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FACTORS INFLUENCING THE USE OF INORGANIC FERTILIZER BY FARMERS IN GHANA

CLASS NO.
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253227
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BY

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Thesis submitted to the Department of Agricultural Economics and Extension of the College of Agriculture and Natural Sciences, University of Cape Coast, in partial fulfillment of the requirements for the award of Doctor of Philosophy Degree in Agricultural Extension

MAY 2015

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

..... 24/11/2015.....

FELICIA ANSAH-AMPROFI Date

(Candidate)

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

The agricultural sector in Ghana is characterised by low productivity partly due to declining soil fertility. Governments of Ghana have assisted farmers to use fertilizer to improve the fertility of soils through the fertilizer subsidy programme. However, the factors influencing the use of inorganic fertilizer which is the study have not been fully explored. The study used a descriptive-correlation survey design to collect data from the six agro-ecological zones of Ghana. Descriptive statistics were used to describe the data. Cross tabulations were used to determine differences between some independent variables. The Pearson's product-moment correlation was used to determine the relationship between fertilizer use and the independent variables of the study. The multiple linear regression was used to determine the best predictors of fertilizer use. The results of the study showed that most farmers (69.7%) were found to be in the age group of 35-60 years. Most maize farmers (84.4%) use fertilizer at rates lower than the recommended rate of 375kg/ha. The mean quantity of fertilizer used per year by maize farmers in Ghana is 76.3kg/ha. Most farmers (71.8%) were found to have positive attitude towards the use of fertilizer. The study revealed that cost of fertilizer, farmers' attitude towards fertilizer use and extension information support were the best predictors of fertilizer use, and all together accounted for 41% of the independent variables contribution to the variance in fertilizer use. The study recommends among others that to improve fertilizer use in Ghana, the Ministry of Food and Agriculture and the private sector should collaborate to invest and improve the port, road and rail infrastructure to reduce distribution and fertilizer costs so as to make fertilizer affordable to farmers. Also researchers should work towards coming out with application recommendations for specific soil types.

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ACKNOWLEDGEMENTS

It is a momentous occasion to be able to finish this research. I owe a debt of gratitude to the most high God, and to all who placed their resources and expertise at my disposal for this work. My special thanks go to Prof. J.A. Kwarteng for his guidance, supervision and constructive comments throughout the conduct of the study. Many thanks go to Prof. Ernest L. Okorley, my co-supervisor for his academic direction and extremely useful suggestions that went into this work. His promptings were most appreciated, and I shall always remember his firmness and good sense of humour.

I am particularly grateful to Wienco Ghana Limited for their financial support that enabled me conduct the field survey. I also owe lots of gratitude to the former Director, Plant Protection and Regulatory Services Directorate, Mr. Vesper Suglo for his patience, guidance and support. The willingness of Fertilizer Inspectors and Agricultural Extension Agents in the selected regions to interview farmers was most significant in making this thesis a success.

I am grateful to Prof. Festus Annor-Frempong, Dr Albert Obeng Mensah, Mr. Martin Bosompim and Mr. Nathan Adu-Gyimah for their suggestions, assistance and encouragement. Mr. Emmanuel Dziwornu and Ms Rebecca Tei played the crucial role of helping me with data entry and analysis.

My heartfelt appreciation to my husband, Mr. SampsonAnash-Amprofi and children, Grace, Sammy (Jnr), Kweku, Bondze, Joe and Paintsil for inspiring me to this height.

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DEDICATION

In loving memory of my late father, Mr. Robert William Mensah.

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LIST OF ACRONYMS

AAGDS	Accelerated Agricultural Growth and Development Strategy
AGRA	Alliance for Green Revolution in Africa
A E A	Agricultural Extension Agent
CEC	Cation Exchange Capacity
DAES	Directorate of Agricultural Extension Services
DAP	Diammonium Phosphate
E P A	Environmental Protection Agency
F A O	Food and Agricultural Organisation
FASDEP	Food and Agriculture Sector Development Policy
F B Os	Famer Based Organisations
G D P	Gross Domestic Product
GPRS	Ghana Poverty Reduction Strategy
GSS	Ghana Statistical Service
IFDC	International Fertilizer Development Centre
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture

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ISFM	Integrated Soil Fertility Management
MDG	Millennium Development Goals
MOFA	Ministry of Food and Agriculture
MOP	Muriate of Potash
MTADP	Medium Term Agricultural Growth and Development Strategy
N P K	Nitrogen, Phosphorus, Potassium
PBC	Perceived Behavioural Control
PFRD	Pesticide and Fertilizer Regulatory Division
PPRSD	Plant Protection and Regulatory Services Directorate
SPSS	Statistical Products for Service Solutions
SRI	Soil Research Institute
SSP	Single Super Phosphate
TORA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour
TSP	Triple Super Phosphate

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CHAPTER ONE

INTRODUCTION

Background to the Study

Ghana, in 2010 had a population of 24,658,823 people, and according to the Ghana Statistical Service, Ghana's population is growing at a rate of 2.5 percent per annum (GSS, 2012). This growth in population along with growth in per capita income and urbanization will create increased demand for food, fiber, and raw materials. The increase in demand for such Agricultural products can only be supplied through the increased productivity of the Agriculture sector. Agriculture continues to be the largest sector of Ghana's economy, employing over half of the labour force and contributing about 39 percent of gross domestic product (GDP), compared with about 26 percent for industry and 31 percent for the services sector respectively (MOFA, 2010c).

Economic development in Ghana has historically been dependent on the success of agriculture. A number of policies and programmes have been formulated for the growth of the agricultural sector since the early 1990s. These include the Medium Term Agricultural Development Programme (MTADP) and the Accelerated Agricultural Growth and Development Strategy (AAGDS). The MTADP put emphasis on the free market system and thus an increased private participation. The freeing of trade was expected to reduce marketing costs, raise producer prices and stimulate investment, and the privatisation of input supply was assumed to improve the reliability of supply and reduce costs through competition.

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With the introduction of the private sector, government's control and participation in the economy was curbed and this came with its problems (MOFA, 1990). Subsequent policies and policy instruments in both the Ghana Poverty Reduction Strategy (GPRS) and Food and Agriculture Sector Development Policy One and Two (FASDEP I and II) and related documents seek to promote agricultural modernization through storage, processing, input supply, output marketing, irrigation, mechanization, technology development (research), agricultural credit, improved extension service and development of Farmer Based Organizations (FBOs) (MOFA, 2007). The Medium Term Agricultural Sector Investment Plan (METASIP) was also developed in 2010 for the implementation of the broad strategies of FASDEP II (MOFA, 2010c).

In the development of the agriculture sector, it has been widely acknowledged that the maintenance, restoration and enhancement of soil health are key elements in increasing agricultural growth, development of food security and sustainable agricultural systems (Fuentes, Bumb & Johnson, 2012). During the past two decades, increasing attention has been paid to the impacts of the use of plant nutrients on food security. In response to that, one of the priorities of the Ghana's Environmental Action Plan towards promoting agricultural growth has been the amelioration, maintenance and enhancement of soil fertility in the country (MOFA, 1998).

In spite of these efforts, agriculture in Ghana suffers from high costs of agriculture inputs, particularly fertilizer, low usage of fertilizer and declining soil fertility. These constraints collectively undermine the sustainability of food

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security in particular, and agriculture productivity in general. Various research results indicate agricultural productivity in Africa, West Africa, and Ghana is reducing because of declining soil fertility (Bumb, Johson & Feuntes, 2011). FAO (2004b) reported on negative nutrient balance for all crops in Ghana and explained the low levels of crop productivity in the country. For instance, the yield of maize, the mostly widely grown crop in Ghana averages 1.5 metric tons per hectare as against its potential yield of 6.0 metric tons per hectare contributing to annual food deficit in most parts of Ghana (PPMED, 2009). Results of simulations made by International Food Policy Research Institute (IFPRI) shows that annual consumption rate of Ghana and most West Africa countries will not lead to the achievement of the Millennium Development Goal (MDG) of reducing hunger and poverty (Bumb, Johnson & Fuentes, 2011).

The challenge of high cost of fertilizer in the country was worsened by some of the policies of the government. For example, in the 1980s as part of implementing the World Bank led Structural Adjustment Programme (SAP), Ghana adopted the neoliberal policy whereby the government removed subsidies, liberalized the marketing of fertilizers, and eliminated guaranteed minimum prices. In addition, government withdrew from its involvement in the direct production and distribution of related agricultural inputs in order to promote private sector involvement in agricultural marketing (MOFA, 1998). Concerning the fertilizer sector in particular, these reforms meant a removal of fertilizer subsidy and the entry of private traders into the importation and marketing of fertilizers to promote competition and efficient fertilizer sector. This change in policy and the

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depreciation of the exchange rate however lead to rapid increases in fertilizer prices. Yawson, Armah, Afrifa, & Dadzie (2010) reported that such prices increases can lead to reduction in fertilizer use by farmers.

In 2008, the government as a result of the reduced use of fertilizer, once again introduced fertilizer subsidies through a voucher-based system to promote fertilizer use and improve crop productivity of smallholder farmers (Banful, 2009). According to Yawson, Armah, Afrifa, & Dadzie (2010) after the first year of implementation, and because of challenges that confronted the fertilizer voucher system, it was replaced with the waybill receipt system in 2009/10. Key design features of the waybill system were the elimination of vouchers and the inclusion of all farmers (small-, medium- and large-scale) who are involved in the production of various crops that use the four types of fertilizer (NPK 15:15:15, NPK 23:10:15, Urea, and Ammonium Sulphate) included in the subsidy programme, as a result there is no targeting mechanism to specific crops or to beneficiaries. The types of fertilizer included in the subsidy programme did not change and are those typically used in food crops production. The current fertilizer subsidy policy is not being properly implemented and is having challenges as the new blanket waybill system that covers all farmers will require substantial amounts of public funds, making the sustainability of the programme an uphill task. Despite the fertilizer subsidy policy being implemented, the use of fertilizer in the country according to Fuentes, Bumb & Johnson (2012), cannot be said to have increased appreciable enough so as to ameliorate the declining soil fertility

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and also to reach the expected annual target of 50kg/ha by the year 2015 as agreed to by African Leaders in Abuja, Nigeria (AU, 2006).

Statement of the Problem

Agriculture is the largest sector of the Ghana's economy, it accounts for between 35% to 37% of its Gross Domestic Product and employs over 60% of the active population (MOFA, 2010a). The agricultural sector is consequently the cornerstone of any food security and poverty reduction strategy. This sector is unfortunately characterized by low productivity of most farms. The low level of productivity had been attributed to a broad range of factors that include low use of improved technologies including agricultural inputs such as fertilizer.

It is well acknowledged that the primary means of enhancing soil fertility in agriculture is through the use of fertilizer (Byerlee & Heisey, 1992). The use of fertilizer in increasing crop yields and improving food security is therefore a major developmental issue in Ghana. Thus the government of Ghana since 1998 had developed and been implementing a National Soil Fertility Management Plan, and has since the year 2008 been implementing the fertilizer subsidy programme to address soil fertility and related issues with the aim to increase agricultural production. This plan and subsidy programme notwithstanding, fertilizer use in Ghana is among the lowest in the world. According to the IFDC (2012) Fertilizer Assessment Report, Ghana's fertilizer consumption of 12kg/ha is far less than the world's average of 90kg/ha. However, there is currently limited empirical information on the factors contributing to the use of fertilizer in the country. An understanding of the quantity of fertilizer use and factors influencing it would be

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critical in informing current and future fertilizer development plans for food security in the country.

Objectives of the Study

The general objective of the study is to examine fertilizer use and key factors influencing the use of fertilizers by farmers in Ghana.

Specific objectives

The specific objectives are to:

1. Determine the accessibility of fertilizers to farmers in Ghana in terms of availability, distance to source of fertilizer, cost and ability to buy.
2. Determine the annual quantity of fertilizer use (kg/ha) by maize farmers in Ghana.
3. Examine the effect of farmers' orientation towards fertilizer use on use of fertilizer in Ghana.
4. Examine the contribution of institutional factors to use of fertilizer in Ghana.
5. Determine the relationships that exist between farmer's access to fertilizer and quantity of fertilizer used by maize farmers in Ghana.
6. Determine the relationships that exist between socio-demographic factors and quantity of fertilizer used by maize farmers in Ghana.
7. Determine the predictors of fertilizer use in Ghana.

Research Questions

The following questions are therefore posed:

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1. How accessible are fertilizers to farmers in terms of availability, cost, ability to buy and distance to the nearest source of fertilizer?
2. What quantities of fertilizer are used (kg/ha) by maize farmers in Ghana?
3. How does farmers' orientation towards fertilizer use affect farmer's use of fertilizer?
4. How do Institutional factors contribute to farmers' use of fertilizer?
5. Are there any relationships between farmer's access to fertilizer and use of fertilizer in Ghana?
6. Are there any relationships between socio-demographic factors and use of fertilizer in Ghana?
7. What are the best predictors of fertilizer use in Ghana?

Hypothesis of the Study

The hypotheses of the study are:

1. Ho: There is no significant relationship between the accessibility of fertilizer and fertilizer use in Ghana.

   Hi: There is significant relationship between the accessibility of fertilizer and fertilizer use in Ghana.

2. Ho: There is no significant relationship between farmer's orientation towards fertilizer use and farmer's use of fertilizer.

   Hi: There is a significant relationship between farmer's orientation towards fertilizer use and farmer's use of fertilizer.

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3. Ho: There is no significant relationship between institutional factors and farmers' use of fertilizer.

Hi: There is significant relationship between institutional factors and farmers' use of fertilizer.

4. Ho: There is no significant relationship between the socio-demographic characteristics of farmers and farmers' use of fertilizer in Ghana.

Hi: There is a significant relationship between the socio-demographic characteristics of farmers and farmers' use of fertilizer in Ghana.

Justification of the Study

Ghana is faced with the problem of low fertility status of its soils resulting in low productivity of crops. Ensuring food security however is the number one objective of the Ministry of Food and Agriculture, and fertilizer is among the most important technologies used in restoring soil fertility and increasing food production in the world. Farmers are faced with numerous problems which prevent them from using fertilizer to increase their productivity so as to attain food security. The fertilizer use challenges faced by farmers are worsened by some of the policies and support services provided by government. There is therefore the need to study the key factors influencing the use of fertilizers by farmers in Ghana.

The study will provide data for decision making and the development of strategies regarding the critical area of fertilizer access and institutional support for fertilizer use in the country. It is hoped that it will be useful especially to the

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Ministry of Food and Agriculture who are being challenged in the implementation of the current subsidy policy.

The study data would also give the Research Institutes and Ministry of Food and Agriculture better insight into farmers behaviour and the decision to use or not to use fertilizer, farmers' attitude towards fertilizer use and rates of fertilizer applied by maize farmers, and this will help in decisions to develop recommended application rates and to develop strategies regarding the critical area of fertilizer use. Relatively few empirical studies have been carried out on fertilizer use and factors influencing fertilizer use in Ghana. This research will make available knowledge on fertilizer use which could be used as a reference material by Research Institutes, MOFA and other stakeholders.

Definition of Key Terms

The key terms used in this study are defined as follows;

Fertilizer: is used synonymously with inorganic fertilizer in this study, and means fertilizer produced by chemical processes or derived from inorganic substance or synthetic substance, which contains one or more recognized plant nutrients(s) that is used for its plant nutrient content and is designed for use or claimed to have value in promoting plant growth.

Fertilizer Use (kg/ha): the total fertilizer consumption, measured in kilogram of plant nutrient, divided by the total hectare of arable and permanent cropland.

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Delimitations of the Study

The study was delimited to only six districts within the six selected regions in the six agro-ecological zones of the country. Despite the geographical limitation, a good coverage of soil and cropping characteristics is assured.

Fertilizers include organic and inorganic types; however the quantity of fertilizer use or fertilizer consumption according to FAO, 1991 is determined with only the inorganic fertilizers. This study therefore did not consider organic fertilizers found in the country for the determination of quantity of fertilizer used by maize farmers.

Limitations of the Study

There are many farmers who use fertilizer to improve the yield of their crops; however the sampling involved only crop producing farmers who have registered with MOFA offices. The sampling process though logical did not include all farmers producing crops in the study area. Ideally the study should have considered the population based on the 2010 population census in the study area.

Organization of the Thesis

This study is reported in five chapters. Chapter one is the introduction, it provides the background to policies on fertilizer and the challenges faced by farmers regarding the use of fertilizers. The research problem, objectives and justification of the study were stated.

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Chapter two reviews literature of topics relevant to the research which included the theories of adoption, innovation-diffusion, perceived attributes, theories of reasoned action and planned behaviour. Factors influencing fertilizer use including; farmer characteristics, agro ecological factors, fertilizer policy reforms, farmers' orientation towards fertilizer use, and the contributions of institutional support to fertilizer access and use were also reviewed.

Chapter three presents the methodology which describes the procedures and techniques used in collecting, managing and analyzing the data. It also presents the study area, the research design, the population studied, the sample, the sampling procedure, research instrumentation, the pretesting, data collection, processes and analysis that were used as well as rationale behind the choice of the techniques for the study.

Chapter four presents the results and discussions of the study. The results of the study would be presented and discussed in relation to the objectives and the literature reviewed. The results are presented in eight sections under the following headings; Demographic and farm-related characteristics of farmers, accessibility to fertilizer use, quantities of fertilizer used by maize farmers, farmers' orientation to fertilizer use, institutional factors supporting fertilizer use, relationships between farmers' access to fertilizer and quantity of fertilizer used, relationships between socio-demographic characteristics of farmers and quantity of fertilizer used, and the best predictors of fertilizer use. Finally the fifth chapter presents the summary, conclusion and the recommendations of the study.

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CHAPTER TWO

LITERATURE REVIEW

General Overview

The growth in fertilizer use has played an important role in accelerating agriculture growth, and ensuring food security in several countries (Fuentes, Bumb, & Johnson, 2012). This review of literature pulls together existing theoretical and empirical studies that provide a background and necessary basis for the study. It attempts to review relevant studies done on various aspects of fertilizer use, including fertilizer supply to farmers relating to availability and accessibility of fertilizer in the domestic market, farmers' orientation towards fertilizer use, challenges farmers face in using fertilizer, policy reforms guiding fertilizer use and extension information support for fertilizer use.

Soil Fertility Situation in Ghana

Management of soil fertility has been the pre-occupation of farmers for thousands of years; this problem is global in nature (Camara & Heinemann, 2006). In Ghana, the rapid growth in population has resulted in increased demand for agricultural goods and services. As a result, the traditional system of shifting cultivation has been abandoned for continuous cultivation leading to the degradation of soils, other natural resources and productive capacity. This is mostly as a result of the depletion of nutrients from soils resulting from the shortening of fallow or rest periods for cultivated lands. In addition to continuous cultivation, traditional soil exhausting cultivation practices are still being used

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extensively, consequently considerable plant nutrients are being removed and lost than are being applied resulting in progressive impoverishment of soils (Gerner, Asante, Owusu-Bennoa & Marfo, 1995). According to FAO (2005), almost all the crop balances in Ghana show a nutrient deficit, that is, the difference between the quantities of plant nutrients applied and the quantities removed or lost. The fertility status of soils in Ghana is considerably low, with the exception of potassium which is mostly abundant in the soils of Ghana; the levels of organic carbon, nitrogen and available phosphorus are generally very low. This calls for the use of fertilizer to replenish the nutrients in our soils. Bumb, Teboh, Atta, & Asenso-Okyere (1994) reported that growth in fertilizer use has played an important role in accelerating agricultural growth and ensuring food security in several developing countries. However, Ghana and many countries in Sub-Saharan Africa are unable to benefit from such transformation as a result of low levels of fertilizer use.

Ghana's Food and Agriculture Development Policy (FASDEP II) stresses that the agriculture sector must grow at a rate between 6% - 8% per annum in the next four years to meet the increasing challenges of feeding and providing adequate nutrition for the growing population (MOFA, 2007). The adoption and use of improved technologies can lead to the achievement of 6% or more annual growth in agricultural output. Improved technologies, practices, and methods of cultivation will be necessary for the technological transformation of Ghana's agriculture. Among such measures, fertilizer use will play a lead role. Under the modernization of agriculture to ensure food security, increased fertilizer use will

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be required for the cultivation of improved crop varieties and the replenishment of nutrients removed by crops under intensified and continuous cultivation (Bumb, Teboh, Atta, & Asenso-Okyere, 1994).

Theoretical Foundation of the Study

In this study, a number of theories were explored to identify the variables that interact to explain the phenomenon of fertilizer access and use. The most obvious theories that explain the use of an innovation or technology are the adoption and the innovation-diffusion theories. This is because if a technology like fertilizer is introduced it must pass through the first phase of acceptance or rejection, and even if it is accepted what happens over time, whether the use of fertilizer is intensified or abandoned shall depend on the benefits, people's opinion and attitudes and other external factors. Other theories such as theories of perceived attributes, theories of reasoned action and planned behavior shall be used to expand the understanding of this phenomenon. For better understanding of fertilizer access and use, the theories stated shall be reviewed.

The Adoption Theory

Adoption is defined as the use of an innovation or a new technology or practice by a farmer among economic units over a period of time (Rogers, 1983). Technology is the combination of knowledge inputs and management practices which are deployed together with productive resources to produce a desired output

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(Reijntjes, Haverkort, & Water-Bayer, 1992). Fertilizer is an input which farmers use to obtain the desired output of increased soil fertility and crop yield and is referred to as a technology (Kelly, 2006).

Technologies like fertilizers play an important role in economic development. Adoption and diffusion of technology are two interrelated concepts describing the decision to use or not use and the spread of a given technology among economic units over a period of time. The introduction of a new technology consists of two phases. In the first phase, the new technology is introduced to farmers through for instance, demonstration plots or other means and the technology will be adopted when found beneficial. The second phase is characterized by declining use of the technology over time until abandonment (Dinar and Yaron, 1992). Fertilizer use in Ghana can be seen from these two perspectives. Farmers can be said to be aware of the benefits of fertilizer use, it is important to know factors constraining its use, could it be that farmers have reached the second phase of abandonment? Abandonment or the discontinue use of a technology is a reflection of either a loss of profitability due to increasing costs of inputs, falling yields or the results of a switch to another more profitable technology. Since a better technology has not yet been developed to replace fertilizer, and the proper use of fertilizer has not yet resulted in falling yields, there is the likelihood abandonment or discontinue use of fertilizer if cost increases. Adoption of any technology is not a one step process as it takes time for adoption to complete. The duration of adoption of a technology vary among economic units, regions and attributes of the technology itself. First time adopters may continue or

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cease to use the new technology. Adoption studies identified and described five categories of adopters in a social system. The categories included innovators, early adopters, early majority, late majority, and laggards (Mosher, 1979; Rogers, 1983). Rogers (1983) in his study indicated that the majority of early adopters are expected to be younger, more educated, venturesome, and willing to take risk. In contrary to this group, the late adopters are expected to be older, less educated, conservative, and not willing to take risks. However, the usefulness of this categorization is restricted as there is evidence indicating a movement from one category to the other, depending on the technology introduced.

The rate of adoption is represented by an S-shape curve graph (Nutley et al, 2002). The concept of early and late adopters provided the basic hypothesis for explaining the S-shaped nature of the adoption curve or path. The theory states that innovation adoption grows slowly and gradually in the beginning. It then assumes a period of rapid growth that will taper off and become stable and eventually decline (Rogers, 1995). Mansfield (1961) in his studies attributed the S-shaped nature of the curve to the spread of information as well as economic factors. Another study by Feder et al (1985) also revealed that the S-shape diffusion curve can be explained by the profit maximization behaviour, learning by doing and subjective evaluations of decision makers. Another aspect of importance is time. Innovations are seen to be communicated across space and through time. With time, a technology like fertilizer is likely to be adopted and used when farmers find it to be economical and profitable.

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The Innovation-Diffusion Theory

The study of the diffusion of innovations emerged as a prominent research field after the publication of a seminal work by Ryan & Gross (1943) who analysed the adoption of hybrid corn seeds among farmers in two communities in Iowa, highlighting the importance of communication processes. Diffusion of innovations is referred to by (Brown, 1981; Stoneman, 2002) as the spread of innovations across social groups over time, that could be individuals, companies or governments. Roger's diffusion of innovation theory, published in 1962, describes the factors that may motivate people within a social group to adopt new technologies over time. The four key components of the diffusion of innovations are the innovation, communication channels, time, and social groups. With the diffusion of an innovation or technology like fertilizer the four key components of the theory that is the technology (fertilizer), communication channels, time, and social groups must be properly managed over time to ensure effective and continues use.

The term *innovation*, which scholars from different fields of thought refer to as different concepts, such as ideas, practices, products, services, processes, technologies, policies, structures, and administrative systems that the adopting unit perceives as new (Rogers, 2003; Damanpour & Schneider, 2006). For example a new innovation maybe a new type of insecticide for adoption which can reduce the devastating effects of insects, some innovations also manifest themselves in behavioural forms such as improved cultural practices. Heemskerk (2005)

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specifically defined agricultural innovation as the result of a social negotiation between farmers.

Diffusion is a specific kind of communication which includes: an innovation, two individuals or other units of adoption, and a communication channel. Rogers (2003) defined communication as "a process in which participants create and share information with one another in order to reach a mutual understanding" which occurs through channels between sources. "A *source* is an individual or an institution that originates a message and the channel is the means by which a message gets from the source to the receiver". Mass media and interpersonal communication are two communication channels. The mass media channels include TV, radio, or newspaper and interpersonal channels consist of a two-way communication between two or more individuals (Rogers, 2003).

On the other hand, "diffusion is a very social process that involves interpersonal communication relationships", thus, interpersonal channels are more powerful to create or change strong attitudes held by an individual. Finally, a social system is considered as interactions among individuals to solve a joint goal (Rogers, 2003).

The theory explains the behaviour of the adoption of new technology. For example, those individuals who are most likely to adopt a new technology first are called early adopters. Early adopters are made up of opinion leaders, who are respected by their peers in a local setting. They are the first individuals within a local setting to adopt a new innovation and then provide an evaluation of the

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innovation to peers. On the other hand, "laggards are the last in a social system to adopt an innovation (Rogers, 1995). Innovations are seen to be communicated across space and through time. It explains how the adoption of an innovation like fertilizer grows slowly and gradually in the beginning. This is because it is at the early stage that farmers get information or gain knowledge about the benefits of the use of fertilizer. How it then assumes a period of rapid growth, which is when most farmers have received the information and are using fertilizer. Then it tapers off and become stable and eventually decline (Rogers, 1995). Effective and continues use of fertilizer by farmers according to the Innovation-Diffusion theory can only result from proper management of the fertilizer, time, the channels through which information on the technology is communicated, and the type of people found in the social system.

Theory of Perceived Attributes

The theory of perceived attributes is based on the view that individuals adopt an innovation with the following perceived attributes; relative advantage, not complex, compatibility, trialability and observability of the technology (Nutley et al., 2002). The innovation must first have some relative advantage over an existing innovation or the status quo. Secondly, there must be compatibility with existing values and practices. Thirdly, the innovation should not be too complex. Fourthly, the innovation must be trial-able which means the innovation can be tested for a limited time without adoption and finally, there must be observable

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results in the adoption of the innovation (Rogers, 1995). The perceived attributes are further explained below;

Relative advantage of the technology

This is the degree to which a technology is perceived to be better than the ideas it supersedes in terms of economic, profitability, social prestige, physical convenience, low initial cost, lower perceived risk, decreasing discomfort, psychological satisfaction or saving time. Relative advantage is regarded as the one with the strongest effect on the rate of adoption (Roger, 2003). Adesina & Baidu-Forson (1995) reported that farmers are likely to adopt and use a technology if they perceive the technology to be profitable, by reducing cost and increasing income without necessitating major changes in their farming systems.

Compatibility of technology

This refers to the degree to which the technology is perceived to be consisted with farmer's goals and aspiration, social-cultural values, past experiences, needs, and existing farm practice (Adams, 1982). Therefore the influence of an individual's perception by way of his beliefs, values and attention can affect adoption, Adams (1982) stated that technologies which are compatible with previous experiences usually catch on faster and are adopted and used more quickly. A technology can be compatible or incompatible with socio-cultural values, beliefs and previously-introduced ideas or with clients' need for innovations. For example, it will be very difficult to introduce pig husbandry among Muslims even if it is a very profitable enterprise. Many change agents face

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equally difficult challenges promoting technologies that run counter to strongly-held values (Zanu, Antiwaa & Agyeman, 2012).

Trialability of the technology

This is the degree to which a technology may be experimented with, on a limited basis (Kwarteng and Zinnah, 1994). If a farmer can try a technology without committing much of his resources he will adopt and use it more readily, if its performance meets his objectives. Rogers (2003) reported that, the triablilty of a technology, as perceived by members of a social system, is positively related to its rate of adoption and use.

Observability of technology

This is the degree to which the result of a technology is visible to others. Some results are easily observed and communicated, whereas, others are difficult to describe. Farmers learn much observing and discussing their colleagues' experience, their observations often being a reason to start a discussion and its subsequent adoption and use (Van den Ban. & Hawkins, 1996).

Many researches have been done using this theory to examine factors that influence farmers' adoption of new farm technologies. Some include conservation practices, precision technologies and conventional agricultural practices (Floyd, et al., 2003; Weir, & Knight, 2004). The innovation diffusion theory explains farmer behaviour more effectively when used in combination with the theory of perceived attributes (Floyd et al, 2003). The theory explains that farmers take decisions on whether or not to use a technology based on their beliefs, socio-cultural values and

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observations made during demonstrations conducted on the technology. For farmers to want to use fertilizer to enrich their soils, the fertilizer must have advantage over existing soil enriching products like manure and compost. It must be trial-able or demonstrated for others to see and take decisions on, and it must be easy to use or user friendly.

The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) according to Ajzen (1985) builds upon the Theory of Reasoned Action (TORA) which states that, a person's intention is a function of two basic determinants; the first one is a personal factor (an individual's positive or negative evaluation of performing the behaviour) and the second one reflects social influence (the person's perception of the social pressures put on him to perform or not to perform the behaviour in question) (Ajzen, 1985). For example, if people evaluate the suggested behaviour as positive (attitude), and if they think their significant others want them to perform the behaviour (subjective norm), this results in a higher intention (motivation) and they are more likely to do so. The TPB was an attempt to predict and understand behaviours when control is incomplete (Fishbein & Ajzen, 1975). Burton (2004) asserts that, the theory of planned behaviour was created in order to include socioeconomic, socio-cultural, psychological and economic approaches into the behavioural analysis of people in a society, for example farmers.

According to Ajzen (1991) behavioural intentions are a function of three components: attitude toward a behaviour, subjective norms (social pressure), and

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perceived behavioural control (self-confidence) which is a measure of a person's perceived ability to perform a behaviour and ability is intended to incorporate a person's consideration of resources and opportunities that are recognised as conditional for the performance of some behaviour. The TPB proposes that behaviour is predicted by the strength of an individual's intention to behave the way they do. Attitudes, subjective norms and perceived behavioural control are assumed to be predictable from an individual's beliefs about the behaviour. Behavioural intentions have been defined as the subjective probability that an individual will engage in a specified behaviour (Fishbein & Ajzen, 1975).

Intentions comprise all the motivation factors that affect behaviour and indicate how much effort an individual will exert to perform behaviour, for example a farmer using a technology like fertilizer. According to Ajzen (1991) intentions are considerably accurate in predicting behaviour. Consequently, the theory predicts that the stronger an individual's intent to perform behaviour, the more likely the individual will engage in that behaviour. Attitude towards the behaviour refers to the individual's positive or negative assessment of engaging in the behaviour. An individual's attitude is a multiplicative component consisting of the individual's strength of belief associated with the behaviour and the individual's subjective evaluation or weighted importance of the beliefs attribute. The theory predicts that as the individual perceives the behaviour as favourable, he or she will more likely intend to perform the behaviour (Fishbein & Ajzen, 1975).

