators, each taking a different aspect of the social interaction: civic engagement, frequency of interaction in social institutions and social network size (Katungi, 2006). Main factors affecting the maize production which include the lack of technology, limited access to or the use of inappropriate technology among others are to blame for the food deficiency in many parts of the developing world (von Braun *et al.*, 2007) to which Yendi Municipality is no exception.

Though, with improved maize technologies production can be accelerated and challenges of food security will be overcome in the developing world especially Yendi Municipality. Technology can be defined as a new, scientifically derived, often complex input supplied to maize farmers or crop farmers by organisations with the help of technical expertise. It is a process designed to attain a given action whilst decreasing the uncertainty in the most cause-effect way (Simpson and Owens, 2002). Maize farmer awareness and use of improved technologies largely influence output of any farm produce. The major challenge there is how farmers see the need to use improved technologies.

#### **2.14 Farmers' Perception on the Characteristics of Improved Technologies**

Perceptions on the characteristics of modern agricultural technology are also essential factors that are related with farmers' demand for improved farming technologies (Adesina and Forson, 1995). Farmers may be subjective in evaluating the cultural and technical aspects of improved technologies differently. Hence, understanding the

farmers' perceptions is essential the in designing and promotion of new farming technologies (Uaiene *et al.*, 2009).

Generally, farmers' perceptions on the characteristics of improved maize farming technologies can be separated into three main categories thus maize yield performance, the cost requirements and the risks. Feder *et al.* (1985) reported that yield performance is one of the main characteristics of improved varieties that affect adoption behaviour of farmers. Previous studies show that the rate of adoption of improved varieties is high, on condition that the varieties meet expectations of the adopting farmers. An improved variety can be adopted at very high rates, on condition that the improved variety is economically and technically superior to the local varieties. Neill and Lee (2001) reported that farmers' adoption of improved farming technologies is also influenced by farmers' perception of its initial capital investment required and labour requirements, needed to undertake the underlying technology.

Similarly, Martel *et al.* (2000) reported that farmer's adoption of improved farming technologies is due to their perceived reduced labour requirements and other production costs, and minimal risk (for example crop diseases) during production and/or post harvesting of the new technology in Honduras. They further argue that bean farmers usually compare the improved bean variety to their local or current variety. Farmers' stands higher chance to adopt an improved bean variety if it yields well under diverse environmental conditions, has high economic profit, and is tolerant to disease and insects.



Adegbola and Gardebroek (2007) also reported the effect of information sources on improved technology adoption and modification in Benin, aside direct costs, yields and profits associated with new maize seeds, and reduce risk of the seed characteristics due to potential yield losses and poor grain quality. These losses increase the risk of food insecurity for the households and decrease farmers' income, if the losses in quantity are not adequately compensated for by higher prices due to deficit in the national supply. With regards to risks, numerous studies revealed that farmers also give consideration to environmental aspects (Ramirez, 2003), or for deviations in the local agro-ecological patterns (Doss, 2003).

The slow progress in adoption of improved farming technologies that can upsurge maize productivity is generally not well noted to reduce agricultural output in Yendi Municipal and Ghana as a whole. The slow rate of adoption of improved farming technologies could be due to low expected gains from the practice or other factors such as institutional or farmers' attitude which may not encourage the technology adoption (Obwona, 2000; Ajibefun, 2006).

### **2.15 Determinants or Factors that Influence Farmers Adoption of Modern Technology**

Various factors that are likely to determine or influence farmers' adoption of improved technology are discussed below. Farmers' decisions about whether and how to adopt improved technologies are accustomed by the dynamic interaction between technology characteristics and the collection of conditions and circumstances (Loevinsohn *et al.*, 2012). Among the factors that determine the modern technology or productivity is





classified as: characteristics of the farmer, input characteristics, and institutional factors (Langyintuo and Mekuria, 2005). They added that, characteristics of the farmer comprise but not limited to the following: age, gender, family size, farm size and educational level while institutional factors include comprise being a member of a farmer group, access to production area cultivated and marketing information, whether farmers received credit and accessibility to road as well as storage infrastructures. Adesina *et al.* (1993) also postulated that, input characteristics refer to the farmer's perception of the qualities of a particular input.

### **2.15.1 Farmers' Household Factors**

Previous studies on adoption of technologies in developing countries have proven farmers' socio-demography characteristics (for example age, gender, education and household size) have influence on household adoption behaviours (Doss *et al.*, 2003). Some studies reported that the rate of adoption of technology is higher among households headed by males as compared to households headed by female due to discrimination (Doss *et al.*, 2003). A study conducted in Burkina Faso and Guinea shows the young and old sorghum farmers in adopting new technology (Adesina and Forson, 1995). Young farmers adopt the technology due to their long term plans and readiness to take risks whilst old farmers adopt because of accumulation of capital or greater access to credit, because of their age.

However, the effect of farming experience (measured by the age of the household head) is not always positively associated with farmers' adoption behaviours. For example, Zavale *et al.* (2005) reported that older farmers in Mozambique are less likely to adopt





improved maize variety than younger farmers. According to Adegbola and Gardebroek (2007), educated farmers are able to better process information, more accurately assess the profitability of modern technology, and allocate inputs more efficiently, compared to those farmers with no education.

The level of education attained by the households in Mozambique is absolutely associated with adoption behaviours of households (Zavale *et al.*, 2005; Uaiene *et al.*, 2009). The level of farmer's education has a major influence on the farmers' decision to adopt modern technology. Educational level of a farmer increases his ability to acquire, process and use information that is of relevance to adoption of improved maize technology (Mignouna *et al.*, 2011; Lavison, 2013; Namara *et al.*, 2013). For instance, a study by (Ajewole, 2010) on adoption of organic fertilisers establishes that the farmer level of education has a positive and important influence on adoption of improved technology. As higher education influences farmers' attitudes and thoughts making them more open, rational and able to analyse the benefits of the modern technology (Waller *et al.*, 1998).

This facilitates the introduction of modern innovation which ultimately affects most adoption process (Adebiyi and Okunlola, 2010). In contrast, negative or insignificant effect of education on the adoption rate of technology (Banerjee *et al.*, 2008; Samiee *et al.*, 2009; Ishak and Afrizon, 2011). Studying the effect of education on technology adoption, Uematsu and Mishra (2010) described a negative influence of education towards adoption of genetically modified crops. It is evident that the mixed results on the influence of farmer's education and adoption of improved technology, more studies need to be conducted to establish the core facts.



Age is also considered to be a determinant of adoption of improved technology. Older farmers are supposed to have increased knowledge and experience over time and are able to evaluate information of technology than younger farmers (Mignouna *et al.*, 2011; Kariyasa and Dewi, 2011). On the contrary, age has been proven to have a negative relationship with technology adoption. This was elucidated by Mauceri *et al.* (2005) that as producers or farmers grow old there are an increase in risk distaste and a lessened interest in their long term investment on the farm.

Whilst their counterparts that are younger are naturally less risk-averse and are ready to try modern technologies. A study by Alexander and van Mellor (2005) revealed that adoption of maize that is genetically modified increased with age for fresher farmers as they advance experience and increase their stock of human capital nonetheless declines with age for older farmers. Gender issues in adoption of agricultural technology have been examined for a long time and numerous studies have indicated mixed evidence regarding the different roles males and females play in adoption of technology (Bonabana-Wabbi, 2002).

In analysing the impact of gender on adoption of technology, Morris and Doss (1999) reported that there is no significant relation between gender and likelihood to adoption of improved maize in Ghana. It was concluded that adoption decision of technology adoption largely depends primarily on farmer's access to resources, instead of gender. If adoption of new maize depends on access to labour, land or other resources, and if in a specific context the male farmers tend to have good access to these resources than female farmers, the technologies most likely will not benefit males and females equally.

Gender influence on adoption of farming technology as household head is basically the primary decision maker and generally men have more access to and control over important production resources than their female farmers' due to socio-cultural values and norms (Mesfin, 2005; Omonona *et al.*, 2006; Mignouna *et al.*, 2011). A study by Obisesan (2014) on technology adoption revealed that, gender had a noteworthy and positive influence on adoption of cassava in Nigeria. The finding conforms to that of Lavison (2013) which showed male farmers were most likely to adopt organic fertiliser not like their female counterparts.

Studies conducted by Appleton and Scott (1994) reported that, gender influences farmer use of productivity enhancing technologies such as improved seeds and animal traction. Similarly, Langyintuo and Mekuria (2005), recommended gender as one of the variables to be considered in improved technology use by observing that, provision of extension services which is vital in use of productivity enhancing technologies.

Making gender one of the variables in improved technology use studies is imperative since women-headed farm families are comparatively poor compared to male-headed ones (UBoS, 2010). Also, studies conducted by Morris *et al.* (1999), Doss (2001) and Asante (2013), also reported that in Ghana, nonetheless no significant difference exists between the rates at which men and women practice improved technologies in their maize farms, rates of use of row planting and improve maize varieties have been significantly lower among female farmers than among male farmers



Household size can be used as a measure of labour availability which influence adoption process as larger household have the ability to relax the labour limits required during introduction of improved farming technology (Bonabana-Wabbi, 2002; Mignouna *et al.*, 2011). Household members above eighteen years are close to labour availability may influence the adoption of improved farming technology positively as its availability reduces drastically the labour constraints (Gbegh and Akubuilu, 2013).

According to Kafle (2010), he posited that, it is uneasy to offer a general view of the influence of household size on agricultural technology practice since both positive and negative influences have been observed in previous studies. Although Amaza *et al.* (2007), in analyzing the influence of family size on the extent of use of maize productivity enhancing technologies reports an inverse correlation between farm size and maize productivity enhancing technologies.

The reasons given for the inverse correlation was that large households particularly those living in villages are living in abject poverty with the little money they have are mostly spent on basic necessities of life, leaving little or no money for buying technological or production inputs. Perz, (2003), also reported that a large-size family may allow use improved technologies such as pesticides and fertilizer which are labour intensive. Hence, if labour is supplied by the family member, use of improved technologies is likely to be positive. However, no significant influence of household size on use of maize production technologies in Northern Ghana was found by Mohammed *et al.* (2012).

### 2.15.2 Institutional Factors

The institutional factors that affect the adoption of technologies by farmers include extension contacts and membership of cooperatives. To be precise the institutional factors such as access to extension services, credit, and price information from markets, roads and partaking in agricultural association have been extensively used to assess adoption behavior of crop farmers. Access to extension services provided by government, non-governmental organisations, and other stakeholders play a vital role in the adoption of improved farming technologies (Pattanayak *et al.*, 2003).

Farmers who are exposed to information about modern technologies by extension agents (through group discussion, training, plots demonstration, and among other form of information delivery) tend to adopt modern technologies. As reported by IFPRI (1998) a modern technology is only as good as its delivery mechanism to farmers. Agricultural extension services enhance the efficiency of adoption decisions making. Membership of farmer based groups is a positive coefficient with adoption (Gbegeh and Akubuilu, 2013).

Farmers, who have membership to cooperatives that can pull resources together for their individual gain, give them the opportunity to adopt many technologies than other farmers who are not members. Also, members of cooperatives get more reliable information on improved farm management practices than non-members of cooperatives. Farm based organisations links the individual farmer to the larger society and exposes the farmer to a variety of ideas. A membership to a cooperative society is



postulated to be absolutely associated with the adoption of improved modern technologies.

### 2.15.3 Income Level

The adoption of a new technology is keenly determined by the net gain to the adopting or innovating farmer thus including all costs of using the improve technology (Foster and Rosenzweig, 2010). In technology adoption the wealth of farmers is crucial because wealthy farmers can better handle risks which facilitate the adoption of improved technologies (Doss and Morris, 2001). Samiee *et al.* (2009) in the research revealed that there is a substantial relationship between integrated pest management adoptions with an annual farm income, which is most likely to influence the adoption of improved maize technologies. The cost of adopting farming technology has been reported as a major constraint to adoption of technology. For instance, the elimination of subsidies on prices of fertilisers and seeds since the 1990s because of the World Bank-sponsored structural adjustment programmes in sub-Saharan Africa has extended this constraint (Muzari *et al.*, 2013).

Off farm income has proven to have positive impact on adoption of technology. As it acts as essential strategy for overcoming credit constraints faced by most rural farmers in many developing countries (Reardon *et al.*, 2007). Off-farm income is stated to act as a supernumerary for borrowed capital in challenging economies where credit markets are either dysfunctional or missing (Ellis and Freeman, 2004; Diiro, 2013). According to Diiro (2013) off- farm income is anticipated to provide rural farmers with liquid capital for buying productivity enhancing inputs such as new seed and fertilisers.



#### **2.15.4 Farm Characteristics**

Farm size influences the adoption costs, credit constraints, human capital, labour requirements, risk perceptions, tenure arrangements and more. Farm size can influence and in turn be exaggerated by the other factors affecting adoption (Lavison, 2013). With small farms, it has been debated that large fixed costs are a constraint to adoption of technology (Abara and Singh, 1993) particularly if the technology requires a significant amount of initial set-up cost, known as “lumpy technology”. Farm size was momentous in elucidating and positively correlated with organic systems adoption for the current production in maize in Turkey (Boz and Akbay, 2005). Programmes that produce important gains serve as motivation for people to participate fully in them. Maize farmers need to see advantages or expect outcome to obtain greater utility in adopting an improved technology. Moreover, farmers should be able to perceive the problem that warrants adoption of an alternative action (Bonabana-Wabbi, 2002).