A subjective norm (SN) refers to the individual's perception of the social pressures to engage or not to engage in the behaviour. In particular, it encompasses

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an individual's perception of whether or not to engage in the behaviour as seen from his or her significant others. As a result, the theory predicts that if the individual perceives that his or her significant others would encourage such behaviour; the individual will more likely engage in the behaviour. The significant others of a farmer which include his wife, children, farmer friends, chief farmer and other people close to him, could influence his decision to engage in fertilizer use.

Perceived behavioural control (PBC) refers to the individual's perceptions of the ease or difficulty of performing the behaviour. It predicts that the greater an individual perceives that he or she has control, the more likely the individual will intend to engage in the behaviour (Fishbein & Ajzen, 1975). An assumption underlying TPB is that most human behaviour is rational. TPB help us to explore the rationality that underlies the individual's decision to engage, or not engage, in behaviour (Zubair & Garforth, 2006).

Attitudes, subjective norms, and perceived behavioural control are shown to be related to a set of salient behavioural, normative, and control beliefs about the behaviour (Ajzen 1985; 1991). The behavioural belief refers to an individual's positive or negative evaluation of self-performance of the particular behaviour. That is the degree to which performance of the behaviour is positively or negatively valued (perceived benefits or consequences of taking the desired action).The normative belief refers to an individual's perception about the particular behaviour, which is influenced by the judgment of significant others

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e.g., other farmers', input dealers, friends, family members, etc (perceived opinions of others regarding one's performance of the behaviour).

Control belief refers to an individual's beliefs about the presence of factors that may facilitate or impede performance of the behaviour (Ajzen, 2001). The behavioural, normative, and control beliefs are influenced by a variety of socio-demographic factors, such as social, cultural, personal and situational factors which Burton (2004) states is the main reason for the introduction of TPB. The theory of planned behaviour is relevant to this study in the sense that there could be other socioeconomic, socio-cultural, psychological and economic pressures that may prevent a person from using a technology like fertilizer even though he/she may have intention to do so.

Empirical Review

This section is a review of empirical studies that provide a background and necessary basis for the study. It attempts to review relevant studies done on various aspects of fertilizer use, including fertilizer supply to farmers relating to types, availability and accessibility of fertilizer in the domestic market, farmers' orientation towards fertilizer use, challenges farmers face in using fertilizer, policy reforms guiding fertilizer use and extension information support for fertilizer use.

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Common Fertilizer Types

The world fertilizer industry has evolved overtime. From the initial production of single nutrient fertilizer products, the fertilizer industry has currently become very sophiscated and produces various specifications of fertilizers including complex and fortified fertilizers (Palm, Myers & Nanda, 1997). Some common fertilizer specifications and types produced worldwide are indicated in Table 1; the specifications are basically straight fertilizers, complex fertilizers, micronutrients, water soluble complex fertilizer, and fortified fertilizers (PFRD, 2012).

According to Fuentes, Bumb & Johnson (2012) Ghana in the 1960s and 1970s imported mostly low-analysis fertilizers like Ammonium sulphate (AS) and Single super phosphate (SSP). The pattern changed in the 1980s when Ghana started importing high-analysis fertilizer like various forms of NPKs (15-15-15, 20-10-5), Muriate of potash, Urea and Diammonium phosphate (DAP). Statistics indicate NPK and AS are dominant fertilizer products used in Ghana, however Ammonium sulphate is a low-analysis fertilizer, unless soils are deficient in sulfur, Ammonium sulphate is an economically costly fertilizer. The economic cost of nitrogen is much higher through Ammonium sulphate than through Urea; hence, a switch to Urea would be a desirable move (Fuentes, Bumb, & Johnson, 2012). Also unless soils are deficient in potash, the uniform application of NPKs throughout the country may not be an optimum strategy. Agronomic and soils research suggest that soils in Ghana are not deficient in potash. In such a situation,

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the use of DAP and compounds like 20-20-0, and application rates based on specific site and crop type being cultivated should be promoted.

Table 1: Common fertilizer specifications and types

Fertilizer specification	Examples
Straight nitrogenous fertilizers	Urea, Ammonium sulphate, Ammonium Chloride
Straight phosphatic fertilizers	Single super phosphate, Triple super phosphate, Rock phosphate
Straight potash fertilizers	Potassium chloride (Muriate of potash), Potassium sulphate
Straight sulphur fertilizer	Sulphur 90% (powder), sulphur granular
N. P. K. Complex fertilizers	N. P. K. (15-15-15), N. P. K. (12-11-18 with Mg0), N. P. K. (15-15-15-9 (S)
N. P. Complex fertilizers	Ammonium phosphate, Diammonium phosphate, Nitro phosphate
P. K. Complex fertilizers	Mono-potassium phosphate
N. K. complex fertilizers	Potassium nitrate (13-0-45)
Micronutrients	Manganese sulphate, Ammonium molybdate, Zinc sulphate monohydrate
Fortified fertilizers	Zincated urea, Boronated single superphosphate, NPK complex fertilizer fortified wilt boron
Water soluble complex fertilizer	Potassium nitrate, Calcium nitrate, Potassium magnesium sulphate

Source: PFRD Report (2012)

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Fertilizer Use in Ghana

Camara and Heinemann, in 2006, reported that although Africa has 13% of the world's arable land and contain more than 12% of the world's population, its fertilizer consumption (tons plant nutrient) is the lowest in the world. In 2002, Africa accounted for only 3% (or 4 million tons) of the world consumption, compared to 9% (or 13 million tons) and 54% (or 77 million tons) in Latin America and Asia and the Pacific.

Fertilizer use has played an important role in accelerating agricultural growth and ensuring food security in several developing countries (World Bank, 2012). The FAO conducts fertilizer use assessment in kilogram per hectare (kg/ha) annually to keep records of fertilizer consumption throughout the world (FAO, 1991). Across the continent the average use rate is 20kg NPK per hectare. Regional differences are great, ranging from North Africa and South Africa, which consume 61 and 69 kg per hectare, respectively, to the sub-Saharan region where average consumption is just 8 kg per hectare. In contrast the average worldwide rates are 93 kg of NPK per hectare, 102 kg per hectare in south Asia, and 202 kg of NPK per hectare in East Asia (FAO, 2004b). Annequin (2010) in his presentation at a workshop on Managing Risk in the Fertilizer Value Chain in West Africa, described fertilizer use and growth in Ghana as fluctuating. Fertilizer import prior to 1980 was around 60,000 ton which declined to 20,000 ton during 1985/86. During 1990s it increased to about 56,000 tons and it reached 93,000 tons during 2003-04. During 2006 it shot up to 189,000 tons, it was 335,000 tons in 2009, 368,700 tons in 2010, and 380,800 tons in 2011(MOFA, 2012).

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According to Yawson, Armah, Afrifa & Dadzie (2010) the observed increase in the use of fertilizer in Ghana is as a result of the Government fertilizer subsidy programme. Despite the increases, fertilizer use is still low in the country and can be said to be comparatively insignificant. Fertilizer consumption on the commercial farms and plantations is estimated at 200-300 kg of product/ha, whilst the consumption on the small private farms is in the range of 0-50 kg products/ha (IFDC, 2012).

IFDC (2012) in the assessment of fertilizer use in Ghana found out that on the basis of fertilizer use by crop and region, cereals like maize, sorghum and rice account for a larger share of fertilizer use in Ghana. Although root crops play an important role in providing the national food supply, fertilizer use on root crops is minimal. Likewise, tree crops also account for a small proportion of fertilizer use. Despite its importance as an export crop, fertilizer use on cocoa like other tree crops has been negligible, however with the introduction of Asasewura a special grade of fertilizer by the Cocoa Research Institute of Ghana (CRIG), and the associated significant increases in yields of cocoa, the use of cocoa fertilizer is expected to more than double in the future. A study carried out in Ghana on the adoption of cocoa production technologies by Mensah (2006) had earlier observed the expected increase in fertilizer use by cocoa farmers.

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Farmer Characteristics and Fertilizer Use

Research has proved that certain farmer characteristics influence a farmer's decision to adopt and use a particular technology. Commonly explored farmer characteristics influencing adoption and use of technology include sex, age, educational level, experience, household size or number of dependants, and farm size (Karuga, 2012).

Sex of farmer and fertilizer use

Nelson (1981) stated that, it is wrong to assume that an effective development programme for men will automatically translate into an effective programme for women as well. This implies that men and women have different needs and desires. Doss and Morris (2001) observed that men and women access resources like land, labour, extension services, credit, etc differently. Sex was found to be significant in the adoption of modern maize varieties and chemical fertilizer use in Ghana. Croppenstedt & Demeke (1996) also noted that in areas where variations exists in the access to such facilities as credit, extension visits and other resources by men and women, sex is likely to affect the rate of technology adoption. CIMMYT (1993) had earlier observed that significant difference exist between men and women farmers adoption of technologies. It may be that the technologies developed for use were less appropriate for women. Also women farmers are less likely to command resources like land, credit or information to take full advantage of the technology.

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Obinne (1995) in his research pointed out that women have inadequate access to extension service. FAO (1998) is also of the view that females in the rural areas are loaded with domestic tasks and family obligations and are controlled by social restraints such that they are not able to leave home to participate in extension programmes. The inability of ladies to attend extension programmes does not offer them the opportunity to have access to information on new technology for adoption. Udoh and Umoh (2011) in their research also pointed out that although women contribute the greatest percentage in farming occupation in Africa, their rate of fertilizer use is low because women have smaller farm sizes and usually cultivate noncash crops which they tend to apply less quantities of fertilizer to.

Age of farmer and fertilizer use

The effect of age is not straight forward in adoption literature although age plays a very important role in agriculture. The United Nation (2001) categorized the youth age as ranging between 18 and 34 years, adults between 35 and 60 years and the elderly above 60 years. Literature indicates that farmers in Africa and Ghana specifically are gradually ageing, this means that the number of youth in agriculture by the United Nation's categorization is diminishing. A study carried out by Keraita & Drechsel (2004) revealed that the majority of farmers in Ghana fall between the ages of 20 and 40 years. The Ministry of Food and Agriculture conducted a similar study and observed that majority of farmers in Ghana fall between the ages of 30 and 50 years (MOFA, 2011). In Nigeria it was found that

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majority of farmers were between the ages of 31 and 50 years (Ofuoku, Egho & Enujeke, 2009; Ogunlade, Agbeniyi & Oluyole, 2010).

Older farmers may have more experience and resources, and hence have wider investment options including use of fertilizers. On the other hand younger farmers are likely to own smaller parcels of land and thus use less fertilizer (Waithaka, Thorton, Sherperd, & Ndiwa, 2007). However, according to Myers (1991) and Rogers (2003) younger farmers are more likely to use and manage fertilizer properly because they have had more education and are more knowledgeable about new practices and may be more willing to bear the risk due to their longer planning horizon than the older farmers who are more conservative and would wait to tread cautiously and are hence slow in adopting technology. FAO (2000) also reported that aged farmers who may be weak and not well resourced when allowed to assume greater roles in farming may not use costly technology like fertilizer which may lead to lower productivity.

Education level of farmer and fertilizer use

Education is one of the most important factors in acceptance, rejection and adoption of a technology or innovation. It has been established that farmers who acquire some form of education easily adopt technologies than those who do not. This assertion is confirmed by Asiabaka and Owens (2002) who noted that about 86% of respondents had some form of education and this influenced their adoption behavior. The majority of farmers in Ghana have had some form of education (Bosompem & Mensah, 2012; Zanu Antwiwaa & Agyemang, 2012).

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Many adoption studies show some relationship between adoption and the educational level of the farmer. Oluoch-Kosura, Marenya & Nzuma (2001) examined the factors affecting the adoption of soil fertility management technologies as well as intensity of fertilizer use in Kenya; their results indicated that education (formal schooling) positively influenced the use of fertilizer. An extra school year was found to increase the probability of fertilizer adoption by 18 percent and its intensity of use by 1 kilogram per hectare. Pannell, Marshall, Barr, Curtis, Vallency, & Wilkinson (2006) observed that education determines the type of tasks farmers can perform. Education also determines the level of participation and how to relate new technologies and prices of inputs to farming operations. In Nigeria, Agwu (2004) revealed that 70% of farmers were literates and this places them in a better position to be aware of, understand and adopt improved cowpea technologies. Education gives farmers better access to information about fertilizers and more knowledge of how much fertilizer to use, thus education is expected to favourably affect fertilizer use decision (Zhou, Yang, Mosler & Abbaspour, 2010).

Experience of farmer and fertilizer use

Farming experience has been shown to be a major determinant of agricultural productivity and management of farming enterprises (Oluyole, Adebiyi & Adejumo, 2007). Kaijage (1989) noted that farmers who have been in farming for less than 10 years are often considered less experienced while those who have been engaged for more than 10 years are considered experienced. It was

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observed by Egyir and Beinpuo (2009) in their studies on urban agriculture that majority of farmers had farming experience of over ten years.

Oluyole, Adebiyi & Adejumo (2007) found that farming experience is positively related to agricultural production and management abilities, and concluded that knowledge is obtained through experience over the years of work. A farmer, according to Udoh and Umoh (2011) acquires experience to enable him succeed in farming; this is because experience has shown that the longer one stays in an occupation the higher the skills derived. More experience and knowledge of the farming system is expected to have a positive effect on adoption as experience helps one to adjust to adverse farming conditions and to adopt and use modern farming technologies.

However according to Asante-Mensah (1988) carrying out a farm practice for a long time could also pose a barrier to change as recommended practices would not be adopted. New technologies would on the other hand be more highly adopted and used by farmers who have farmed for a shorter time than those who have farmed for a longer time.

Household size of farmer and fertilizer use

The effect of household size or number of dependants on farmers' adoption behavior has been conflicting in literature; however one of the most important factors conditioning the level of production and productivity of farmers is the size of the family. Family size is an important determinant of farmers' productivity as

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it is an important source of family labour (Yusuf, Okunmadewa, Adenegan & Oyekale, 2010). In Ghana households are classified into five categories: single (1 person), small (2 persons), medium (3-5 persons), large (6-8 persons) and very large (9 persons and more) (Ghana Districts, 2006b).

Describing the household size of maize farmers in Ghana, Adams and Bartholomew (2010) reported that 52 percent of farmers had household sizes of between 4 and 6. The Ghana Statistical Service in 2008 indicated that the mean household size of Ghanaians stood at four and this is considered as medium. In Nigeria, Agwu (2004) revealed that majority (37%) of farmers had family sizes between 5 and 9 people. A study by Okoruwa, Ogundele, and Oyewus (2006) in Nigeria showed a positive significant relationship between household size and farmers' productivity in rice production.

Shiferaw and Holden (1998) reported that adoption was higher among smaller households. This might be because smaller households are likely to have more resources than large ones, hence will commit more resources to the adoption of fertilizer which they may find to be affordable. This is in contrast with the finding of Bhati (1975) who found a positive effect of household size on adoption of fertilizer. Yim (1978) and Flinn, Karki, Rawal, Masicat & Kalirajan (1980) however reported that household size is an insignificant variable in fertilizer use.

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Farm size and fertilizer use

Farm size, consistent with expectation is supposed to influence adoption of technology including fertilizer use. Obasi (2007) found farm size to have a direct relationship with agriculture productivity. It is estimated that Africa has an average of about 33 million farms most of which are below two (2) hectares (Nagayets, 2005; Von Braun, 2005). In another development, the mean farm size of farmers in Ghana was found to be 1 ha (MOFA, 2006). Farm sizes of less than 2 hectares of crop land are usually considered small (Nagayets, 2005).

It has been reported by Thapa (2007) that there exist an inverse relationship between farm size and productivity. Adoption in most research results have however increased with expansion in farm size (Maiangwa, Ogungbile, Olukosi & Atala, 2007). It is often assumed that large-scale farmers will be more likely to adopt technology, especially if the innovation requires extra cash investment. It may be that a certain threshold farm size is necessary before the investment in technology become worthwhile. It may also be that on large farms, improved management practice for example mechanization is used thus making a recommendation like fertilizer use more appropriate for them. Farm size could also be related to access to information or credit that would facilitate the adoption of a recommendation or technique (CIMMYT, 1993).

Occupational status and fertilizer use

The effect of occupational status on farmers' adoption behavior has been conflicting in literature; Udoh and Umoh (2011) are of the view that full time farmers are more likely to adopt and use modern farming techniques including the

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use of fertilizers. Reardon *et al.* (1999) are of the view that farmers with secondary occupation are often educated and have innovative ways of improving their farms. Ouma et al (2006) observed that farmers with secondary occupation have other off-farm employment and are able to make extra income which may be channeled into the acquisition of farm inputs and technologies including the purchase of fertilizer. It is interesting to note that all the views expressed point to the fact that both the full time farmer and the farmer with secondary occupation have the capacity to increase the use of fertilizer based on certain advantages they possess.

Farming income and fertilizer use

Income of farmers has implications for acquisition of agricultural inputs and agricultural production (Baidu-Forson, 1999). The income level of a farmer determines his spending. According to Udoh and Umoh (2011) farmers with high level of income are likely to purchase large quantities of farm inputs. The higher the income level, the higher the response to the purchase of appropriate farm inputs. Wealthier farmers may be the first to try a new technology, especially if it involves purchased inputs like fertilizer. This may be because wealthier farmers are more able to take risks or have better access extension information or to credit, or they may be able to use their own cash resource to experiment with a new technique (CIMMITY, 1993). Most farmers in Ghana own small scale farms and as a result are low income earners, this limits their ability to purchase agricultural inputs, expand their farms and use improved technologies.

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Agro-ecological Zones and Fertilizer Use

Fertilizer use by farmers according to Muriuki and Qureshi (2001) depends on the character of the agro-ecological zone being cultivated and the type of crop to be cultivated. This is because each ecological zone has its own climate, soil and vegetation. Ecological zones may also be called "Climate-Soil-Vegetation" zones since the three factors are related and influence the use of fertilizer. Plant fertilizer use efficiency is influenced by climate and soil factors such as soil pH and mineral content (Crawford, Jayne & Kelly, 2006)

The efficacy of fertilizer is affected by climate, that is, rainfall and temperature. For fertilizers to dissolve and become available for crops, it is necessary that adequate moisture be supplied. Thus, the benefits of fertilizer application may not be seen in a dry season. However, if the following season is wet, plants will benefit because fertilizer not used up in the previous season will dissolve into solution and become available for plants. Too much moisture is not good either, because it enhances fertilizer loss through erosion and leaching. Also, soil aeration and consequently, root growth is adversely affected (Crawford, Jayne & Kelly, 2006).

Most fertilizers used in agriculture and horticulture are applied to soil because it is used as the medium for growth. Soils differ in their mineral and physical properties, so they affect the activity and efficacy of fertilizers differently. Bationo, Hartemink, Lungu, Naima, Okoth, Smaling & Thiombiano (1995) indicated that physical properties of a soil have to do with its moisture holding capacity, drainage, texture and depth. Fast draining soils (e.g. a sandy soil) are

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more prone to leaching than slow draining soils (e.g. Heavy clay), so, fertilizer losses are higher from the former than from the latter. Those that have low moisture holding capacities are prone to drought conditions, and so do not benefit from fertilization as much as those with a high moisture holding capacity (Muriuki and Qureshi, 2001).

According to Grove (1993) climate is basically the rainfall intensity and its distribution pattern of the zone. The farmer is interested not only in the mean annual rainfall at his location, but also in its distribution and reliability throughout the season and between years, as poor distribution during the growing season may result in poor crop growth and yield. The intensity and distribution pattern of rainfall and the soil type determines the vegetation of a zone. Ghana, according to Ahn (1970) falls into two main vegetation zones, the forest and the savanna. The forest is found where rainfalls are relatively high and well distributed. Savanna is found where rainfalls are generally lower, and/or where the dry seasons are long and severe. Forest soils are more fertile and productive than savanna soils largely because of the heavier vegetation cover. The considerable difference between forest and savanna soils helps one to predict likely nutrient or fertilizer needs of soils. Zhou, Yang, Mosler & Abbaspour (2010) in their research found that fertile soils negatively affect fertilizer use, as fertile soils were found to require less fertilizer for plant growth and farmers farming under such conditions shall use less fertilizer.

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Crop Type and Fertilizer Use

According to FAO (2005) different crop species accumulate nutrients differently even under the same soil fertility levels. Generally, legumes require more Calcuim than cereals, while uptake of Phosphorus in cabbages and potatoes is generally more than that of Nitrogen. Nutrient enrichment also varies with plant part under consideration. For example, in maize, Potassium accumulates in the stalks and Nitrogen in the seed. Plant scientists recommend that different crops should be grown in rotation to avoid nutrient imbalance and depletion caused by continual removal of some nutrients at the expense of others like in the continuous cultivation of a mono-crop. A good ration should include crops that have different rooting zones and a legume. Crop rotations are also beneficial in disease and pest control because they help to break the cycles of pests and diseases (Voh, 1979; Van Kauwenbergh, 2006).

Drechsel, Giordano & Enters (2005) reported that another crop factor that determines fertilizer use is the net economic return per unit of fertilizer applied. Crops with a high economic value like vegetables and ornamentals (flowers) justify a large expenditure on fertilizer and for this reason farmers who grow such crops use more fertilizers. However, in Ghana, cereals like maize, sorghum and rice account for a larger share of fertilizer use. Although root crops play an important role in providing the national food supply, fertilizer use on root crops is minimal. Likewise, tree crops also account for a small proportion of fertilizer use. Despite its importance as an export crop, fertilizer use on cocoa like other tree

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crops until recently has been negligible (Gerken, Suglo & Braun, 2001; IFDC, 2012)

Farmers' Orientation towards Fertilizer Use

Farmers' orientation towards a particular phenomenon or use of a technology can be predicted as behaviour that can be deliberative and planned. Theories have shown that a person's behaviour is determined by his or her intention to perform the behaviour and that this intention is, in turn, a function of his or her attitude towards the beheviour and his or her subjective norm (Ajzen, 1991). Fishbein and Ajzen (1975) further explained in their theory of reasoned action that a person's behavioural intentions are based on the persons' attitude and subjective norms. The influence the people around a particular person would have on their action or behavior is known as subjective norm. Opinion of reference people or people who are significant or matter, could positively or negatively influence behaviour and to a large extent determines a farmers' attitude towards a phenomenon or technology such as fertilizer. Also there could be other socioeconomic, socio-cultural, psychological and economic pressures that may prevent a person from using a technology like fertilizer even though he/she may have intention to do so. Attitude like knowledge and skills determine the use of technologies. Farmers' attitudes are more likely to correspond with their behaviours (Van Den Ban and Hawkins, 1996). Research have shown in Delta State, Nigeria that fertilizer usage is low due to unfavourable attitude of farmers towards the use of fertilizer (Okoedo- Okojie and Aphunu, 2011).

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Accessibility of Fertilizer to Farmers

Accessibility to fertilizers is a function of availability of fertilizer and the ability of the farmer to buy the needed quantity of fertilizer for use. Gregory & Bumb (2006) found that fertilizer use by farmers is affected by Supply and Demand factors. They further differentiated the constraints affecting fertilizer supply in Africa into those related to market development, those that are technical and infrastructural.

Ghana like many sub-Saharan African countries has no facilities for domestic production of fertilizer although there are some deposits of rock phosphate in the country. All the fertilizers used in the country are imported, and thus operates basically the imported supply chain system. The IFDC (2012) found the fertilizer supply system in Ghana is a simple one. The major importers get their supplies from overseas suppliers. The source is mainly from The Netherlands, France and Romania. From the major importers, the fertilizer goes through intermediary channels consisting of registered wholesalers and retailers. They found the major importers to be four private companies – Yara Ghana Ltd (Subsidiary of Yara international ASA) and its partner cocoa fertilizer Company Wienco Ghana Ltd.; Louis Dreyfus Commodities (GH), formerly Golden Stork (Subsidiary of SCPA Sivex international); Diznegoff Ghana Ltd. (Subsidiary of Balton CP Ltd); and Chemico Ltd. Chemico Ltd is the only large importer which does not have an international parent company.

The wholesalers are located in most of the regional capitals whilst the retailers are located in the districts and sell the fertilizer to the farmers.

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Alternatively farmers may buy fertilizers directly from the wholesalers. Also through an alternative route, farmers in the oil palm sector, cocoa sector, large pineapple plantations, rice irrigation project, etc. get fertilizer directly from major importers through tender or credit sales managed by facilitators (IFDC, 2012)

Farmers' demands for fertilizer is determined to a large extend by the demand for the crop produced. In general, the demand for fertilizer depends on the price of the crop(s), the price of fertilizer, price of other inputs that substitute for or complement fertilizer, and the parameters of the production function that describe the technical transformation of the inputs into an output (Debertin, 1986). Crawford, Jayne, & Kelley (2006) also described factors impacting farmer demand for fertilizers as inability to acquire the desired amount of fertilizer for effective use so as to have the desired result of optimum or improved productivity.

In the absence of fertilizer, it is difficult for farmers especially in Africa to increase yields since most of the soils have been depleted due to continuous cropping. Agricultural yields in Sub-Saharan Africa have been hampered by little access to fertilizers due to poor infrastructure and the inability of farmers to always afford them (IFDC, 2007). Fuentes, Bumb, & Johnson (2012) found the high price of fertilizer and the long distance from the farm to the nearest fertilizer dealer shop to hinder fertilizer use. Olwande, Sikei, & Mathenge (2009) who used a double hurdle model to study the effect of a number of factors on intensification of fertilizer use in Kenya, had earlier found distance to source of fertilizer to negatively influence adoption decisions by farmers. According to Udoh and Umoh (2011) the quantity of fertilizer use by farmers decline with increasing distance to

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the nearest source of fertilizer or market centre. The distance from farms to source of fertilizer, gives an indication of access to fertilizer. The distance also determines the level of fertilizer use, for as the distance to the source increase, fertilizer use is likely to decrease.

Even though fertilizer use in Ghana is gradually increasing, its high cost still makes it difficult for farmers to afford. Shareef (2012) reported that farmers in the country had complained that they had difficulty accessing fertilizer in the farming season. In the three northern regions of Ghana, farmers were of the view that fertilizer was expensive and not readily available in their communities (Donkoh & Awuni, 2011). Farmers in other Africa countries are also of the view that fertilizer is not always available to them at the right time and in cases where they are, their prices are so high they cannot afford (Bamire, Fabiyi & Manyong, 2002; Gregory & Bumb, 2006; Vanlauwe & Giller, 2006; Udoh & Umoh, 2011). The high price of fertilizers recorded in Ghana can be attributed to two main facts, the fact that Ghana does not produce inorganic fertilizer domestically and also government's acceptance and implementation of neoliberal economic policies. Ghana does not produce inorganic fertilizer domestically as it has no facilities for domestic production. Exclusive dependence on imports to meet domestic fertilizer requirement leads to high fertilizer prices as a result of fluctuations in world prices, exchange rate depreciating in the country, and maximization of profit by private companies (Bumb, Teboh, Atta & Asenso-Okyere, 1994). The implementation of neoliberal policy of unregulated market through liberating private enterprises from any bonds imposed by the government and the subsequent

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withdrawal of government from the direct importation and distribution of fertilizer in order to promote private sector importation and marketing of fertilizers has also led to rapid increase in fertilizer prices.

Kimenye (2002) observed that poor road network in most rural areas increase agricultural operation costs and introduce high risks of failing to deliver farm produce, supplies and materials on time. Access to good roads is very important as it reduces perishability and increases the value of farm produce, farmers usually rely on good roads to ensure the timely delivery of their goods to the market. In most parts of rural Africa basic infrastructure such as good roads is greatly lacking and this makes the transportation of agricultural produce very difficult and expensive by farmers (Kelly, 2006). Due to the bad nature of roads that link farming communities to market centres in Ghana, transportation of agro inputs such as fertilizer to farms. and harvested crops from the farm gate to the main roads or market centres is difficult and expensive. (Boateng, Keraita & Akple, 2007)

Good markets for farmers have the potential of increasing their standard of living as they get fair prices for their agricultural products. Improving market access for farmers is of paramount importance as it will go a long way to improve their standard of living (World Bank, 2003).The distance from farms to the source of fertilizer measures access to market. Olwande, Sikei and Mathenge (2009) and Udoh and Umoh (2011) found that the quantity of fertilizer used by farmers decline with increasing distance to the nearest source of fertilizer. Boateng, Keraita & Akple (2007) also found out that marketing of agricultural produce is

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faced with a number of problems; access roads to facilitate evacuation of farm produce from the producing centres to the market are either in very bad condition or non-existent and inadequate storage facilities and insufficient agro-processing plants that hinder agricultural production. During the harvesting period, farmers are at the mercy of middlemen who purchase farm produce cheaply in the remote rural areas of production. Farmers in Africa often struggle to sell their produce to middlemen at cheaper prices because they do not have access to markets (Bumb, Johnson, Feuntes, 2011). However when markets are available, farmers have to travel long distances before they get access to these markets. All these problems results in a general lack of good prices for their produce and therefore deters farmers from increasing production and hence using fertilizers (Boateng, Keraita & Akple, 2007).

Institutional Factors supporting Fertilizer Use

The government of Ghana is committed to the welfare of farmers and continues to support them through subsidizing agricultural inputs, providing credits, training and extension services. There is also evidence of government's support to farmers in increasing production by supporting agricultural development projects (Khor & Hormeku, 2006). The government is supporting the youth who are into agriculture by providing them with agricultural input on credit. In the cocoa sub-sector for instance, government has been committed to implementing policy measures such as effective diseases and pests control programme, bonus payment and the hi-tech programme in order to contribute to

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the growth of the agricultural GDP, increase foreign exchange earnings, create employment and reduce poverty in the country (Breisinger, Diao, Kolavalli & Thurlow, 2008).

A research carried out in the Gomoa and the Awutu-Effutu-Senya Districts of the Central Region revealed that government through the President's Special Initiative on Cassava is seeking to increase substantially the nation's foreign exchange earnings through the transformation of smallholder production methods and the processing of cassava for export (Tonah, 2006). Locally cassava is being processed into beer and this has opened more opportunities for the marketing of cassava. There are numerous problems confronting the fertilizer industry, these constraints according to Gregory & Bumb (2006) include; uncertain policy environment related to fertilizers (mainly unexpected public sector subsidies that deter the development of a private sector retailer network), inadequate human capital, limited access to finance by importers and dealers, lack of market information, which discourages market transparency and information flow, and small size of the markets. Gregory & Bumb (2006) further mentioned the constraints of weak fertilizer marketing regulatory systems, physical insecurity leading to limited development of rural input supply stores, infrastructural constraints including poor roads, both main roads and feeder roads, leading to increased transportation costs and increased fertilizer price.

Government support to farmers is made evident in policies that have been developed and are being implemented, especially the support given to farmers in

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subsidizing fertilizers to ensure cheaper prices for farmers (Banful, 2009; Yawson, Armah, Afrifa, & Dadzie, 2010).

Policy support for fertilizer use

Policy is defined as a statement of intent or a set of principles developed to guide decisions or actions of a group, private sector entity or government organizations to enable them achieve their objectives or goal. Fertilizer policies are basically to guide the government plan and implement activities that will ensure efficient use of fertilizers by farmers. African farmers pay the highest fertilizer prices in the world. This contributes to the lowest fertilizer application rates and the lowest productivity in the world. To overcome this problem many African countries had to undergo policy reforms, and many governments imposed price controls and subsidies so as to increase fertilizer use (Bumb, Debrah, and Maene, 2006). The universal subsidies and state-controlled distribution systems of the 1970's and 1980s proved to be fiscally unsustainable and inefficient. After a period of market liberalization which further reduced the use of fertilizer, there was a renewed interest in fertilizer subsidies.

Approaches to increasing fertilizer use and farm productivity includes taking steps to reduce inefficiency and transaction cost in fertilizer procurement and distribution, providing complementary investments in human capital development, research into fertilizer responsive crop varieties and recommendations, intensification of extension services, infrastructure development

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and effective regulatory systems. All these can be achieved when good fertilizer policies are formulated by countries. A fertilizer subsidy policy was developed for Ghana in the year 2010; following this, in the year 2013 a national fertilizer policy was also developed by the Ministry of Food and Agriculture to guide the efficient production or importation, sale and use of fertilizer (MOFA, 2010; MOFA, 2013). According to Bumb, Teboh, Atta and Asenso-Okyere (1994) various policies affect the development of fertilizer in developing countries. Some of the policies which are solely on fertilizer development include; pricing and subsidy policy, supply policy, research and development policy, quality control policy, farm use policy and environmental policy. These policies shall directly affect fertilizer use depending on how they are developed and implemented.

Pricing and subsidy policy

Bumb, Teboh, Atta, & Asenso- Okyere (1994) indicated that the main objective of a pricing policy is to provide incentives for efficient fertilizer use. In this arena, both crop and fertilizer prices are important. Another objective of the pricing, policy is to provide a stable pricing environment so that fluctuations in prices are minimized and profitability of fertilizer use maximized. High price fluctuations may produce cyclical investment and production behaviour leading to excessive surpluses or deficits in crop markets and thereby reduce incentives for adoption of technologies including fertilizer use. In many African and Latin American countries, the lack of a stable remunerative pricing environment discouraged fertilizer use in the 1980s.

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In a survey of 38 developing countries FAO reported that 68% used fertilizer subsidies (FAO, 2003). It is therefore evident that most developing countries have made use of input subsidies. With fertilizer subsidies the challenge is to determine the optimal level of fertilizer subsidies so that food security may not be impaired. With the back drop of the international food, energy and fertilizer price hikes, the government of Ghana instituted a country-wide subsidy on 50kg bags of four specific types of fertilizer in 2008. This is in consonant with the national fertilizer policy which guides the government to intervene during emergencies or special programmes for farmers. The policy directs the Government to introduce some interventions which must be executed through transparent, non-distorting market-friendly mechanisms (MOFA, 2013). The voucher-based fertilizer subsidy programme implemented in 2008 thus relied on a public private partnership in which the sourcing of fertilizer was handled solely by existing fertilizer importers and distribution is by private retail outlets, while the role of the public sector was confined to the distribution and reimbursement of the vouchers. Due to the challenges of the fertilizer voucher system after the first year of implementation, the voucher system was replaced with the waybill receipt system in 2009/10 (Yawson, Armah, Afrifa & Dadzie, 2010). Yawson, Armah, Afrifa & Dadzie (2010) further explained that the key design features of the 2010 program were the elimination of vouchers and the inclusion of all farmers (small-, medium- and large-scale) who are involved in the production of various crops that use the types of fertilizer included in the subsidy program. Therefore, there is no targeting mechanism to specific crops or to beneficiaries. The types of fertilizer included in the subsidy program did not change and are those typically used in

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food crops production; therefore, the program is designed to attract farmers (small, medium or large) who will grow food crops. This design feature is still aligned with the objectives of the initial subsidy program.

This new waybill system was designed and implemented by the Ministry of Food and Agriculture, lead by the Crops Services Directorate in close collaboration with the major fertilizer companies, whereby each company has allocated quotas of various fertilizer types after price negotiations. The companies are to import fertilizers, clear shipments from the ports, pay all the charges and deliver allocated quantities of the various types of fertilizers to their main distributors in the designated regions and districts. Under this system, in 2010, farmers received on average a 40 percent subsidy per 50-kg bag of fertilizer, across all eligible fertilizer products. The total cost of the subsidy was valued at GHC 20.654 million in 2008 and GHC 26 million in 2009 (MOFA, 2010a). The implementation of the subsidy programme has since been ongoing, despite the huge financial and implementation challenges.

Supply policy

The main objective of any fertilizer supply policy is to provide fertilizers to farmers at the lowest cost possible, through either domestic production or import or both (Kelly, 2006). With the discovery and production of oil petroleum in Ghana, the country is yet to go into domestic production of fertilizer; consequently the country relies solely on its supply through imports. The national fertilizer policy directs that the importation and exportation of fertilizer in Ghana shall be the preserve of the private sector. In a bid to develop economies-of-scale, the

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Government of Ghana may consider mechanisms to pool the country's fertilizer demands to that of its neighbours for bulk importations by the private sector to reduce cost. According to the national fertilizer policy, production of fertilizers in Ghana shall be open to national and international private investors. All investors interested in establishing a fertilizer production plant in the country must comply with the requirements of all National Laws and Legislative Instruments. The Government shall also encourage domestic production of fertilizers through appropriate targeted tax relief and tariff regime as well as maintaining a stable exchange rate (MOFA, 2013).

Research and development policy

Many developing countries do not have adequate capacity for research; they also do not establish proper linkage between research and extension. Consequently, many research findings never get translated into farmer recommendations (Kelly, 2006). According to Fuentes, Bumb & Johnson (2012) efficient and environmentally sound fertilizer use requires adequate institutional capacity in research. Without adequate research, fertilizer may be used improperly. Inappropriate fertilizer products may be distributed to farmers. Likewise, without proper soil and crop analysis, farmers may use wrong products and recommendations. The national fertilizer policy gives direction for research on fertilizer use. Ghana has well-resourced Research Institutions, and the policy directive to the Research is to ensure that studies are conducted to avoid blanket recommendations among others. When policy is developed and implemented such that adequate funding for research is provided and direction for proper linkage

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between research and extension service given, a positive impact on fertilizer use is assured (Crawford, Jayne & Kelly, 2005).

Quality control policy

A position paper on Fertilizer Policy in Africa states that, appropriate, science-based quality standards need to be established and their implementation enforced. African countries' quality standards should be based on successful experience in other countries, including some countries in Africa. While these standards must protect consumers and the environment, over-regulation that would interfere with a well-functioning market should be avoided (Eilitta, 2006). Laws and regulations are necessary in the world fertilizer industry to control the quality of fertilizers, to minimize fraud and to reduce environmental pollution resulting from misuse and overuse of fertilizers. Fertilizer control and regulation ensures that the quantity of nutrients and quality of fertilizer carrier materials meet the specified standards. In the developed countries, these laws and regulations are well defined and legislated. The main items of legislation have to do with; production and storage, transport and distribution, control of the quality and presentation of the product and, environmental protection arising from fertilizer use (Byerlee & Heisey, 1992; Muriuki & Qureshi, 2001).

To ensure an effective control of fertilizer in Ghana, the Plants and Fertilizer Act 2010, (Act 803) have been enacted. Part III of the Act has provisions for the control of fertilizers which is in consonant with the national fertilizer

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policy. The Act provides for creation of an administrative framework and procedure for managing the fertilizer, authorizes collection and evaluation of relevant information and taking decision in the matter and places obligations and restriction on people who handle fertilizer and provides incentives. The Act also have provisions that ensures fertilizer use does not harm human and environment, provides that nationally producers, distributors and users of fertilizers bear the primary responsibility for proper management, and industry has the duty to produce and distribute fertilizers that can be used safely and should test fertilizers for adverse effects and inform users of necessary safety precautions required (MOFA, 2010d).

Cooperation among various agencies involved in the management of fertilizers is necessary for effective and efficient fertilizer use. All concerned therefore and have to fulfill their obligations and duties of developing research information, checking quality of fertilizer and disseminating of fertilizer use information.

Farm use policy

The national fertilizer policy provides direction for the use of fertilizers on farms in Ghana. The policy directs that extension services shall be ensured by the government through the Directorate of Agricultural Extension Services (DAES), while the private sector extension services shall support their efforts to ensure a nationwide coverage. Also complementary use of inorganic, organic and biological Fertilizers according to the policy shall be encouraged through the development of Integrated Soil Fertility Management systems tailored to the

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agricultural production systems in the country. Crawford, Jayne & Kelly (2005) observed that research institutions when properly funded to conduct research could come out with adequate fertilizer recommendations, and a well-resourced extension service shall ensure that appropriate recommendations or technologies are disseminated to farmers. Also strategies for monitoring and evaluation of technology dissemination when put in place to assess impact of dissemination as alternative approaches for promoting fertilizer use in Africa shall lead to improved fertilizer use. Crawford, Jayne & Kelly (2005) also stated that farm use policies must be consistent to ensure farmers have proper access to the benefits of fertilizer use in a sustainable manner.

Environmental policy for fertilizer use

The lack of proper policy in this area has led to soil degradation in many developing countries, and pollution of land, air, and water in the developed countries. Unless proper measures are developed and appropriate policies introduced, the environmental problems facing developed countries may also affect many developing countries (Zhou, Mosler, & Abbaspour, 2010). Ghana has an environmental policy which is specific to fertilizer use. The policy gives direction for the efficient use of fertilizer, by the extension services guiding farmers not to indulge in excessive use of fertilizer in order to prevent pollution of air, water and farm produce or soil degradation. Relevant Research and

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Development (R&D) institutions also are directed to regularly update site-specific and crop-specific fertilizer recommendations to ensure judicious use of fertilizer.

This policy guide is up hold the role efficient fertilizer use can play in preventing soil degradation which results from the depletion of plant nutrients and the chemical pollutants associated with fertilizer use. According to Fuentes, Bumb & Johnson (2012) efficient and environmentally sound fertilizer use requires the identification and promotion of environmentally safe fertilizer practices and the use of safe fertilizer products which are essential for the achievement of food security, clean environment and sustainable resource base.

Infrastructural system

The fertilizer industry is faced with two major infrastructural problems as a result of the bulky nature of fertilizers. They include transportation and storage infrastructure (Kelly, 2006). Transport infrastructure including road, ports, railway, vehicles and transporters plays a role in maintaining food security and rural development. Fertilizers are moved from the port by road and railways to the hinter lands or rural areas.

According to Gregory & Bumb (2006) in many countries such as Zambia, Tanzania, Ghana and Nigeria, feeder roads linking communities in the rural areas are in poor condition, this add to transportation cost and makes inputs including fertilizers costly resulting in low use. There is the need for investment into the transport sector to bring about positive changes in the agricultural marketing pattern.

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Storage infrastructure has also been a continuous problem for many countries in Africa including Ghana. In Ghana due to the importance attached to cocoa, there are many facilities constructed at the ports for their storage (Gregory & Bumb, 2006). However, importers of fertilizer face huge challenges in acquiring storage facilities for their wares. There are no adequate warehouses for fertilizers and even when it is available, they come at a very high cost which is offloaded on the price of fertilizers sold to farmers.

Access to credit

Farmers in Ghana are mostly small scale farmers. The large farms represent about 10% of the farming lands (Asante, 2002). Ghanaian farmers mostly depend on donor funds, governmental agencies or NGOs for funds to improve their farming. Access to credit from the traditional banks is mostly non-existent as they see farming as a high risk area. There is the need for farmers to have access to credit so as to get funds to buy agro-inputs including fertilizer to promote food production. FAO (2004a) emphasized the need for credit to farmers on the grounds that credit in the short run, enables the poor to weather shocks. Debertin (1986) also reported that in four out of six studies in different parts of the world on factors influencing the rate of adoption of improved practices, the availability and the use of credit was significantly related to the adoption of higher yielding varieties.

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In Ghana, only about 5-6 percent of the 22 million people have access to formal banking. Farmers' access to credit has been positively linked to their production (Basu, Blavy & Yulek, 2004). This is confirmed by Quaye, Adofo, Agyeman & Nimoh (2010) who observed that limited access to credit negatively affects production. Akpoko and Yiljep (2000) in their adoption study in Nigeria found a positive correlation between access to credit and fertilizer use. Kodiechi (2002) was also of the opinion that farmers are unable to access credit from financial lending institutions in Nigeria because of the high cost of administering such loans and the perceived high default rates among farmers by these institutions. Many microfinance institutions however support small-scale enterprises, but they are often skeptical about supporting farming activities due to the high risk involved (Boateng, Keraita, & Akple, 2007). The Agricultural Development Bank and Rural Banks which were created with the goal of helping farmers are now focused on serving salaried workers, while farmers face difficulties obtaining credit to purchase agro inputs (MOFA, 2007).

Extension information support for fertilizer use

Information support is an important factor that affects adoption. For farmers to adopt a technology they must first know about it. The information may come from several sources for instance print media, radio, television, extension, etc. It is important to explore the degree to which farmers have received the necessary information.

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Various source of information are used to disseminate agricultural techniques in developing countries where resources are limited and major sources of farm practice information dissemination remains undoubted by extension source. Benor and Harrison (1977) reported that the extension agent still plays an important role as source of information and hence exerts considerable influence on adoption of recommended agricultural practices.

According to Opoku-Asiamah (2008) information has a key role to play in educating and communicating the impact of the diseases and sharing agricultural production techniques that encourage food security and save labour. For farmers to adopt a technology they must know about it. In the developing countries where resources are limited, the major source of farm practice information remains undoubtedly the extension sources. Vissoh (1994) confirmed in the study he carried out in Atlantique, Mono and Queme (Benin) that extension services are the major channel of diffusion of innovations mostly used by small scale farmers.

According to Vanclay (2004) sources of information vary in relation to both the stage of adoption the farmer is in and to his relative position in the adoption cycle. Vanclay (2004) further said that individuals are important information sources because regardless of practice or place or person, adoption decisions almost always involve other individuals as information sources. Marsh, Pannell and Lindner (2000) conducted a survey on adoption impact in coastal Kenya on smallholder Dairy Technology. The result revealed that the most important sources of information about Dairy cattle Technology were extension agents' demonstrations with households owning cattle (Feder & Roger, 1986).

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Farmers' understanding on the use of fertilizer is influenced by the quality of information available on fertilizer (dosage, application rate, price, availability) and their access to that information, including extension activities-demonstration plots, observation and experience of other farmers, and other technical packages use like improved varieties (Camara and Heinemann, 2006). Extension information support, according to Kebede, Gunjal & Caffin (1990) and Ouma, Groote, & Ownor (2006) updates farmers knowledge and stimulate adoption.

In the research into factors influencing pesticide use, which is also a divisible technology as fertilizer use, Gerken, Suglo, & Braun (2001) pointed out that factors influencing pesticide use can be categorized according to their possible effect. The first category consisted of price factors. The second category consisted of factors which are under the direct influence of state policy and the third category were institutional factors and information which have an indirect effect, mostly long term on pesticide use.

Extension services are the major channel of dissemination of information on innovations and technologies mostly used by farmers in Ghana and sub-Sahara Africa. Africa's experience with approaches to agricultural extension have been varied and, to date not adequate to the task at hand (Gregory & Bumb, 2006). According to Elitta (2006) extension service is constrained by poor effectiveness of efforts to disseminate technologies to all farmers. There is also lack of sound strategy for targeting appropriate technologies and skills to specific locations, and poor monitoring and evaluation of technology dissemination efforts and impact in Africa countries. Kelly (2006) observed that farmer's perceptions are influenced

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by levels of basic education and exposure to technologies through farmer training programmes or demonstrations. Increases in fertilizer demand will depend on extension programs capable of teaching farmers about appropriate fertilizer doses, and supporting management practices so that farmers' perception of the response approximate the true agronomic and economic potential of the fertilizer.

Agricultural extension agents play the role of disseminating information and transferring technology to farmers to increase their production, they also present information about new advances or breakthroughs in agriculture that may positively impact farmers and livestock producers (Bokor, 2005). Van den Ban and Hawkins (1996) has long explained that the goals of agricultural extension have been defined to include transferring information from the global knowledge base and from local research to farmers, enabling them to clarify their own goals and possibilities, educating them on how to make better decisions and stimulating desirable agricultural development.

Majority of rural farmers in Ghana do not have access to extension services as the ideal farmer to agricultural extension agents (AEAs) is 1: 400 compared with the national ratio of 1:1,670 (Bannor, 2012). The national figure is woefully inadequate and in certain districts, the ratio is much higher or non-existent. This means that extension agents are seldom able to meet the needs of majority of farmers as they lack logistics that will enable them to visit all farms in their catchment areas. It was found from a study by Danso, Drechsel, Wiafe-Antwi, & Gyiele (2002) in the Ashanti Region that 55 percent of farmers had contact with extension. Peprah (2011) in his study on access to credit and technical efficiency

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of vegetable growers in the Mfantsiman district of Ghana observed that, vegetable farmers had access to extension officers who guided them on the application of fertilizer and insecticides, best farming practices and general advisory services. However, Osei-Bonsu, Baah and Afrifa (2001) in their study on pests and diseases of cocoa in Ghana observed that extension support to farmers especially cocoa farmers is far from satisfactory.

Benor and Harrison (1977) and Ersado, Armacher & Alwang (2004) in their study of the relationship between farmers and extension agents in relation to adoption revealed that contact with extension workers influences positively farmers' adoption behavior. There is a high positive correlation between the use of personal information sources and adoption of recommended farm practice. They also concluded that the closer a farmer associates with the extension service and its personnel the more likely it is that he or she can be influenced to adopt and use improved farm practices. Many relevant agricultural production and soil management technologies including fertilizer use have been developed in Ghana but these are yet to achieve their full potential impact because of limited dissemination resulting in low levels of adoption and use (Asante, 2002).

It can be concluded from the literature reviewed that the decision to use fertilizer is influenced by several factors, these include the fertilizer itself as a technology, what benefits or advantages does it possess? Is it available? Is it economical or profitable? How is the use of fertilizer being promoted? What are the institutional guidelines being used to ensure effective use of fertilizer? What policies are being implemented? Is the extension information support adequate?

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How does the society perceive fertilizer use? People's behaviour is affected by socio-cultural, socioeconomic and psychological issues, it is therefore important to understand the opinion, attitude and behavior of others in the society because the intension of the farmer to use fertilizer can be positively or negatively influenced by people close or significant to him. For purposes of this study the factors that have been identified shall be grouped into four broad elements 1) farmers' characteristics, 2) farmers' orientation towards fertilizer use, 3) Accessibility to fertilizer, and 4) Institutional factors influencing fertilizer use. The elements or variables, and how they relate are shown in conceptual framework (Figure 1). There is the need for variables to function properly to positively influence the intension of farmers towards the use of fertilizer.

Conceptual Framework

From the literature reviewed, it is evident that there are several factors that can influence the access to fertilizer and the use of fertilizer by farmers. However, to achieve the objective of the study which seeks to examine fertilizer use and key factors influencing the use of fertilizers by farmers in Ghana, the study concentrated on farmers' characteristics, farmers' orientation towards fertilizer use, accessibility to fertilizer, and institutional factors influencing fertilizer use.

The theories revealed that the adoption and or use of fertilizer as a technology, is a function of the availability of the technology and information on the technology, the extent of economic merits (profitability) of the technology, the amount of investment required to adopt the technology (cost), the uncertainty or possible risks associated with the technology, and subjective evaluation of the

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farmer. The theories suggest that the best predictor of behaviour is intension, or that a person's behaviour is determined by his intension to perform the behaviour (technology use). The theories also revealed that farmers attitude towards the specific behaviour (in this study, fertilizer use), their subjective norms (beliefs and opinions of people the farmers care about), and perceived behavioural control (the perceptions of their ability to perform a given behaviour which in this study is to have access to fertilizer and to use fertilizer) combine to give the intension to perform. Farmers' characteristics which include sex, age, educational level, and household size among others determine whether or not a technology like fertilizer would be used. There is also a relationship between farmers' attitude and fertilizer use, as farmers' attitude determines whether or not fertilizer would be used. Farmers' characteristics and their attitude towards fertilizer use can therefore be said to affect fertilizer access and use. Institutional factors like policies on fertilizer use, extension support, source of information for fertilizer use, and access to credit, that are put in place by the government may affect or may be related to the access and use of fertilizer. Accessibility to fertilizer which include variables like availability of fertilizer, distance to the nearest source of fertilizer, cost of fertilizer and the ability to buy fertilizer can also positively or negatively affect fertilizer use by farmers.

The ultimate aim of performing or using an improved technology such as fertilizer is to improve the standard of living of farmers. This can be achieved through better decision-making processes for the adoption and use of fertilizer. Such an ultimate aim can be realized through a synergic combination of the factors

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mentioned. These factors, depending on how they occur or are handled can positively or adversely affect the use of fertilizer by farmers. The framework therefore was developed with a strong conviction that desired change in access to fertilizer and fertilizer use can come through combined effects of the variables shown in Figure 1. Each of these variables has already been discussed in relation to existing literatures.

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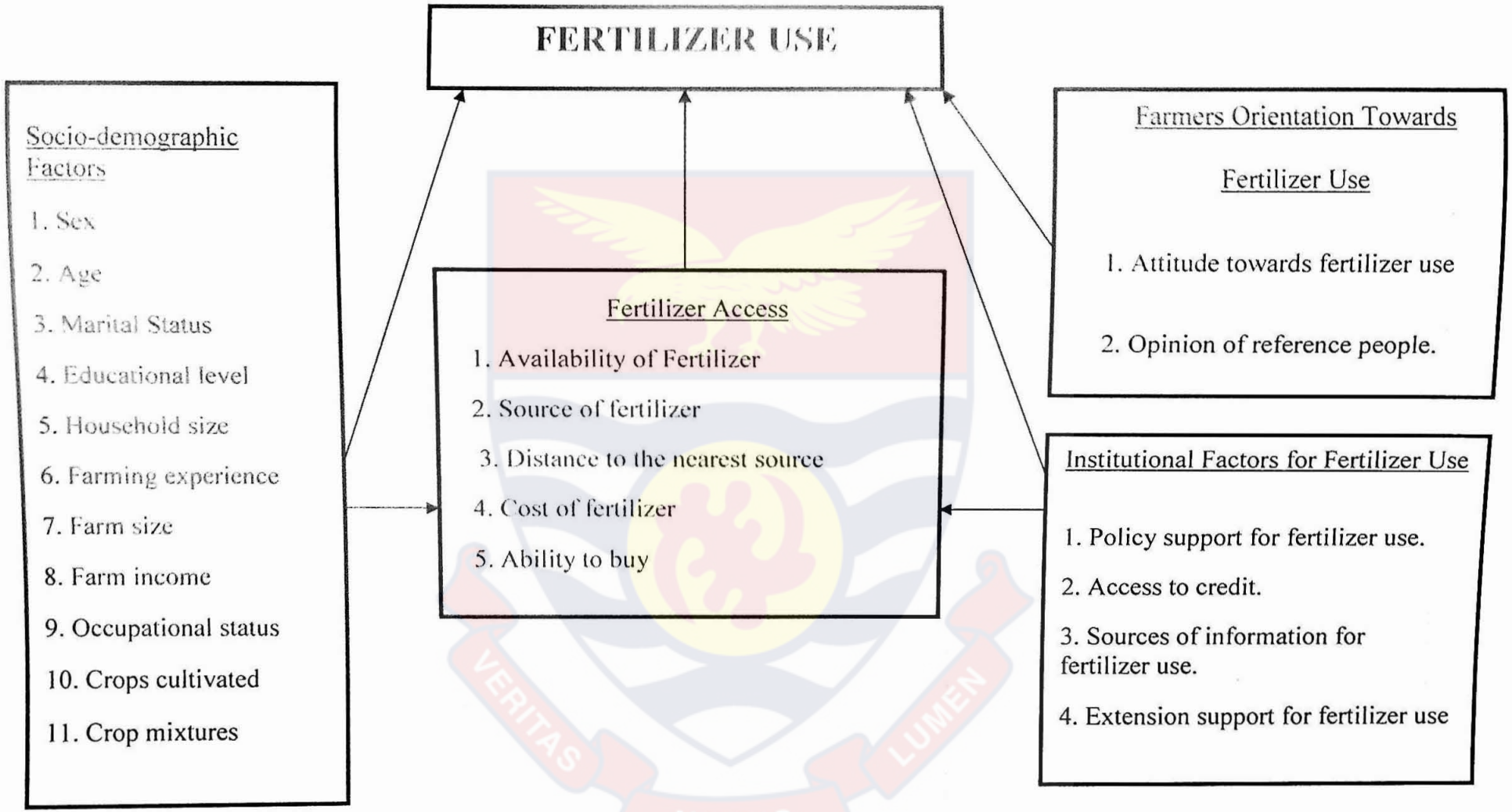


Figure 1: Conceptual Framework of Factors influencing Fertilizer Use

Source: Author's Construct

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CHAPTER THREE

METHODOLOGY

General Overview

This chapter describes the procedures and techniques used in collecting, managing and analyzing the data. It also presents the research design, the population studied, the sample, the sampling procedure, research instrumentation, the pretesting, data collection, processes and analysis that were used as well as rationale behind the choice of these techniques for the study.

Study Area

This study targeted farmers in Ghana. Ghana is a tropical country in West Africa with a population of about 20.4 million. It is situated between latitudes 4°, 45" and 11°, 11" North and extends from longitudes 1°,14" East to 3°,17" West. It shares common boundaries with Togo to the east, Burkina Faso to the north, Cote d'Ivoire to the west and the Atlantic Ocean to the south (Figure 2).

Ghana is a democratic country with an elected executive president, parliament, and judiciary as the arms of government. Ghana has ten regions and 230 district assemblies. The regions are Central, Greater Accra, Western, Eastern, Volta, Ashanti, Brong-Ahafo, Northern, Upper East and Upper West. The main local languages are Twi, Fanti,

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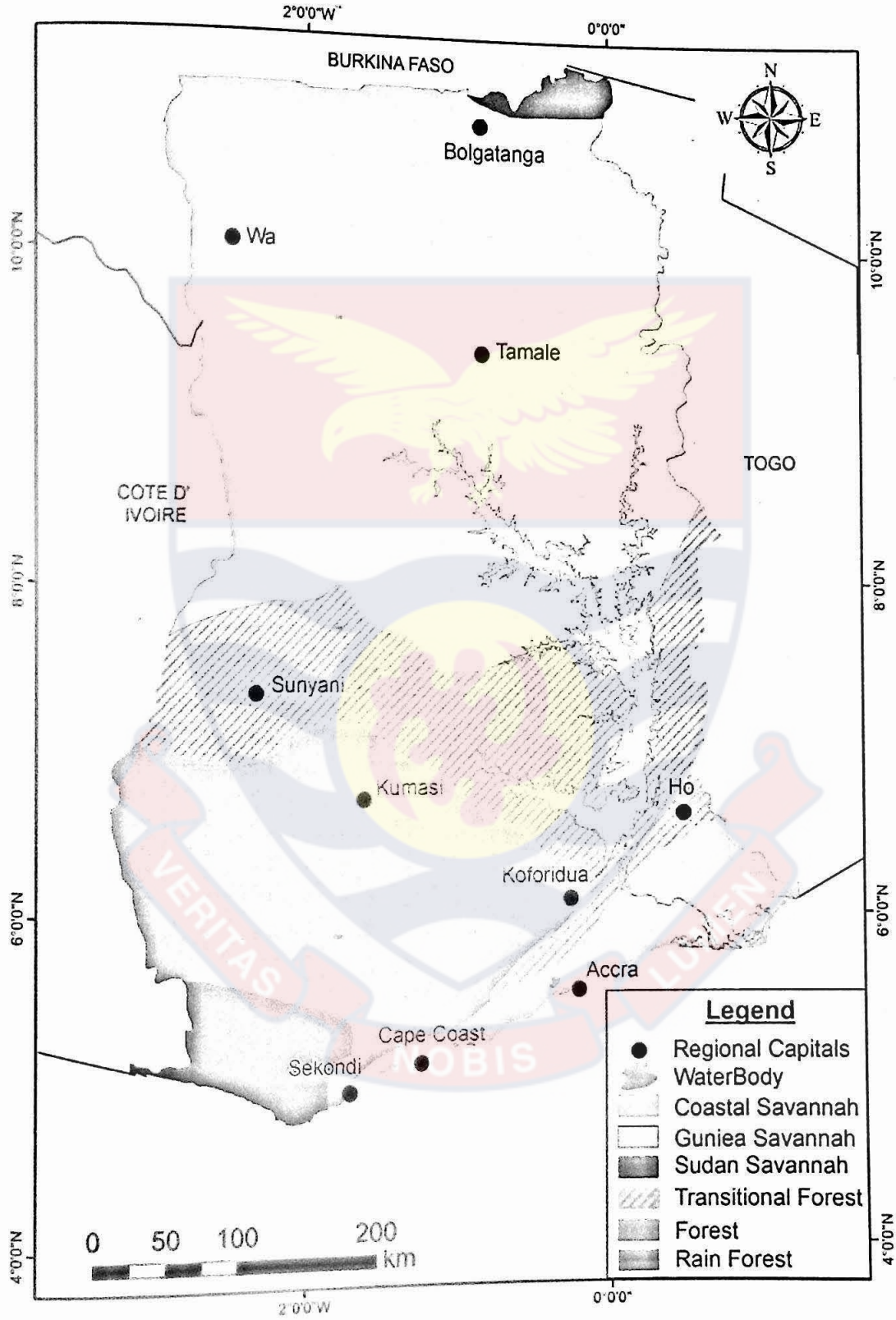


Figure 2: Agro-ecological zones of Ghana

Source: Department of Geography, University of Cape Coast.

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Ewe, Ga, Hausa and Dagbani. English is the official language of communication (Gale, 2007).

Ghana is an agricultural country and agriculture accounts for about 35% of the gross domestic product and employs about 65% of the labour force. Agriculture plays a primary role in food security in the country. Besides producing a substantial part of food directly, it contributes the highest proportion of the foreign exchange required to import shortfalls in the domestic production. The sector also contributes to household incomes through employment; however, agricultural incomes are the lowest in the country resulting in a very high proportion of poor rural households (MOFA, 2012)

The country is divided into six agro-ecological zones on the basis of their climate, which are basically the temperature, humidity and rainfall experienced in the zones. The six ecological zones are; Rainforest, Deciduous forest, Transitional forest, Coastal savannah, Guinea savannah, and Sudan savannah (Figure 2). The climatic factors of rainfall and temperature determine the wet and dry seasons in the different agro-ecological zones. The Tropical Eastern Coastal Belt is warm and comparatively dry, the southwest is hot and humid and the north is relatively hot and dry, compared with the other parts of the country. The mean annual rainfall ranges from 800 mm in the Coastal Savannah to 2,200 mm in the Rain Forest. The rainfall pattern is uni-modal in the Sudan and Guinea Savannah Zones and bi-modal in all the other zones (Gale, 2007).

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According to Ahn (1970) the soils of Ghana are highly weathered with predominantly light textured surface horizons in which sandy loams and loams are the common textural classes. The lower soil horizons have relatively heavier textures varying from coarse sandy clay loams/sandy loams to clays. Heavier textured soils are normally abundant in the valley bottoms, which are ideal for rice cultivation. The subsurface horizons showing features of accumulation or significant alterations contain abundant coarse material either as gravel or stone/concretionary materials. The coarse nature of the soils has an adverse impact on their physical properties, particularly their water holding capacity. Thus water stress in crops is not uncommon during the growing season. The levels of organic carbon, nitrogen and available phosphorus are generally very low. Potassium is mostly abundant in the soils of Ghana.

The intensity and distribution pattern of rainfall and the soil type determines the vegetation of a zone (Grove, 1993). Ghana falls into two main vegetation zones, the forest and the savanna. The forest is found where rainfalls are relatively high and well distributed. Savanna is found where rainfalls are generally lower, and/or where the dry seasons are long and severe. Forest soils are more fertile and productive than savanna soils largely because of the heavier vegetation cover. The considerable difference between forest and savanna soils helps one to predict likely nutrient or fertilizer needs of soils (Ahn, 1970).

The climatic conditions, mainly rainfall and the soil types also determine the type of crops that are cultivated in various parts of the country. As a result there is variation in crops grown across the major agro-ecological zones (Grove,

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1993). The moist southern areas (Rainforest, deciduous forest and transitional forest) support tree crops, major grains, starchy staples and many vegetables whilst the drier savannah areas (Coastal and Northern Zones) support the growth of cereals (maize, millet, sorghum, rice) root crops (yam and cassava), legumes (cowpea and peanuts), tobacco and cotton. Cassava is grown in all the agro-ecological zones, with the exception of the Sudan Savannah Zone (Gerken, Suglo & Braun, 2001). Crops cultivated also have different nutrient needs. Under the same soil fertility levels different crops accumulate nutrients differently. The level of consumption of fertilizer by farmers in the agro-ecological zones in Ghana are not the same, this is due to the varied climatic conditions, soil type, vegetation types, and crop types grown (FAO, 2005).