#### **2.15.5 Studies Conducted on Adoption of Agricultural Technologies**

Farmers cannot easily use new technologies because of multiple factors that include lack of information, liquidity constraint, sometimes the returns of the technology, unavailability of the technology and the risk related to the use of improved technology (Doss *et al.*, 2003; Kudis *et al.*, 2011). Smallholder farmer’s adoption of agricultural technologies is usually a continuous process of learning where farmers obtain information about the technologies, test and adapt the innovation or technologies on their farm and make use of them (Doss, 2006).



Adoption of agricultural technology research findings has many policy implications for the agricultural sector development. It makes the evaluation of new innovational distribution impacts possible, documentation of an innovation or extension effort impact, for identification and reduction of the constraints of adoption, and as a research guide to focus on innovation priority (Doss, 2003; Langyintuo and Mungoma, 2008). The rate of innovations adoption and utilisation by farmers largely depend on mentoring, sensitisation, and demonstration by extension agents (Legal and Oluloye, 2008).

A study conducted by Lawal *et al.* (2005) in some villages in the Southwest Nigeria revealed improved varieties of seeds were highly adopted (about 56.7%). However, similar study conducted in same area by Omobolanle and Samuel (2006) also recounted rate of improved crops technology adoption was low due to low research and extension outreach received by farmers. Holloway *et al.* (2007) and Langyintuo and Mekuria (2008) recognised neighbourhood effects as an essential factor that could greatly influence farmers' decision on adoption. It was stated that farmers' choices of technologies are influenced by the behaviour of their neighbouring farmers or by the agro-ecological characteristics.

The fortune status of farmers has influence on adoption. Generally, wealth influence positively farmers' adoption decision; because access to more resources increase farmers risk bearing ability (Morris *et al.*, 1999). Adesina and Forson (1995) argued that older farmers can have much experience in crop production and can be more exposed to the potentials in new innovation or technology than younger farmers. It was also



reported that they could as well be further risk averse than younger farmers and have a lesser likelihood in the adoption of improved technology.

In Nigeria, empirical studies on adoption of agricultural technology recommend that factors such as farmers' socio-economic characteristics, credit access or cash resources and information from extension and other media influence farmers' rate of adoption of new agricultural technology (Ayinde *et al.*, 2010; Idrisa *et al.*, 2012). For instance, Ayinde *et al.* (2010) reported that factors such as access to extension agents, credit access, and farmer's level of education, farming experience and farm size have substantial and positive influence on adoption. In a study conducted by Kudi *et al.* (2011), farmers' awareness has substantial influence on the adoption rate of agricultural innovation.

Adoption of agricultural innovations and technologies such as fertiliser, herbicides and pesticides has led to increase in crop production (Tilman *et al.*, 2002) with sub-Saharan African region making steady growth in agricultural productivity as a result of adoption of the agricultural technology (Nin-Pratt and Yu, 2010; Fuglie and Rada, 2013). There are still general growing concerns on the ability of the traditional agricultural practices to feed the population in African countries, especially Ghana that cannot be free from high rate of poverty, food insecurity and malnutrition. Maize is the staple crop that can contribute to food security if improved technologies are adopted (De Groote *et al.*, 2002).





## **2.16 Theoretical Framework for the Study**

### **2.16.1 Rogers Adoption and Diffusion Theories**

The process of adopting new technologies or innovations has been studied for more than 30 years, and one of the most popular adoption models is described by Rogers in his book, *Diffusion of Innovations* (Sherry and Gibson, 2002). Previous researches from a multiple disciplines have employed the model as a framework. Several of these disciplines include communications, economics, education, history, political science, public in the area of adoption and technology diffusion (Dooley, 1999; Stuart, 2000).

Diffusion of innovations theory by Rogers is the most suitable for studying the adoption of technology in the field high of education and its environment (Parisot, 1995; Medlin, 2001). Hence, it can be employed in the field of agriculture and other educational environments. Apparently, several diffusion researches includes technological innovations, therefore generally, the technology and innovation are often used as synonyms (Rogers, 2003).

### **2.16.2 Innovation Decision Process Theory**

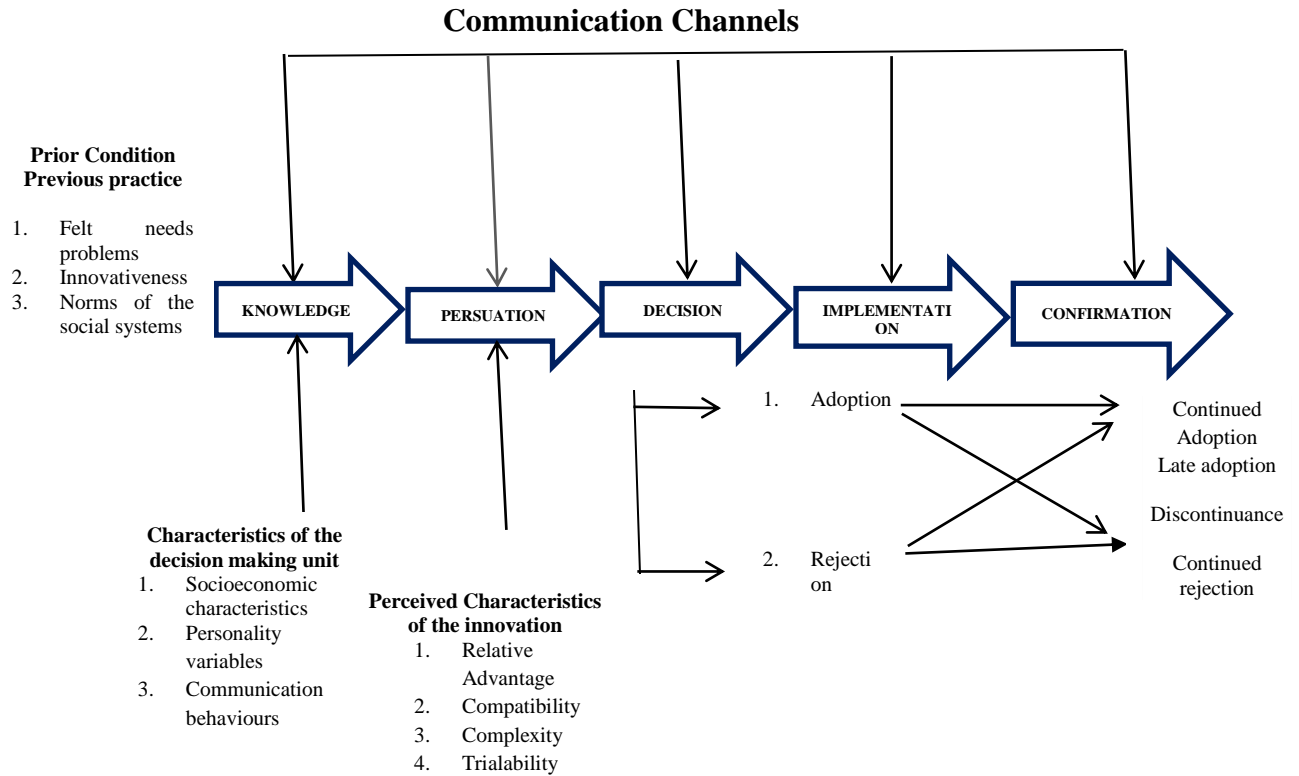
Innovation decision process can be described as an information-seeking and information-processing activity, where an individual is encouraged to minimise uncertainty of the advantages and disadvantages of an innovation (Rogers, 2003). According to Rogers (2003) the innovation-decision process comprises of five stages: knowledge, persuasion, decision, implementation, and confirmation. These stages



typically follow each other in a time-ordered manner. The process is discussed as: The first stage which is the knowledge stage occurs when an individual is exposed to the existence of an innovation, learn about the innovation and gains some understanding of how it functions. The individual tries to determine what the innovation is and how it works (Rogers, 2003). The second stage is persuasion stage. This stage occurs when an individual forms a favourable or unfavourable attitude toward the innovation.

The individual must be convinced of the value of the innovation and then decide either to adopt the innovation or not. This is term as the decision stage being the third stage. Prior to the decision, the individual engages in activities that lead to a choice to adopt or reject the innovation. Consistently, the implementation stage follows the decision stage which is the fourth stage. With this stage an innovation is put into practice. Finally, the decision must be reaffirmed or rejected thus the confirmation stage.

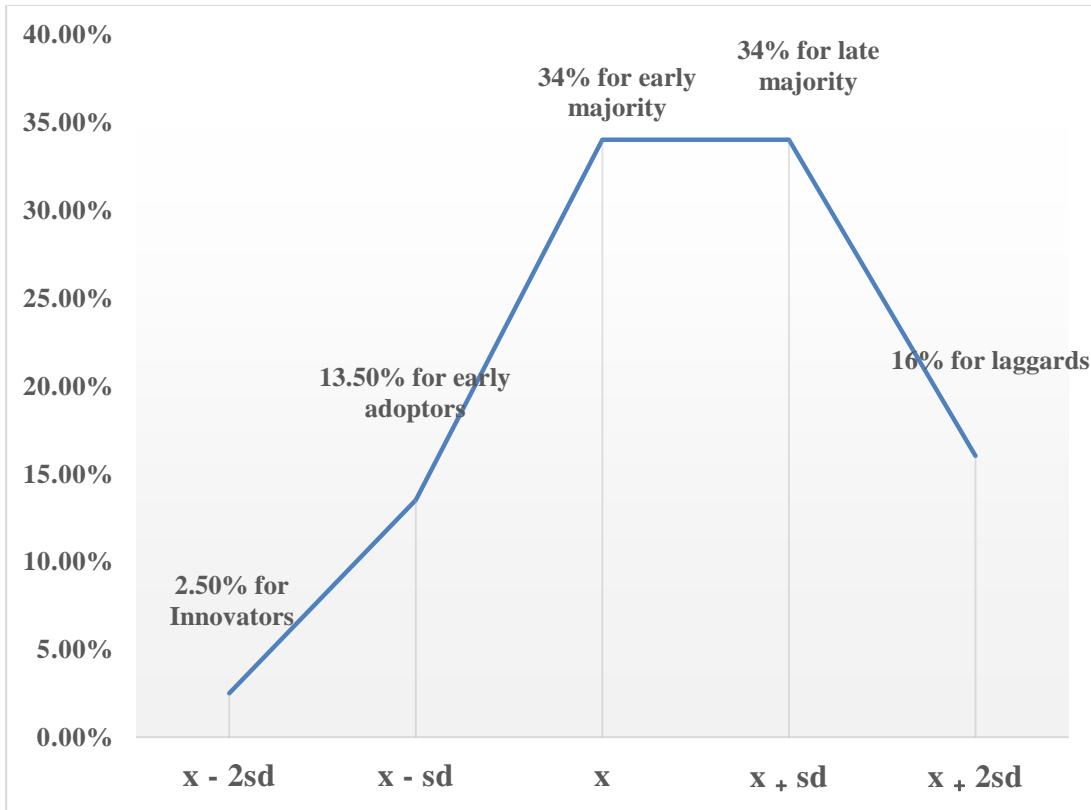
The decision concerning an innovation has already been made, but at the confirmation stage the individual looks for support for his or her decision. This decision can be reversed if the individual is exposed to conflicting messages about the innovation (Rogers, 2003).



**Figure 2.1: A model of five stages in the innovation decision process (Source Roger, 2003)**

### 2.16.3 Individual Innovativeness Theory

Innovativeness is the degree to which an individual embrace or take new ideas as compared with other members of a social system. According to Rogers (1962) not all individuals in a social system adopt an innovation at the same time. Relatively they adopt in a time series. These are therefore classified into adopter categories. They included innovators, early adopters, early majority, late majority, and laggards. Thus, adopters were categorised based on innovativeness. As shown below the distribution of adopters is a normal distribution.



**Figure 2.2: Adopter category on the basis of innovativeness (Source: Rogers, 1962)**

Also, Rogers (2003) noted that incomplete adoption and non-adoption do not form part of this adopter classification. Only adopters of successful innovations generate this curve over time. In this normal distribution, each category is defined by a percentage of respondents who are consistent. For example, the area lying under the left side of the curve and two standard deviations below the mean includes innovators who adopt an innovation as the first 2.5% of the individuals in a system.



**Innovators:** Innovators are those willing to experiment with new ideas. They usually take risk and are ready for the consequences of a failure in their adventure. According to Dearing (2009), he posited that, needs or motivations differ among people according to their degree of earliness in adoption (innovativeness) and this elucidates why innovators are first to adopt because of novelty and having little to lose. Nonetheless, Rogers (2003) argued that in spite of their originality the innovators may not be respected by other members of the social system because the innovators are often seen as those who do not conform to the norms and values of the social system. One can therefore suggest that the innovative farmers are those who are more susceptible to adopt new techniques of food production. Therefore, extension workers are more likely to target the innovative farmers first when introducing a new technology.

**Early Adopters:** As can be seen from Figure 2.1 above the early majority, who are anticipated to adopt the innovation before the late majority and the laggards. Early adopters do not move outside the boundaries of the social system much as the innovators. Early adopters generally hold positions in the social system and are usually opinion leaders. Hence, other members of the social system perceive early adopters as role models who offer advice and information about innovations. Early adopters can be respected farmers in the community whose positive opinions about the innovation are understood as a stamp of approval. An innovation is therefore expected to spread from early adopter farmers to early and late majority farmers through face-to-face communication.



**Early Majority:** This category interacts easily with their peers. They do not hold leadership roles in the social system but influential in the diffusion process. Early adopters usually brainstorm before adopting an innovation and are neither the first nor the last to adopt it. Decisions about innovations are taken by innovators and early adopters before the early majority.