Research Design

A descriptive-correlational survey design was used to allow the researcher to gather data and analyse the quantitative variables of the study. According to Amedahe (2000) a descriptive research involves collecting data in order to test hypotheses or answer research questions concerning the current status of the subject of the study. Also the main purpose of descriptive research is to accurately portray the incidence, distribution and characteristics of a group or situation (Best & Khan, 1998). In this study, the design will help determine the factors influencing the use of fertilizer by farmers in Ghana.

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A descriptive study, according to Fraenkel and Wallen (2000) describes and interprets what is. It is concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident or trends that are developing. It is primarily concerned with the present, although it often considers past events and influences as they relate to current conditions. Furthermore, the choice of the design was based on observations made by Best and Khan (1998) who stated that the descriptive design uses the logical methods of inductive-deductive reasoning to arrive at generalizations. It often employs methods of randomization so that errors may be estimated when population characteristics are inferred from observation of samples. The research design helped determine the factors influencing the use of fertilizers by Ghanaian farmers. Secondary data sources such as journals, books and other relevant literature provided additional information.

Population of the Study

Population refers to all members of a particular group of individuals (organizations, institutions, events, or other subjects being studied) that one wishes to describe or about which one wishes to generalize (Fraenkel, Sawin & Wallen, 1999). The population for this study was 1,240,000 farmers involved in food crop production in six regions of Ghana who were registered by MOFA within the years 2009/2010.

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Sampling Procedure and Sampling Size

The study adopted a multistage sampling procedure to draw random samples since the population was scattered all over the Ghana and the researcher did not have enough resources to cover all (Fraenkel, Sawin & Wallen, 1999). Best and Kahn (1998) has recommended multistage sampling method where a population is infinite or a population list is non-existent or unreliable as was the case for the study. The first stage of sampling, six regions out of ten regions found to be fully or partially located in the six agro-ecological zones of the Ghana was purposively selected. The agro-ecological zone was used as the basis for sampling to ensure a good coverage of soil and cropping characteristics. Murinki and Qureshie (2001) had found fertilizer use by farmers to depend on the characteristics of the agro-ecological zone.

The Upper East region is partially located in the smallest agro-ecological zone (Sudan savannah) had only six of its districts fully or partially situated in the Sudan savannah zone. Therefore at the second stage, six districts were also purposively selected in each of the selected six regions to ensure equity. At the third stage, the list of registered crop producing farmers collected from MOFA district offices were used to randomly select twenty farmers from each district to ensure that the 120 farmers needed in each region for the study is attained. A total of 120 farmers were selected in each region or agro-ecological zone resulting in a sample size of 720 farmers for the study. The major goals of sampling are to establish the representativeness of what is being studied, to reduce bias, and to be able to make inferences from findings base on a sample to the larger from which

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the sample was drawn (Baker, 1999). Sampling also depends on the type of study. Fraenkel and Wallen (2000) stated that for a descriptive study, the sample should contain a minimum of 100 elements for a correlational study and a minimum of 30 elements for causal comparative studies. They further stated that a minimum of 50 elements would be required to ascertain the existence of relationships. Hence the 720 farmers sampled through the multisampling procedure for the study was deemed appropriate. Table 2 shows the selection procedure and sampling size. The details of sampled districts and communities in the various regions or agro-ecological zones are presented Appendix C.

Table 2: Selection procedure and sample size

Agro-Ecological Zone	Region Selected	Number of Districts Selected	Number of Farmers Sampled Per District	Total Sample Size Per Zone
Sudan Savanna	Upper East	6	20	120
Guinea Savanna	Northern	6	20	120
Transitional Zone	Brong Ahafo	6	20	120
Forest	Ashanti	6	20	120
Rainforest	Western	6	20	120
Coastal Savanna	Central	6	20	120
Total Sample Size				**720**

Source: Field Survey, 2012

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Variables of the Study

The Dependent variable for the study is fertilizer use by farmers.

The independent variables in the study include the following:

i. Socio-demographic characteristics of farmers; sex, age, educational level, marital status, farming experience, household size, occupational status, farming experience, household income and types of crops cultivated.

ii. Farmers orientation towards fertilizer use; opinion of reference people and farmers' attitude towards fertilizer use.

iii. Access to fertilizer; fertilizer types sold, availability of fertilizer, sources of fertilizer, distance to the nearest source, cost of fertilizer and ability to buy fertilizer.

iv. Institutional factors influencing fertilizer use; policy support for fertilizer use, access to credit, source of information on fertilizer use and extension support for fertilizer use.

Instrumentation

To analyze the factors influencing the use of fertilizer by farmers, a validated interview schedule was developed and used to collect data from farmers.

Face validity of the research instrument was ensured by the researcher, content validity was checked by the lecturers in the Department of Agricultural Economics and Extension of the University of Cape Coast. Plant Protection and

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Extension experts at the Ministry of Food and Agriculture also ensured the content validity of the research instruments.

Fraenkel and Wallen (2000) recommended that a strong effort be made to find out if a suitable instrument is already available before one tries to develop an instrument. As suitable ones were not available, the researcher designed an interview schedule for the collection of data.

The interview schedule for farmers was developed based on the objectives of the study and consisted of five sections which sought to find:

i. The socio-demographic characteristics of the farmers which included their sex, age, educational level, marital status, category of farming, farming experience, farm size, type of crops cultivated, and household income.
ii. Access to fertilizer, including fertilizer types sold, availability of fertilizer, distance to the nearest source, cost of fertilizer, ability to buy fertilizer.
iii. Quantity of fertilizer used by maize farmers.
iv. The farmers' orientation towards fertilizer use, including opinion of reference people and attitude of farmers towards fertilizer use.
v. Institutional factors for fertilizer use, including policy support for fertilizer use, access to credit, source of information on fertilizer use, and extension support for fertilizer use.

The interview schedule contained both open and pre-coded close-ended items. Likert-type scale was developed to determine the farmers' attitude towards fertilizer use and also used to guide farmers determine problems influencing credit

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acquisition, usefulness of information received, and the benefits of the fertilizer support. Wherever it was appropriate, items were presented on a tabular form to simplify the instrument.

Pre-testing of Research Instrument

The pre-testing was carried out in the Upper West Region within the Guinea Savannah zone from 7th November 2011 to 30th November 2011. Pre-testing of the research instrument was done to ensure its reliability and validity. The quality of the instrument was tested in terms of readability, ease of understanding, relevance and representativeness of the question items in the research instruments by the administrators of the questions and the respondents. Pre-testing helped the researcher to identify error(s) that arose from the research instrument. The necessary corrections and modifications were effected before the research instrument was finally administered. The pre-testing ensured efficiency and effectiveness in the administration of the research instrument

The data collected from the test study was entered into the SPSS data file for computer analysis to generate alpha coefficients for the subscales. As shown in Table 3, the Cronbach's alpha co-efficient obtained ranged from 0.722 to 0.854 indicating that, the Likert-type scale set of questions in the instrument were reliable. These Cronbach's alpha co-efficients values of 0.70 or more are considered as reliable by Pallant (2001).

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Table 3: The Cronbach's alpha co-efficient for the subscales

Subscales	Number of items	Cronbach's alpha scale
Problems associated with credit acquisition	4	0.854
Benefits of fertilizer policy support	5	0.722
Farmers attitude towards fertilizer use	5	0.747
Usefulness of information received	5	0.804

Source: Field data (2011)

Data Collection

Six Fertilizer Inspectors and six Agricultural Extension Agents were trained at the Sasakawa Center of the Department of Agricultural Economics and Extension at the University of Cape Coast to assist the researcher in the collection of data for the study. The training focused on; the purpose of the study, the understanding of content of the instrument, knowledge and skills related to relevant information and recording responses accurately, and how to establish standards of confidentiality.

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The collection of data for the study began in December, 2011 and ended in March, 2012. Thus a period of four months was used to administer questionnaires to 720 Farmers.

Data Analysis

The questionnaires collected were screened for their usability; data obtained from the fieldwork was edited. The analysis processes followed a structured format comprising coding and developing a frame of analysis and finally the actual analysis. These steps were strictly followed to ensure that the data was properly cleaned and to ensure quality results. The template for the interview schedule was laid using the statistical package for social sciences (SPSS) software version 16. The statistics generated were based on the objectives of the study.

Descriptive Statistics involving the use of mean, standard deviation and percentage were computed to describe the data, summarizing and finding percentages in order to draw inferences, deductions and conclusions. Objective one (1) was analyzed using descriptive statistic such as frequencies, percentage, mean, and standard deviation. Chi-square test was used to compare the accessibility variables and the dependent variable. Objective three (3) was analyzed using descriptive statistic such as frequencies, percentage, mean, and standard deviation. The Chi-square test was employed to compare the variables of farmers orientation and fertilizer use. Objective four (4) was analyzed using

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descriptive statistic such as frequencies, percentage, mean, and standard deviation. Chi-square test was used to compare the Institutional variables and the dependent variable. Objectives five (5) and six (6) were analyzed using the Pearson's correlation and were tested at 0.05 level of significance. This was to determine direction and strength of relationship among socio-demographic characteristics of the farmers and the dependent variable, and farmer's access and the dependent variable respectively.

The multiple linear regression analysis was used to analyse for the best predictors in objective seven (7). To assess the contribution of each predictor towards the variance in the dependent variable (fertilizer use), the independent variables that showed significant correlations with fertilizer use were regressed using the multiple linear regression model. The multiple linear regression model gives the opportunity to load all the predictor variables into one model and find which one contribute more to the variation in the dependent variable. The model for multiple linear regression given six observations, is $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + \varepsilon$ where; Y = fertilizer use (dependent variable), b_0 = intercept, $b_1 - b_6$ = regression coefficients, $X_1 - X_6$ = independent variables (X_1 = cost of fertilizer; X_2 = farmers' attitude, X_3 = Access to credit, X_4 = distance to fertilizer source, X_5 = availability of fertilizer and X_6 = extension information support) and ε = random error.

Variables regressed using the multiple linear regression model, according to literature, are expected to move in certain specific directions. From the study of Oumou and Ariga (2011), a direct (positive) and a significant relationship was

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found between availability of fertilizer and fertilizer use. A significant and an indirect (negative) relationship was observed between fertilizer use and distance to source of fertilizer in a study by Olwande and Mathenge (2009). Udoh and Umoh (2011) concluded in their study that the quantity of fertilizer used by farmers decline with increasing distance to the nearest source of fertilizer or market centre. The study of Odoh and Umoh (2011) found an indirect (negative) and a significant relationship between cost of fertilizer and fertilizer use. Udoh and Umoh (2011) also stated that the cost of fertilizer may determine to a large extent the quantities of fertilizer to be used.

From the study of Okoedo-Okojie and Aphunu (2011), a direct (positive) and a significant relationship was found between farmers' attitude towards fertilizer use and fertilizer use. The study of Akpoko and Yiljep (2000), also found a direct (positive) and a significant relationship between access to credit and fertilizer use and concluded that the availability of credit either in cash or kind enhances farmers' availability to purchase or acquire inorganic fertilizer. Extension information support was also found to be significant and directly (positively) related to fertilizer use by Kelly (2006), which implies the higher the Extension information support, the more fertilizer that will be used. Extension information support updates famers' knowledge and stimulates adoption (Kebede *et al*, 1990, Ouma *et al* 2006).

Objective two (2) was analyzed using the Fertilizer Use Calculation formula outlined below to find quantities of fertilizer use by maize farmers. This research limits the calculation of fertilizer use to maize because maize is produced

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in all the Agro-ecological zones of the country. It is also the crop that farmers throughout the country apply fertilizers to during production and accounts for a large share of fertilizer use in Ghana.

Fertilizer Use Calculation:

Fertilizer use in kilogram per hectare of cropland is calculated by dividing the total fertilizer consumption, measured in kilogram of plant nutrient, by the total hectare of arable and permanent cropland [Σ R (kg/ha) x 1ha ÷ Σ LS (ha)] (FAO, 1991). Fertilizer consumption is defined as the quantity of plant nutrients used per unit of arable land including land area under irrigation. The consumption of fertilizer by farmers in a country can be assessed in several ways. It can be assessed in terms of; total fertilizer imported or manufactured into/by the country or household-level estimates of fertilizer application per hectare, that is quantities actually used by farmers on crops (FAO, 1991). For the purpose of this study, the household-level estimates of fertilizer application per hectare (N x 50kg) ÷ (S acres / 2.5 acres) ha = R kg/ha shall be used. Calculation procedure is as follows:

1. Fertilizer Consumption per Hectare or Rate of application of fertilizer per hectare per household (R) =

(N x 50kg) ÷ (S acres / 2.5 acres) ha = R kg/ha

Where: N = Number of bags of fertilizer used, and

S = Land size in acres

2. Quantity of Fertilizer Use per hectare in a country or a given

area = Σ R (kg/ha) x 1ha ÷ Σ LS (ha)

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Where: ΣR = Sum of Rates of application of fertilizer per household

ΣLS = Sum of Arable Land sizes cultivated or cropped in hectares for area under study.

Field Problems

The main problems encountered by the research assistants (AEAs and Fertilizer Inspectors) during the survey was non- cooperation of some of the respondents. Some farmers initially refused to be interviewed because they complained of having participated in interviews but authorities have not responded to concerns raised about high cost of agro inputs and credit facilities for their farming activities. After persisting and convincing them about the importance of the survey they finally participated.

The other problem encountered was communication. Some of the respondents were illiterate and therefore, the research assistants had to translate the questions into the various local languages. this prolonged the duration of the interview sessions and finally resulted in the delay of the completion of the fieldwork.

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CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

This chapter presents the results and discussions of the study. The results of the study have been presented and discussed in relation to the objectives and the literature reviewed. The results are presented in tabular and graphical forms and immediately described to highlight the important elements and features. Based on the results, Section One describes the key socio-demographic and farm-related characteristics of the farmers. Section Two describes accessibility of fertilizers to farmers its terms of fertilizer types sold in the country, availability of fertilizers, source of obtaining fertilizer, distance to source, cost of fertilizer and ability to buy fertilizer. Section Three discusses fertilizer use constraints and quantities of fertilizer used on maize. Section Four discusses farmers' orientation towards the access and use of fertilizer. Section Five discusses Fertilizer policies and information support for fertilizer use.

The relationship between fertilizer use and farmers access to fertilizer is discussed in Section Six. Section seven discusses the relationship between fertilizer use and socio-demographic and farm-related characteristics of the farmers. Section eight based on results of the study provides recommendations considered worthwhile to ensure the increased access and use of fertilizer in Ghana.

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Socio-Demographic and Farm-Related Characteristics of Farmers

Tables 4 to 14 present some demographic data of the farmers selected for the study. These include sex, age, marital status, educational level, household size, farming experience, farm size, farming income, occupational status and types of crops cultivated by the farmers.

Sex Distribution of Farmers

A total of 720 farmers were sampled for this study. Table 4 shows the sex grouping of 77.36% males and 22.64% females. The study revealed that the men farmers interviewed were more than three times (77.36%) the number of women farmers (22.64%). This is consistent with the findings of Dankwa (2002) who conducted a survey in Ashanti region and found that out of the 160 farmers interviewed 135 were males and 25 females. Kumi (2004) and Marshall (2004) also found male farmers populations to be higher than those of female farmers in their studies. Despite these findings it has been observed that women farmers constitute the larger agricultural labour force in Ghana and produce seventy percent (70%) of the food crops (MOFA, 2001).

Obinne (1995) in his research pointed out that although women contribute the greatest percentage in farming occupation in Nigeria, they have inadequate access to extension service. FAO (1998) is of the view that females in the rural areas are loaded with domestic tasks and family obligations and are controlled by social restraints such that they are not able to leave home to participate in

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extension programmes. In line with these observations the low number of female farmers recorded in this study could probable be due to social constrains that did not allow them to register with the MOFA offices so as to have the opportunity to be sampled for the study. This study however has recorded a high percentage of males under the background of low use of fertilizer in the country.

Table 4: Frequency distribution of sex of farmers

Sex	Freq	Percent	Cum. Percent
Male	557	77.36	77.36
Female	163	22.64	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

Age Distribution of Farmers

Age of farmers in this study was grouped based on the United Nations' age categorization stated in the literature review. Table 5 shows the age groupings and the age distribution of farmers interviewed. The farmers in the study were of different age groups. Age is an important factor in the performance, perceptions and abilities of an individual. The mean age for farmers interviewed was 43.7years with a standard deviation of 10.41. The Table also shows that 22.4 percent of the farmers were 34 years and below, while 5.8 percent were older than 60 years. Most of the farmers (69.72%) fell within the age range of 35 to 60 years which

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was found to be the modal group. However Asante (2002) and Mensah (2006) in their studies on cocoa farmers, found farmers of ages of fifty years and above dominating the cultivation of cocoa farms in Ghana.

Table 5: Frequency distribution of age of farmers

Age (Years)	Freq	Percent	Cum. Percent
34 years and below(Youth)	176	24.44	24.44
35 to 60 years (Adult)	502	69.72	94.16
More than 60 (Elderly)	42	5.84	100
Total	720	100	

n = 720 Mean = 43.7 SD =10.41 Source: Field Survey Data, 2012

A study carried out by Keraita & Drechsel (2004) revealed that the bulk of farmers in Ghana fall between the ages of 20 and 40 years. In Nigeria it was found that majority of farmers were between the ages of 31 and 50 years (Ofuoku, Egho & Enujeke, 2009; Ogunlade, Agbeniyi & Oluyole 2010). The Ministry of Food and Agriculture in a study in Akuapim South Municipal also found that majority of farmers in Ghana fall between the age of 30 and 50 years (MOFA, 2011). These findings show that more younger men and women are now in the farming profession and this is significantly going to influence agricultural production as it has been found that younger people are receptive to change and are more willing to accept risk, and therefore the risk of adopting and using a technology like the

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application of fertilizers. Also younger farmers are said to have longer planning horizons and are therefore more likely to adopt and use fertilizer (Myers, 1991).

Educational level of Farmers

Table 6 shows the educational background of farmers interviewed. The educational background of farmers interviewed was generally low, about a total of 53.4% had only up to Basic school education. 23.9% of farmers interviewed had no formal education at all, while 12.1%, 3.9% and 5.6% of farmers interviewed had secondary, technical and tertiary education respectively. The findings of this study is similar to that of Opoku-Asiama (2008) who reported in her study that 29.2% of the farmers in the Ga East and Ga West of Ghana did not have any formal education and concluded that this would negatively affect their ability to receive, decode, and understand written information, and also accept technologies requiring calculation skills. The very low percent of farmers with higher levels of education engaged in farming shows that people with higher levels of education prefer not to engage in farming, as they do not find it to be attractive and profitable.

To increase the intensity of fertilizer use will require improving the knowledge levels of farmers through increasing training and education. It has been established that farmers who acquire some form of education easily adopt and use technologies than those who do not (Asiabaka and Owens, 2002). Oluoch-Kosura,Marenya & Nzuma (2001) also examined the factors affecting the adoption of soil fertility management technologies as well as intensity of fertilizer use in

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Kenya, their results indicated that education (formal schooling) positively influenced the use of fertilizer. The nature of information collection and interpretation associated with fertilizer application suggests that more education would enhance the ability of the farmer to use fertilizer. Education gives farmers better access to information about fertilizers and more knowledge of how much fertilizer to use, thus education is expected to favourably affect fertilizer use decision (Zhou, Yang, Mosler & Abbaspour, 2010). According to Zhou et al (2010) the literacy level among farmers is highly correlated with the utilization of fertilizer and modern technology as a whole. It is therefore important for the youth of today to have the desire to have their education to at least the senior high school level, and to take up the challenge of going into farming using improved technology.

Table 6: Frequency distribution of educational level of farmers

Educational Level	Freq.	Percent	Cum. Percent
No formal education	172	23.9	23.9
Basic	385	53.4	77.3
Secondary/High/O-level/ A-level	87	12.1	89.4
Technical/Vocational/Commercial	28	3.9	99.3
Tertiary	48	6.7	100
Total	720	**100**	

n = 720 *Source: Field Survey Data, 2012*

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Marital Status of Farmers

Table 7 below shows the marital status of the farmers. Majority of the farmers (89.03%) are married. This is followed by 5.6% of the farmers who are not married. The widows are 3.8%, and the remaining minority of 1.12% are divorced and separated. It is generally accepted that the status of being married makes both men and women to be more responsible and to take whatever they are doing more seriously.

Table 7: Frequency distribution of marital status of farmers

Marital Status	Freq	Percent	Cum. Percent
Single	43	5.97	5.97
Married	641	89.03	95.0
Divorced	4	0.56	95.56
Separated	4	0.56	96.12
Widowed	28	3.88	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

The marital status of farmers could help in stimulating them to improve the conditions of their farms, for instance, by adopting improved methods of farming in order to produce more food for their families. Table 7 shows that 89.03% of the farmers are married; this is similar to the findings of Baah, Anchirinah & Amon-

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Armah (2011) who found 82% of cocoa farmers interview in the Eastern Region to be married. A greater percentage of the farmers being married are more likely to utilize more fertilizer for more yields since they are likely to have more dependents to feed.

Farming Experience of Farmers

For the purpose of this study, farmers were classified into less experienced, experienced and very experienced. Table 8 shows that about 6.4% of the farmers have been farming for 4 years and below, 16.9 % have been farming for 5 years to 10 years, and the remaining 76.7% of the farmers have been farming for more than 10 years. This result confirms the observation made by Egyir and Beinpuo (2009) in their studies on urban agriculture that majority of farmers had farming experience of over ten years.

Table 8 : Frequency distribution of farming experience of farmers

Farming exp (years)	Freq	Percent	Cum. Percent
4 years and Below (Less Experienced)	46	6.4	6.4
5 – 10 (Experienced)	122	16.9	23.3
Above 10 years (Very Experienced)	552	76.7	100
Total	720	**100**	
n = 720	*Mean = 15.41*		*S.D = 1.90*

Source: Field Survey Data,2012

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The mean years of experience of farmers were, 15.4 years with a standard deviation of 1.90. The results, according to this study's classification show that most of the farmers are experienced, 76.7% of farmers interviewed have had more than ten years working experience. Oluyole, Adebiyi & Adejumo (2007) found that farming experience is positively related to agricultural production and management abilities, and concluded that knowledge is obtained through experience over the years of work. It is therefore, expected that farmers' accumulated experience in farming would positively influence their perception of improved technologies and thus the use of fertilizer. Accumulated farming experience may also help farmers to adjust to adverse farming conditions and to adopt modern farming technologies (Kaijage, 1989).

Occupational Status of Farmers

For the purpose of this study, fulltime farmers are farmers who do not have other source of income and rely solely on farming for their livelihood. Farmers with additional occupation are farmers who have other source of income and do not rely solely on farming for their livelihood. Table 9 shows that out of the 720 farmers sampled, 75.7% are fulltime farmers while 24.3% are farmers with additional occupation.

Views on occupational status of farmers and fertilizer use are varied in literature. Udoh and Umoh (2011) are of the view that full time farmers are more likely to adopt and use modern farming techniques including the use of fertilizers.

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Table 9: Frequency distribution of occupational status of farmers

Occupational Status	Freq	Percent	Cum Percent
Fulltime Farmers	543	75.7	75.7
Farmers with additional occupation	175	24.3	100
Total	**720**	**100**	

n = 720 *Source: Field Survey Data, 2012*

Reardon *et al.* (1999) are of the view that farmers with additional occupation are often educated and innovative in ways of improving their farms. Ouma et al (2006) observed that farmers with additional occupation are able to make extra income which may be channeled into the acquisition of farm inputs and technologies including the purchase of fertilizer. It is interesting to note that all the views expressed point to the fact that both the full time and farmers with additional occupation have the capacity to increase the use of fertilizer based on certain advantages they possess.

Household Size of Farmers

For the purpose of this study, households were classified into small for 1 to 5 members, medium for 6 to 8 members, large for 9 and more members. Table 10 shows the various household sizes of farmers interviewed, most farmers, 38.3%, had household size of six to eight living under the same roof; 36% of farmers had household with membership of 1 to 5, and then 25.7% of farmers with household

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of 9 and more members. The results show most farmers (74.3%) interviewed have small to medium household size.

Table 10: Frequency distribution of household size of farmers

Household Size (Numbers)	Freq	Percent	Cum. Percent
1-5 (Small)	259	36.0	36.0
6-10 (Medium)	276	38.3	74.3
More than 10 (Large)	185	25.7	100
Total	**720**	**100**	

n = 720 *Source: Field Survey Data, 2012*

Shiferaw and Holden (1998) reported that adoption and use of technology was higher among smaller households. This might be because larger households are likely to have less resource as compared to the small ones, hence will commit less resource to the adoption and use of fertilizer which they may find not to be affordable. This is in contrast with the finding of Bhati (1975), who found a positive effect of household size on adoption and use of fertilizer. Makokha *et al* (2001) in their studies on the effect of various factors on farmer's demand for fertilizers in Kenya, found household size to have a significantly positive influence on farmers' demand for fertilizer. This however is in contrast with the finding of Suh (1976), Yim (1978) and Flinn *et al* (1980) who reported that household size is an insignificant variable in fertilizer use. Although the effect of household size on fertilizer use by farmers has been varied in literature, it can still be said that the

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size and composition of each household is unique and could influence farming and fertilizer use.

Farm size of Farmers

For the purpose of this study, farm size was classified into small for 2 hectares and less, medium for 3 ha to 5 ha, and large for more than 5 ha. Table 11 shows the various farm sizes of farmers interviewed, most farmers, 67.4%, had farm size of 2 ha and less; 21.5% of farmers had farm size of 3 ha to 5 ha, and then 11.1% of farmers with farm size of 5 ha and above. The results shows most farmers (67.4%) interviewed have small farm size as farm sizes of less than 2 hectares of crop land are usually considered small (Nagayets, 2005) This study found the mean farm size to be 1.8ha, but in 2006, MOFA reported the mean farm size of farmers in Ghana to be 1ha.

Table 11: Frequency distribution of farm size of farmers

Farm size (ha)	Freq	Percent	Cum. Percent
Small (2ha and Less)	485	67.4	67.4
Medium (3-5ha)	155	21.5	88.9
Large (More than 5ha)	80	11.1	100
Total	**720**	**100**	
n = 720	*Mean = 1.8*	*SD =1.69*	

Source: Field Survey Data, 2012

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It has been reported by Obasi (2007) that farm size determines the quantity of inputs use and that there exist a direct relationship between farm size and productivity. Ariga et al (2008) also found out that farm sizes have a positive and direct effect on the purchase and use of fertilizer. It is assumed that the size of a farm is directly related to the farmer's wealth, and farmers with large scale farms are more likely to adopt a technology, especially if the technique requires an extra cash investment. Large scale farmers therefore are likely to use more fertilizers and other improved technologies than small scale farmers. In this research most farmers interviewed were found to be small scale farmers and are therefore not likely to purchase and use fertilizers.

Farming Income

For the purpose of this study, farmers' income recorded was classified into small for GHC 1,400 and less; medium for GHC 1500 – GHC 2500; and large for more than GHC 2500. Table 12 shows the various income levels of farmers interviewed, most farmers, 73.33%, had income ranging between GHC 1,400 and less; 16.39% of farmers had income ranging between GHC1500 – GHC 2500; and then 10.28% of farmers with income of more than GHC 2500. The results show most farmers (73.33%) interviewed have low income.

Income of farmers has implications for acquisition of agricultural inputs and agricultural production. The income level of a farmer determines his spending. According to Udoh and Umoh (2011) farmers with high level of income are likely

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to purchase large quantities of farm inputs. Wealthier farmers may be the first to try a new technology, especially if it involves purchased inputs like fertilizer. This may be because wealthier farmers are more able to take risks or have better access extension information or to credit, or they may be able to use their own cash resource to experiment with a new technique (CIMMITY, 1993). This study shows that majority of farmers interviewed are low income earners. The lower the income level, the lower the response to the purchase of needed farm inputs, and this affects the use of fertilizer in the country. Most farmers in Ghana are low income earners, this limits their ability to purchase agricultural inputs, expand their farms and use improved technologies.

Table 12: Frequency distribution of farmers' income

Farmers' income (GHC)	Freq	Percent	Cum. Percent
Low (1400 and less)	528	77.33	73.33
Medium (1500 - 2500)	118	16.39	89.72
High (More than 2500)	74	10.28	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

Major Crops Cultivated by Farmers

The frequency distribution of major crops cultivated in the country is presented in Table 13. Maize, vegetables, and cassava were the major crops

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selected, and were indicated by 79.4%, 67.1%, and 48.5% of the farmers respectively as the major crops cultivated on their farms. While 48.1% of the farmers claimed cocoa was the major crop, for 46.5% of them it was plantain, whilst 44.7% cultivated sorghum. The remaining of major crops cultivated by the farmers included oil palm (40.1% of the farmers), groundnut (36.4% of the farmers), citrus (36.1% of the farmers), millet (35.5% of the farmers), cowpea (33.5% of the farmers), rice (32.1% of the farmers), yam (27.5% of the farmers), cocoyam (20.7% of the farmers), coconut (14.9% of the farmers), and rubber (7.4% of the farmers) in descending order of importance.

The results of this study confirms that of Gerken *et al* (2001) who found sheanuts, cashew and bambara beans in addition to crops found in this study as the major crops cultivated in Ghana. The study indicates that Maize, vegetables, and rice are cultivated in all the agro ecological zones. Cassava is cultivated in all the agro ecological zones except the Sudan savannah. Tree crops cultivated in Ghana include citrus, coconut, oil palm, and rubber in the Rain forest, citrus and oil palm in the Forest zone, citrus in the Transitional zone, and coconut in the Coastal savannah. The intensity and distribution pattern of rainfall and the soil type determines the crop type that can be cultivated in a particular agro ecological zone. The soil type and the crop cultivated can also determine the type and quantity of fertilizer to use in a particular agro ecological zone. According to Gerken, Suglo & Braun (2001) and IFDC (2012) in Ghana cereals like maize, sorghum and rice account for a larger share of fertilizer use. Also vegetables and horticultural crops also account for an appreciable proportion of fertilizer use. Based on the crops

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Table 13: Frequency distribution of major crops cultivated by farmers

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Crop Mixture	AGRO-ECOLOGICAL ZONE												Total	Total
	Rainforest		Forest		Transitional		Coastal Savannah		Guinea Savannah		Sudan Savannah			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Maize	106	88.33	118	98.33	120	100.00	115	95.83	74	61.67	39	32.50	572	79.40
Vegetable	51	42.50	83	69.17	108	90.00	98	81.67	113	94.17	30	25.00	483	67.10
Cassava	39	32.50	120	100	103	85.83	74	61.67	13	10.83			349	48.50
Cocoa	73	60.83	111	92.50	105	87.50	57	47.50					346	48.10
Plantain	71	59.17	102	85.00	115	95.83	47	39.17					335	46.50
Sorghum					91	75.83			118	98.33	113	94.17	322	44.70
Oil Palm	63	52.50	98	81.67	86	71.67	42	35.00					289	40.10
Groundnut					89	74.17			97	80.83	76	63.33	262	36.40
Citrus	74	61.67	98	81.67	88	73.33							260	36.10
Millet					22	18.33			114	95.00	120	100.00	256	35.50
Cowpea			19	15.83	61	50.83	41	34.17	63	52.50	57	47.50	241	33.40
Rice	42	35.00	29	24.17	62	51.67	13	10.83	75	62.50	10	8.33	231	32.10
Yam					78	65.00			120	100.00			198	27.50
Cocoyam	29	24.17	62	51.67	58	48.33							149	20.70
Coconut	35	29.17					72	60.00					107	14.90
Rubber	36	30.00	17	14.17									53	7.40

n = 720 (multiple responses) *Source: Field Survey Data, 2012*

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cultivated in the various agro-ecological zones as shown in Table 13, it can be inferred that farmers in the Guinea savannah and Transitional forest zones use more fertilizer as the bulk of cereals are cultivated in the two zones.

Cropping System Practiced by Farmers

Table 14 shows the frequency distribution of the type of cropping system practiced by farmers interviewed. Mixed cropping is practiced by 91.6% of the farmers in the Rain forest zone, 90.8% of farmers in the Forest zone, 70% of farmers in the Coastal savannah, 60.8%, 52.5%, and 50.8% of farmers in the Transitional, Guinea Savannah and Sudan Savannah zones respectively. The Table shows that mono cropping is practiced by 49.2%, 47.5%, 39.2%, 30%, 9.2%, and 8.4% of the farmers in the Guinea Savannah, Sudan savannah, Transitional, Coastal Savannah, Forest, and Rainforest respectively.