**Late Majority:** The late majority adopt an innovation largely due to pressure from their peers. This category is indeed vigilant about the innovation and its consequences. In the context of this discussion the late majority can be farmers who adopt the innovation because of economic necessity. To reduce uncertainty about the innovation, interpersonal connections of close peers should persuade the late majority to adopt it (Rogers, 2003). Independently Dearing (2009) and Sahin (2006) postulated that it is important for project implementers to focus on encouraging social norms rather than the benefits of the technology when dealing with the late majority adopters. Because the late majority wants to hear that many of the other conservative people like themselves think that the innovation is normal or essential.

**Laggards:** They category of adopters are more doubtful about innovations and change than the late majority category. Their social relationship within the social system is not connecting and they consist of members of the same group. They are expected to have no leadership positions with the social system. As a result of lack of resources at their domain they do not take risk with the innovation. Rather they prefer to be convinced that the innovation works before they adopt it. This seeks to suggest that the laggards

are those of farmers who take a longer time to adopt the technology than their counterparts. Individuals or other units in a system who most desire the benefits of a new idea are generally the last to adopt an innovation.

Dearing (2009) and Sahin (2006) share a diametrical view to this assertion, they argued that Rogers (2003) did not give due cognizance to the fact that some adopters may have the characteristics of innovators and early adopters but will not adopt quickly, while those who are less educated and wealthy might adopt quicker than the innovators and early adopters as they are supported by the implementers of the project to adopt the technology.

#### **2.16.4 Rate of Adoption Theory**

Rate of adoption is the relative speed with which an innovation is adopted by members of a social system (Rogers, 2003). Therefore, rate of adoption can be measured by the number of individuals who adopted the idea for a specified period, for instance one year. Hence, the rate of adoption is a numerical indicator of the sharpness of the adoption curve for an innovation. Diffusion takes place over a period of time with innovation going through a slow, gradual growth period, follow by dramatic and rapid growth, and then a gradual stabilization and eventually to a decline.







### 2.16.5 Perceived Attributes Theory

Perceived attributes theory assumes that there are five attributes upon which an innovation is judged: that it can be tried out that is trialability, that results can be observed that is observability, that it has advantage over other innovations or the present circumstance relative advantage, that it is not overly complex to learn or use complexity, that it fits in or compatible in the circumstance in which it will be adopted that is compatibility.

Detailed discussions of the attributes are as follows: **Relative Advantage**; the greater the extent to which an innovation is perceived to be superior to the idea or the old one it is replacing, the greater the rate of adoption of the innovation. It is measured in terms of economic benefits, cost reductions, suitability, social aspects and satisfaction. One of the important factors that affect adoption of technology or innovation by users is economic factor (Fuglie and Kascak, 2001). It is expected that the adoption level will increase when the adopters obtain the greater benefits (Jeon *et al.*, 2006; Lin *et al.*, 2007).

**Compatibility**; the extent to which an innovation is perceived to be well-matching with the existing values, the past experiences and the needs of the potential adopters. Increased compatibility absolutely influences rate of adoption. Compatibility In some diffusion research, relative advantage and compatibility were viewed as similar, although they are conceptually different.



**Complexity;** how the users find the innovation complex based on their skills. The less complex an innovation is perceived to be, greater the rate of adoption. The complicated innovation such as in aspects of skills, technology, or knowledge will cause the acceptance of adoption become slower because of these constraints (Lin *et al.*, 2007).

**Trialability;** the degree to which the innovation can be experimented on a limited basis. An increased opportunity for trialability increases adoption. Many studies have been carried out in various fields to find out and understand the factors that influence adoption of new technology among farmers (Pannell *et al.*, 2006; Li *et al.*, 2010).

**Observability;** talks about the visibility of innovation to others, when it is more visible it yields positive results as the rate of adoption will be greater. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others. The observability of an innovation is perceived by members of a social system, is positively related to its rate of adoption. In summary, innovations offering more relative advantage, compatibility, simplicity, trialability, and observability will be adopted faster than other innovations (Rogers, 2003). He added that, getting a new idea adopted, even when it has obvious advantages, is difficult, so the availability of all of these variables of innovations speed up the innovation-diffusion process.

## 2.17 Conceptual Framework for the Study

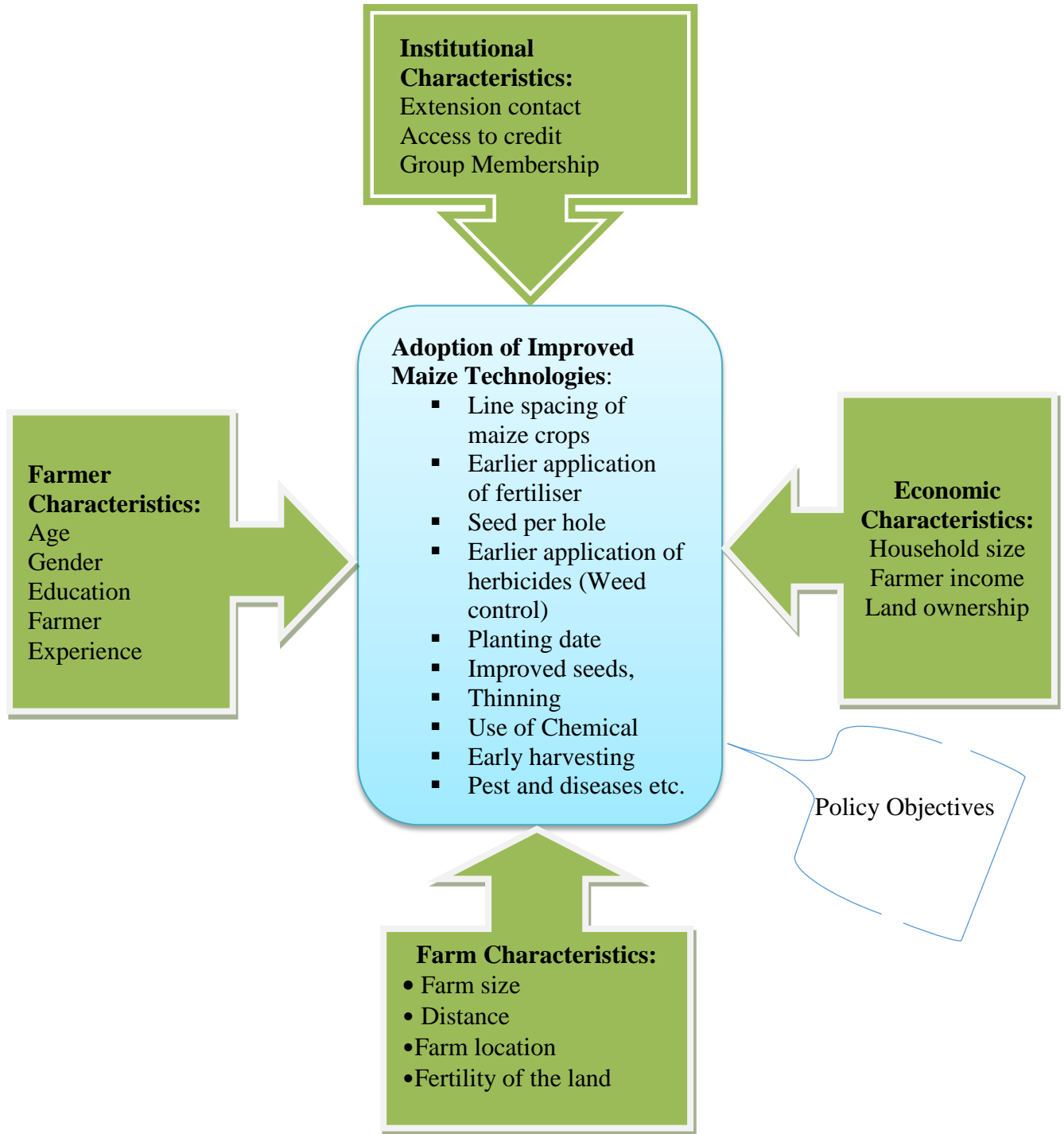
Usually, a farmer that adopts improved technology is expected to have higher level of productivity than one who does not adopt the technology. Given the number of technologies presented, farmers that adopt the maximum number of technologies are more likely to produce higher than those that are unable to adopt. The concept of adoption is a behavioural choice at a particular time and space, which implies that some farmers may adopt despite being aware of the choices and some may not adopt despite being aware. Literature on adoption shows that, adoption of improved agricultural technologies is postulated to be affected by a multitude of personal attributes, socio-economic characteristics, demographic and institutional factors (Feder *et al.*, 1985; Kebede *et al.*, 1990). These factors are essential motivations influencing the farmer's behaviour towards the new technology and its final adoption.

The diagram in Figure 2.3 reflects the concept of socio-economic factors influencing the adoption of improved maize farming technologies in the Yendi municipality of Northern Region. The diagram is clearly a figurative representation of the interaction among the variables used in the study. The variables which have been conceptualized as independent variables include; age, gender, education, farming experience, extension contact, access to credit, group membership, farm size, distance to market, household size, farmer income, land ownership and how they influence technology adoption. The dependent variables interact with moderating variables in the periphery in order to enhance effective adoption of improved maize farming technologies. The moderating



variable in this case is the government policies and programs through which some of these technologies are introduced. Innovations in production systems by actors in the agricultural value chain depend on availability of these technologies. Moser and Barrett (2003) as well as Minten and Barrett (2008) reported that Asia's Green Revolution presented the importance of the use of productivity enhancing technologies in transforming present day agriculture and therefore use of improved technologies should be taken seriously by farmers in developing countries in order to increase production. Use of productivity enhancing technologies is reported to have major positive effects on agricultural productivity improvement in developing countries (Nin *et al.*, 2003). The availability of new improved agricultural productivity enhancing technologies to farmers and the abilities of farmers to accept and use these technologies are also essential.





**Figure 2.3: Conceptual framework for the study**  
Source' Authors Design, 2017

## CHAPTER THREE

### RESEARCH METHODOLOGY

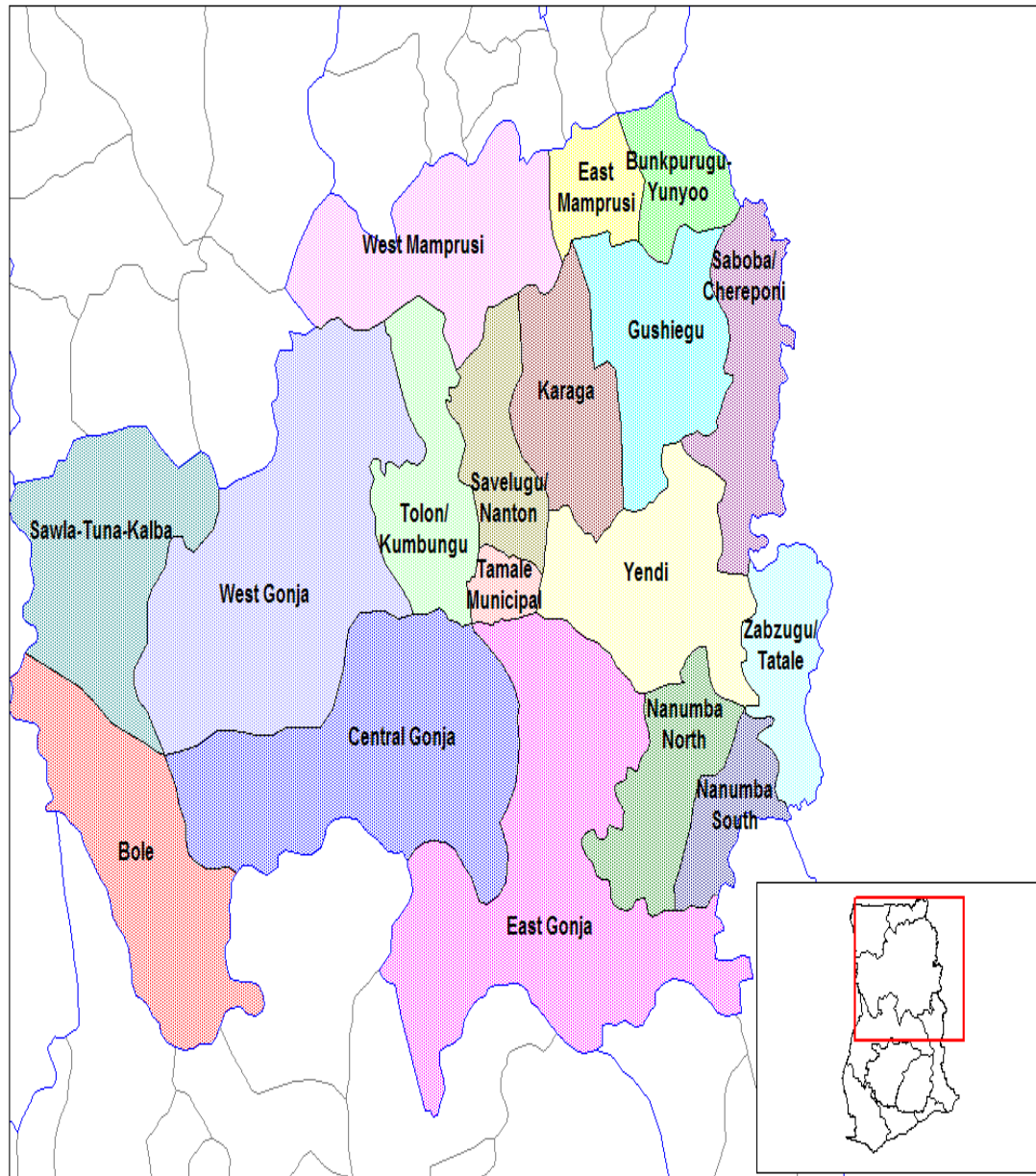
#### 3.1 Introduction

This chapter on research design and methodology deals with the following sub-topics: study area, research design, sample size determination and sampling procedure, data collection methods, methods of data analysis, Poisson model specification, empirical model and ethical consideration.