Majority of farmers interviewed across the various Agro-ecological zones practice mixed cropping. This confirms the findings of Gerken, Suglo & Braun (2001) who found mixed cropping as the main system of farming in Ghana. With this system two or more crops are cultivated simultaneously on the same plot of land and is practiced mainly at the subsistence level. Mono cropping on the other hand is the modern type of farming, which is more open and done on a large-scale. It is more geared towards the production of industrial or export crops such as rubber, oil palm, citrus, cocoa, cotton, coconut, and pineapple, and to a lesser extent, maize, rice, and vegetables. Modern methods are used in the mono cropping system, which include farm machinery, irrigation, improved seed

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varieties, pesticides, and fertilizer (Grove, 1993). Baidu-Forson (1999) in his study found farm size and type of cropping system practiced to be among factors influencing adoption of land-enhancing technology in the Sahel zone. Most of the respondents in this study according to the results practice mixed cropping. They may therefore not use improved technology like fertilizer on their crops, as their farms could only be for sustaining the family and not for commercial purpose.

Table 14: Frequency distribution of cropping system practiced by farmers

Agro Ecological Zone	Cropping System	Frequency	Percent
Rainforest Zone	Mono Cropping	10	8.4
	Mixed Cropping	110	91.6
Forest Zone	Mono Cropping	11	9.2
	Mixed Cropping	109	90.8
Transitional Zone	Mono Cropping	47	39.2
	Mixed Cropping	73	60.8
Coastal Savannah Zone	Mono Cropping	36	30.0
	Mixed Cropping	84	70.0
Guinea Savannah	Mono Cropping	61	50.8
	Mixed Cropping	59	49.2
Sudan Savannah	Mono Cropping	63	52.5
	Mixed Cropping	57	47.5
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

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Accessibility of Fertilizers to Farmers

Fertilizers are important inputs for increasing agricultural productivity; farmers who have no access or cannot afford to buy and use fertilizers usually have low yields (Okon & Enete, 2009). FAO (2005) and Annequin (2010) mentioned unavailability and irregular supply of fertilizer as constrains influencing fertilizer use in West Africa. The first objective of this study seeks to determine the accessibility of fertilizer in Ghana in terms of; the types of fertilizer that are known and used by farmers, the availability of fertilizers to farmers, distance to the nearest source, the cost of fertilizers and farmers ability to buy fertilizers for use. The accessibility of fertilizers in Ghana is discussed in details.

Fertilizer Types Farmers Know

Table 15 presents the type of fertilizer farmers indicated that are found in the Ghanaian market. The most known fertilizer is the NPK which 94.2% of farmers interviewed are aware of. This is followed by the Sulphate of Ammonia, known by 88.1% of farmers. The least known fertilizer among the farmers is the Diammonium phosphate followed by the Muriate of potash, which are known by 6.7% and 1.1% of farmers respectively. Other fertilizer types which include Cocofeed, Kieserite, SSP, TSP, Organic foliar fertilizer, Sidalco, Sulfan are also known by 13.1% of the farmers.

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Table 15: Frequency distribution of fertilizer types farmers know

Fertilizer type	Freq.	Percent
NPK	678	94.2
Urea	455	62.2
Sulphate of Ammonia	634	88.1
Muriate of potash	48	6.7
Diammonium phosphate	8	1.1
Asase Wura	308	42.8
Others (Cocofeed, SSP, TSP, Organic foliar fertilizers, Kieserite , Sidalco, Sulfan, etc)	94	13.1

n = 720 (Multiple Responses) Source: Field Survey Data, 2012

Bumb et al (2011) reported that the main fertilizer types imported and used in Ghana are Urea, Sulphate of Ammonium, Diammonium phosphate, and NPK product and their blends, and this is consistent with the results of this study. The Ghana government in the 1960s and 1970s imported Sulphate of Ammonuim and later in the 1980s imported various forms of NPKs, Urea, Muriate of Potash, and Diammonium Phosphate. These fertilizers were promoted for use by Extension Officers. It is surprising that after fifty decades of research on fertilizer use and recommendations, instead of site and crop specific fertilizer

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blends, the fertilizer types currently on the market are still the same as those that were previously promoted by the government in the 1980s.

Factors Influencing the Choice of Fertilizer Type by Farmers

There are many factors that can influence the decision made by a farmer regarding the choice of fertilizer type to use on the farm. From Table 16, the most influential among the factors affecting the choice of fertilizer among farmers is the performance of crops when fertilizers are applied to, this was indicated by 65.4% of farmers interviewed. Second most influential factor in the choice of fertilizer by farmers is the type of crop under cultivation by the farmer, indicated by 64.7% of farmers. This is followed by Recommendations by AEAs, FBO, or NGOs, selected by 60.6% of farmers, then knowledge or information about the effectiveness of the fertilizer, selected by 55.6% of farmers. 40.7% of farmers indicated price of fertilizer influence their choice, followed by recommendation by input dealers, and other sources, indicated by 30% and 22.6% of farmers respectively. Least among the factors selected by 12.8% of farmers is the promotions by the fertilizer companies.

The majority of farmers (65.4%) selected crop performance as the most influential factor, this implies farmers choose fertilizers depending on the fertilizer's ability to increase their crop yields and improve on their profit margins. This confirms the findings of Kelly (2006) that profitability of fertilizer use is associated with crop response to nutrients in the fertilizer, and is a determinant of

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fertilizer use. The type of crop the farmer cultivates is the second factor which influences farmers' decision as to the type of fertilizer to use, this is so because each crop has its specific nutrient needs, cereals like maize, sorghum, rice, etc may need some levels of nitrogen which can be found in various fertilizer types like NPKs, SA, DAP, and Urea. Whilst horticultural and tree crops like oil palm, citrus, pineapple, etc may need some levels of nitrogen, potassium, and phosphates which can be found in various NPKs, DAP, and Muriate of potash, it is therefore not surprising farmers would like to buy fertilizer depending on the type of crop they intend cultivating.

Farmers are of the view fertilizers are not affordable, it is not surprising price of fertilizer has been indicated by 40.7% of farmers as a factor influencing the choice of fertilizer type to use. Farmers are likely to use fertilizer types that are cheap and may not be appropriate for their soil type and crops, or may use lesser quantities of fertilizer because they may not have the ability to buy enough. Knowledge or information about the fertilizer was indicated by 55.6% of the farmers. When appropriate information is disseminated this helps the farmers to make decision on types of fertilizer and quantities to use, and types of crops to use them on; farmers are therefore able to make the right decision when they have the appropriate information.

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Table 16: Frequency distribution of factors influencing choice of fertilizer type by farmers

Factor	Frequency	Percent
Crop performance	469	65.4
Type of crop being cultivated	466	64.7
Recommendations by AEA, FBO or NGO	436	60.6
Knowledge or information about the effectiveness of fertilizer	400	55.6
Price of fertilizer	293	40.7
Recommendation by input dealers	216	30.0
Information from other (radio, newspaper, etc)	163	22.6
Type being used by neighbours	156	21.7
Promotion of fertilizer companies	92	12.8

n = 720 (multiple responses) *Source: Field Survey Data, 2012*

Availability of Fertilizer

Availability of fertilizer as indicated by farmers is captured in figure 3. According to majority of the farmers (41.6%), fertilizer is only available sometimes. On the other hand, 33.2% of farmers say fertilizers are often available and 24.7% of them say fertilizers are always available, while 0.5% of farmers

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indicated that fertilizer is never available. This finding implies that about 50% of farmers interviewed find the availability of fertilizer not to be as required. Yawson, Armah, Afrifa & Dadzie (2010) and Donkor & Awuni (2011) found out that farmers were of the view that fertilizers are expensive and not readily available in their communities. Fertilizers are never or only sometimes available to about 50% of farmers interviewed, this is because most private entrepreneurs are reluctant to establish fertilizer supply shops in the rural areas leading to limited supply or limited availability of fertilizers to farmers in remote areas.

Jayne, Govereh, Wanzala & Demeke (2003) in their study on fertilizer market development reported on low levels of fertilizer use in many countries due to the fact that distribution points are scattered and happened not to be close to the fertilizer user or farmer. Gregory and Bumb (2006) also reported that unavailability of fertilizer is one of the problems leading to low use of fertilizer in developing countries.

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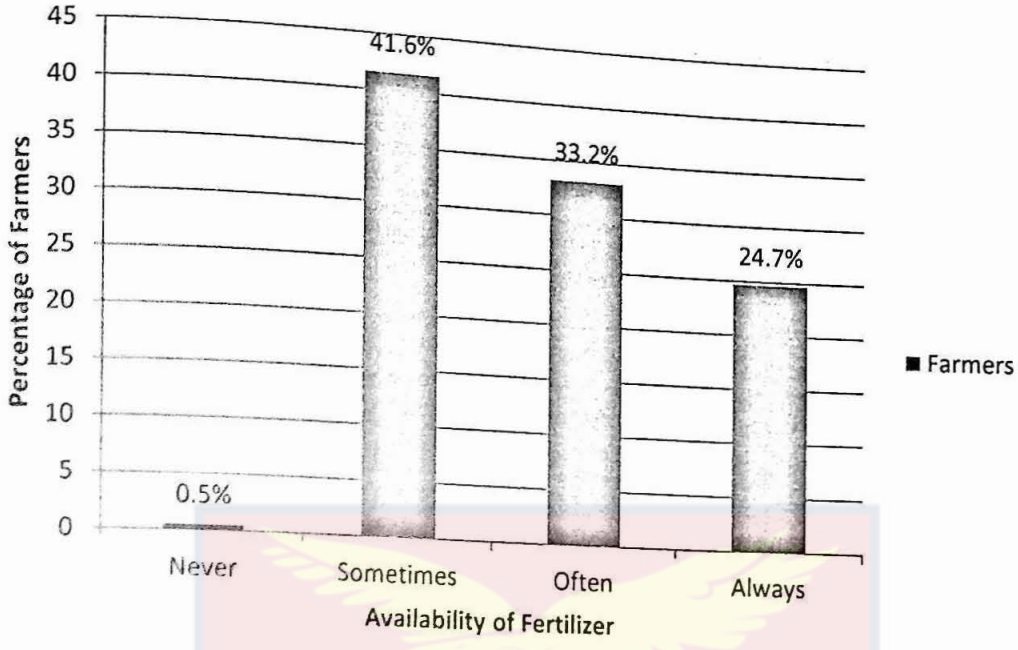


Figure 3: Availability of fertilizer *Source: Field Survey Data, 2012*

Source of Obtaining Fertilizer

As presented in Table 17, the leading source of fertilizer acquisition among the farmers is the agro input dealers, indicated by 72.4% of farmers interviewed; this is followed by the Agricultural Extension Agents as a source, indicated by 52.8% of the farmers, and then markets as source where fertilizers are obtained indicated by 23.6% of the farmers. Other sources where farmers obtain their fertilizers include the wholesalers, indicated by 8.8% of the farmers, 8.6% of farmers indicated they obtain fertilizer from other farmers. The Table shows that 7.1% of farmers obtain fertilizers from other sources such as the MOFA block farm project, cocoa purchasing clerk, cocoa hi-tech company, private agents, district agriculture offices and plantation farm project.

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Farmers interviewed obtain their fertilizer through other farmers and AEAs due to the fact that they are probability located far from the purchasing center or shops. Though AEAs and other farmers are not registered dealers, they serve as a link between the farmers and the Agro input dealers. The remaining farmers interviewed (23.6%) obtain their fertilizers from markets, these traders who sell in the markets are mostly unregistered middlemen who sell on table tops and are likely to sell adulterated and improperly stored fertilizers. The sources indicated by farmers confirm the fertilizer supply system currently operating in

Table 17: Frequency distribution of source of fertilizer

Source of fertilizer	Frequency	Percent
Agro input dealer	521	72.4
AEA	380	52.8
Market	170	23.6
Distributors (wholesale)	63	8.8
Other farmers	62	8.6
Others (MOFA block farm project, CPC, CHC, private agents, DAO, plantation farm project)	51	7.1

CPC- Cocoa Purchasing Clerk CHC- Cocoa Hitech Company DAO- District Agriculture Offices

Source: Field Survey Data, 2012

n =720 (multiple response)

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Ghana as observed by Gregory and Bumb in 2006 where farmers buy from retailers (agro input dealers, AEAs, and open market) and wholesalers (distributors) located in the districts and regional capitals respectively. The lack of retail shops at the remote farming communities compel some farmers to buy from other farmers and some AEAs who are not registered to sell fertilizer.

Distance to Source of Fertilizer

Distance covered in order to reach one's source of fertilizer can also affect the decision on fertilizer use. Table 18 shows that majority of farmers (49.6%) interviewed have to travel 11km to 20km in order to acquire their fertilizers. This is followed by a high percentage of farmers (42.4%) that travel between 1km to 10km to reach their fertilizer sources. The remaining 8.1% have to travel more than 20km in order to get fertilizer for their farms. The table also shows that the farmers interviewed had to travel an average distance of 13.7km to the source of fertilizer. Oumou & Ariga (2011) in their study in Kenya found the average distance travelled by farmers to purchase fertilizer to be 4.2km. This is an indication that the situation in Ghana needs to be improved upon.

According to Waithaka et al (2007) the distance from farms to source of fertilizer gives an indication of access to fertilizer. The distance also determines the level of fertilizer use, because as the distance to fertilizer source increases, it will result in the decreased use of fertilizer. Udoh and Umoh (2011) observed that the amount of fertilizer used declines with increasing distance to the nearest

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fertilizer source. This is because far distance attracts additional cost due to increase in transport fares.

Table 18: Frequency distribution of distance to source of fertilizer

Distance to Source	Freq	Percent	Cum Percent
Near (1 to 10km)	305	42.4	42.4
Far (11 to 20km)	357	49.6	91.9
Very Far (21km and above)	58	8.1	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

Perceived Cost of Fertilizer

Table 19 shows that 43.3% of farmers interviewed perceived the price of fertilizer to be high; this is followed by 28.8% of farmers who indicated that the cost of fertilizer is very high. Although 27.6% indicated that the cost is moderate, only 0.3% indicated the cost of fertilizer is low. This result is similar to the findings of Gregory and Bumb (2006) who found the farm-gate prices of fertilizers of countries in sub-Sahara Africa to be higher than that of international price levels. The high cost could be as a result of supply problems which include inefficiency in procurement, distribution, marketing, and high internal transportation costs (Kelly, 2006). The high cost of fertilizers could be attributed to the implementation of neoliberal policy of unregulated market by the freeing of private enterprises from any bonds imposed by the government and the subsequent withdrawal of government from the direct importation of fertilizer. The high cost could also be attributed to the fact that Ghana does not produce inorganic fertilizer

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domestically and imports all fertilizers into the country for use by farmers. The fluctuations in world prices, depreciating exchange rates in the country and the maximization of profit by private companies together contribute to the eventual high cost of fertilizer in the country (Bumb, Teboh, Atta & Asenso-Okyere, 1994).

Appendix D shows the prices of fertilizer products on the market during the period the survey of this research was conducted. In this study a total of 72.1% of farmers indicated that the cost of fertilizers is high or very high. The cost of fertilizer may determine to a large extent whether or not a farmer will use fertilizer; higher prices therefore adversely affect fertilizer use. In their study of determinants of fertilizer use for maize production, Makokha *et al* (2001) cited high prices as one of the constraints that hindered the use of fertilizers. Udoh and Umoh (2011) in their study on fertilizer use in rural Nigeria found that the prices of fertilizer are extremely high and as a result prevented low income farmers from purchasing fertilizer for use.

Table 19: Frequency distribution of farmers' perception of cost of fertilizer

Cost of Fertilizer	Freq	Percent	Cum. Percent
Low	2	0.3	0.3
Moderate	199	27.6	27.9
High	312	43.3	71.2
Very High	207	28.8	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

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Ability to Buy Fertilizer

Table 20 shows that 50% of farmers interviewed indicated that they are often able buy fertilizer for use; this is followed by 28.9% of farmers who indicated that they are able to buy fertilizer sometimes. Although 11.8% indicated that they are never able to buy fertilizers, 9.3% indicated that they are able to buy fertilizers always. This result is similar to the findings of Okoedo-Okoje and Aphunu (2011), who found majority of farmers in the Delta State of Nigeria unable to purchase fertilizer for use. Accessibility to fertilizers is a function of availability of fertilizer and the ability of the farmer to buy the needed quantity of fertilizer for use. Crawford, Jayne, & Kelley (2006) described factors impacting farmer demand for fertilizers as the inability to buy the desired amount of fertilizer

Table 20: Frequency distribution of farmers' ability to buy fertilizer

Ability to buy fertilizer	Frequency	Percent	Cum. Percent
Never	85	11.8	11.8
Sometimes	208	28.9	40.7
Often	360	50.0	90.7
Always	67	9.3	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

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for effective use so as to have the desired result of optimum or improved productivity. The inability to buy fertilizer could be the result of lack of resource to purchase the fertilizer or the unavailability of fertilizer.

Relationship between Sex of Farmer and Ability to buy Fertilizer

Table 21 shows the cross tabulation of sex of farmers interviewed against their ability to buy fertilizer. A total of 557 males and 163 females were interviewed. Only 10 (6%) of the women were able to always buy fertilizers as against 57 (10%) of the men interviewed. The table shows that the Chi square statistical analysis comparing the difference between males ability to buy fertilizer and females ability to buy fertilizer indicates the difference existing among the number of males and females is significant [$x^2_{(1, N=720)} = 11.98$, P=0.01].

Table 21: Cross tabulation of sex of farmer with ability to buy fertilizer

Sex	Never	Sometimes	Often	Always	Df	x^2	Sig.
Male	61	147	292	57	1	11.98	0.01*
Female	24	61	68	10			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

This implies men are able to buy fertilizer more than women. Croppenstedt & Demeke (1996) in their study noted that in areas where variations exists in the access to facilities like credit, extension visits and other farming resources for men and women, men are likely to have better access and would be able to buy fertilizer and other farming inputs. Women on the other hand have limited access

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to resource and may not be as able as the men to purchase needed farming inputs including fertilizers.

Relationship between Age of Farmer and Ability to buy Fertilizer

Table 22 shows the cross tabulation of Age of farmers interviewed against their ability to buy fertilizer. A total of 502 adults, 176 youth and 42 elderly were interviewed. The table shows that the Chi square statistical analysis comparing the difference between the ability of the different age groups to buy fertilizer indicates that the difference existing among the number of youth, adult and elderly is significant [$x^2_{(2,\ N=720)} = 22.05$, P=0.00]. The table shows that majority of the farmers totaling 308 who often and always have the ability to buy fertilizers are those who fall in the adult age group. This confirms the observation of Waithaka, Thorton, Sherperd, & Ndiwa (2007) that older farmers may have more experience and resources, hence have wider investment options and ability to buy fertilizer for use. On the other hand younger farmers are likely to own smaller parcels of land, less resourced and may not be able to buy fertilizer for use always.

Table 22: Cross tabulation of age of farmer with ability to buy fertilizer

Age	Never	Sometimes	Often	Always	df	x^2	Sig.
Youth	20	54	89	13	2	22.05	0.00*
Adult	51	143	256	52			
Elderly	14	11	15	2			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

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Relationship between Educational Level and Ability to buy Fertilizer

Table 23 shows the cross tabulation of the educational level of farmers interviewed against their ability to buy fertilizer. A total of 548 of the farmers had formal education, and 172 had no formal education. The table shows that the Chi square statistical analysis comparing the difference between the ability of the different educational levels to buy fertilizer indicates the difference existing among the number of the different educational levels is significant [$x^2_{(4, N=720)} = 11.51$, P=0.03].

Table 23: Cross tabulation of educational level with ability to buy fertilizer

Educational Level	Never	Sometimes	Often	Always	df	x^2	Sig.
No formal education	21	61	75	15	4	11.51	0.032
Basic	48	108	193	36			
Secondary/High/O-level/ A-level	9	20	53	5			
Technical/Voc/Com	6	7	9	6			
Tertiary	1	12	30	5			
Total	**85**	**208**	**360**	**67**			

n = 720 *Source: Field Survey Data, 2012*

The table shows that out of the 427 farmers, who are often and always able to buy, a total majority of 337 are educated and the remaining 90 had no formal education. This confirms the findings of Oluoch-Kosura, Marenya & Nzuma (2001) that education (formal schooling) positively influenced the use of fertilizer in Kenya. Educated farmers are able to buy fertilizer because they have better

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understanding of the technology. Pannell, Marshall, Barr, Curtis, Vallency, & Wilkinson (2006) observed that education determines the level of participation and how to relate new technologies and prices of inputs to farming operations.

Relationship between Marital status and Ability to buy Fertilizer

Table 24 shows the cross tabulation of the marital status of farmers interviewed against their ability to buy fertilizer. A total of 641 of the farmers were married, and 43 were not married. The table shows that the Chi square statistical analysis comparing the difference between the ability of the marital status to buy fertilizer indicates the difference existing among the number of the different levels of marital status is significant [$x^2_{(4, N=720)} = 19.88$, P=0.01].

Table 24: Cross tabulation of marital status with ability to buy fertilizer

Marital Status	Never	Sometimes	Often	Always	Df	x^2	Sig.
Single	6	18	18	1	4	19.88	0.01*
Married	71	178	329	63			
Divorced	0	1	3	0			
Separated	0	1	3	0			
Widow	8	10	7	3			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

The table shows that majority of the farmers totaling 392 who often and always have the ability to buy fertilizers are those who are married. It is generally

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accepted that the status of being married makes both men and women to be more responsible and to take whatever they are doing more seriously.

Baah, Anchirinah & Amon-Armah (2011) also found that the marital status of cocoa farmers helped in stimulating them to improve the conditions of their farms, for instance, by adopting improved methods of farming in order to produce more food for their families. Also a greater percentage of the farmers who are married, if they do not have other more serious financial commitments are more likely to utilize more fertilizer for more yields since they are likely to have more dependents to feed.

Relationship between Household size and Ability to buy Fertilizer

Table 25 shows the cross tabulation of the household size of farmers interviewed against their ability to buy fertilizer. A total of 276 of the farmers are found in medium households, 259 in the small households, and 185 in large households. The table shows that the Chi square statistical analysis comparing the difference between the ability of the different households to buy fertilizer indicates the difference existing among the number of the different households is significant [$x^2_{(2,\ N=720)} = 10.05$, P=0.003]. The table shows that 40.3% of the 67 farmers who always have the ability to buy fertilizers are found in the large household. Larger households may have larger farm sizes, and this may lead to the use of more fertilizers. Adoption increases with expansion in farm size; also, farmers with

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Table 25: Cross tabulation of household size with ability to buy fertilizer

Household size	Never	Sometimes	Often	Always	Df	x^2	Sig.
Small	34	89	121	15	2	10.05	0.003*
Medium	35	82	134	25			
Large	16	37	105	27			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

large farms tend to be wealthier and are more likely to be able to apply more fertilizers on their farms. This confirms the finding of Bhati (1975), who found a positive effect of household size on adoption and the ability to buy fertilizer. This study however is in contrast with the findings of Shiferaw and Holden (1998), who found that adoption was higher among smaller households, this might be because smaller households are likely to have more resources than large ones, hence will commit more resources to the purchase of fertilizer. Yim (1978), Flinn, Karki, Rawal, Masicat & Kalirajan (1980) contrary to our findings reported that household size is an insignificant variable in fertilizer use.

Relationship between Farm size and Ability to buy Fertilizer

Table 26 shows the cross tabulation of the farm size of farmers interviewed against their ability to buy fertilizer. A total of 485 of the farmers are found to have small farm sizes, 155 to have medium farm sizes, and 80 to have large farm sizes. The table shows that the Chi square statistical analysis comparing the

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difference between the ability of farmers in the different farm size categories to buy fertilizer. The results indicate that the difference existing among the number of farmers in the different farm size categories is significant [$x^2_{(2, N=720)} = 151.6$, P=0.00]. The table shows that 66.25% of the large scale farmers always have the ability to buy fertilizers, 5.2% of the medium scale farmers always have the ability to buy fertilizer, and only 1.2% of small scale farmers always have the ability to buy fertilizer. This confirms the findings of Ariga et al (2008) who found out that farm sizes have a positive and direct effect on the purchase and use of fertilizer. Large scale farmers therefore are likely to have the ability to purchase and use more fertilizers and other improved technologies than small scale farmers.

Table 26: **Cross tabulation of farm size with ability to buy fertilizer**

Farm size	Never	Sometimes	Often	Always	df	x^2	Sig.
Small	85	189	205	6	2	151.6	0.00*
Medium	0	19	128	8			
Large	0	0	27	53			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

Relationship between Farming Experience and Ability to buy Fertilizer

Table 27 shows the cross tabulation of the farming experience of farmers interviewed against their ability to buy fertilizer. A total of 46 of the farmers are found to be less experienced, 122 found to be experienced, and 552 very experienced. The Chi square statistical analysis comparing the difference between

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the ability of farmers in the different levels of farming experience to buy fertilizer indicates that the difference existing among the number of farmers in the different farming experience levels is significant [$x^2_{(2, N=720)} = 13.37$, P=0.04]. The table shows that majority of the farmers totaling 310 who often and always have the ability to buy fertilizers are found in the very experienced group. A farmer, according to Udoh and Umoh (2011) acquires experience to enable him succeed in farming; this is because studies have shown that the longer one stays in an occupation the higher the skills derived. Oluyole, Adebiyi & Adejumo (2007) also found that farming experience is positively related to agricultural production and management abilities, and concluded that knowledge is obtained through experience over the years of work. The very experienced farmers in this study have the ability to buy fertilizer because they may have gathered knowledge on fertilizer use over the years, are likely to be more skillful and also could be better resourced.

Table 27: Cross tabulation of farming experience with ability to buy fertilizer

Farming Experience (Years)	Never	Sometimes	Often	Always	df	x^2	Sig.
1-4 (less experienced)	4	10	30	2	2	13.37	0.04
5-10 (Experienced)	8	29	71	14			
> 10 (Very experienced)	73	169	259	51			
Total	**85**	**208**	**360**	**67**			

n = 720 *Source: Field Survey Data, 2012*

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Relationship between Farming Income and Ability to buy Fertilizer

Table 28 shows the cross tabulation of the farming income of farmers interviewed against their ability to buy fertilizer. A total of 528 of the farmers are found in low income group, 118 in the medium income group, and 74 in high income group. The Chi square statistical analysis comparing the difference between the ability of the various income groups to buy fertilizer indicates the difference existing among the number of farmers of the different income groups is significant [$x^2_{(2,\ N=720)} = 20.05$, P=0.00]. The table shows that all the 74 high income earners recorded in the study were found among the farmers totaling 427 who often and always have the ability to buy fertilizer. This confirms the findings of Udoh and Umoh (2011) who found farmers with high level of income to be more likely to purchase large quantities of farm inputs. This may be because wealthier farmers are more able to use their own cash resource to purchase farm input like fertilizer.

Table 28: Cross tabulation of farming income with ability to buy fertilizer

Farming Income (GHC)	Never	Sometimes	Often	Always	df	x^2	Sig.
Low (1400 and less)	85	189	242	12	2	20.05	0.00*
Medium (1500-2500)	0	19	91	8			
High (more than 2500)	0	0	27	47			
Total	85	208	360	67			

n = 720 *Source: Field Survey Data, 2012*

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Relationship between Occupational Status and Ability to buy Fertilizer

Table 29 shows the cross tabulation of the occupational status of farmers interviewed against their ability to buy fertilizer. A total of 545 of the farmers are fulltime farmers and 175 are farmers with secondary occupation and are involved in other off farm income generating activities. The Chi square statistical analysis comparing the difference between the ability of the farmers in the full time and farmers with secondary occupation to buy fertilizer indicates the difference existing among the number of the two levels of occupational status is not significant [$x^2_{(1,\ N=720)} = 5.77$, P=0.12]. This implies that both types of occupational status have same ability to buy fertilizer for use.

Ouma et al (2006) however observed that farmers with secondary occupation have other off-farm employment and are able to make extra income which may be channeled into the acquisition of farm inputs and technologies including the purchase of fertilizer. Udoh and Umoh (2011) on the other hand are of the view that full time farmers are more likely to adopt and use modern farming techniques including the use of fertilizers. This study found no significance difference between the two levels of farmers' occupational status. It is interesting to note that all the views expressed point to the fact that both the full time farmer and the farmer with secondary occupation have the capacity to increase the use of fertilizer based on certain advantages they possess.

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Table 29: Cross tabulation of occupational status with ability to buy fertilizer

Occupational Status	Never	Sometimes	Often	Always	df	x^2	Sig.
Full time farmers	71	159	261	54	1	5.77	0.123
Farmers with secondary occupation	14	49	99	13			
Total	**85**	**208**	**360**	**67**			

n = 720 *Source: Field Survey Data, 2012*

Fertilizer Use among Farmers

Fertilizer use in Ghana is among the lowest in the world. According to the FAO report in 2005, Ghana's fertilizer consumption of 8kg/ha is far less than the world's average of 90kg/ha. Yawson, Armah, Afrifa & Dadzie (2010) also stated that fertilizer use is about 12 kg/ha which is still low for the country, fertilizer consumption on the commercial farms and plantations is estimated at 200-300 kg of product/ha, whilst the consumption on the small private farms is in the range of 0-50 kg products/ha.

IFDC (2012) in the assessment of fertilizer use in Ghana found out that on the basis of fertilizer use by crop and region, cereals like maize, sorghum and rice account for a larger share of fertilizer use in Ghana. Although root crops play an important role in providing the national food supply, fertilizer use on root crops is minimal. The second objective of this study seeks to determine the quantity of fertilizer use by maize farmers in the country. Maize has been identified to be

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cultivated in all the regions and zones of the country. The use of fertilizer by farmers is discussed in details.

Relationship between Sex of Farmers and Fertilizer Use

From Table 30, 92% of the farmers out of which 75.0% were males and 17% females, responded in the affirmative that they use fertilizer. The remaining 8% of the respondents constituting 2.4% males and 5.6% females do not use fertilizer. A Chi Square statistical analysis comparing the difference between male fertilizer users and female fertilizer users indicates that the difference existing among the number of males and females who use fertilizer is significant [$x^2_{(1, N=720)} = 9.158$. P=0.00].

Table 30: Cross tabulation of sex of farmers with fertilizer use

	Fertilizer Use				
Sex	Use Fertilizer	Do Not Use Fertilizer	df	x^2	Sig
Male	540(75.0%)	17(2.4%)	1	9.158	0.00*
Female	122(17.0%)	41(5.6%)			
Total	**662 (92.0%)**	**58 (8.0%)**			

n = 720 *Source: Field Survey Data, 2012*

According to CIMMYT (1993) studies have shown that significant difference exist between men and women farmers adoption of technologies. It may be that women farmers are less likely to command resources like land, credit or information to take full advantage of technologies like the use of fertilizer.

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Croppenstedt & Demeke (1996) also noted that in areas where variations exists in the access to such facilities as credit, extension visits and other resources by men and women, sex is likely to affect the rate of technology adoption. Doss and Morris (2001) also observed that sex was significant in the adoption of modern maize varieties and fertilizer in Ghana. According to Waithaka, Thorton, Sherperd & Ndiwa (2007) males may use more fertilizer because they command most of the household resources, including use of cash income. Women on the other hand use less fertilizer because they have smaller farm sizes which require less quantities of fertilizer. Their farm income is low so women may buy less fertilizer. Palm, Myers & Nanda (1997) in Cameroon also conducted studies on household heads and fertilizer use; they observed that more male farmers used fertilizer than female farmers. This study found a significant difference between the number of male farmers and female farmers that use fertilizer, this confirms the findings of Palm et al (1997) and Waithaka et al (2007).