#### 3.2 Study Area

The study was conducted in the Yendi Municipality (Figure 3.1) which is the capital of the Dagbon Kingdom. It is located in the Northern Region and lies between Latitude  $9^{\circ}$ – $35^{\circ}$  North and  $0^{\circ}$ – $30^{\circ}$  West and  $0^{\circ}$ – $15^{\circ}$  East (GSS, 2014). Strategically, the Municipality is located at the heart of the eastern corridor of the Region with a landmass of 1,446.3 sq. km (Ghana Statistical Service, 2010). The capital of the Municipality is Yendi, which is about 90 km from the Tamale (GSS, 2014).





**Figure 3.1: Districts/Municipal Map of Northern Region**

**Source: GSS (2014)**

### 3.2.1 Climate, Vegetation and Soil

In Yendi Municipality, the mean annual rainfall is 1,125 mm that usually occurs from January- December. To be precise the mean rainfall in the Municipal during wet season (April-Oct.) is 1,150 mm whilst in the dry season (Nov.–March) is 75 mm (GSS, 2014). This leaves an annual mean deficit that range from 500 mm to 600 mm making the rainfall pattern seasonal and unreliable. The temperature of the area ranged from 21 °C- 36 °C (GSS, 2014).

The vegetation type is savannah in areas which is not influenced by anthropogenic activities (settlements and farming activities). However, the type is degraded one that is usually found around human settlements and heavy farm lands. Perennial bush burning is having a great influence on the vegetation and consequently on the climate. The economic trees in the Municipality include endowed cashew, dawadawa, mango and shea trees (GSS, 2014).

Generally, soil is made up of sedimentary rocks that include mudstones, shales and volcanic sandstone in the Municipality. This parent materials soils gives the various soil types such as alluvial soils, clay, laterite, sandy soils and ochrosols, with low organic content. This is usually affected or worsens by the perennial bush burning and agricultural practices that are not good for soil management. This greatly affects crops yield per acre (low yields), which cause shortage of food in the lean or dry season in the Municipality (GSS, 2014).







### **3.2.2 Population Size and Migration**

The population of Yendi Municipality is 117,780 representing 4.8% of the Northern region population (GSS, 2010). More than half of the population (56.1%) in the Municipality lives in the rural areas. The age dependency ratio is 93.3 in the Municipality. The age dependency ratio of male is 104.2 whilst female is 96 (GSS, 2014). Close to three quarters (74.7) of migrants in the Municipality were born in elsewhere in the Northern region. About 18% of the migrants in the Municipality were born in other regions in Ghana with less than 8% born outside Ghana (GSS, 2014).

### **3.2.3 Household Size, Marital Status and Religion**

The household population is 116,602 with a total number of 12,721 households in the Municipality. In the Municipality, average household size is 9.3 persons. About 54.6% of the populations aged 12 years and older in the Municipality are married. Very small proportions showed they were divorced whilst 1.1%, separated (0.7%) and widowed (3.9%). The observed trend could be due to the fact that majority of the population in the Municipality are Moslems (GSS, 2014).

The most dominant religion is Islam in the Municipality that is more than two thirds of the population. More than 90% of the population in the Municipality is Ghanaians by birth, with less than 3% of the population having dual nationality. Less than 0.8% of the population is Ghanaians by naturalisation whilst non-Ghanaians constitute less than 2.5% (GSS, 2014).



### **3.2.4 Economic Activity and Employment**

More than two thirds of the population (70.9%) aged 15 years and older are economically active out of which 73.3% are males who are more likely to be economically active than females (68.6%). Of the economically active population, 95.8 percent are employed and more than half (55.1) of the unemployed population (GSS, 2014).

### **3.2.5 Agriculture**

Close to three quarters of households (72.9%) in the Municipality are engaged in agriculture. Most agricultural households (96.2%) are into crop farming. The majority of agricultural households (48.3%) are into livestock rearing with those in poultry (chicken) farming forming the majority (30.0%) (GSS, 2014).

### **3.2.6 Social and Cultural Structure**

The population of the Municipality has varied ethnic groups with the Dagombas constituting the majority. The other ethnic groups include Akan, Basare, Chokosi, Ewe, Hausa, Moshie and Konkomba. The population is largely rural with 56% living in the rural areas whilst 44% are in urban communities. Out of the total population, 50% are males and females (50%). The main religious groups include Moslems (67.2%), Traditionalists (13.2%), Christians (17.4%), No Religion (1.8%) and others (0.3%) (GSS, 2014).

### **3.3. Research Design**

The study adopted a descriptive survey research design for the study. Descriptive research design may comprise of any or all of the following: observation, case studies, and surveys. It is a vehicle for measuring the characteristics of a large population (Orodho, 2003). It maintains a high level of confidentiality, it also allows the researcher an opportunity to obtain accurate view of response to issues as well as test theories on social relationships at both the individual and group level (Kothari, 2003).

Descriptive survey design was appropriate for the study since it enabled the collection and analysis of both qualitative and quantitative data. Quantitatively, the study used the closed-ended sections of the questionnaire to obtain data on the factors influencing the adoption of improved maize farming technologies. Qualitatively also, the study used the data from interviews to support the quantitative data.

### **3.4 Sample Size Determination and Sampling Procedure**

According to the MoFA Directorate of the Yendi Municipal Assembly (2014) the total population of maize farming households is 12,721 which constitute the sampling frame. The households were selected from 12 communities across three zones of the Municipality. The communities selected were Zang, Gundogu, Kuga, Gukpegu, Zugu, Bago, Yimahagu, Nakpachei, Bini, Bagbani, Kpatia and Nalogu.



Sample size was determined using the coefficient of variation given by Nassiuma (2000). As most surveys, studies or experiments usually accept a coefficient variation of 30% at most. The study considered a coefficient variation of 25% and 0.02 as the standard error.

The formula given by Nassiuma (2000) is: 
$$n = \frac{NC^2}{C^2 + (N-1)e^2} \dots\dots\dots (3.1)$$

Where, n = Sample size, N = total household population of maize farmers, C = Covariance, e = Standard error.

The number of households sampled for the study was therefore:

$$= \frac{(12,721) \cdot (0.25)^2}{0.25^2 + (12,721 - 1)(0.02)^2} = 154 \text{ households.}$$

Applying proportion, the sample size for the various zones were then calculated as follows;

$$\text{Yendi zone} = \frac{(154) \cdot (4,626)}{(12,721)} = 56 \text{ maize farmers}$$

$$\text{Gbungbalga zone} = \frac{(154) \cdot (4,295)}{(12,721)} = 50 \text{ maize farmers}$$

$$\text{Malzeri zone} = \frac{(154) \cdot (3,965)}{(12,721)} = 48 \text{ maize farmers}$$

A multistage sampling technique was used for selection of respondents. At first stage, the entire municipality was stratified into three strata (zones). At the second stage Simple random sampling was used to select twelve (12) communities and one hundred



and fifty-four (154) maize farming households (respondents). Proportion was applied to select the sample size per community. (Table 3.1). Thirty (30) maize farmers from the three zones were purposively selected for the three FGDs and four extension agents for the research work. The sampling of maize farming households by communities is shown in table 3.1.

**Table 3.1: Sampling frame and sample size for each community**

Zones	Operational Zones	Sample Size for each community
Yendi	Gundogu	16
	Kunkon	12
	Zang	15
	Gukpegu	13
Gbungbalga	Zugu	12
	Bago	13
	Yimahagu	11
	Nakpachei	14
Malzeri	Kulkpanga	12
	Paansiya	12
	Kpatia	11
	Nalogu	13
Total	12	154

### 3.5 Data Collection Methods

The data was collected from March to April, 2017 from 154 randomly selected farmers in Yendi Municipal using questionnaires in depth interviews Focus Group Discussion (FGD), and Questionnaires. The questionnaire comprises of five sections that captured data on demographic characteristics, farming activities and socioeconomic





characteristics, institutional factors influencing the adoption of improved technologies, adoption of improved maize farming technologies, and challenges related to adoption. The researcher consulted leadership of all the communities and briefed them on the study and the aim of the study and also articulated the need to conduct an interview with farmers in their respective communities. Farmers were allowed to ask the researcher questions for clarifications during the data collection.

**In-depth Interviews:** This study used in-depth interviews because it assisted the researcher to understand the respondents' experience and perspective. In-depth interview was used to gather information about things and processes that could not be observed effectively by other means. The in-depth interviews were conducted with the aid of an interview guide so as to make the interview flexible to make room for probing further. The in-depth interviews were conducted with the Ministry of Food and Agriculture, some officials of Masara Ariziki, as well as four extension officers from MoFA.

**Focus Groups Discussions:** Wimmer and Dominick (2011), posited that, focus group or group interviewing is a good research method used to help the researcher understand people's attitude and behaviour. Carey (1994) cited in Lindlof and Taylor (2002), it was reported that the major reason for interviewing people in focus groups is to exploit the group or collective effect, where the explicit use of the group interaction produces insights that would have been less accessible without the interaction found in a group. This suggests that members of the discussions can be influenced to speak out by the ideas and experiences expressed by others. The researcher organized three (3) separate focus group discussions (FGDs) with the maize farmers. Each group comprised of (10)

farmers, representing (5) males and (5) females in each stratum. The researcher organised the discussion with equal sex representation in that composition in order to ascertain if the various categories would elicit different responses, due to the fact that different groups of farmers such as females might have different needs and challenges. Furthermore, the literature suggests that if the group is not well composed, some members might be reluctant to speak because of the composition of the group members (Krueger & Casey, 2009).

**Questionnaire:** A structured questionnaire was used to collect data from the respondents, the structured questionnaire consisted of both open-ended and closed-ended questions. The open-ended questions gave the respondents the chance to express themselves while the closed-ended questions on the other hand gave the respondents pre-coded responses in which the respondents selected the option they agreed most. A total of 154 questionnaires were administered.

### 3.6 Methods of Data Analysis

Data analysis involved sorting of essential variables and examining of information gathered to establish faults. Data was analysed by using both qualitative and quantitative techniques. Descriptive statistics such as the frequency distributions means and percentages was used to analysed objective (i) and (ii), Poisson regression model was used to analyse (objectives iii), whilst the Kendall Coefficient of Concordance was used to analysed objective (iv). The choice of the Kendall coefficient of concordance was as a result of the homogeneous nature of the study area.

### 3.6.1 Empirical Model Specifications

### 3.6.2. Empirical Model

The empirical Poisson model used to assess the factors influencing adoption of improved Maize farming technologies is specified as:

$$ADOPT = \beta_0 + \beta_1 AFR + \beta_2 EXV + \beta_3 HHS + \beta_4 ACR + \beta_5 EDU + \beta_6 MS + \beta_7 FE + \beta_8 GM + \beta_9 FS + \mu_i$$

Where;

**Table 3.2: Independent variables and their priori expectation**

Variable	meaning	Definition	Expectation
MS	Marital status	Dummy variable; 1 = if married and 0 = singled	Positive (+)
AFR	Age of the farmer	Number of years	Positive (+)
HHS	Household size	Number of people in the household	Positive (+)
EDU	Education	Number of years schooled	Positive (+)
FE	Experience	Number of years farm maize	Positive (+)
FS	Farm size	Number of hectares farm	Positive (+)
GM	Group membership	Dummy variable; 1 = membership and 0 = otherwise	Positive (+)
ACR	Access to credit access	Dummy variable; 1 access credit and 0 = otherwise	Positive (+)
EXV	Extension contact	Dummy variable; 1 = access to extension officer, 0 = otherwise	Positive (+)







### 3.6.3 Dependent Variable

The dependent variable is a count data which is equal to the weighted sum of the improved technology adopted by each of the farmer. Maggino and Rubiglioni (2011) posited that, weights are assigned to variables because of the differences in contribution that each variable makes to total output. Additionally, weight should satisfy the following basic conditions: the weights are non-negative numbers, the weights for each case add up to unity, the weights may require to be re-scaled in order to have an identical range and the weights must be relating in some way to the corresponding score. As postulated by Bobko *et al.* (2007) weights determined by multiple regression maximizes the linear relationship between the independent variables and dependent variable (at least in the sample used to the general weights); it is statistically well defined and no additional inputs are needed from the subject matter experts to generate weights; therefore this procedure is more objective than the experts opinion used in general weights for variables.

### 3.6.4 Measurement of Adoption

In this study, the dependent variable is the adoption of improved maize farming technologies. To appropriately capture this variable, the study presented a number of improved maize farming technologies to the farmer and sought to find out whether or not he/she had used and /or continues to use same at present and the number of times used, by posing the following questions:

“Have you used the following technologies during the farming season?”



“Do you still use the technology?”

“If Yes, Number of times used?”

Adoption was quantified using a binary variable, whereby farmers who had adopted were assigned a value of 1 and those who did not, were assigned a value of 0. Adoption decision by the two categories of farmers was influenced by their perceptions about the incentives and the disincentives contained in the package. The number of technologies adopted was then used as the dependent variable in the Poisson estimation. Similar approach was adopted by Mbugua Felitus in Kenya to measure an analysis of factors influencing the adoption of recommended maize package in Makuyu division Murang’a South district, in Kenya.

$$\text{Rate of Adoption} = \frac{\text{Number of technologies adopted} \times 100}{\text{Number of technologies}}$$

Where n is the number of maize farmers that adopted particular improved maize farming technology and N is the total number of improved maize farming technologies listed. The rate of adoption represents the percentage of farmers that have adopted the improved maize farming technologies in the study area.