Relationship between Household size and Fertilizer Use

Table 31 shows that, 231 farmers from small households, 253 farmers from medium households and 178 farmers from large households responded in the affirmative that they use fertilizer. The remaining 58 of the respondents constituting 28 farmers from small households, 23 from medium households and 7 from large households do not use fertilizer. A Chi Square statistical analysis comparing the difference between farmers from the different household sizes who use fertilizer indicates that the difference existing among the number of small,

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medium and large households farmers who use fertilizer is significant [$x^2_{(2, N=720)}$ = 9.158, P=0.00]. The households that do not use fertilizer in this study have 48.3% from small households, 39% from medium households, and only 12% from large households. The table also shows that 96.2% of farmers from large households use fertilizer. This confirms the finding of Bhati (1975), who found a positive effect of household size on adoption and use of fertilizer. This is in contrast with the findings of Shiferaw and Holden (1998), who found that adoption and use of fertilizer was higher among smaller households, this might be because smaller households are likely to have more resources than large ones, hence will commit more resources to the purchase of fertilizer which they may find to be affordable.

Table 31: Cross tabulation of household size with fertilizer use

Household Size	Use Fertilizer	Do Not Use Fertilizer	df	x^2	Sig
Small	231	28	2	7.24	0.027*
Medium	253	23			
Large	178	7			
Total	662	58			

n = 720 *Source: Field Survey Data, 2012*

Makokha *et al* (2001) in their studies on the effect of various factors on farmer's demand for fertilizers in Kenya, also found household size to have a significantly positive influence on farmers' demand for fertilizer.

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Relationship between Farm size and Fertilizer Use

Table 32 shows the cross tabulation of the farm size of farmers interviewed against fertilizer use. A total of 485 of the farmers are found to have small farm sizes, 155 to have medium farm sizes, and 80 to have large farm sizes. The table shows that the Chi square statistical analysis comparing the difference between fertilizer use by farmers in the different farm size categories. The results indicate that the difference existing among the number of farmers in the different farm size categories is significant [$x^2_{(2, N=720)} = 22.65$, P=0.00]. The table shows that 88.6% of the 485 small scale farmers use fertilizers, and 96.3% of the 80 large scale farmers use fertilizer. This confirms the findings of Ariga et al (2008) who found out that farm sizes have a positive and direct effect on the use of fertilizer. Large scale farmers therefore are likely to use more fertilizers and other improved technologies than small scale farmers.

Table 32: Cross tabulation of farm size with fertilizer use

Farm Size	Use Fertilizer	Do Not Use Fertilizer	Df	x^2	Sig
Small Scale	430	55	2	22.65	0.000*
Medium Scale	155	0			
Large Scale	77	3			
Total	662	58			

n = 720 *Source. Field Survey Data, 2012*

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Relationship between Farming experience and Fertilizer Use

Table 32 shows the cross tabulation of the farming experience of farmers interviewed against fertilizer use. A total of 46 of the farmers are found to be less experienced, 122 to be experienced and 552 found to be more experienced. The table shows that the Chi square statistical analysis comparing the difference between farming experience categories and fertilizer use. The results indicate that the difference existing among the number of farmers in the different farming experience categories is significant [$x^2_{(2, N=720)} = 14.06$, P=0.001].

Table 33: Cross tabulation of farming experience with fertilizer use

Farming Experience	Use Fertilizer	Do Not Use Fertilizer	df	x^2	Sig
Less Experienced	46	0	2	14.06	0.001*
Experienced	120	2			
More Experienced	496	56			
Total	**662**	**58**			

n = 720 *Source: Field Survey Data, 2012*

The table shows that out of the 662 farmers that use fertilizer, only 6.9% are from the less experienced category, 18.1% are from the experienced category, and 74.9% from the more experienced category. This study found that more farmers in the more experienced category use fertilizer, this confirms the findings of Oluyole, Adebiyi & Adejumo (2007) who found that farming experience is positively related to agricultural production and management abilities, and

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concluded that knowledge is obtained through experience over the years of work. It is therefore, expected that farmers' accumulated experience in farming would positively influence their perception of improved technologies and thus the use of fertilizer.

Farmers' Reasons for Using Fertilizer

A summary of open ended responses for reasons why farmers use fertilizer is as shown in Table 34. Using multiple response, increases in crop yield as a result of fertilizer use was the reason given by 662 (91.9%) of farmers interviewed. this was followed by 264 of the farmers (36.6%) who claim fertilizer use improves their soil, and finally 218 of the farmers (30.3%) indicated they use fertilizer because it is part of a credit facility or part of a promotional package.

Fertilizers, whether organic or inorganic, are used basically to improve soil fertility and to increase the yield of crops. From table 34, it can be seen that 91.9% of farmers interviewed said they use fertilizer to increase yield of their crops. The use of fertilizer to improve soil condition indicated by 36.6% of the farmers is related to using fertilizer to increase the yield of crops; this is an indication that basically farmers use fertilizer on their crops to ensure increased productivity. Although most farmers would want to use fertilizer for improved yield they are of the view that fertilizers are expensive, it is therefore not surprising that 30.3% of the farmers also use fertilizer because it is part of a credit or promotional package. This is also an indication that more farmers will use fertilizer when it is made affordable.

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Table 34: Frequency distribution of farmers reasons for fertilizer use

Reasons for use of fertilizer	Frequency	Percent
Increases yield	662	91.9
Improves the soil condition	264	36.6
Part of Credit/Promotional Package	218	30.3

n= 720 (multiple responses) Source: Field Survey Data, 2012

Farmers Reasons for Non-use of Fertilizer

A summary of open ended responses for reasons why farmers do not use fertilizer is as shown in Table 35. Fertilizer price is expensive was indicated by 58 of the farmers (8.05%) who were interviewed as their reason for not using fertilizer. This was followed by produce does not taste well which was indicated by 50 of farmers (6.94%) interviewed. The number of farmers who indicated there were into subsistence farming and there was no need to use fertilizer was 47 that is 6.53%. Crops with fertilizer applied to it does not store well or fertilizer reduces produce shelf life, fertilizer supplied on time. non-availability of fertilizer, soils are fertile and fertilizer not effective were reasons indicated by 6.11%, 5.0%, 3.50%, 2.36% and 1.66% of the farmers respectively for not using fertilizer. With the exception of the 2.36% of farmers among the non-users of fertilizer who said their soils were fertile and so do not use fertilizer; the other farmers need to be educated to appreciate the need for fertilizer use. Farmers who have fertile soils can be said to have good reason not to use fertilizer. Other reasons like fertilized produce do not taste well or store well are perceptions that have not been proved by research,

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and when farmers are well informed these perceptions should not unfavourably influence farmers intension to use fertilizer .

Table 35: Frequency distribution of farmers reasons for non-use of fertilizers

Reasons for non-use of fertilizer	Frequency	Percent
Cost is expensive	58	8.05
Fertilized produce does not taste well	50	6.94
Small scale farming do need not fertilizer	47	6.53
Fertilized produce does not store well	44	6.11
Fertilizer not supplied on time	36	5.00
Fertilizer not available	25	3.50
Soils are fertile	17	2.36
Fertilizer not effective	12	1.66

n = 720 (multiple responses) Source: Field Survey Data, 2012

Fertilizers being expensive, fertilizers not being available, and fertilizers not being supplied on time are constrains that prevent farmers from using fertilizer. Farmers are likely to use more fertilizer when these constrains are addressed.

Constraints influencing the Use of Fertilizer

Constraints influencing the use of fertilizer as indicated by farmers interviewed are shown in Table 36. The Table shows that majority of farmers (69.3%) see cost of fertilizer as the main constraint to fertilizer use. Lack of financial resource is also considered as a constraint by 66.5% of the farmers. This is followed by access to credit indicated by 62.1% of farmers. 57.8% of farmers

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interviewed found knowledge or information about fertilizer to be an important constraint. Late arrival of fertilizer, availability of fertilizer, and distance from source and package size followed as constraints, indicated by 57.4%, 38.0%, 22.6% and 17.1% of farmers respectively. The three top most constraints identified included cost of fertilizer, lack of financial resource and access to credit all happen to be financial issues. The result confirms the findings of Kelly (2006) which revealed that capacity of farmers to use fertilizer depends on financial capital (income, assets, and access to credit). This result also confirms the findings of Udoh and Umoh (2011) who observed high price of fertilizer to be the major constraint to fertilizer consumption.

Table 36: **Frequency distribution of constraints of fertilizer use**

Factor	Frequency	Percentage
Cost of fertilizer	499	69.3
Lack of financial resource	479	66.5
Access to credit	447	62.1
Knowledge or information about fertilizer	416	57.8
Late arrival of fertilizer	413	57.4
Availability of fertilizer	274	38.0
Distance from source	163	22.6
Package size	123	17.1

n =720 (multiple response) *Source: Field Survey Data, 2012*

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Knowledge and experience about the existence of a particular farm technology enables the farmer to make optimum use of it. It is therefore not surprising the knowledge or information about fertilizer was indicated as the fourth leading constraint. Oumou and Ariga (2011) also found lack of knowledge on fertilizer use as a factor that influences the use of fertilizer by maize farmers in Kenya. The remaining constraints indicated point to the fact that fertilizer use can be intensified or increased when fertilizer purchasing centres are located close to the farm gates, and fertilizer is made available when needed and on time.

Relationship between Sex of Farmers and Fertilizer Package Size Problems

Table 37 shows that about 66% of farmers interviewed indicated that they had problems with the most common fertilizer package size of 50kg, while about 33.9% indicated that they had no problem with the 50kg fertilizer package size. This study and other studies by Udoh and Umoh (2011) in Nigeria and Oluoch-Kosura, Marenya & Nzuma (2001) in Kenya revealed that the common fertilizer package size on the market is 50kg bag. This is not surprising because for inorganic fertilizers the standard package size specification is 50kg in the Africa region and this is the same as reported by Bumb, Johnson & Feuntes (2011) in their study on fertilizer market in Ghana. Various reasons were given by farmers for their preference for other package sizes, the reasons include expensive fertilizer due to the large package size and heavy weight of the package. Farmers, especially women farmers find the fertilizer too big to carry or transport to their farms, also they have problems buying larger bags as they not have enough money to purchase

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and most often if they are able to buy, the rest that is not used go waste (Oluoch-Kosura et al, 2001; Udoh and Umoh, 2011).

Table 37: Cross tabulation of sex of farmers with farmers having fertilizer package size problems

Sex	Farmers with Package Size Problems	Farmers with no Package Size Problems	df	x^2	Sig
Male	270 (37.5%)	228 (31.7%)	1	1.93	0.22
Female	206 (28.6%)	16 (2.2%)			
Total	476 (66.1%)	244 (33.9%)			

n=720 *Source: Field Survey Data, 2012*

From the table, 270 (37.5%) males are found to have problem with fertilizer package sizes whereas 228 (31.7%) have no problem. For females, 206 (28.6%) reported having problem with the package sizes while 16 (2.2%) have no problems. The Chi square statistics comparing males (31.7%) and females (28. 6%) having problems with the package sizes shows that no significant difference exists between the two sexes [$x^2_{(1,\ N=720)} = 1.93$, P=0.22], meaning males and females both have problems with the fertilizer packages on the market.

Preferred Package Size

Table 38 presents the preferred fertilizer package size of farmers. Majority of farmers (39.4%) prefer the 25kg package size, this is followed by 50kg package size which is preferred by 26.2% of the farmers. While 18.6% of farmers prefer

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the 20kg package size, the least preferred is 5kg package size preferred by 6.9% of farmers, followed by 10kg package size preferred by 7.2% of farmers interviewed.

Table 38: Frequency distribution of preferred package size

Preferred Package Size (Kg)	Freq	Percent	Cum percent
5	50	6.9	6.9
10	52	7.2	14.1
20	134	18.6	32.7
25	106	39.4	72.1
50	200	27.9	100
Total	**720**	**100**	

n=720 *Source: Field Survey Data, 2012*

Udoh and Umoh (2011) in their study on fertilizer use in rural Nigeria found that 48.8% of the respondents could not afford the purchase of 50kg bag fertilizer because they found them to be expensive. Crawford et al (2006) stated that bulk purchase of fertilizers is the preferred option for farmers in America, and 25kg as the mode with the packaged fertilizers on the American market. Fertilizer availability in different bag sizes can be an indicator of affordability as Ghanaian farmers who are mostly small scale farmers may have sufficient income to purchase only small bags instead of the traditional 50 kg bag. Packaging of fertilizers in smaller quantities like 5, 10, 20, 25kg bags will enable farmers especially small-scale farmers and women farmers who in this study indicated that they preferred 25kg bags, to buy and use on their smaller farm plots. Smaller packaging sizes shall also make lifting and transporting of fertilizer bags easier.

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The greater the bag options available to farmers, the greater the likely of purchase and use of fertilizer.

Quantity of Fertilizer Use (Kg/ha) on Maize by Farmers in the various Agro – ecological Zones

The use of fertilizer by farmers in a country can be assessed in several ways. It can be assessed in terms of **i)** total fertilizer imported or manufactured into/by the country, **ii)** percentage of farmers using fertilizer in the country, **iii)** percentage of cultivated land under fertilizer application or **iv)** household-level estimates of fertilizer application per hectare (FAO, 1991). For this study fertilizer use by maize farmers has been assessed in terms of household-level estimates of fertilizer application per hectare.

Table 39 shows the quantity of fertilizer in kg/ha used on maize by farmers in the various Agro – ecological zones. The recommended application rate for maize throughout the country is 375kg/ha (MOFA, 2006). Using calculation for the household-level estimates of fertilizer application per hectare as shown in chapter 3, the least rate recorded for this study is 41.7kg/ha and the highest 437.5kg/ha. For this study 572 farmers out of the720 studied indicated that they cultivate maize. Considering the varied application rates recorded and for ease of documentation, the rates have been categorized as shown in the table. The rates most used by farmers were between 0 – 50kg/ha, recorded by 277 farmers. This was followed by 114 farmers who used rates that fell within the rate range of 100 – 150kg/ha. Only 83 farmers fell within the recommended rate of 351 – 400kg/ha.

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The table also shows that 77.4% of farmers interviewed in the Rainforest zone and 55.1% of farmers interviewed in the forest zone are found in the least range of application which is not surprising as most of the soils found in these zones are comparatively fertile. For the recommended range of 301 – 400kg/ha, 41.9% of farmers in the Guinea Savannah and 33.3 % of farmers in the Transistional forest zones were found, which shows farmers in these two zones tend to use more fertilizer, this is due to the fact that farmers in the transitional zone have large scale farms, and those in the Guinea Savannah have soils that are not fertile and may have to use more fertilizer. From the table, it can be observed that only 89 farmers out of the 572 farmers cultivating maize use the recommended rate of fertilizer application for maize. The remaining 483 farmers use rates far below the recommended rate of 375kg/ha. Oumou and Ariga (2011) in their studies also found that most maize farmers in Kenya use rates far below the recommended rate.

The low application rates used by farmers could be due to inadequate knowledge on fertilizer use or other constrains which could include limited resource for the purchase of adequate fertilizer. Okoedo-Okojie and Aphunu (2011), and Oumou and Ariga (2011) in their studies on fertilizer use found inadequate knowledge and limited capital as the two major causes of low usage of fertilizer.

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Table 39: Frequency distribution of quantity of fertilizer applied to maize in the various agro-ecological zones

Quantity of Fertilizer applied to maize in kg/ha	Coastal Savannah		Rainforest		Forest		Transitional Forest		Guinea Savannah		Sudan Savannah	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
0 - 50	67	58.3	82	77.4	65	55.1	40	33.3	12	16.2	11	28.2
51 - 100	8	6.9	2	2.0	8	6.8	14	11.7	4	5.4	0	0.0
101 – 150	40	34.8	10	9.4	32	27	17	14.1	7	9.5	8	20.5
151 - 200	0	0	6	5.6	2	1.7	2	1.7	8	10.8	5	12.8
201 - 250	0	0	0	0	0	0	2	1.7	4	5.4	4	10.3
251 – 300	0	0	0	0	10	8.5	2	1.7	2	2.7	2	5.1
301 – 350	0	0	0	0	1	0.9	0	0	6	8.1	0	0
351 – 400	0	0	6	5.6	0	0	40	33.3	31	41.9	6	15.4
401 – 500	0	0	0	0	0	0	3	2.5	0	0	3	7.7
Total	**115**	**100**	**106**	**100**	**118**	**100**	**120**	**100**	**74**	**100**	**39**	**100**

n= 720 *Source: Field Survey Data, 2012*

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Fertilizer Use per year by Maize Farmers in the Agro-ecological Zones

Table 40 presents the average fertilizer use in kg/ha by maize farmers in the various zones in the country. The table shows that the Transitional Forest was found to be the agro-ecological zone with the highest quantity of fertilizer used on maize (135kg/ha), followed by the Guinea Savannah (116.6kg/ha), Forest Zone (72.8kg/ha), Sudan Savannah (61.5%), Costal savannah (42.8kg/ha) and the last being the Rain Forest (29kg/ha). A One-Way ANOVA analysis of fertilizer use in the various ecological zones shows that significant differences exist between them. There is a significant difference between Rainforest and Forest zone, Rainforest and Transitional forest, Rainforest and Guinea savanna, as well as between Rainforest and Sudan savanna. There are also significant differences between the Forest zone and the Transitional forest, the Coastal savanna and Guinea savanna. There is also significant difference between the Transitional and the Coastal savanna, and Sudan savanna. There is also a significant difference between Coastal savanna and the Guinea savanna and Sudan savanna. Finally, there is a significant difference between Guinea savanna and Sudan savanna. This is consistent with the findings of FAO (2005) who found that the level of consumption of fertilizer by farmers in the agro-ecological zones in Ghana are not the same, and that, it is due to the varied climatic conditions, soil type, vegetation types, and crop types grown in the country.

This study also found the mean fertilizer use or consumption for maize farmers in Ghana to be 76.33 kg/ha. The fertilizer use or consumption of 76.33 kg/ha recorded in this study for maize farmers in Ghana is lower than that of maize

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farmers in Kenya which was observed by Oumou & Ariga (2011) to be 117.1 kg/ha. The FAO in 2004 found the average consumption rate of fertilizer for all crops in Ghana to be 8kg/ha, and Bumb et al in 2011 found it to be 12kg/ha.

Table 40: Anova analysis of fertilizer use per year by maize farmers in the Agro-ecological zones

Agro-ecological zone	N	Quantity of fertilizer use (Kg/ha)	SD	df	F	Sig
Rainforest	106	29.05	17.79	5	65.03	0.00*
Forest	118	72.86	58.54			
Transistional Forest	120	135.05	68.87			
Coastal Savannah	115	42.81	32.18			
Guinea Savannah	74	116.62	75.09			
Sudan Savannah	39	61.57	34.55			
Total	572					

n= 720 Source: Field Survey Data, 2012 Mean = 76.33

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Maiangwa et al (2007) in their study on adoption of chemical fertilizer in the North-West zone of Nigeria found the fertilizer application rates of 41.49kg/ha for Kano state, and 67.24kg/ha for Katsina state. The fertilizer use by maize found to be 76.33kg/ha in this study is an indication that the overall consumption of 12kg/ha recorded by Ghana in 2011 is likely to increase in the year 2012.

Comparison of fertilizer use in the various Agro-ecological zones

From the ANOVA result presented in table 40, it can be seen that a significant difference exists between at least two of the ecological zones on fertilizer use [$F_{(5,566)}$=65.03, p=.00]. For this reason, a post-hoc analysis was conducted using the Bonferonni multiple comparison method. Table 41 shows that significant differences were found between all the ecological zones except between Coastal savannah and the Rainforest. Sudan savannah and the Forest, and then Guinea savannah and the Transitional forest. Differences were observed between almost all the agro-ecological zones because the climatic conditions, soil types, vegetation types, and crop types grown in the country in the various zones vary. The Rainforest, Forest and Transitional forest are found where rainfalls are relatively high and well distributed. The Coastal savannah, Guinea savannah and Sudan savanna are found where rainfalls are generally lower, and/or where the dry seasons are long and severe. Forest soils are more fertile and productive than savanna soils largely because of the heavier vegetation cover and thus may not need as much fertilizer as the savannah soils. The considerable difference between

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forest and savanna soils contributes to the significant differences observed between the zones.

Table 41: Bonferonni's Post Hoc Multiple Comparison of means of fertilizer use in the Agro-ecological zones

Zone	Rainforest	Forest	Transitional forest	Coastal savanna	Guinea savanna	Sudan savanna
Rainforest						
Forest	43.89*					
Transitional forest	105.98*	62.0*				
Coastal savanna	13.48	30.4*	92.50*			
Guinea savanna	86.22*	42.33*	19.76	72.74*		
Sudan savanna	32.52*	11.37	73.46*	53.70*	53.70*	

Source: Field Survey Data, 2012 $p < 0.05$

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Farmers' Orientation towards the Use of Fertilizer

Farmers' orientation towards the use of fertilizer can influence their decision on fertilizer usage. The opinion of people who are significant, or matter to farmers are very important. Their opinion positively or negatively influence farmers' behaviour, and to a large extent determines a farmers' attitude towards fertilizer use. Attitude like knowledge and skills determine the use of technologies. The third objective of this study seeks to examine farmers' orientation towards the access and use of fertilizer, the opinion of reference people on fertilizer use, and the attitude of farmers towards fertilizer use. The orientation of farmers towards the use of fertilizer is discussed in details.

Farmers' Assessment of Reference People

For the purpose of this study, six reference people as indicated in table 42 were selected. The table shows farmers' assessment of the reference people who could influence the decision of farmers, the study found that 56.9% of the farmers interviewed found the Agricultural officers' opinion on fertilizer use to be most important to them. This was followed by 21% of farmers finding the opinion of fertilizer dealers being most important. The opinion of other farmers, husband/wife, and FBO executives followed being selected by 11%, 7.9% and 3.2% of farmers respectively. The Assemblyman was not selected by any farmer and as such scored 0%. This is an indication that farmers interviewed did not find the opinion of assemblymen on fertilizer use to be important to them. The first

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three reference people who were scored highest by the farmers are the Agricultural officers, fertilizer dealers and other farmers in descending order of importance. Agricultural officers are trained to provide advisory services to stakeholders in the agriculture sector. They have frequent interactions with the farmers on agricultural productivity issues including fertilizer handling and use; it is not surprising most of the farmers studied found their opinion to be most important.

Table 42: Frequency distribution of farmers' assessment of reference people

Reference People	Freq	Percent	Cum. Percent
Assemblyman	0	0.0	0.0
FBO Executives	23	3.2	3.2
Other Farmers	79	11.0	14.2
Husband/Wife	57	7.9	22.1
Agriculture Officers	410	56.9	79.0
Fertilizer Dealers	151	21.0	100
Total	720	100	

n = 720 *Source: Field Survey Data, 2012*

The fertilizer dealers were found to be the second most important because they sell fertilizers to farmers. They have information from fertilizer importing companies on their products and are also trained by Agricultural officers to enable them better serve their customers who are mostly farmers. Other farmers were recorded as the third most important; this is not surprising because farmers find it easy learning from each other as they understand each other. This shows that farmers value the

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opinion of other farmers. The remaining 3.2% of farmers found the opinion of their spouses on fertilizer use as the most important. This is an indication that spouses have the ability to influence their partners who are farmers whether or not to use fertilizer.

Farmers' Assessment of Opinion of Reference People on Fertilizer Use

Table 43 shows farmers' assessment of the opinion of the reference people selected. The lowest percentage recorded as favourable by farmers was 64.4% for Assemblymen and the highest of 98.8% for Agricultural officers. The remaining reference people's opinion was scored by more than 90% farmers in the favourable category. This is an indication that the influence of people who matter to farmers on the use of fertilizer is favourable or can be said to be positive. Only 1.1% to 7.9% of farmers found the opinion of the reference people on fertilizer use to be unfavourable. Opinion of reference people influences behaviour and to a large extent determines ones' attitude towards a phenomenon; usage of fertilizer under this high favourable influence should be high unless it is constrained by other factors. Okoedo-Okojie and Aphunu (2011) in their study at the Delta State of Nigeria found the attitude of farmers to be unfavourable and usage of fertilizer to be low.

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Table 43: Frequency distribution of farmers' assessment of opinion of reference people on fertilizer use

Reference People	Favourable Opinion		Unfavourable Opinion	
	Freq	Percent	Freq	Percent
Assemblyman	463	64.3	57	7.9
FBO Executives	674	93.6	46	6.4
Other Farmers	660	91.7	60	8.3
Husband/Wife	681	94.6	39	5.4
Agriculture Officers	712	98.9	8	1.1
Fertilizer Dealers	700	97.2	20	2.8

n = 720 (multiple responses) Source: Field Survey Data, 2012

Farmers' Attitude towards Fertilizer Use

To determine farmers' attitude towards fertilizer use, six statements were presented and Likert-type rating scale of strongly disagree, coded 1; disagree, coded 2; agree, coded 3, and strongly agree coded 4 used for the assessment. The number of farmers who scored strongly disagree and disagree were summed and the mean calculated to find number of farmers with negative attitude. The number of farmers who scored agree and strongly agree were summed and the mean calculated to find number of farmers with positive attitude. Table 44 shows that 262 of the farmers representing 36.4% of farmers interviewed have negative attitude, the remaining 458, representing 63.6% who are the majority have positive attitude.

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Attitude, like knowledge and skills determine the use of technologies. Farmers' attitudes are more likely to correspond with the behaviours (Van Den Ban and Hawkins, 1996). Farmers whose attitude towards fertilizer use is positive are more likely to use fertilizer. It is therefore not surprising when Okoedo-Okojie and Aphunu (2011) in their study at the Delta State of Nigeria found the attitude of farmers to be unfavourable and usage of fertilizer to be low. The positive attitude observed in this study implies that all things being equal fertilizer use by Ghanaian farmers should be high.

Table 44: Frequency distribution of farmers' attitude towards fertilizer use

Farmers attitude	Freq	Percent	Cum Percent
Negative	262	36.4	36.4
Positive	458	63.6	100
Total	**720**	**100**	

n = 720 *Source: Field Survey Data, 2012*

Relationship between Farmers' Attitude and Fertilizer Use

Table 45 shows the relationship between the attitude of farmers towards fertilizer use and fertilizer use. A total of 458 of the farmers were found to have positive attitude towards fertilizer use and 262 with negative attitude towards fertilizer use. The Chi square statistical analysis comparing the difference between the two levels of attitude and fertilizer use indicates the difference existing among the number of farmers with the two different attitudes is significant [$x^2_{(1, N=720)}$ = 1.23, P=0.026].

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Table 45: Cross tabulation of farmers' attitude with fertilizer use

Attitude	Do not Use Fertilizer	Use Fertilizer	df	x^2	Sig
Negative	20	242	1	1.23	0.026*
Positive	38	420			
Total	**58**	**662**			

n = 720 *Source: Field Survey Data, 2012*

The table shows that the farmers with positive attitude who do not use fertilizer are 38 and represent 8.3%, also those with positive attitude who use fertilizer are 420 which represent 91.7% of the farmers who use fertilizer on their farms. This study finds the difference between the two farmer attitudes and fertilizer use to be significant. This is not surprising as attitude, like knowledge and skill determines the use of technologies. Van Den Ban and Hawkins (1996) also found farmers' attitudes to correspond with the behaviours, especially behaviours to use or not to use farming technologies.

Relationship between Farmers' Attitude and Ability to buy Fertilizer

Table 46 shows the cross tabulation of overall attitude of farmers interviewed against their ability to buy fertilizer. A total of 458 of the farmers have positive attitude and 262 have negative attitude. The Chi square statistical analysis comparing the difference between the two levels of farmers' attitudes towards

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fertilizer use and their ability to buy fertilizer indicates that the difference between the two levels of attitude and the ability to buy fertilizer is significant [$x^2_{(2, N=720)}$ = 21.28, P=0.00]. The table shows that majority of the farmers totaling 325 who often and always have the ability to buy fertilizers have positive attitude. According to Fishbein and Ajzen (1975) a person's behavioural intentions are based on the persons' attitude, a farmer with a positive attitude towards fertilizer use is more likely to want to buy fertilizer and this has been observed in this study.

Table 46: Cross tabulation of farmers' attitude with ability to buy fertilizer

Farmers' attitude	Never	Sometimes	Often	Always	df	x^2	Sig.
Negative attitude	73	87	93	9	2	21.28	0.00**
Positive attitude	12	121	267	58			
Total	**85**	**208**	**360**	**67**			

n= 720 *Source: Field Survey Data, 2012*

Contribution of Institutional Factors to Access and Use of Fertilizer by Farmers

The government of Ghana is committed to the welfare of farmers and through Institutional provisions continue to support them through the development and the implementation of policies, subsidizing agricultural inputs, providing credits, training and extension services. The fourth objective of this study seeks to determine the Contribution of Institutional factors to farmers' use of fertilizer in the country. The contribution of Institutional factors to farmers' use of fertilizer is discussed in details in this section.

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Fertilizer Policy Support Awareness among Farmers

According to Bumb et al (1994), fertilizer policies affect the development of fertilizer but most developing countries do not have functional fertilizer policies. Fertilizer policies when properly implemented positively affect the fertilizer producers or manufacturers, the importers, wholesalers, retailers and the farmer or end user. This leads to the increased use of fertilizer and increased crop productivity. Figure 4 shows that 69.6% of farmers are aware of some fertilizer policies in place whereas 31.4% are not aware of any. Strategic policies like the FASDEP II and Fertilizer Subsidy Policy have been in place guiding fertilizer sales and use. Also plans and projects like the National Soil Fertility Management Plan and the AGRA supported for Fertilizer Quality Control project are in place in the country to address fertilizer quality and use issues. Also a comprehensive document on fertilizer policy for Ghana has now being developed. It is therefore not surprising that almost 70% of farmers happen to be aware of some form of fertilizer policy operating in Ghana. In spite of ongoing policy reforms, according to Banful (2009) and Yawson et al (2012) the policy environment remains uncertain, human capital is inadequate, access to finance, technical and market information is limited and operations along the fertilizer supply chain remain sub-optimal.

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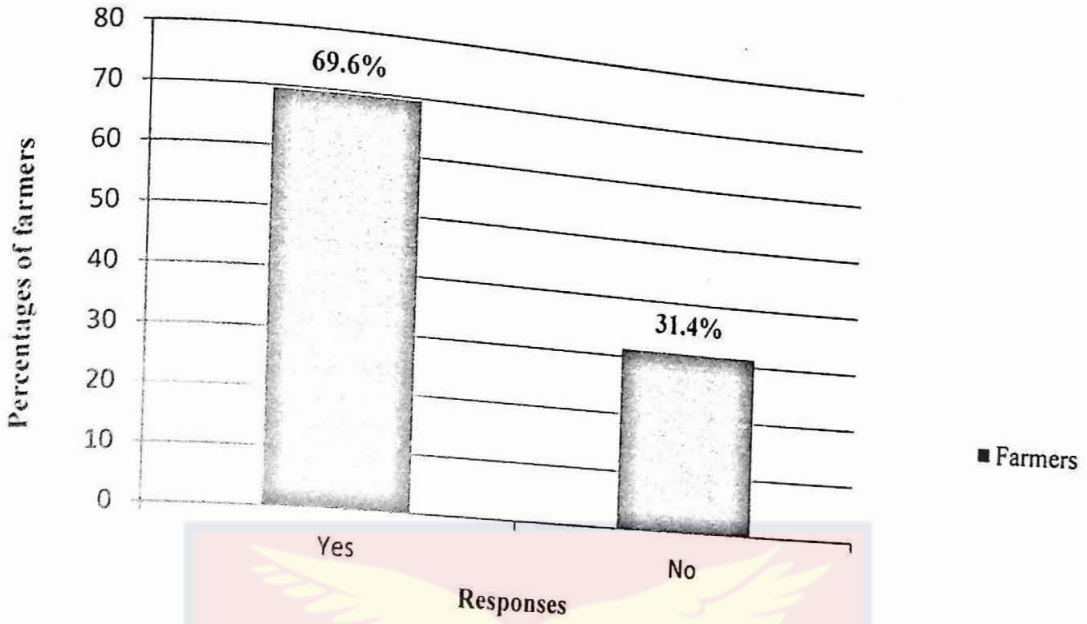


Fig. 4: Awareness of fertilizer policies

Source: Field Survey Data, 2012

Fertilizer Policy Benefit Rating by Farmers

Table 47 presents farmers ratings of how beneficial government fertilizer policies are to farmers in their farming activities. Based on the ratings of 1-strongly disagree, 2-disagree, 3-agree and 4-strongly agree, the table shows that farmers interviewed disagreed (Mean = 1.80; SD = 0.97) that fertilizer price is affordable. With ratings of (Mean = 2.58; SD = 0.94) farmers disagreed on the fact that fertilizers are always available. Farmers interviewed also disagreed (Mean = 2.42; SD = 0.97) that fertilizers are supplied on time. This is an indication that policy support on fertilizer pricing and supply is not adequate. With ratings of (Mean = 2.73; SD = 0.94) and (Mean = 2.77; SD = 0.94) respectively, farmers did not fully agree to the fact that fertilizer sources are closer to farms and fertilizers are of quality. None of the farmers scored a mean of 3.0 or 4.0 for any of the

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policies being implemented; this is an indication that there is still more to be done by the government on issues related to fertilizer policy.