### **3.6.5 Count Data Analysis: Poisson Model**

The Poisson regression model is best suited in the context of econometrics for estimation of models with count data dependent variable, and is the starting point for count data analysis (Cameron and Trivedi, 1990; Greene, 2003). It was employed for the estimation of the maize farmers’ decision on how many improved maize farming

technologies farmers adopt. The probability of adopting  $k$  improved maize farming technology given  $n$  independent improved technologies is represented by the binomial distribution:

$$P(Y = k) = \binom{n}{k} P^k (1 - P)^{n-k} \dots \dots \dots (3.2)$$

Where  $\binom{n}{k} = \frac{n!}{k!(n-k)!} \dots \dots \dots (3.3)$

and  $p$  is the probability of adopting  $k$  improved technology

Statistical theory states that a repetition of a series of binomial choices, from the random utility formulation, asymptotically converges to a Poisson distribution as  $n$  becomes large and  $p$  becomes small:

$$\lim_{n \rightarrow \infty} \binom{n}{k} P^k (1 - P)^{n-k} = \frac{e^{-\lambda} \mu^k}{k!} \dots \dots \dots (3.4)$$

Where  $\mu$  is the mean distribution, such as the mean number of technologies adopted by the farmer. The formula presented in (1) allows modelling of the probability that a household adopts the number of improved maize farming technologies  $k$  given a parameter  $\mu$ .

The maize farmers make series of discrete household decisions that sum across an aggregation of choices to a Poisson distribution. The Poisson regression model is the development of the Poisson distribution presented in (1) to a non-linear regression model of the effect of independent variables  $x_i$  on a scalar dependent variable  $y$ . The density function for the Poisson regression is

$$f(y/x_i) = \frac{e^{-\mu_i} \mu_i^y}{y!} \text{ and } y = 0, 1, 2 \dots \dots \dots (3.5)$$



Where  $f(y)$  denotes the probability that the variable  $y$  takes non-negative integer values, and where  $y!$  stands for  $y$  factorial.  $\mu$  is the mean of distribution, such as the mean number of technologies adopted by the maize producer. Where the mean parameter as the function of the regressors  $x_i$  and parameter vector  $\beta$  is given by  $f(y/x_i) = \mu = \exp(x' \beta)$  and  $y = 0, 1, 2, \dots, n$

Also note that  $\beta_i = \frac{\partial E[y/x_i]/\partial x_i}{E(y/x_i)} = \frac{\partial \log E(y/x_i)}{\partial x_i} \dots \dots \dots (3.6)$

The  $\beta_i$  is the marginal effects of the Poisson model, which can be interpreted as the proportionate change in the conditional mean if the  $j$ th regressor changes by one unit.

The Poisson model sets the variance to be equal to the mean. That is

$V(y/x_i) = \mu(x_i, \beta) = \exp(x' \beta) \dots \dots \dots (3.7)$

The first two moments are:

$E[y_i] = \mu$  and  $Var(y_i) = \mu \dots \dots \dots (3.8)$

This displays a very strong assumption, which is the equality of mean and variance property of the Poisson distribution. Poisson regression has many extensions, such as the Negative Binomial and the Zero-inflated model. Since the dependent variable of a Poisson regression is a count variable, the coefficients are interpreted as: a one unit change in the independent variables, is expected to change the dependent variable (for example number of improved technologies adopted) by the respective regressor coefficient, given that the other regressors in the model are held constant, Cameron and Trivedi (1990), Greene (2003) and Wooldridge (2003).





### 3.6.6 Challenges Affecting Farmers Adoption of Improved Farming Technologies

Objective four sought to examine the challenges maize farmers are encountered with in the adoption of improved maize farming technologies. Preliminary contacts with maize farmers in the study area led to the identification of various factors that could constitute challenges to farmer’s adoption of improved maize technologies. The list of challenges was summarized into 5 as follows: costly to adopt, complex to adopt, lack of skills to adopt, risk and uncertainty and lack of production resources. Kendall Coefficient of Concordance (W) proposed by Maurice G. Kendall and Bernard Babington Smith (2010) was used to determine the degree of agreement in the ranked challenges to technology adoption.

W is a measure of the agreement among raters or judges assessing a set of subjects in ranked order (Legendre, 2010). It is used to assess the degree to which respondents in a study provide common ranking on an issue with same general property. The limits for W must fall between zero (0) and one (1) when the ranks assigned by each respondent are assumed to be the same as those assigned by other respondents and zero (0) when there is maximum disagreement among the rankings of the respondents.

Preference ranking, the total ranked score for each item was computed and W calculated using the formulae;

$$W = \frac{12(S)}{m^2(n)(n^2 - 1) - mT} \dots\dots\dots(3.9)$$

Where n is the number of objects, m is the number of variables and T is a correction factor, S is a sum-of-squares statistic over the row sums of ranks  $R_i$ , and R is the mean

of the  $R_i$  values computed first from the row-marginal sums of ranks  $R_i$  received by the objects:

$$S = \sum (R_i - R)^{-2} \dots \dots \dots (3.10)$$

For tied ranks  $T$  is;

$$T = \sum t_k^3 - t, \dots \dots \dots (3.11)$$

$t_k$  = the number of tied ranks in each ( $k$ ) of groups of ties. The sum is computed over all groups of ties found in all  $m$  variables of the data table,  $T = 0$  when there are no tied values and the equation becomes;

$$W = \frac{12(S)}{m^2(n)(n^2 - 1)} \dots \dots \dots (3.12)$$

$W$  is an estimate of variance of the row sums of ranks  $R_i$  divided by the maximum possible value the variance can take; this occurs when all variables are in total agreement. Hence  $0 \leq W \leq 1$ ;  $W = 1$  represents perfect concordance/agreement and 0 indicates perfect disagreement in the ranking.

The Friedman's Chi-square statistics ( $X^2$ ) is given by;

$$X^2 = m(n - 1)W \dots \dots \dots (3.13)$$

This quantity is asymptotically distributed like chi-square with  $(n-1)$  degrees of freedom; it can be used to test  $W$  for significance. This approach is satisfactory only for moderately large values of  $m$  and  $n$  (Kendall and Babington Smith, 1939; Legendre, 2010) as in this study where  $n = 154$  and  $m = 5$



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.0 Introduction

This chapter presents the results and discussions of the study. The first section discusses the demographic characteristics of the respondents, the farming system in the area and the respondents' access to institutional factors in the area. The levels of adoption is discussed in section two which includes awareness of the maize farming technologies as well as the training received on the technologies. The third section looks at the socioeconomic factors influencing the adoption of the improved maize farming technologies while the chapter is concluded by presenting the challenges to adoption in the area.

#### 4.1 Socio-Demographic Characteristics of the Respondents

Descriptive statistics estimated from the sample of 154 maize farmers are presented in Table 4.1. The results showed that 58 percent of the respondents were males. This was expected as males dominate in the production of maize in the Northern region of Ghana even though females are believed to perform more than 60 percent of the farming activities. Gender influence the adoption of technologies as it affects the sourcing of agricultural information and use. Female farmers are more risk loath (Croson and Gneezy, 2008) and perceptions that women are not supposed to be farmers also limit their accessibility to agricultural information sources (Doss, 2001).



**Table 4.1: Summary statistics of maize farmers demographic and socio-economic characteristics**

Variable	Mean	Std Deviation	Minimum	Maximum
Age	40.46	6.57	26.00	56.00
Sex	0.58	0.49	0.00	1.00
Marital status	1.36	0.93	1.00	5.00
Farm size	1.95	1.14	0.40	6.40
Household size	8.25	3.52	4.00	26.00
Maize farming experience	14.93	7.94	2.00	36.00
Access to credit	0.01	0.11	0.00	1.00
Extension contact	0.41	120.6	0.00	1.00
Group membership	0.17	0.36	0.00	1.00
Farmer income	2.29	0.10	1.00	5.00

**Source: Field Survey, 2017**

The majority (83%) of the respondents who were into maize farming in the area were married. Comparatively, the findings of this survey seem to lend support to findings of GSS (2014) that reported that about 54.6% of the populations aged 12 years and older in the Municipality are married, with small proportions of divorced cases of 1.1%, separated (0.7%) and widowed (3.9%). The observed trend could be due to the fact that the majority of the population in the Municipality is Moslems (GSS, 2014). Maize is a staple food crop in the region, it is therefore not surprising that many of the sampled maize household respondents were married.





As marital status also influences the desire to increase in productivity for family consumption and income is high among farmers who are married than their counterparts who are not married (Opara, 2008).

The survey revealed that the mean age of the respondents was 40years with a standard deviation of 6.57. It was obvious from the survey that the majority (56%) of the respondents who are maize farmers were within the economically active age group as the average age shows a relatively young population. Age is also considered to be a determinant of adoption of improved technology. Older farmers are supposed to have increased knowledge and experience over time and are able to evaluate information of technology than younger farmers (Mignouna *et al.*, 2011; Kariyasa and Dewi, 2011). The age of a farmer influences the levels of information access and farming experience. Older farmers might have engaged in concurrent receiving and provision of information as they are often confronted with communication barriers (Katungi, 2006).

The study revealed that respondents' household size comprised an average of 8 individuals with a standard deviation of 3.52 (Table 4.1). Comparatively, the average household size of the respondents seems to be consistent with the average household size of 9.3 persons in the Yendi Municipality reported by GSS (2014). This large family size may serve as cheap and reliable source of labour for maize farming within the household. As household size can be used to measure labour availability which influence adoption process as larger household have the ability to relax the labour limits required during introduction of improved farming technology (Bonabana-Wabbi, 2002; Mignouna *et al.*, 2011).





The mean farm size of households in the study area was about 1.9 hectares with a standard deviation of 1.4. This small farm size shows that farmers in the area are smallholders (Table 4.1). The implication of this is that greater proportion of the maize farmers in the area was smallholder maize farmers. This is an indication that farming in the area is at the subsistence level. This could constraint the adoption of improved technologies due to the small farm size (Agwu *et al.*, 2008). One of the resources that indicate wealth and proxy for social status is land size which has influence on farmers in the Yendi Municipality and in the country as a whole. Basically, farm size influences the adoption costs, credit constraints, human capital, labour requirements, risk perceptions, tenure arrangements and more. Farm size can influence and in turn be exaggerated by the other factors affecting adoption (Lavison, 2013). Farmers with big farms sizes are better informed, richer and keener in searching for improved technologies information (Okwu and Iorkaa, 2011).

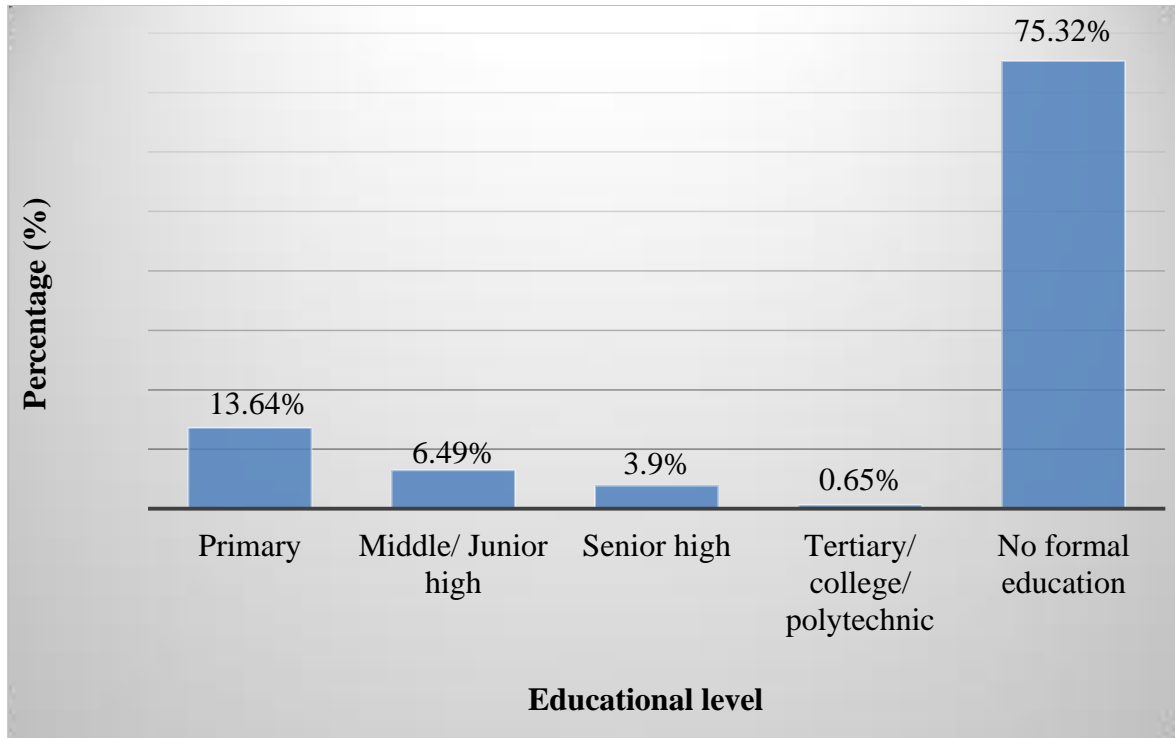
In terms of maize farming experience, an average of 14 years with a standard deviation of 7.94 was recorded among the sampled farmers. The mean number of years in maize farming has shown a significant experience in maize farming and this can have significant effect on the adoption of new and improved farming technologies in maize farming. The farmer socio-economic characteristics that include level of education, farm size and farming experience influence the adoption of improved technologies (Hudson and Hite, 2003).