Table 47: Fertilizer policy benefit rating by farmers

Fertilizer Policy Benefit	Mean	SD
Fertilizer prices are affordable	1.80	0.975
Fertilizer is always available	2.58	0.941
Fertilizer is supplied on time	2.42	0.912
Fertilizer source are closer to farms	2.73	1.118
Fertilizer farmers buy are of quality	2.77	1.046

Scale: 1- strongly disagree 2-disagree 3-agree 4-strongly agree

n = 720 (multiple responses) Source: Field Survey Data, 2012

According to Bumb *et al* (1994) fertilizer policies affect the development of fertilizer. Fertilizer policies when properly implemented positively affect the fertilizer producers or manufacturers, the importers, wholesalers, retailers and the farmer. The results obtained indicate there is still more to be done by the government on issues related to the fertilizer policy for it to be beneficial to the farmer.

Farmers' Opinion on Level of Policy Support

Table 48 shows that 43.75% of farmers rated the level of policy support for fertilizer use to be good, followed by 27.64% of farmers who found policy support to be very good, 14.58% and 14.03% of farmers rated policy support to be

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poor and very good respectively. Farmers' ratings of policy support were based on their perception of benefits derived.

Fertilizer policies shall directly affect fertilizer use depending on how they are developed and implemented. The level of policy support could positively or negatively impact on adoption and use of fertilizer. According to Bumb, Teboh, Atta and Asenso-Okyere (1994), policies like pricing and subsidy policy, supply policy, research and development policy, quality control policy, farm use policy and environmental policy affect the development of fertilizer in developing countries.

Table 48: Frequency distribution of farmers' opinion on perceived level of policy support

Level of Policy Support	Freq	Percent	Cum. Percent
Poor	105	14.58	14.58
Fair	101	14.03	28.61
Good	315	43.75	72.36
Very good	199	27.64	100
Total	**720**	**100**	

n =720 *Source: Field Survey Data, 2012*

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Farmers Access to Credit

From Table 49, only 26.7% of the farmers responded in the affirmative that they have access to credit for their farming activities. The remaining 73.3% of the farmers do not have access to credit. Access to credit is an important factor for farmers as it ensures there is the resource for purchasing needed farming inputs. However majority of farmers in the study indicated they do not have access to credit this could mean many farmers do not access credit and may as a result not have the resources to purchase fertilizer. Oluoch-Kosura et al (2001) examined the factors affecting the adoption of soil management technologies as well as intensity of fertilizer use in Kenya and found out that access to credit positively influenced the use of fertilizer. Olwande & Mathenge (2008) and Okwoche, Asogwa, & Obinne (2012) concluded in their study that lack of credit could be a serious disincentive for acquisition of fertilizers or any extension technology.

Table 49: Frequency distribution of access to credit by farmers

Access to Credit	Freq	Percent	Cum. Percent
No	528	73.3	73.3
Yes	192	26.7	100
Total	720	100	

n =720 *Source: Field Survey Data, 2012*

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Difficulty in Accessing Credit by Farmers

Table 50 shows that majority of the farmers (63.3%) indicated that access to credit for the purchase of fertilizer is very difficult; the second majority of farmers (27%) indicated that it is difficult, 7.2% of famers indicated credit is easy to acquire, with only 2.5% of farmers indicating that credit is very easily accessible. The availability of credit either in cash or kind enhances farmers' ability to purchase or acquire fertilizer (Maiangwa et al, 2007). However majority of farmers in the study indicated acquisition of credit is difficult or very difficult, and this could mean many farmers do not access credit and may as a result not have the resources to purchase fertilizer. According to Olwande and Mathenge (2008) lack of credit could be a serious disincentive for acquisition of fertilizers or any extension technology.

Table 50: Frequency distribution of difficulty in accessing credit by farmers

Difficulty	Frequency	Percent
Very easy	18	2.5
Easy	51	7.2
Difficult	195	27.0
Very difficult	456	63.3
Total	720	**100**

n=720 *Source: Field Survey Data, 2012*

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Problems Associated with Credit Acquisition

Table 51, shows that farmers interviewed find the demand for collateral from the credit agencies to be a very serious problem (Mean = 4.78; SD = 0.06), this is followed by delay in the release of credit which was rated by farmers as serious (Mean = 4.44; SD = 0.75). High interest rates, according to farmers is a serious problem in the acquisition of credit and was rated (Mean = 4.3; SD = 0.82). The least of the challenges/problems is the cumbersome processing procedures, which was rated as moderately serious (Mean = 3.21; SD = 1.31). The responses on the problems associated with credit acquisition fall within the ratings of moderately serious (Mean = 3.21; SD = 1.31) and very serious (Mean of 4.78; SD = 0.06) with no significant difference in the mean scores of all of them (x^2=1.57, p=0.16). These ratings showed no significance between the problems, and this is an indication that problems associated with credit acquisition are all serious and measures must be put in place to mitigate them. Kelly (2006) revealed that the capacity of farmers to use fertilizer depends on financial capital, which included income, assets, and access to credit. This implies that when farmers get access to credit, they could have more resources to purchase more fertilizer for use. Absence of collateral agreements and reduced interest rates could encourage farmers to access credit for their farming activities including the purchase of fertilizer.

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Table 51: Problems associated with credit acquisition

Problem	Mean	Standard deviation	x^2	Sig
Delay in the release of credit	4.44	0.752	1.57	0.16
Demand for collateral	4.78	0.063		
Cumbersome processing procedures	3.21	1.311		
High interest rates	4.30	0.824		

Scale: 1- not a problem 2-not serious 3-moderately serious 4-serious 5-very serious

n= 720 (multiple responses) *Source: Field Survey Data, 2012*

Relationship between Access to Credit and Ability to buy Fertilizer

Table 52 shows the cross tabulation of the access to credit by farmers interviewed against their ability to buy fertilizer. A total of 528 of the farmers said they do not have access to credit and a total of 192 farmers said they have access to credit. The Chi square statistical analysis comparing the difference between farmers accessibility to credit indicates that the difference existing among the number of farmers with access to credit and farmers without access to credit is significant [$x^2_{(1, N=720)} = 2.02$, $P=0.03$] The table shows that only 8.9% of farmers who do not have access to cerdit are able to buy fertilizer. on the other hand 10.4% of who

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have access to credit are able to buy fertilizer. This confirms the findings of Oluoch-Kosura et al (2001) who examined the factors affecting the adoption of soil management technologies as well as intensity of fertilizer use in Kenya and found out that access to credit positively influenced the use of fertilizer.

Table 52: Cross tabulation of access to credit with ability to buy fertilizer

Access to credit	Never	Sometimes	Often	Always	df	x^2	Sig.
No	65	158	258	47	1	2.02	0.03
Yes	20	50	102	20			
Total	**85**	**208**	**360**	**67**			

n = 720 *Source: Field Survey Data, 2012*

Fertilizer Use Information Sources

Farmers can have several sources of obtaining information on the use of fertilizers. Table 53 shows that the most common source of information for the farmers is the agricultural extension service (65.1%). This is followed by radio stations (59.6%), other farmers (48.6%), fertilizer dealers (47.1%) and research/universities/education institutions (37.5%). The most unused source is the internet (16.8%), followed by the print media (20.1%), television (31.5%) and the fertilizer companies (35.4%).

The study shows that the Agricultural Extension Service is the most common source of information for the farmer, but one can argue that the Agricultural Extension Service has not been able to reach about 35% of farmers

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with fertilizer use information as only about 65% of farmers indicated the Agricultural Extension Services as their fertilizer use information source.

Table 53: Frequency distribution of fertilizer use information source

Source	Freq	Percent
Agricultural extension service	469	65.1
Fertilizer dealers	339	47.1
Fertilizer company	255	35.4
Research/universities/educational institutions	270	37.5
Other farmers	350	48.6
Print media (newspaper, journals)	145	20.1
Radio	429	59.6
Television	227	31.5
Internet	121	16.8
Other Sources	-	-

n= 720 (multiple responses) Source: Field Survey Data, 2012

One could attribute this to the fact that the extension officers in Ghana are severely stretched as the extension farmer ratio is more than 1: 1500 (MOFA, 2006). FM radio stations are the second source of information for farmers, these stations can

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reach most rural areas, it is not surprising extension providers are using radio to reach farmers. 48.6% of farmers interviewed indicated that they receive fertilizer use information from other farmers, the high ranking of fertilizer use information from other farmers, is a prove that farmer to farmer dissemination of agriculture information is high, contact farmers should therefore be better resourced to share information and farm technologies with other farmers. The internet, although could serve as a good source of information of fertilizer use is accessed by only 16.8% of farmers, this could be due to the fact that the most farmers need some level of formal and ICT education to be able to use the internet. Taking into consideration the fact that Agricultural Extension Service cannot serve all farmers, and the fact that the other sources put together serve about 40% of farmers, there is the need for the Agricultural Extension Service and the research institutions to link up and provide the other information sources or information providers with the right extension messages for dissemination to farmers so as to complement their efforts.

Farmers Trained in Fertilizer Use

Table 54 indicates that 55.4% of farmers interviewed have attended or received some form of training on the use of fertilizers, while 44.6% of farmers had not received any training. Training of farmers is crucial in fertilizer use and soil fertility management as a whole.

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Fertilizer use requires formal learning or at least guidance or demonstration from the extension provider. Training provides knowledge and experience about the existence of farm technology which enables the farmer to make optimum use of it. Training also encourages hands on practice, and sharing of knowledge and experiences by farmers, which contributes to adoption of technologies.

Table 54: Frequency distribution on farmers trained in fertilizer use

Trained on fertilizer use	Freq	Percent	Cum Percent
Farmers trained	399	55.4	55.4
Farmers not trained	321	44.6	100
Total	**720**	**100.0**	

n = 720 *Source: Field Survey Data, 2012*

The training services provided to stakeholders along the supply chain in the long run has a cumulative effect on the farmer or end user of fertilizer, who will use fertilizer more effectively and efficiently leading to increased crop yield and income. Okoedo-Okojie and Aphunu (2011) in their study at the Delta State of Nigeria found that low knowledge level of farmers contributed to low usage of fertilizer.

Availability of information on technologies, according to Ersado, Armacher & Alwang 2004, is one of the factors influencing adoption and use of technology. Information support to farmers is very important and influences the

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adoption of technology. Before technology can be disseminated there is the need for research-extension linkages to be strengthened to ensure information flow from researchers to agricultural extension workers, and vice versa. The technology or technical information on the proper use of fertilizer when developed by the researchers must be properly packaged by the extension agents and disseminated to the farmers through awareness creation using various extension methods. A high level of extension support exposes farmers to information and existing technology which enables them to make optimum use of both. On the other hand a low level of extension support leads to low levels of adoption of technology (Kebede *et al*, 1990).

Usefulness of Fertilizer Information Received by Farmers

Table 55 shows that the mean ratings of usefulness of information received by farmers. Farmers rated information received regarding selection of fertilizers to be useful (Mean = 3.13; SD = 1.083). Information on the application rates was rated useful by farmers (Mean = 3.19; SD = 1.067). Information on how to apply fertilizers was rated useful and had the highest rating (Mean = 3.43; SD = 0.714). Information on storage of fertilizer was also rated useful (Mean =3.07; SD = 1.054). Farmers found all information received on fertilizer use to be useful, except for the information on the impact of fertilizer use on the environment, which farmers scored slightly useful (Mean=2.45; SD=1.116). Farmers studied found the information on the impact of fertilizer on the environment to be slightly useful, this could be due to the fact that it was not well understood. The rating

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recorded for the impact of fertilizer on the environment shows that just presenting the information to the farmer is not enough. It is important to demonstrate and to use participatory learning approaches to ensure the message or technology is understood and shall be applied or used.

Table 55: Usefulness of fertilizer use information

Information received	Mean	SD
Selection of fertilizer	3.13	1.083
Recommended application rates	3.19	1.067
How to apply fertilizer	3.43	0.714
Storage of fertilizer	3.07	1.054
Impact of fertilizer use on the environment	2.45	1.116

Scale: 1- not useful 2-slightly useful 3-useful 4-very useful

n = 720 (multiple responses) Source: Field Survey Data, 2012

Perceived Level of Extension Information Support for Fertilizer Use

Table 56 shows that majority of farmers (47.6%) rated the level of extension information support for fertilizer use to be good, followed by 27.8% of farmers who found extension support to be fair. 14.6% and 10% of farmers rated extension information support to be very good and poor respectively. None of them rated extension information support as very poor.

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Table 56: Perceived level of extension information support for fertilizer use

Level of Information Support	Freq	Percent	Cum. Percent
Poor	72	10.0	10.0
Fair	200	27.8	37.8
Good	343	47.6	85.4
Very Good	105	14.6	100
Total	**720**	**100**	

n=720 *Source: Field Survey Data, 2012*

The level of extension support could positively or negatively impact on adoption of technologies. A high level of extension support exposes farmers to information and existing technology which enables them to make optimum use of both. On the other hand a low level of extension support leads to low levels of adoption of technology (Kebede, Gunjal & Caffin 1990). Availability of Extension service, according to Ersado, Armacher & Alwang (2004) is one of the institutional factors influencing adoption and it is important to have an extension service that is effective and efficient.

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Relationship between Fertilizer Use and Famer Characteristics

The correlation co-efficients presented in Table 57 show significant relationships between fertilizer use and farmer characteristics in the study. In the study, age, level of education, household size, farm size and farming experience of farmers were found to be correlated. Using the Davis' convention (Appendix B) which describes the magnitude of correlation co-efficient for the interpretation of correlation co-efficient, the results show that, the strengths of the relationships ranged between moderate and negligible (Davis, 1971).

The study showed an indirect (negative) and negligible relationship between fertilizer use and age of farmer (r = -0.05), a direct and negligible relationship between fertilizer use and farming experience or number of years of farming (r = 0.03), a direct and a low relationship between fertilizer use and the level of education (r = 0.12), a direct and a low significant relationship between fertilizer use and farm size of farmers (r = 0.28) and a direct and a moderately significant relationship between fertilizer use and household size of farmers (r = 0.32).

The fourth null hypothesis which stated that there is no significant relationship between the socio-demographic characteristics of small-scale farmers and fertilizer use is rejected, and the alternate hypothesis accepted because there was a significant relationship between fertilizer use and household size of farmers (r = 0.32). The positive and significant correlation found between fertilizer use and the household size variable in this study implies that larger households may have larger farm sizes, and this may lead to the use of more fertilizers. There was also a significant relationship between

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fertilizer use and farm size of farmers (r = 0.28). The positive and significant correlation found between fertilizer use and the farm size variable in this study implies that when farmers increase their farm sizes they may use more fertilizers.

Age of farmers and use of fertilizers were negatively correlated. The implication is that older farmers use less fertilizer, while the younger farmers use more fertilizer. Olwande and Mathenge (2008), and Maidngwa *et al*, 2007 found age had a positive relationship with adoption and intensification of fertilizer use in Kenya, and adoption of inorganic fertilizer in Nigeria respectively. A number of studies (Voh, 1979; Akpoko and Yidjep, 2000) in line with the current result have shown age to have a negative influence on adoption and use of fertilizer. However this current result and other studies mentioned are at variance with those of Liao, (1968) and Yim (1978), who found adoption to be generally unrelated to farmers' age.

The correlation between level of education and fertilizer use was positive but not significant. A positive coefficient for education implies that the use of fertilizer increases with higher level of educational attainment. The argument is that higher education levels are associated with greater information acquisition on improved technologies. Some studies (Kebede, Gunjal and Caffin, (1990); Adesina and Baidu-Forson, (1995); Maiangwa, Ogungbile, Olukosi & Atala (2007)) in line with this current result also found a positive relationship between education and the adoption of technologies and soil conservation effort.

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Farming experience or number of years of farming and use of fertilizers were negatively correlated. This implies that farmers with experience use less fertilizer and this is in contrast with the findings of Udoh and Umoh (2011), who found experience to be positively correlated to adoption of fertilizer use and modern technology. It is believed that the longer the time that the farmer spends carrying out a certain practice, a higher level of the skill for that practice is acquired. Also experienced farmers may have more resource to purchase more fertilizer for use.

Household size and use of fertilizers were positively correlated and significant. A positive sign for household size implies that fertilizer use is higher among larger households. This is supported by Bhati (1975) who found a positive effect of household size on adoption. Meanwhile Yim (1978) and Adesina (1996) found no significant impact of household size on adoption whilst, Yim (1978) specifically reported that household size is an insignificant variable in fertilizer use. Oluoch-Kosura, Marenya & Nzuma, 2001 and Maiangwa, Ogungbile, Olukosi, & Atala, 2007, however, found household size to be negatively related to the adoption of inorganic fertilizer.

The positive and significant correlation found between fertilizer use and the farm size variable in this study implies that farmers with large farms use more fertilizer. It has been reported by Obasi (2007) that farm size determines the quantity of inputs used and that there exist a direct relationship between farm size and productivity. Ariga, Jayne, Kibaara & Nyaro (2008) also found out that farm sizes have a positive and direct effect on the purchase and use of fertilizer. It is assumed that the size of a farm is directly related to the farmer's

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wealth, and farmers with large scale farms are more likely to adopt a technology.

Table 57: Correlation between fertilizer use and farmer characteristics

Factor	1	2	3	4	5	6	7	8
1	1.00							
2	-0.05	1.00						
3	0.12	0.09*	1.00					
4	0.32*	-0.26*	-0.01	1.00				
5	0.03	0.08	0.12	0.01	1.00			
6	0.28*	0.66*	0.13	-0.02	0.19	1.00		

1=Fertilizer use
2=Age
3= Educational Level
4= Household size
5=Farming Experience
6=Farm size

*. *Correlation is significant at the 0.05 level (2-tailed).*
**. *Correlation is significant at the 0.01 level (2-tailed)*

Source: Field Survey Data, 2012

Relationship between Fertilizer Use and Farm related Factors

The correlation analysis examined the relationship between fertilizer use and availability of fertilizer, cost of fertilizer, distance to fertilizer source, access to credit, farmers' attitude to fertilizer use, and extension information support for N=720 farmers. The Pearson correlation co-efficients presented in Table 58 shows significant relationships between fertilizer use and the independent variables of the study. Using the Davis' convention (Appendix B) which describes the magnitude of correlation co-efficients for the interpretation of correlation co-efficients (Davis, 1971), the results show that, the strengths of the relationships ranged between substantial (high) and negligible.

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The study showed a direct (positive) but a negligible relationship between availability of fertilizer and fertilizer use (r = 0.01), indirect (negative) and moderately significant relationship between fertilizer cost and fertilizer use (r=-0.34), indirect and significantly low relationship between distance to fertilizer source and fertilizer use (r = -0.17), direct and highly significant relationship between farmers' attitude and fertilizer use (r = 0.68), direct and moderately significant relationship between the extension information support and fertilizer use (r = 0.32), and finally a direct and highly significant relationship between access to credit and fertilizer use (r = 0.63).

The first null hypothesis stated that there is no relationship between the accessibility of fertilizer and fertilizer use. Accessibility was studied in terms of availability of fertilizer, distance to the nearest source, and cost of fertilizer. The result of the study showed a direct (positive) but a negligible relationship between availability of fertilizer and fertilizer use (r = 0.01), an indirect and a significantly low relationship between distance to fertilizer source and fertilizer use (r = -0.17), an indirect and moderately significant relationship between the fertilizer cost and fertilizer use (r = -0.34). Based on these three findings, the first null hypothesis which stated that there is no significant relationship between the accessibility of fertilizer and fertilizer use is rejected and the alternative hypothesis is therefore accepted.

A significant negative relationship found between fertilizer use and distance to source of fertilizer in this study is consistent with the findings of Olwande and Mathenge (2009) who found distance to source of fertilizer to negatively influence adoption decisions by farmers. According to Udoh and Umoh (2011) the quantity of fertilizer used by farmers decline with increasing

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distance to the nearest source of fertilizer or market centre. The distance from farm to source of fertilizer, gives an indication of access to fertilizer. The distance also determines the level of fertilizer use, for as the distance to the source increase, fertilizer use is likely to decrease.

On the other hand, the negative correlation found between cost of fertilizer and fertilizer use is expected, and it means the lower the cost of fertilizer, the more fertilizer is purchased and used by farmers. Udoh and Umoh (2011) stated that the cost of fertilizer may determine to a large extent the quantities of fertilizer to be used.

The result of the study shows a direct and highly significant relationship between farmers' attitude towards fertilizer use and fertilizer use ($r = 0.68$), based on this finding the second null hypothesis which stated that there is no significant relationship between farmers orientation towards fertilizer use and fertilizer use is rejected and the alternative hypothesis is therefore accepted.

Farmers' attitude towards fertilizer use was found to be significant in this study, other studies by Okoedo-Okojie and Aphunu (2011) found significant relationship between attitude towards fertilizer use and fertilizer use. It is believed that farmers with favourable or positive attitude towards fertilizer could use more fertilizer.

The third null hypothesis stated that there is no relationship between institutional factors and fertilizer use. Institutional factors were studied in terms of policy support, access to credit and extension information support The result of the study shows a direct and moderately significant relationship between the

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extension information support and fertilizer use (r = 0.32), and a direct and highly significant relationship between access to credit and fertilizer use (r = 0.63). Based on these two findings, the third null hypothesis which stated that there is no significant relationship between institutional factors and fertilizer use is rejected and the alternative hypothesis is therefore accepted.

Extension information support was also found to be significant and positively related to fertilizer use, which implies the higher the Extension information support, the more fertilizer that will be used. Availability of extension services has been identified by Ersado, Armacher & Alwang (2004) as one of the institutional factors influencing adoption. A positive correlation coefficient for extension contact or extension information support means that adoption or use of fertilizer increases with greater extension contact. Extension information support updates famers' knowledge and stimulates adoption (Kebede, Gunjal & Caffin, 1990; Ouma. Groote & Owuor, 2006).

Access to credit was significant and positively correlated to fertilizer use. The positive correlation between access to credit and fertilizer use found in this study is consistent with the findings of Akpoko and Yiljep (2000) which revealed a positive correlation between access to credit and fertilizer use. A positive correlation means that the greater the supply of credit, the higher the adoption. The availability of credit either in cash or kind enhances farmers' availability to purchase or acquire inorganic fertilizer.

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Table 58: Correlation between fertilizer use and farm related factors

Factor	1	2	3	4	5	6	7
1	1.00						
2	.01	1.00					
3	-.34**	.13**	1.00				
4	-.17*	-.04	-.04	1.00			
5	.68**	.21	.05	.37**	1.00		
6	.32**	-.02	-.06	.19*	.12*	1.00	
7	.63**	.05	.07	.02	.59*	.20**	1.00

1=Fertilizer use
2=Availability of fertilizer
3=Cost of fertilizer
4=Distance to fertilizer source
5=Attitude to fertilizer use
6=Extension information support
7=Access to credit

*. *Correlation is significant at the 0.05 level (2-tailed).*
**. *Correlation is significant at the 0.01 level (2-tailed)*
Source: Field Survey Data, 2012

Best Predictors of Fertilizer Use by Maize Farmers

Table 59 shows the regression analysis of the best predictors of fertilizer use by maize farmers. A significant model is generated (R^2= .066, F=7.71, p=.00) from the multiple linear regression analysis conducted. The R-squared (R^2) value of .066 means that the independent variables regressed together explains 6.6% of the total variation in fertilizer use. The low R-squared value could be attributed to the fact that not all variables importantly related to fertilizer use may have been included in the study. These variables not included in the study were therefore not regressed. Also, fertilizer use, which is a human behaviour, is harder to predict as compared to other physical

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processes. However, the statistically significant predictors allow the low R-squared value to be used to make conclusion.

The table shows that only three of the factors loaded into the model contributed significantly to explaining the variance in fertilizer use. These factors include cost of fertilizer contributing 19.3% variance (β=-.193, p=.00), farmers' attitude to fertilizer use contributing 12.3% variance (β=.123, p=.00) and extension information support contributing 9.6% variance (β= .096, p=.01) together, these three variables accounted for 41% of the independent variables contribution to the variance in fertilizer use.

Table 59: Multiple linear regression of independent variables on fertilizer use

	B	Std. Error	β	p
Constant	56.569	46.679		.226
Cost of fertilizer	-25.565	5.171	-.193	.000
Farmers' attitude	34.020	10.550	.123	.001
Access to credit	11.082	8.364	.059	.118
Distance from farm to source of fertilizer	-.683	.758	-.035	.368
Availability of fertilizer	9.946	8.990	.043	.269
Extension information support	13.349	4.496	.096	.012

Source: Field Survey Data, 2012 $R^2=.066, p<.05$

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The cost of fertilizer contributing negative 19.3% variance in fertilizer use means the cost of fertilizer is accountable for 19.3% of the non use of fertilizer. Thus the higher the cost of fertilizer, the less fertilizer is purchased and used by farmers. Farmers' attitude to fertilizer use contributing 12.3% variance and extension information support contributing 9.6% variance means that the more favourable farmers' attitude and the more information support that is given to farmers; the more fertilizer is purchased and used by farmers. Thus from the findings of this study, it can be said that the best predictors of fertilizer use are cost of fertilizer, farmers' attitude to fertilizer use, and extension information support.

The result is similar to that of Udoh and Umoh (2011) who found that the quantities of fertilizer used was affected by the cost of fertilizer. The negative regression found means that the higher the cost of fertilizer, the less fertilizer is purchased and used by farmers. The findings are also consistent to that of Okoedo-Okojie and Aphunu (2011) who found significant and direct relationship between farmers' attitude towards fertilizer use and fertilizer use. Farmers with favourable or positive attitude towards fertilizer may tend to use more fertilizer. The result of the study is also comparable to those of Kebede *et al*, 1990, and Ouma *et al* 2006 who found Extension information support to be significant and positively related to fertilizer use, which implies the higher the Extension information support, the more fertilizer that will be used.

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CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

Introduction

The chapter includes a summary, which deals with the objectives of the study, aspects of methodology and the main findings. On the basis of the analysis of the results of the study, conclusions reached appear after the summary. The chapter also highlights recommendations considered worthwhile to ensure the increased use of fertilizer in Ghana

Summary

The agricultural sector in Ghana is unfortunately characterized by a low productivity of majority of farms as a result of declining soil fertility. This low level of productivity stems largely from the fact that soil nutrients that are absorbed by crops are not sufficiently replaced by external sources. The general objective of the study is to examine the key factors which influence the access and use of fertilizer by farmers in Ghana. The specific objectives were to determine the accessibility of fertilizers to farmers in Ghana in terms of availability, distance to source of fertilizer, cost and ability to buy; determine the annual quantity of fertilizer use (kg/ha) by maize farmers in Ghana; examine the effect of farmer's orientation towards fertilizer use on farmer's access and use of fertilizer; examine the contribution of institutional factors to farmer's access and use of fertilizer in Ghana; determine the relationships that exist between farmer's access to fertilizer and fertilizer use; determine the effect of socio-demographic factors on farmers use of fertilizer in Ghana; and determine the best predictors of fertilizer use. Descriptive – correlation survey

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was used to generate data for the study. Farmers in the various ecological zones in Ghana constituted the population for the study. The multi-stage random sampling technique was used to select 720 farmers for the study. The research instrumentation involved the use of pre-tested structured interview schedule. Trained enumerators administered the instrument.

Descriptive statistics were used to analyze the data collected. Pearson's product – moment coefficient of correlation techniques was used to determine the nature and strength of the relationships between fertilizer use and background characteristics of farmers; and also between fertilizer use and accessibility to fertilizer variables studied. And the multiple linear regression was used to determine the best predictors of fertilizer use. The following is a summary of major findings of the study.

Major findings of the study

The demographic graphic characteristics of respondents studied revealed that the men farmers interviewed were three times (77.4%) more than women farmers interviewed (22.6%), majority of farmers (69.7%) were found to be in the age group of between 35-60 years, and a generally high percentage of 77.3% had only basic school education or no formal education.

The study also revealed that fertilizers are sometimes available to majority of farmers and often arrive late. Fertilizers found in the Ghanaian market are NPK, Sulphate of ammonia, Urea, Asase Wura, Muriate of Potash and Diammonium Phospate. The study revealed that there were no special fertilizer formulations for specific crops except for cocoa. The study observed

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that the leading source of fertilizer acquisition among farmers is the agro input dealer shop. Most farmers (49.6%) travel from eleven kilometers to twenty kilometers to reach the source of fertilizer. Other constraints to the use of fertilizer identified included lack of credit, unavailability of capital, lack of knowledge or information about fertilizer use, unavailability of fertilizer, late arrival of fertilizer, and fertilizer package size. The study found the three top most constraints of fertilizer use to be the cost of fertilizer indicated by 69.3% of the farmers, capital availability indicated by 66.5% of the farmers, and lack of credit indicated by 62.1% of the farmers, which all happens to be financial issues. 57.8% of farmers interviewed found knowledge or information about fertilizer to be an important constraint. Late arrival of fertilizers, availability of fertilizer, and distance from fertilizer source to farm, followed as constraints indicated by 57.4%, 38.0%, and 22.6% of farmers respectively. The study found that 66.1% of farmers interviewed had problems with the most common fertilizer package size of 50kg. and also revealed that the 25kg package size was most preferred by 39.4% of the farmers.

The recommended application rate for maize throughout the country is 375kg/ha, however the study revealed that the least rate applied by maize farmers is 41.7kg/ha and the highest 437.5kg/ha. Most of the farmers (84.4%) were found to be using fertilizers at rates lower than the recommended rate. The study also revealed the overall fertilizer use by maize farmers in the order of the most to the least of the zones as follows; Transitional Forest (135.05kg/ha), Guinea Savannah (116.62kg/ha), Forest Zone (72.86kg/ha), Sudan Savannah (61.57kg/ha) Costal Savannah (42.81kg/ha), and Rain Forest

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Zone (29.05kg/ha). The average fertilizer use by maize farmers can be said to be 76.33kg/ha in Ghana.

The study revealed that 56.9% of farmers interviewed found the opinion of Agricultural officers on fertilizer use to be important to them, also 71.8% of the farmers assessed were found to have positive attitude towards fertilizer use. The study revealed that 69.6% of farmers who are in the majority are aware that fertilizer policies are in place whereas 31.4% are not aware of any fertilizer policy. The study also revealed that farmers interviewed disagreed (Mean = 1.80; SD = 0.97) that fertilizer prices are affordable; the farmers again disagreed that fertilizers are supplied on time with ratings of (Mean = 2.42; SD = 0.91). They however scored between disagree and agree concerning the fact that fertilizer is always available, fertilizer sources are closer to farms, and fertilizers farmers buy are of quality by recording ratings of (Mean = 2.58; SD = 0.94), (Mean = 2.73; SD = 1.12), and (Mean = 2.77; SD = 1.05) respectively. Some farmers also agreed to the fact that there is some level of policy support as 43.75% of those studied indicated that the level of policy support is good.