The average income of farmers maize farmers in the area is GH¢500 - GH¢ 999, with a standard deviation of 0.10. This income earned by farmers is woefully inadequate and therefore can affect farmers ability or decision to adopt a technology. The adoption of a new technology is keenly determined by the net gain to the adopting or innovating farmer thus the inclusive of all costs of using the improved technology (Foster and Rosenzweig, 2010). In technology adoption the wealth of farmers is crucial because wealthy farmers can better handle risks which facilitate the adoption of improved technologies (Doss and Morris, 2001).

#### **4.1.1 Respondent's Level of Education**

The survey revealed that about 75.32% of the respondents have no formal education, 13.64 had primary education, 6.49% had middle and junior high education, 3.9% had secondary education and 0.65% had tertiary/college education (Fig. 4.1).





**Figure 4.1: Distribution of respondents based on level of formal education**

**Source: Field survey, 2017**

It is obvious from the survey that majority of the maize farmers in the Yendi Municipality have not had formal education, which could consequently affect their adoption of improved maize farming technology as enlightenment enhances people decision making and analysis of situations. Since, access to agricultural information is influenced by the farmer's level of education. Farmers with formal education stand high chance of adopting a new technology to increase productive. Education gives the farmer ability to derive, decode and evaluate useful agricultural information for production (Ani, 1998).

In developing countries such as Ghana most farmers are found in rural areas and are not or less educated. The level or status of farmer resource affects his or her decision to adopt an improved agricultural technology (Khan *et al.*, 2008).

The average number of years spent in formal schooling in the area among the sample respondents was about 2 years. Imoru and Ayamga (2015), also found the average number of years in school among maize farmers in the Northern region of Ghana to be 2 years. This low level of education among the rural households in the Yendi Municipality may have negative impact on adoption of agricultural technologies. The mean years of schooling of the respondent farmers in the area also mean they are unable to read and write. High level of education among farmers would make them more responsive to many agricultural extension programmes and policies (Agwu *et al.*, 2008) leading to adoption of new and improved technologies.

## **4.2 Farming System in the Study Area**

In the context of this study, farming system takes into account the combination of farm household, cropping and livestock system that maize farmers in the study area are engaged in.

### **4.2.1 Type of Crops and Animals**

Crops such as maize, rice, yam, groundnut, millet, soya beans and beans were the common crops grown in the Yendi Municipal. During the focus group discussions, it was affirmed that maize was the most common crop grown by farmers in the area as all



households grow maize in their farms. This is not surprising as maize is an important staple in the region. It was also reported during the discussions that maize crop is always mono crop. The study also revealed that cattle, sheep, goat and poultry were the animals kept in the area.

#### 4.2.2 Purpose of Farming Maize

This sought to ascertain from maize farmers their reasons for the cultivation of maize in the area. Whether for purpose of income or household consumption or both.

**Table 4.2: Purpose of farming maize**

Purpose of farming maize	Frequency	Percentage
Household consumption	9	5.8
Income and household consumption	145	94.16
Total	154	100

#### Field survey, 2017

Farmers were also asked the reasons for farming maize. The study revealed about 94.2 percent of the maize farmers respondents cultivates maize purposely for consumption and income whilst the remaining 5.8 percent cultivate maize for only consumption purpose. The survey revealed that majority of the farmers interviewed in the area were cultivating maize because of both income generation and household food consumption.

### 4.3 Institutional Characteristics of the Respondents

Generally, institutional factors deal with the degree in which institutions impact on technology adoption by smallholders (Meinzen-Dick *et al.*, 2004). Institutions include all the services to agricultural development, such as finance, insurance and information dissemination (Meinzen-Dick *et al.*, 2004). The institutional factors considered in this study are group membership, access to credit and access to extension services. Membership of farming based groups is a positive coefficient with adoption (Gbegehand Akubuilu, 2013). Farmers who have membership to cooperatives that can pull resources together for their individual gain hence an opportunity to adopt many technologies than other farmers who are not members.

Also, members of cooperatives get more reliable information on improved farm management practices than non-members of cooperatives. Farm based organisations link the individual farmer to the larger society and expose the farmer to a variety of ideas. A study by Ayinde *et al.* (2010) reported that factors such as access to extension agents, credit access, and farmer's level of education, farming experience and farm size have substantial and positive influence on adoption. Results of the institutional characteristics being accessed showed that, 41 percent were visited by an extension officer during the maize production season, while 40.3 percent of the respondent farmers do not have access to any of these institutional support, less than 20 percent of the respondents belonged to farmer groups, only 1.3 percent of them were able to access credit for their maize farming (Table 4.1).



It can be deduced that about (59%) of the maize farmers interviewed have not had contact with agricultural extension agents, which can negatively affect adoption of improved maize farming technologies. As reported by Agwu *et al.* (2008), low extension farmer contact does not augur well for adoption agricultural technologies.

#### **4.4 Levels of Awareness on Improved Maize Farming Technologies**

The study sought the views of the respondents on their awareness of agricultural technologies on maize farming. Ten technologies were presented to the respondents to indicate their awareness and training received on each technology. Table 4.3 presents the levels of awareness of the various improved maize farming technologies in the area. With regards to the farmers' awareness of line spacing technology, almost all the sampled farmers (99.3%) were aware of the line spacing technology whilst only 0.7% was not aware of line spacing as improved maize farming technology (Table 4.3). All the respondents (154) were fully aware of early fertiliser application as an improved maize farming technology. However, they affirmed that they were not able to practice it because of lack of money to purchase the fertiliser for early fertilisation, on the maize crop. Again, about 96.8 percent (149) of the respondents were well aware of putting the required number of seeds per hole as a technology that could improve productivity, whilst only 3.2 percent of maize farmers were not aware of it (Table 4.3). Furthermore, about 97.4 percent of the respondents were aware of early herbicides application technology (Table 4.3).





**Table 4.3: Levels of awareness of improved maize farming technologies**

<b>Technology</b>	<b>Frequency</b>	<b>Percentage</b>
Line spacing	153	99.3
Early fertiliser application	154	100
Seed per hole	149	96.8
Early herbicides application	150	97.4
Planting date	98	63.6
Improved seed	142	92.2
Thinning	49	31.8
Pest and disease control	46	31.2
Use of chemical	100	66.2
Early harvesting	138	89.6

**Field survey, 2017**

About 63.3 percent of the farmers contacted were aware of recommended planting date of maize whilst the remaining 36.7 percent were aware of recommended date of planting of maize (Table 4.3). About (92.2%) percent of maize farmers were aware of the availability of improved maize seeds (Table 4.3). Majority of the contacted farmers were also aware of the availability of improved maize seeds. Technologies such as thinning, pest and disease control, use of chemicals and early harvesting were having awareness rate of (31.8%), (31.2%), (66.2%) and (89.6%), respectively (Table 4.3). From Table 4.3, it can be seen that except thinning (68.2%) and pest and disease control (68.8 %).





The high level of awareness of the technologies may have a positive influence on maize production in the Municipality. As, it is reported by Simtowe *et al.* (2012) that technology awareness is an important requirement for adoption to occur. However, in most cases exposure to a technology is not random. Simtowe *et al.* (2012) reported individuals may be exposed to new technologies because they are targeted by researchers or extension workers based on the prejudice of their higher probability of adoption. In a study conducted by Kudi *et al.* (2011), farmers' awareness has substantial influence on the adoption rate of agricultural innovation.

#### **4.5 Training Received on Improved Maize Farming Technologies**

Awareness of a technology is a necessary condition but not a sufficient condition for the adoption of technologies by farmers. Farmers may be aware of the technologies but because of their limited knowledge in the use of such technologies it may lead to non-adoption of the technologies. Even though there were high levels of awareness of the technologies, very few of the farmers have had training on these technologies (Table 4.4). The survey revealed that training received by respondents in the 10 technologies ranged from 0 to (13.6%), (Table 4.4). Only (12.3%) of the 154 farmers interviewed reported that they have received training on early fertiliser application. Similarly, (12.3%) received on putting the recommended number of seedlings per hole. Technologies such as early herbicides application, recommended planting date, improved seed, pest and disease control, use of chemicals and early harvesting all have percentages less than 10. However, none of the farmers contacted indicated receiving training on thinning of maize.

**Table 4.4: Training received on improved maize farming technologies**

Technology	Trained		Not trained	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Line spacing	21	13.6	133	86.4
Early fertiliser application	19	12.3	135	87.7
Seed per hole	19	12.3	135	87.7
Early herbicides application	9	5.8	145	94.2
Planting date	3	1.9	153	98.1
Improved seed	1	0.6	153	99.4
Thinning	0	0	154	100
Pest and disease control	3	1.9	151	98.1
Use of chemical	2	1.2	152	98.8
Early harvesting	8	5.2	146	94.8

### Field survey, 2017

This is obvious that adoption of these technologies means their proper implementation could be tedious for farmers as their educational background is low. This lack of training on the use of these technologies may have a significant effect on the level of adoption. Less than 15 percent of the farmers interviewed indicated that they have received training regarding line spacing. Respondents argued that, line spacing allows the farmer to sow more per unit area as compared to not using the line spacing technology.





The majority (87.7%) of the farmers contacted have not attended workshop or training on early fertiliser application. These low levels of trainings may prevent farmers from deriving maximum benefits from these technologies. Since, Adegbola and Gardebroek (2007) reported sources of information to have effect on improved technology adoption and modification in Benin, aside direct costs, yields and profits associated with new maize seeds, and reduced risk of the seed characteristics due to potential yield losses and poor grain quality. Farmers cannot easily use new technologies because of multiple factors that include lack of information, liquidity constraint, sometimes the returns of the technology, unavailability of the technology and the risk related to the use of improved technology (Doss *et al.*, 2003; Kudi *et al.*, 2011).

#### **4.6 Rate of Adoption of Improved Maize Farming Technologies**

The study sought to identify the rate at which farmers adopt the improved maize farming technologies. As indicated by Table 4.4, farmers may practice one or more of these technologies on their maize farms. The study showed that, line spacing in maize farming was the most dominant technology adopted by the farmers as 86.4 percent of them were practicing this technology whilst the remaining 13.6% of the maize farmer claimed they do not practice line spacing (Table 4.5). Basically, proper line spacing of maize crops come with a lot of benefit that include good yield, allows easy cultural practices such as weeding, ridging, fertiliser application and proper circulation of air among the maize crops that reduce pest and disease prevalence among others.

**Table 4.5: Rate of adoption of improved maize farming technologies**

Technology	Frequency	Percentage
Line spacing	133	86.4
Early fertiliser application	55	35.7
Seed per hole	130	84.4
Early harvesting	105	68.2
Early herbicides application	24	5.6
Planting date	10	6.5
Improved seed	37	24
Use of chemical	8	5.2
Thinning	0	0
Pest and disease control	0	0

**Field survey, 2017**

It is also obvious that line spacing allows the maize farmers to use more than one technology especially, soil and water conservation technologies on the farm that is crucial to soil management and increase in maize productive. Hence, the probable reason for most maize farmer’s adoption of the line spacing technology. However, the major challenge with line spacing technology is that more labour is required. The survey revealed that placing the recommended number of seeds per hole was the second highest improved technology adopted by the maize farmer’s with about 84.4 percent of the farmers practicing it whilst the remaining 15.6 percent are non-adopters (Table 4.5). The study showed that about 35.7 percent of maize farmers have adopted the practice





whilst 64.3 percent are non-adopters of earlier application of fertiliser, although there was 100 percent awareness of early fertiliser application technology by the farmers (Table 4.5). Lack of income at the early stages of farming was the main reason for the non-adoption of the early fertiliser application as a technology which was affirmed by most respondents and discussants in the focus group discussion.

The practice of early harvesting was also encouraging as about 68.2% of the sampled respondents were practicing early harvesting whilst remaining percent were non-adopters (Table 4.5). The study generally revealed low adoption of some improved maize farming technologies. About 36.6 percent have adopted early herbicides application, 6.5 percent were practicing (adopters) planting their maize within the recommended planting dates whilst the remaining percent were non-adopters; about 24 percent of the farmers reported that they adopted the use of maize improved seed for maize farming whilst the remaining percent were are non-adopters; and 5.2 percent adopted use of chemical whilst the remaining percent are non-adopters of the improved technology (Table 4.5).

This means that farmers in the area are using previous season seeds for cultivation in the following season. The adoption of improved maize seeds is low as compared to finding by Lawal *et al.* (2005) in some villages in the Southwest Nigeria which revealed improved varieties of seeds were highly adopted (about 56.7%). The survey also revealed that maize farmers have not adopted thinning and pest and disease control as improved maize farming technologies in the study area as no single farmer have adopted any of them. Similar study by Doss *et al.* (2003) on adoption of maize and wheat technologies in East Africa showed factors associated with farmers' adoption

decisions to include economic attributes, farmers' socio-demographic characteristics, farmers' perception about the characteristics of technologies, and institutional factors.

#### **4.7 Socio-economic and Institutional Factors Influencing Adoption of Improved Maize Farming Technologies**

Table 4.6 presents the socioeconomic and institutional factors influencing the adoption of improved maize farming technologies among farmers in the Yendi municipality. The results from the estimated parameters of the adoption of improved maize farming technologies have shown that only four factors were influencing the adoption of improved maize farming technologies in the area. The factors that were statistically significant include: education, maize farm size, access to credit and access to extension contact. All the variables were positively influencing the adoption of improved maize farming technologies in the area.

The results have shown that the variables included in the model were all strongly influencing the adoption of improved maize farming technologies in the area as the Chi<sup>2</sup> value was significant at 1 percent ( $P < 0.01$ ) (Table 4.7). However, the variables in the model could not explain the variation of probability of adoption better as the Pseudo R<sup>2</sup> only explained 2 percent of the variation in the adoption of the improved maize farming technologies by the variables. The results is not surprising as education is expected to have positive influence on the adoption of improved maize farming technologies, the results have shown that education influence adoption positively. The implication of this finding is that higher educated farmers are likely to adopt improved maize farming technologies than farmers with low level of education.



**Table 4.6: Estimates of Poisson regression model showing the socio-economic and Institutional factors influencing the adoption improved maize technologies**

Variable	Coefficient	Robust std error	p> z
Constant	0.7708	0.7278	0.29
Marital status	0.0076	0.081	0.925
Age	0.021	0.0354	0.554
Household size	0.006	0.0059	0.313
Education	0.0188	0.0099	0.059***
Maize farming experience	0.0029	0.007	0.681
Maize farm size	0.0885	0.0298	0.003*
Group membership	0.0494	0.0706	0.484
Credit	0.1793	0.104	0.085***
Extension	0.1881	0.0653	0.004*
Number of Observation = 154		Prob > Chi <sup>2</sup> 0.0000	
Wald Chi <sup>2</sup> = 39.76		Pseudo R <sup>2</sup> = 0.0214	

\* = 1% level of significance and \*\*\* = 10 percent level of significance

**Field survey, 2017**

Educated farmers are expected to show better adoption of technology because of their ability to understand the benefits of technology adoption and the trust they have in extension officers (Oyekale and Idjesa, 2009). Several studies on adoption have shown positive relationship between adoption and education (Lawal *et al.*, 2004; Oyekale and Idjesa, 2009; Singh *et al.*, 2010; Kayode and Adekoya, 2013) indicating a correlation of





this finding from similar studies. Singh *et al.* (2008), found education to have negative effect on the adoption of integrated pest management in paddy but did not show any significant level indicating a deviation from this findings.

As expected maize farm size was significant at the 1 percent level and influence adoption of improved maize farming technologies positively. Farmers with relatively large maize farm size were more likely to adopt improved maize farming technologies than those with relatively small maize farm size. Singh *et al.* (2008) found farm size to have negative relationship with adoption in both paddy and cotton production in Haryana and Punjab in India. The probability of a farmer adopting the maize farming technologies increases by 0.0885 percent if the farmer increases his or her farm size by 1 hectare (Table 4.6). This result is consistent with Singh *et al.* (2010) who found that farm size of land holding was having a positive correlation with adoption of commercial cabbage cultivation technology in District Ghaziabad in India.

Also, as expected of credit from the study, credit access was impacting positively on the adoption of improve maize farming technologies in the study area. Access to credit was statistically significant at the 10 percent level of significance and positively influenced the adoption of maize farming technologies. This means that farmers who accessed credit in the production season were likely to adopt the improved maize farming technologies than those who could not access any credit. Access to credit as expected increases the adoption of improved maize farming technologies and it highlights the importance of providing maize farmers with credit to support their agricultural activities in securing productivity enhancing inputs. Mugusha *et al.* (2012) have reported that access to credit had a positive and significant influence on the rate of technology



adoption and in some cases is a significant condition to adopting a particular technology package.

The coefficient of access to credit was 0.1793 (Table 4.6) implying that if a farmer have a credit access of one Ghana cedis, such a farmer adoption of the improved maize farming technologies would increase by 0.1793 percent (Table 4.6) when all other factors of production are kept constant. Also, having access to extension contact has an influence on the adoption of improved maize farming technologies. Extension contact was significant at the 1 percent level of significance and positively influenced the adoption of the improved maize farming technologies in the area. This result is consistent with the findings of Sulo *et al.* (2012). However, variables such as marital status, age, household size, experience and farmer group membership showed positive relations with adoption but were non-statistically significant.

#### **4.8 Challenges Faced in Adopting of Improved Maize Technologies**

Technological innovations are regarded as a conduit for improving agricultural productivity. However, many of the smallholder farmers are not able to adopt new improved technologies to increase their productivity as a result of some challenges they faced during the adoption process of the new and improved technologies. Preliminary contact with farmers in the Yendi Municipality led to the identification of various factors that could constitute challenges to the adoption of improved maize technologies. The list of major challenges were summarized into 5 as follows: cost of the technology adoption, complex nature of the technology, lack of skills to adopt the technology, risk and uncertainty of the technology and lack of production resources were acknowledged



by the maize farmers as the major challenges inhibiting the adoption of improved technologies in the study area.

**Table 4.7: Ranking of challenges faced by farmers in the adoption process**

Challenges	Sum of Scores	Mean Score	Rank
Costly to adopt	128	2.93	2 <sup>nd</sup>
Complex to adopt	124	2.99	3 <sup>rd</sup>
Lack of Skills to adopt	139	2.73	1 <sup>st</sup>
Risk and uncertainty	117	3.10	4 <sup>th</sup>
Lack of production resources	111	3.20	5 <sup>th</sup>

**Field survey, 2017 Sample size (n) = 154; Number of challenges ranked= 5 = df= 4 Rank 1= most important, Rank 5= least important; Kendall's W= 0.148; Chi-square= 91.432; Sig= 0.000**

The study revealed that about 83.1 percent of the farmers in the area reported that the cost of adopting some technologies was an impeding factor to their technology adoption (Table 4.7). For instance, they argued that the cost of fertiliser was preventing them from early fertiliser application. The cost of adopting farming technology has been reported as a major challenge to adoption of technology. The elimination of subsidies on prices of fertilisers and seeds since the 1990s because of the World Bank-sponsored



Structural Adjustment Programmes in Sub-Saharan Africa has extended this challenge (Muzari *et al.*, 2013).

Similarly, 80.5 percent of the respondents farmers were of the view that some of the improved maize technologies were complex to adopt (Table 4.7). Lack of skills to adopt the technologies was also mentioned as a challenge and 89 percent of the sampled farmers have reported that they do not have the skills required by some of the technologies to adopt them (Table 4.7). This, as they indicated is as a result of their lack of training or education on such technologies.

This perception is strengthened by observations of a farmer at Nakpachei.

*“Infact, we are illiterate farmers, we rely solely on extension officers for information on our farming. The officers usually don’t visit us, they come only to meet some group of farmers. Sometimes we get information about this technologies from our colleague farmers, but as to how to use them is seriously an issue. We need some kind of education and training to be able use these technologies, which sincerely we do not get”*

More than 75 percent of the interviewed farmers reported risk and uncertainty involved in adopting some of the technologies was a challenge to them (Table 4.7). Even though new and improved technologies are recognized to enhancing productivity, farmers think that there are risks and uncertainties in adopting the technologies. The outcomes of the technologies are not known to the smallholder farmers as such the motivation to adopt such technologies is low. Lastly, 71 percent of the sampled smallholder farmers reported lack of productive resources as a major challenge to the adoption of new and





improved technologies (Table 4.7). Many of the new technologies are resource intensive and this is affecting the adoption of technologies among the smallholder farmers. Line spacing and early fertiliser application require more labour for adoption as a result smallholder farmers who do not have large household size to be used as labour and may not be able to hire labour for such activities are unlikely to adopt such technologies.

#### **4.9 Ranking of the Challenges Faced by Farmers in the Adoption Process**

In terms of ranking of the constraints, it was observed from Table 4.7 that lack of skills to adopt the improved maize farming technologies was ranked first with a mean rank value of 2.73 (Table 4.7). The cost of adoption of technology was also seen as a major challenge to adoption and ranked second with a mean rank of 2.93 (Table 4.7). Most of the improved maize farming technologies are complex to adopt. The complex nature of some of these technologies present a challenge in the adoption process and this challenge was ranked third by the sampled respondents with a reported mean rank score of 2.99 (Table 4.7).

The risks and uncertainties associated with adoption of improved maize farming technologies was ranked fourth while lack of production resources was ranked fifth with mean rank scores of 3.10 and 3.20, respectively (Table 4.7). From the above analysis the most pressing challenge that could inhibit farmers ability or decision to adopt an improved technology was lack of skills to adopt the technology with a mean rank of 2.73 with the least pressing challenge being lack of productive resources with a mean rank of 3.20. The results from the Kendall's coefficient of concordance (W) analysis

indicate 14.8% (0.14.8) agreement among rankings of the challenges by maize farmers in the Municipality with a calculated Chi-square value of (19.432) and asymptotic significance of (0.000).



## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.0 Introduction

This chapter is presented on three sections: summary, conclusions and recommendations. The first section summarises the whole work under the various chapters. Conclusions drawn based on the findings of the study are presented in section two of this chapter. The last section is the recommendations made based on the conclusions drawn from the findings of this work.

#### 5.1 Summary

The broad objective of the study was to investigate the factors influencing the adoption of improved maize farming technologies in the Yendi Municipality of the Northern region of Ghana. Ten maize farming technologies were presented to the respondents to indicate their awareness and training received on each technology. The results show high levels of awareness of the technologies in the area. Almost all (99.3%) the sampled farmers were aware of line spacing technology. Similarly, all (154) the respondents were aware of early fertiliser application. Again, about (97%) of the sampled respondents were well aware of putting the required number of seeds per hole as a technology that could improve productivity. Furthermore, about (97.4%) of the respondents were also aware of early herbicides application technology. Also, about (60%) of the farmers were aware of recommended planting date of maize.





Similarly, majority (92%) of the respondents were also aware of the availability of improved maize seeds. Technologies such as thinning, pest and disease control, use of chemicals and early harvesting were having awareness rate of 31.8%, 31.2%, 66.2% and 89.6% respectively. Less than 15 percent of the farmers interviewed indicated that they have received training regarding line spacing.

Majority of the farmers contacted have not attended workshop or training on early fertiliser application. Only 12.3 percent of the 154 farmers interviewed reported that they have received training on early fertiliser application. Similarly, 12.3 percent received on putting the recommended number of in a hole. Technologies such as early herbicides application, recommended planting date, improved seed, pest and disease control, use of chemicals and early harvesting all have percentages less than 10.

Line spacing was the most dominant technology adopted by the farmers as 86.4 percent of them were practicing this technology. This was followed by placing the recommended number of seeds per hole with about 84.4 of the farmers practicing it. Although there was 100 percent awareness of early fertiliser application technology by the farmers, less than 40 percent of them have adopted the practice. About 15.6 percent have adopted early herbicides application while 6.5 percent were practicing planting their maize within the recommended planting dates. About (24%) of the farmers reported that they adopted the use of maize improved seed for maize farming. None of the respondents was practicing thinning and pest and disease control in the study area. The use of chemicals as a pest and disease control measure was less than 10 percent.



The practice of early harvesting was also encouraging as more than half (68.2%) of the sampled respondents were practicing early harvesting.

The Poisson regression analysis showed that only four variables were significantly influencing the adoption of maize farming technologies in the area. The results showed that education influence adoption positively. As expected maize farm size was significant at the 1 percent level and influence adoption of improved maize farming technologies positively indicating that farmers with relatively large maize farm size were more likely to adopt improved maize farming technologies than those with relatively small maize farm size. Access to credit was also impacting positively on the adoption of improve maize farming technologies in the study area. Access to credit was statistically significant at 10 percent level and positively influenced the adoption of maize farming technologies. Also, having access to extension has an influence on the adoption of improved maize farming technologies. Extension contact was significant at 1 percent level and positively influences the adoption of the improved maize farming technologies in the area.

The cost of the technology adoption, complex nature of the technology, lack of skills to adopt the technology, risk and uncertainty of the technology and lack of production resources were acknowledged by the maize farmers as major challenges inhibiting the adoption of improved maize farming technologies in the study area. About 83.1 percent of the farmers in the area reported that the cost of adopting some technologies was an impeding factor to their technology adoption. Similarly, 80.5 percent of the interviewed



farmers were of the view that some of the improved maize technologies were complex to adopt.

Lack of skills to adopt the technologies was also mentioned as a challenge and (89%) percent of the sampled farmers have reported that they do not have the skills require by some of the technologies to adopt them. This, they indicated is as a result of their lack of training or education on such technologies. Also, (75%) percent of the interviewed farmers reported risk and uncertainty involved in adopting some of the technologies was a challenge to them. Even though new and improved technologies are recognized to enhancing productivity, farmers think that there are risks and uncertainties associated with the adoption of the technologies. Lastly, (7.1%) percent of the sampled smallholder farmers reported lack of productive resources as a major challenge to the adoption of improved maize farming technologies. Many of the new technologies are resource intensive and this is limiting the adoption of technologies among the smallholder farmers.

## **5.2 Conclusions**

In conclusion, there were generally high levels of awareness of the technologies among maize farmers in the study area. However, some of the technologies were having (100%) percent level of awareness, others had less than (40%) percent awareness level. This high level of awareness can positively influence farmers decision to adopt or not adopt the technology. In terms of training on the technologies, farmers received very





low levels of training on all the technologies presented to them. This low levels of training received may have a negative influence on adoption of improved maize farming technologies. The study revealed that, the levels of adoption of improved maize farming technologies in the study area were generally low with the exception of line spacing (86.4), seed per hole (84.4%), and early harvesting (68.2%) respectively. The dominant technology adopted in the area was line spacing whilst the least dominant were thinning as well as pest and disease control as none of the farmers adopt it as a technology.

The study also revealed that, factors such as education (0.0188), farm size (0.0885), credit (0.1793) and extension contact (0.1881) were the statistically significant factors that influenced the adoption of the improved maize farming technologies in the area. All this variables were having a positive relationship with the adoption of the adoption of improved maize farming technologies in the study area.

The study further revealed that, lack of skills to adopt the technologies was ranked first as a challenge of adoption as 89 percent of the respondents affirmed it was a major challenge. This was followed by the cost of adopting the technology with 83.1 percent whilst the complexity of the technologies was also mentioned and 80.5 percent of the sampled farmers reported it as a challenge. Challenges such as risk and uncertainties of the technologies and lack of production resources to adopt the technologies were reported representing 75 percent and 7.1 percent, respectively.

### 5.3 Recommendations

Based on the findings, the following recommendations were drawn for policy consideration;

1. The Ministry of Food and Agriculture, research institutions and non-governmental organisations who work with farmers in the rural communities should intensify the trainings on these technologies about the use of these technologies for them to understand its benefits before they can adopt them fully.
2. Additionally, these institutions should also encourage the establishment of more demonstration farms to enable farmers have access to the technologies that are being practice in these demonstration plots.
3. Ministry of Food and Agriculture should intensify E-Extension, in order to be able to reach out to large number of these poor resource constraint farmers.
4. Credit influences technology adoption of improved farming technologies, therefore, MoFA together with other private partners need to support farmers have access to credit.
5. The study revealed that the rate at which farmers adopt improved maize farming technologies area is low. Majority of the maize farmers were found to be adopting the technologies at levels far below the recommended levels. High cost of adoption the technology had been mentioned as one of the challenges constraining maize farmers decision to adopt the technology. The study recommends government subsidy on the cost of technological inputs in order to enable low income maize farmers afford.



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**APPENDIX 1: Questionnaire for maize farmers**

**UNIVERSITY FOR DEVELOPMENT STUDIES**

**DEPARTMENT OF AGRICULTURAL EXTENSION, RURAL DEVELOPMENT  
AND GENDER STUDIES**

**Dear Respondent,**

*This research is part of a study investigating “Factors influencing the adoption of improved maize farming technologies”. The research is purely for an academic exercise and all information given shall be used solely for this purpose. The researcher therefore wishes to have your personal views on the study and will adhere to the principles of confidentiality and anonymity.*

*Thank you for considering this request.*

*INSTRUCTION: Please fill in the spaces or tick where necessary*

Name of respondent.....

Name of Community.....

**A. Demographic Characteristics**

1. Sex of respondent 1. Female [  ] 2. Male [  ].
2. Age of respondent.....
3. Marital status 1. Married [  ] 2. Divorced [  ] 3. Separated [  ] 4. Widowed [  ]
5. Single [  ] 6. Others specify.....
4. How many people do you have in your household.....
5. What is your level of education? 1. Primary level [  ] 2. Middle school/ JSS/ JHS [  ] 3. SSS/ SHS [  ] 4. Technical/ vocational [  ] 5. Tertiary/ college/ polytechnics [  ]
6. Other (specify).....?





6. What is your total farm size.....?
7. a. Apart from being a farmer, do you have any other form of employment? Yes [ ]  
No [ ]
- b. What form of employment? .....

**B. Farming system**

8. What types of crops do you cultivate? 1. Maize [ ] 2. Yam [ ] 3. Soya bean [ ] 4. Groundnuts [ ] 5. Millet [ ] 6. Others specify.....
9. What types of livestock do you rear? 1. Cattle [ ] 2. Goat [ ] 3. Sheep [ ] 5. Poultry [ ]  
6. Others specify.....
10. How many years have you been farming maize.....?
11. What is the estimated size of your maize farm(s) in hectares/acres.....?
12. How did you acquire your maize farm(s)? 1. Through inheritance [ ] 2. Bought [ ]  
3. Hired [ ] 4. Government [ ] 5. Friends [ ] 6. Others specify.....?
13. What do you farm maize for? 1. Household consumption [ ] 2. Income [ ] 3. For animal feed [ ] 4. Other specify.....?

**C. Adoption of Maize Farming Technologies**

14. Complete the table below on awareness, training received, source (s) of training and duration of training.

Technologies	Awareness		Have you received training on it		Source of training	Duration of the training
	Yes	No	Yes	No		
Line spacing of maize crops						
Earlier application of fertiliser						
Seed per hole						
Earlier application of herbicides (weed control)						
Planting date						
Improved seeds						
Thinning						
Pest and disease						
Use of chemical						
Early harvesting						

15. Have you adopted any maize farming technologies in the past five (5) years? Yes [ ]

No]



16. Complete the table below on level of use of maize farming technologies.

Technologies	Have you ever used it before		Do you still use it		If Yes, No. of times used	Give reasons
	Yes	No	Yes	No		
Line spacing of maize crops						
Earlier application of fertiliser						
Seed per hole						
Earlier application of herbicides (weed control)						
Planting date						
Improved seeds						
Thinning						
Pest and disease						
Use of chemical						
Early harvesting						

**D. Socio-Economic Characteristics of Farmers**

17. Are you a member of a Farmer Based Organisation? 1. Yes [ ] 2. No [ ].

18. Do you occupy leadership position? 1. Yes [ ] 2. No [ ].

19. If yes, what leadership position do you hold? 1. Chairman [ ] 2. Secretary [ ]

3. Magaazia [ ] 4. Treasurer [ ] 5. Others specify.....

20. Have you travelled to the city before? 1. Yes [ ] 2.No [ ].

21. If yes, how long have you lived in the City? .....(Years)



22. How much do you earn as annual income (occupational income + external source if any) 1. Less GHC 500.00 [ ] 2. 500.00- 999.00 GHC [ ] 3. 1,000-1,499.00 GHC [ ] 4. 1,500-1,999.00 GHC [ ] 5. 2,000.00 GHC and above [ ].

23. Have you had access to credit in the past five years? 1. Yes [ ] 2. No [ ].

24. If yes, state the type of credit received, sources and amount of credit received since 2013 in the table below.

Type of credit	Source	Amount ( ¢)

25. Do you have access to improved maize farming technologies? 1. Yes [ ] 2. No [ ].

26. If yes, how useful are the extension education programme you have attended in terms of your maize farming? 1. Very useful [ ] 2. Useful [ ] 3. I don't know [ ] 4. Somehow useful [ ] 5. Not useful [ ].

27. What is the total farm size of your household (hectares/acres).....?

28. What proportion is used to cultivate maize (hectares/acres).....?

**E. Institutional factors**

29. Do you have access to agricultural extension? 1. Yes [ ] 2. No [ ].

30. If yes, how often do you get extension visits? 1. Once a week [ ] 2. Once a fortnight [ ] 3. Once a month [ ] 4. Not at all [ ] 5. Others specify.....

31. Have you ever participated in any extension activity (ies) regarding farming? 1. Yes [ ] 2. No [ ].

32. Which type of institutions gives you support in your maize farming? 1. MoFA [ ] 2. NGOs 3. Farmer Based Organisations [ ] 4. Research institutes [ ] 5. Others specify...  
.....





33. Apart from the visits of the agricultural extension agents, what are the other forms of extension services receive from the agricultural extension services for maize farming?

- 1. Visits to agricultural exhibitions [   ]
- 2. Radio/ television extension programmes [   ]
- 3. Leaflets/ pamphlets [   ]
- 4. Video/cinema shows [   ]
- 5. Co-operate society [   ].
- 6. Others specify.....

34. Do you think the extension services provided to you have positive effect in your maize production? 1. Yes [   ] 2. No [   ].

- 1. If yes, what are those positive effects? 1. High yield [   ] 2. Quality of yield [   ] 3. Makes cultural practices easier [   ] 4. Economically efficient [   ] 5. Others specify.....

35. Are there challenges affecting the adoption of improved maize farming technologies in this locality? 1. Yes [   ] 2. No [   ]

36. What technology adoption challenges do you face?

Challenge	Tick	Rank
Costly to adopt		
Complex to adopt		
Lack of skills to adopt		
Risk and uncertainty		
Lack of production resources		

**APPENDIX 2: Questionnaire for extension agents**

**UNIVERSITY FOR DEVELOPMENT STUDIES  
DEPARTMENT OF AGRICULTURAL EXTENSION, RURAL DEVELOPMENT  
AND GENDER STUDIES**

**Questionnaire for Extension Agents**

**Name of Respondent**.....

**Name of Location**.....

1. Sex of respondent Male [  ] Female [  ]
2. Age of respondent.....
3. Please indicate your highest academic qualification 1. G.C.E. 'O' Level or G.C.E. A' Level [  ] 2. Post-secondary in agriculture [  ] 3. Diploma in agriculture [  ] 4. Degree in agriculture [  ]. 5. Post graduate 6. Others (specify).....
4. How long have you been employed as an agricultural extension agent (AEA).....?
5. How often do you visit individual farmers? 1. Once every 2 weeks [  ] 2. Once a month [  ] 3. Once every 3 months [  ] 4. Twice a year [  ] 5. Once a year [  ] 6. No visit [  ] 8. Other (specify).....?
6. What type of farming do you usually give advice or assistance on? 1. Food crops [  ] 2. Cash crops [  ] 3. Vegetables [  ] 4. Animals/ poultry rearing 5. Combination of types.....?
7. Do you attend to farmers with respect to maize technologies? Yes [  ] No [  ]
8. If yes, how often? 1. Once a week [  ] 2. Once a fortnight [  ] 3. Once a month [  ] 4. Not at all [  ] 5. Others specify.....
9. What approaches do you use to impart maize technologies to farmers? 1. Training and visit [  ] 2. Farmers field school [  ] 3. Farmer to farmer visit [  ] 4. Telephone call [  ] 5. Radio [  ] 6. Any other (specify).....?



10. What challenges do you encounter with respect to imparting maize technologies to farmers.....  
.....?

11. In your opinion what do you think can be done to enhance maize technology adoption?.....  
.....  
.....  
.....?





### **APPENDIX 3: Questionnaire for focus group discussion**

#### **Interview Schedule for Focus Group Discussion of Selected Maize Farmers**

1. How do you rate the adoption of improved maize technologies among maize farmers?  
[probe].
2. What do you think are the possible causes of the low adoption of technologies in this area? [probe].
3. What type of training has been received on maize technology adoption over the past 10 years?
4. What do you think are the challenges affecting the adoption of maize technologies?  
[probe].
5. Do you think there are cultural issues that inhibit your choice adoption of improved technologies? [probe]
6. Which of the practices recommended by extension do you find difficult to practice and why?
7. What challenges do you encounter with respect to adoption of technologies?  
[probe]
8. What do you think can be done to improve the adoption of improved maize technologies among maize farmers?



**APPENDIX 4: Sampling frame and sample size for each community**

Zones	Operational Zones	Sample Size for each community
Yendi	Gundogu	16
	Kunkon	12
	Zang	15
	Gukpegu	13
Gbungbalga	Zugu	12
	Bago	13
	Yimahagu	11
	Nakpachei	14
Malzeri	Kulkpanga	12
	Paansiya	12
	Kpatia	11
	Nalogu	13
Total	12	154



**APPENDIX 5: Independent Variables and Their priori Expectation**

Variable	Meaning	Definition	Expectation
MS	Marital status	Dummy variable; 1 = if married and 0 = singled	Positive (+)
FA	Age of the farmer	Number of years	Positive (+)
HHS	Household size	Number of people in the household	Positive (+)
EDU	Education	Number of years schooled	Positive (+)
FE	Experience	Number of years farm maize	Positive (+)
FS	Farm size	Number of hectares farm	Positive (+)
GM	Group membership	Dummy variable; 1 = membership and 0 = otherwise	Positive (+)
ACR	Access to credit access	Dummy variable; 1 access credit and 0 = otherwise	Positive (+)
EXV	Extension contact	Dummy variable; 1 = access to extension officer, 0 = otherwise	Positive (+)



**APPENDIX 6: Summary statistics of maize farmers demographic and socio-economic characteristics**

<b>Variable</b>	<b>Mean</b>	<b>Std Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
Age	40.46	6.57	26.00	56.00
Gender	0.58	0.49	0.00	1.00
Marital status	1.36	0.93	1.00	5.00
Farm size	1.95	1.14	0.40	6.40
Household size	8.25	3.52	4.00	26.00
Maize farming experience	14.93	7.94	2.00	36.00
Access to credit	0.01	0.11	0.00	1.00
Extension contact	0.41	120.6	0.00	1.00
Group membership	0.17	0.36	0.00	1.00
Farmer income	2.29	0.10	1.00	5.00



**APPENDIX 7: Estimates of Poisson regression model showing the socio-economic factors influencing the adoption of improved maize technologies**

Variable	Coefficient	Robust std error	p> z
Constant	0.7708	0.7278	0.29
Marital status	0.0076	0.081	0.925
Age	0.021	0.0354	0.554
Age <sup>2</sup>	0.0004	0.0004	0.339
Household size	0.006	0.0059	0.313
Education	-0.0188	0.0099	0.059***
Experience	0.0029	0.007	0.681
Maize farm size	0.0885	0.0298	0.003*
Group membership	0.0494	0.0706	0.484
Credit	-0.1793	0.104	0.085***
Extension	0.1881	0.0653	0.004*
Number of Observation = 154	Prob > Chi <sup>2</sup> 0.0000		
Wald Chi <sup>2</sup> = 39.76	Pseudo R <sup>2</sup> = 0.0214		



**APPENDIX 8: Ranking of challenges faced by farmers in the adoption process**

<b>Challenges</b>	<b>Sum of Scores</b>	<b>Mean Score</b>	<b>Rank</b>
Costly to adopt	128	2.93	2 <sup>nd</sup>
Complex to adopt	124	2.99	3 <sup>rd</sup>
Lack of Skills to adopt	139	2.73	1 <sup>st</sup>
Risk and uncertainty	117	3.10	4 <sup>th</sup>
Lack of production resources	111	3.20	5 <sup>th</sup>