The study revealed that the most common source of information for farmers is the agricultural extension service (65.1%). This is followed by radio stations (59.6%), other farmers (48.6%), fertilizer dealers (47.1%) and research/universities/education institutions (37.5%). The most unused source is the internet (16.8%), followed by the print media (20.1%), television (31.5%) and the fertilizer companies (35.4%). The study revealed that 55.4% of farmers interviewed had attended or had received some form of training on the use of fertilizers, whilst 44.6% of farmers had not received any training. The study

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also revealed that the usefulness of fertilizer use information received by farmers ranged from slightly useful to useful, with the exception of impact of fertilizer use on the environment rated slightly useful (Mean=2.41; SD=1.475) the remaining information received were rated useful, (Mean=3.13; SD=1.08, Mean=3.19; SD=1.07, and Mean=3.43; SD=0.71) for selection of fertilizer, recommended application rates, and how to apply fertilizer respectively.

The correlation analysis found the cost of fertilizer, distance to fertilizer source, household size, access to credit, farmers' attitude towards fertilizer use, and extension information support to be significantly correlated to fertilizer use. All the relationships were positive and significant apart from cost of fertilizer and the distance to fertilizer source which were negative and significant. Also availability of fertilizer was positive and insignificant.

After regressing the independent variables on the dependent variable, the best predictor variables of fertilizer use were cost of fertilizer, farmers' attitude towards fertilizer use and extension information support. The cost of fertilizer accounted for 19.3% variance (β=-.193, p=.00), attitude to fertilizer use accounted for 12.3% variance (β=.123, p=.00) and extension information support accounted for 9.6% variance (β= .096, p=.01), together these three variables accounted for 41% of the independent variables contribution to the variance in fertilizer use.

The following sections present the conclusions and recommendations that were drawn from the findings.

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Conclusion

Within the context of the characteristics of farmers and the research objectives set for the study, the following conclusions were drawn from the findings:

1. Fertilizers are not always available to farmers in Ghana and often arrive late. Fertilizers found in the Ghanaian market in the order of importance or popularity are NPK, Sulphate of Ammonia, Urea, Asasewura, Muriate of Phosphate, and Diammonuim phosphate. With the exception of Asasewura, Cocofed, and a few other foliar types of fertilizer formulated for applications on Cocoa, there are no special fertilizer formulations for specific crops.
2. Fertilizers are not fully accessible to farmers. In addition to fertilizers not always being available, most farmers travel a distance between 11-20 km to reach fertilizer retail shops or their fertilizer source. These fertilizers are purchased mainly from Agro dealer shops; also farmers who do not live close to purchasing centres obtain their fertilizer supplies from Agricultural Extension Agents.
3. Most farmers found cost of fertilizer as a constraint that prevent them from using fertilizer. Access to credit was found to be positively correlated (r=0.63) to fertilizer use, in this study. Credit was also found to be very significant in determining whether or not a farmer will use fertilizer, as credit empowers farmers to purchase fertilizer and other farm inputs.
4. High cost of fertilizers, lack of access to credit, lack of knowledge or information about fertilizer use, late arrival of fertilizer, long distance to source of fertilizer, and large package size were constraints found to affect fertilizer use.

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5. Most maize farmers apply fertilizer below the recommended rate of 375kg/ha. The average fertilizer application rate for maize per year in this study was 76.33kg/ha. Farmers in the Transitional forest zone were found to apply the highest rates of fertilizer on their maize, followed in a decreasing order by Guinea Savannah, Forest zone, Sudan Savanna, Coastal Savannah, and lastly Rain forest.

6. Policies and programmes aimed at increasing fertilizer use were identified by farmers to be in place. Only 43.7% of farmers in the study find the level of government policy support to be good.

7. Farmers receive fertilizer use information from many sources including the Agricultural Extension Services, fertilizer dealers, and radio stations. However Agricultural Extension Service remains the most important source of information to farmers.

8. Training of farmers in fertilizer use is very important. The study found that about half (55%) of the farmers had received training in fertilizer use. There is the need to intensify fertilizer use technology dissemination so as to increase the use of fertilizer. A high level of extension support expose farmers to information and existing technology which influence adoption.

9. Demographic characteristics of farmers and other farm related factors studied influence the use of fertilizer. Household size, farm size, access to credit, farmers' attitude towards fertilizer use, and extension information support were positively and significantly correlated to fertilizer use, whilst cost of fertilizer and distance to fertilizer source were negatively and significantly correlated to fertilizer use.

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10. Cost of fertilizer, farmers' attitude towards fertilizer use and extension information support emerged as the best predictors of fertilizer use. Together, these three variables accounted for 41% of the independent variables contribution to the variance in fertilizer use.

Recommendations

Based on the findings, discussions and conclusions of the study, the following recommendations are presented to improve the use of fertilizer in Ghana:

1. The Ministry of Food and Agriculture should plan for quantities of fertilizer to be imported by coming out with estimates of quantities of the various types of fertilizers needed in the country annually, so as to import enough fertilizer for timely distribution.
2. The Ministry of Food and Agriculture must register companies that import, distribute and sell fertilizer in the country so as to keep track of them, and should also collaborate with the fertilizer importing companies to ensure timely delivery and constant supply of fertilizers to the regions and district, especially the rural areas.
3. The Ministry of Food and Agriculture must improve upon the fertilizer market information system by providing appropriate and reliable data and information about the national and international fertilizer markets to importers, domestic market distributors and farmers for improved accessibility.
4. Agro Input Dealers Association should facilitate members to obtain credit from bankers to expand their fertilizer business and also locate their shops in the rural areas so as to bring fertilizer closer to the farm gates.

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5. The Co-operative Department should help farmers organize themselves into farmer Based Organizations to educate and provide the farmers with the necessary support so as to increase their chances of accessing financial credit to enable them buy fertilizers for their farms.
6. The government should in partnership with the private sector improve on infrastructure like port facilities, warehouses, railways and roads to improve fertilizer movement and storage, so as to reduce the distribution cost and the final cost of fertilizers imported into the country.
7. The Ministry of Food and Agriculture should intensify information support to farmers by organizing more training programmes for farmers to upgrade their knowledge in fertilizer use.
8. Female farmers who are mainly small scale farmers and the youth who are the future of the country should be encouraged by Agricultural officers to be fully represented at training sessions and other agricultural related activities to ensure a better understanding and their increased use of fertilizer.
9. The Ministry of Food and Agriculture, fertilizer importers and NGOs should intensify fertilizer use campaigns using the appropriate information dissemination channels, especially through radio discussions so as to create awareness about the types of fertilizers and their proper use in order to help farmers develop a positive attitude towards fertilizer use.
10. Other information sources to farmers, like fertilizer dealers and radio stations which provide fertilizer use information must be better resourced with information on fertilizer use and with information dissemination facilities so as to compliment the efforts of the Agricultural Extension Service.

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11. The government should in partnership with the private sector invest into the domestic production of inorganic fertilizer. The government can provide the conducive environment for this to happen while private sector could take advantage of the conducive environment created. A conducive environment could include tax incentives for investing companies.
12. Fertilizers in 50kg bags should be repackaged into 25kg, 20kg, 10kg, 5kg, 2kg and 1kg bags or packets by licensed Repackaging agents. This will ensure farmers buy required quantities at affordable prices.
13. The recommended rate of 375kg/ha for maize was found to be the same in all the ecological zones. Researchers must work towards coming out with recommendations for specific agro-ecological zones and soil types.

Suggested Area of Further Studies

A study to evaluate the various methods of information dissemination used by Agricultural Extension Agents for the dissemination of fertilizer use information to farmers in the country should be carried out to determine their effects on the level of use of fertilizer by farmers and to identify the most efficient method.

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REFERENCES

Adams, M. E. (1982). *Agriculture extension in developing countries.* Singapore: Longman Group Limited.

Adams, S. & Bartholomew, T. A. (2010). The impact of microfinance on maize farmers in Nkoranza in the Brong Ahafo region of Ghana. *Journal of Management Research, 2*(2),1-13.

Adesina, A. A., & Baidu-Forson, J. (1995). Farmers' perception and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics 13*, 1-9.

Adesina, A.A. (1996). *Factors affecting the adoption of fertilizers by rice farmers in Cote d'Ivoire*. Bouake: IITA (IZTA).

African Union [AU] (2006).*Abuja declaration on fertilizer for the African green Revolution.* Retrieved September 21, 2010, from http://www.africafertilizersummit.org/Abuja%20in%20English.pdf

Agwu, A.E. (2004). Factors influencing adoption of improved cowpea production technologies in Nigeria. *Journal of International Agricultural and Extension Education, 11*(1), 81-88.

Ahn, P. M. (1970). *West African soils*. Oxford: Oxford University Press.

Ajzen, I. (1985). From intentions to actions: A theory of planned behaviour. In J. Kuhl, and J. Beckman (Eds.), *Action control: from cognition to behaviour* (pp. 11-39). Heidelberg: Springer.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Ajzen, I. (1991). The theory of planned behaviour: Organizational behaviour and human decision processes. *Annual Review of Psychology, 50*, 179–211.

Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology, 52*, 27-58.

Akpoko, J.G. & Yiljep, Y.D. (2000). Factors associated with the adoption of Treadle pump technology in the north-west part of Nigeria. *Journal of Pure and Applied Sciences, 3* (1), 70-78

Amedahe, F. K. (2000). *Introduction to educational research.* Cape Coast: Center for Continuing Education.

Annequin, P. (2010, June 21-25). *The State of Fertilizer Marketing in West Africa: "Managing Risks in the Fertilizer Value Chain"* Paper presented at IFDC International Training Workshop. Accra, Ghana.

Ariga, J., Jayne, T.S., Kibaara, B. & Nyaro, J.K. (2008). *Trends and patterns in fertilizer use by smallholder farmers in Kenya, 1997 – 2007.* Nairobi:Tegemeo Institute.

Asante, E. (2002). *Determinants of adoption of improved technologies in Ashanti region of Ghana.* Unpublished master's thesis, University of Ghana, Legon.

Asante-Mensah, S. (1988). *The adoption of recommended practices by cocoa farmers: The Ghana cocoa rehabilitation program.* Unpublished master's thesis, the University of West Indies, St Augustine, Trinidad and Tobago.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Asiabaka, C.C. & Owens, M. (2002). *Determinants of adaptive behaviours of rural farmers in Nigeria.* Proceedings of the 18th Annual Conference of Association for International Agricultural and Extension Education (AIAEE). Durban, South Africa.

Baah, F., Anchirinah, V., & Amon-Armah, F. (2011). Soil fertility management practices of Cocoa farmers in the Eastern region of Ghana. *Agriculture and Biology Journal of North America, 2*(1), 173-181.

Baidu-Forson, J. (1999) Factors influencing adoption of land-enhancing technology in the Sahel: Lessons from a case study in Niger. *Agricultural Economics, 230*, 231-239

Baker, T.L. (1999). *Doing social research.* (3rd Edition). Boston: McGraw-Hill College

Bamire, A.S., Febiyi, Y.L., & Manyong. V.M. (2002). Adoption pattern of fertilizer technology among small-scale farmers in two ecological zones of south-western Nigeria: A tobit analysis. *Australian Journal of Agricultural Research. 53*, 901-910

Banful, A. B. (2009). *Operational details of the 2008 fertilizer subsidy in Ghana – preliminary report, Ghana Strategy Support Program (GSSP)* Accra: IFPRI.

Bannor, R. K. (2012). *A study on ministry of food and agriculture workers.* Accra: Human Resource Management and Development Department, MOFA.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Basu, A., Blavy, R. &Yulek, M. (2004). *Micro finance in Africa, experience and lessons from IMF*. Geneva: International Monetary Fund

Bationo, A., Hartemink, A., Lungu, O., Naima, M., Okoth, M., Smaling, E. & Thiombiano, L. (2006, June 9-13). *African soils: Their productivity and profitability of fertilizer use.* Paper Presented at the Africa Fertilizer Summit. Abuja, Nigeria.

Benor, D. & Harrison, J. Q. (1977). *Agricultural extension: The training and visit system.* Washington DC: World Bank Publications.

Best, J.W. & Kahn, J.V.(1998). *Research in education.* (8th Edition). Needham Heights, MA: Allyn and Bacon.

Bhati, U.N. (1975). Use of high-yielding rice variety in Malaysia. *The Developing Economies*, *13*(2), 187-207.

Boateng, O. K., Keraita, B. & Akple, M.S.K. (2007). Gyinyase organic vegetable growers' Association in Kumasi, Ghana. *Urban Agriculture Magazine*, 17, 38-40.

Bokor, K.R. (2005). *Agricultural extension: Its role in national development.* Retrieved September 23, 2012, from http;//www.modernghana.com/print/118522/1/agricultural-extension-its-role-in-national-develo.html

Bosompem, M. & Mensah, E. (2012). Occupational hazards among farmers in the Birim South district in the Eastern region of Ghana. ARPN *Journal of Agricultural and Biological Science*, *7*(12), 1055-1061.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Breisinger, C., Diao, X., Kolavalli, S. & Thurlow, J. (2008). *The role of Cocoa in Ghana's future development.* Ghana Strategy Support Program (GSSP) Background Paper No. GSSP0011.

Brown, L.A. (1981). *Innovation diffusion: A new perspective.* New York: Methuen.

Bumb B.L., Debrah S.K. & Maene L. (2006). *Input subsidies and agricultural development: Issues and options for developing and transitional economies.* Muscles Shoals, AL: IFDC.

Bumb B.L, Johnson M.E, & Feuntes P.A. (2011). *Policy options for improving regional fertilizer markets in West Africa.* International Food Policy Research Institute. IFPRI Discussion Paper 01084.

Bumb, B. L. Teboh, J. F., Atta, J.K. & Asenso-Okyere, W.K. (1994). *Ghana policy environment and fertilizer sector development.* Muscles Shoals, AL: IFDC.

Burton, R. J. F. (2004). Reconceptualising the 'behavioural approach' in agricultural studies: A socio-psychological perspective. *Journal of Rural Studies*, *20*(3),359 - 371.

Byerlee, D. & Heisey, P. (1992). Strategies for technical change in small-farm agriculture, with particular reference to Sub-Saharan Africa. In: N.C. Russel, and C.R. Dowswell, (Eds.). *Policy options for agricultural development in Sub-Saharan Africa.* Virginia: Airlie House.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Camara, O & Heinemann, E. (2006, June 9 - 13). *Overview of the fertilizer situation in Africa.* An IFDC paper presented at Africa Fertilizer Summit. Abuja, Nigeria.

CIMMYT, (1993). *The adoption of agricultural technology: A guide for survey design.* Mexico City: CIMMYT.

Crawford, E. W., Jayne, T. S. & Kelly, V. A. (2005). *Alternative approaches for promoting fertilizer use in Africa with particular reference to the role of fertilizer subsidies.* Michigan: Department of Agricultural Economics, Michigan State University.

Crawford, E. W., Jayne,T. S. & Kelly, V. A. (2006). *Alternative approaches for promoting fertilizer use in Africa.* Agriculture and Rural Development Discussion Paper 22, Washington, D.C.: World Bank.

Croppenstedt, A. & Demeke, M. (1996). *Determinants of adoption and levels of demand for fertilizer for Cereal group farmers in Ethiopia.* Centre for the Study of African Economies. Univ. of Oxford. Working Paper WPS/96-3

Damanpour, F. & Schneider, M. (2006). Phases of the adoption of innovation in organizations: Effects of environment, organizations and top managers. *British Journal of Management. 17*, 215–236.

Danso, G., Drechsel. P., Wiafe-Antwi, T. & Gyiele, L. (2002). Income of farming systems around Kumasi, Ghana. *Urban Agriculture Magazine, 7*, 5-6.

Davis, J. A. (1971). *Elementary survey analysis.* Englewood, NJ: Prentice Hall.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Debertin, D. (1986). *Agricultural production economics.* New York: McMillan Publishing Company.

Dinar, A. & Yaron, D. (1992). Adoption and abandonment of irrigation technologies. *Agricultural Economics,6*, 315-332.

Donkoh, S. A. & Awuni, J. A. (2011). Farmers' perception and adoption of improved farming techniques in low-land rice production in northern Ghana. *Journal of Agriculture and Biological Sciences*, *2*(4), 084 – 093.

Doss, C. R. & Morris, M. L. (2001). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Economics*, *25*(1), 27-39.

Drechsel, P., Giordano, M. & Enters, T. (2005) Valuing soil fertility change: Selected methods and case studies. In: B. Shiferaw, H.A.Freeman, & S.M. Swinton (Eds.). *Natural resources management in agriculture: Methods for assessing economic and environmental impacts.*(pp. 199 – 221) Wallingford: ICRISAT – CAB International.

Egyir, I.S. & Beinpuo, E.N. (2009). *Strategic innovations in urban agriculture, food supply and livelihood support systems performance.* Accra, Ghana. Retrieved September 23, 2012, from http://ruaf.iwmi.org/Data/Sites/4/Documents/PDF/strategicinnovationsinuainaccra.pdfs

Eilitta, M. (2006, June 9-13). *Achieving an African Green Revolution: A vision for sustainable agricultural growth in Africa.* An IFDC Paper Presented at the African Fertilizer Summit. Abuja, Nigeria.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Ersado, L., Armacher, G. & Alwang, J. (2004). Productivity and land-enhancing technologies in northern Ethopia: Health, public investment, and sequential adoption, *America Journal of Agricultural Economics*, *86* (2), 321-331

FAO. (1991). *Manual on fertilizer statistics*. FAO Economic and Social Development Paper 102. Rome: Food and Agriculture Organization of the United Nations.

FAO. (1998, September 4-6). *Training for agricultural and rural development: Extension education reshaping Africa Universities and Colleges for 21st Century.* Workshop proceedings on bringing Africa Universities and Colleges more into Agricultural development, Accra.

FAO. (2000, September 1-3). *HIV/AIDS: A threat to food security and rural development, fruits and vegetable for health.* Report of a joint FAO/WHO Workshop at Kobe, Japan. Rome: Food and Agriculture Organization of the United Nations.

FAO. (2003). *Trade reforms and food security: Conceptualizing the linkages*.Rome: Economic and Social Development Department, Food and Agriculture Organization of the United Nations.

FAO. (2004a).*Fertilizer development in support of the Comprehensive Africa Agriculture Development Programme (CAADP).* Rome: Food and Agriculture Organization of the United Nations.

FAO. (2004b). *Scaling soil nutrient balances.* Rome: Food and Agriculture Organization of the United Nations.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

FAO.(2005). *Fertilizer use by crops in Ghana.* Rome: Land and Plant Nutrition Management Service, Land and Water Development Division, Food and Agriculture Organization of the United Nations.

Feder, G. Just, R.E. & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change*, *32*(2), 255-298

Feder, G. & Roger, S. (1986). The impact of agricultural extension: The training and visit system in India. *The World Bank Research Observer. 1*(2), 139-161.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research.* Reading: Addison-Wesley.

Flinn, J.C., Karki, B., Rawal, T., Masicat, P.&Kalirajan, K. (1980). Rice production in the tarai of Kosi zone, Nepal. International Rice Research Institute. *IRRI Research Paper* NO. 54.

Floyd, C., Harding, A., Paudel, K. C., Rasali, D. P., Subedi, K.& Subedi, P. P. (2003). Household adoption and the associated impact of multiple agricultural technologies in the western hills of Nepal. *Agricultural Systems*, *76*, 715-738.

Fraenkel, J., Sawin, E. & Wallen, N. (1999). *Visual statistics: A conceptual primer.* Boston: Allyn and Bacon.

Fraenkel, J.R. & Wallen, N.E. (2000). *How to design and evaluate research in education* (4th Edition). Homewood, IL: Irwin

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Fuentus, P., Bumb, B. & Johnson, M., (2012). *Improving fertilizer markets in West Africa: The fertilizer supply chain in Ghana.* Muscles Shoals, AL: IFDC/IFPRI.

Gale (2007). *Ghana: Worldmark Encyclopedia of Nations, 2007.* Retrieved August 15, 2010, from http://www.encyclopedia.com/topic/Ghana.aspx

Gerner, H., Asante, G.H., Owusu-Bennoa, E.O.& Marfo. K. (1995). *Ghana privatization scheme.* Lome: International Fertilizer Development Center.

Gerken, A., Suglo, J-V, &Braun, (2001).*Crop protection policy in Ghana: An economic analysis of current practice and factors influencing pesticides use*. Accra: Glade Digital.

Ghana Districts. (2006a). *Central region, economic characteristics.* Retrieved September 20, 2012, from http://www.ghanadistricts.com/region/?r=3&sa=68

Ghana Districts (2006b). *Upper East, social characteristics.* Retrieved September 20, 2012, from http://www.ghanadistricts.com/region/?r=8&sa=468

Ghana Statistical Service (2008). *Ghana Living Standards Survey: Report of the fifth round.* Accra: Ghana Statistical Service.

Ghana Statistical Service (2012). *2010 Population and housing census: Summary report of final results.* Accra: Ghana Statistical Service.

Gregory, D.I. & Bumb B.L. (2006). *Factors affecting fertilizer supply in Africa.* Washington DC: World Bank.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Kebede, Y., Gunjal, K. & Caffin, G. (1990). Adoption of new technologies in Ethiopian agriculture: The case of Tegulet-Bulga district, Shoa province, *Agricultural Economics, 4*, 27-43.

Kelly, V. (2006). *Factors affecting demand for fertilizer in sub- Saharan Africa.* Washington DC: World Bank.

Keraita. B.N. & Drechsel, P. (2004). *Agricultural use of untreated urban wastewater in Ghana.* Accra: International Water Management Institute.

Khor, M. & Hormeku, T. (2006).*The impact of globalisation and liberalisation on agriculture and small farmers in developing countries: The experience of Ghana.* Accra: Third World Network.

Kimenye, L.N. (2002). Promoting farm/non-farm linkage: A case study of French bean processing in Kenya. In Davis et al. (Eds.),*Promoting farm/non-farm linkage for Rural Development: Case studies from Africa and Latin America.* Rome: Food and Agricultural Organization of the United Nations.

Kodiechi, K. C. (2002). *Analysis of loan repayment among farmers: A case study of ACGSF in Enugu state.* Unpublished bachelor dissertation, Department of Cooperative and Rural Development, Enugu.

Krejcie, R. & Morgan, D. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*(3), 607-609.

Kumi, J. A. (2004). *Factors affecting attitudes of Cocoa farmers towards replanting and decision to replace Cocoa with other crops in the*

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Kwaebibirem District, of the Eastern Region, Ghana. Unpublished dotoral thesis, University of Cape Coast, Cape Coast.

Kwarteng, J. K. & Zinnah, M. M. (1994).*Communication and extension methods, a course manual.* Cape Coast: School of Agricultural.

Liao, D.S. N. (1968). *Studies on adoption of new Rice varieties*, China: Institute of Scientific and Technical Information.

Maiangwa, M.G., Ogungbile A.O., Olukosi J.O, & Atala, T.K. (2007). Adoption of chemical fertilizer for land management in the North –West zone of Nigeria. *Tropical Agricultural Research and Extension, 10*, 33-47.

Mansfield, E. (1961). Technical change and rate of imitation. *Econometrica,29*(4), 741-766.

Makokha, S., Kimani, S., Mwangi, W., Verkuijl, H.& Musemb,i F. (2001). *Determinants of fertilizer and manure use for maize production in Kiambu District, Kenya.* Nairobi: International Maize and Wheat Improvement Center and Kenya Agricultural Research Institute.

Marsh, S. P., Pannell, D.J. & Lindner, R.K. (2000). The impact of agricultural extension on adoption and diffusion of Lupins as a new crop in Western Australia. *Australian Journal of Experimental Agriculture 40*(4), 571 - 583

Marshall, C.K.A. (2004). *Farmers' perception on the effectiveness of agricultural extension services provided by Ministry of Food and Agriculture (MOFA) and NGOs in the Central region of Ghana.*

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Unpublished Doctoral Thesis, Department of Agricultural Economics and Extension. University of Cape Coast, Cape Coast, Ghana.

Mensah, K. (2006).*The dissemination and adoption of Cocoa production technologies in Ghana.* Unpublished doctoral thesis, University of Cape Coast, Cape Coast, Ghana.

MOFA (1990). *Mid-Term Agricultural Development Programme (MTADP).* Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (1998). *National soil fertility management plan,1998.* Accra: Directorate of Crop Services Division, Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2001).*Gender and Agricultural Development Strategy (GADS).* Directorate of Agricultural Extension Services, Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2006a).*Agricultural extension handbook.* Accra: GTZ/CIDA.

MOFA (2006b). *Agriculture in Ghana: Facts and figures.* Accra: Statistics, Research and Information Directorate (SRID),Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2007). *Food and Agriculture Sector Development PolicyII.* Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2010a). *Agriculture in Ghana: Facts and figures.* Accra: Statistics, Research and Information Directorate (SRID),Ministry of Food and Agriculture, Accra, Ghana.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

MOFA (2010b). *Fertilizer subsidy programme implementation guidelines.* Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2010c). *Medium Term Agriculture Sector Investment Plan (METASIP) 2011-2015.* Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2010d). *Plants and Fertilizer Act (2010), Act 803.* Accra: Assembly Press.

MOFA (2011). *Akuapem South municipal, Eastern region, Ghana.* Retrieved September 23, 2012, from http://mofa.gov.gh/site/?page_id=1495

MOFA (2012). *Agriculture in Ghana: Facts and figures.* Accra: Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2013). *National fertilizer policy.* Accra: Information Service Unit, Directorate of Agricultural Extension Services,Ministry of Food and Agriculture, Accra, Ghana.

Mosher, S. (1979). *An introduction to agricultural extension.* Singapore: University Press for the Agricultural Development Council.

Muriuki, A. W. & Qureshi J. N. (2001). *Fertilizer use manual: A comprehensive guide on fertilizer use in Kenya.* Nairobi: Kenya Agricultural Research Institute.

Myers, R. J. (1991). Economics testing for risk averse behaviour in agriculture. *Applied Economics 21*, 541-552.

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Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

MOFA (2010b). *Fertilizer subsidy programme implementation guidelines*. Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2010c). *Medium Term Agriculture Sector Investment Plan (METASIP) 2011-2015*. Accra: Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2010d). *Plants and Fertilizer Act (2010), Act 803*. Accra: Assembly Press.

MOFA (2011). *Akuapem South municipal, Eastern region, Ghana*. Retrieved September 23, 2012, from http://mofa.gov.gh/site/?page_id=1495

MOFA (2012). *Agriculture in Ghana: Facts and figures*. Accra: Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture, Accra, Ghana.

MOFA (2013). *National fertilizer policy*. Accra: Information Service Unit, Directorate of Agricultural Extension Services.Ministry of Food and Agriculture, Accra, Ghana.

Mosher, S. (1979). *An introduction to agricultural extension*. Singa- University Press for the Agricultural Development Council.

Muriuki, A. W. & Qureshi J. N. (20
comprehensive guide on fertilize
Agricultural Research Institute.

Myers, R. J. (1991). Econometrics for
Applied Economics, 23, 3d

of

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Okon, U. E. & Enete, A. A. (2009). Resource use efficiency among urban vegetable farmers in Akwa Ibom state, Nigeria. *Tropicaltura*, *24*(4), 211 – 217

Okoruwa, V.O., Ogundele, O.O. & Oyewusi, B.O. (2006, August). *Efficiency and productivity of farmers in Nigeria: A study of rice farmers in north central Nigeria.* Poster paper presented at the International Association of Agricultural Economist Conference, Gold Coast, Australia.

Okunade, E.O.&Oladosu I.O. (2006). *Rating of extension teaching methods for training female farmers in Osun state, Nigeria.* Presentation at the 10th Annual Conference of Agricultural Extension of Nigeria.

Okwoche, V. A., Asogwa, B. C., & Obinne, P.C. (2012). Evaluation of agricultural credit utilization by cooperative farmers in Benue state of Nigeria. *European Journal of Economics, Finance and Administrative Sciences*, 47, 123.

Oluoch-Kosura W.A., Marenya P.P., & Nzuma M.J (2001). *Soil fertility management in Maize-based production systems in Kenya: Current options and future strategies.* Nairobi: Department of Agricultural Economics, University of Nairobi.

Oluyole, K.A., Adebiyi, S. & Adejumo, M.O. (2007). An assessment of the adoption of Cocoa rehabilitation techniques among Cocoa farmers in Ijebu East Local Government Area of Ogun State. *Journal of Agricultural Research and Policies* 2(1), 56-60

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Olwande,J., Sikei G. & Mathenge, M. (2009).*Agricultural technology adoption: A panel analysis of smallholder farmers' fertilizer use in Kenya.* A paper presented at the 83rd Annual Conference of the Agricultural Economics Society. Dublin, Ireland.

Opoku-Asiamah, M. (2008). *Pesticide management and extension information support for small scale farmers in the Ga East and Ga West districts of the Greater Accra region of Ghana.* Unpublished doctoral thesis, University of Cape Coast, Cape Coast Ghana.

Osei-Bonsu, K., Baah, F. & Afrifa, A.A. (2001). *Evaluation of Cocoa conditions, problems and possible solutions in four farming communities surrounding the Kakum Forest Reserve, Central region, Ghana.*Consulting Report for Conservation International, Tafo Cocoa Research Institute of Ghana.

Ouma J.O., Groote H.D., & Owuor G. (2006). *Determinants of improved maize seed and fertilizer use in Kenya: policy implications.* Paper presented at the International Association of Agricultural Economists Conference, Gold Coast Australia.

Oumou, M.C. & Ariga J. (2011). *Factors influencing maize farmers demand for fertilizer in Kenya.* Muscles Shoals, AL: IFDC

Pallant, J. (2001). *SPSS survival manual- A step by step guide to data analysis using SPSS for Windows (Version 10).* Crown Nest:Allen and Urwin.

Palm C.A, Myers R.J.K., &Nanda S.M. (1997). Combined use of organic and inorganic nutrient sources for soil fertility maintenance and

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

replenishment. In: R. J. Buresh, P.A. Sanchez, F. Calhoun (Eds.). *Replenishing soil fertility in Africa.* Madison, Wisconsin: Soil Sciences Society of America.

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., & Vanclay, F. (2006). Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture, 46*(11), 1407 – 1424.

Peprah, J.A. (2011). Access to credit and technical efficiency of vegetable growers in the Mfantseiman District of Ghana. *International Journal of Economic and political Integration, 1*(1), 31-44.

PPMED, (2009). *MOFA 2008 National Annual Review report.* Accra: MOFA

PFRD, (2012). *Pesticide and Fertilizer Regulatory Division, 2011 Annual report.* Accra: MOFA

Quaye, W., Adofo, K. Agyeman, K.O., & Nimoh, F. (2010). Socioeconomic survey of traditional commercial production of Cocoyam and Cocoyam leaf. *African Journal of Food Agriculture. Nutrition and Development, 10* (9), 4060-4078.

Reardon, T., Kelly, V., Yanggen, D.& Crawford, E. (1999). *Determinants of fertilizer adoption by African farmers: Policy analysis framework, illustrate evidence, and implication.* East Lansing, MI: Department of Agricultural Economics, Michigan State University.

Reijntjes, C., Haverkort, B.& Water-Bayer, A. (1992). *Farming for the future; an introduction to low-external input.* London: Macmillan Press Ltd.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Rogers, E.M. (1983). *Diffusion of innovations.*(3rd Edition). New York:Free Press.

Rogers, E.M. (1995). *Diffusion of Innovations.*(4th Edition). New York:Free Press.

Rogers, E.M (2003).*Diffusion of Innovations.*(5th Edition). New York:Free Press.

Rogers, E.M.& Burge, R.J. (1977).Community norms, opinion leadership and innovativeness among truck growers. *Ohio Agricultural Experiment Station Research Bulletin* 37, 1-5.

Ryan, B., & Gross, N.C. (1943). The diffusion of hybrid seed Corn in two Iowa communities. *Rural Sociology, 8*, 15 - 24

Shareef, R. (2012, October 10). *Farmers in Upper East continue to face challenges with fertilizer.Modern Ghana.* Retrieved from http://www.ghanadistricts.com/region/?r=8

Shiferaw, B. & Holden, S.T. (1998). Resource degradation and adoption of land conservation technologies in the Ethopian highlands: A case study in Andit Tid, North Shewa. *Agricultural Economics, 18*, 238-247

Smaling, E.M.A.& Braun, A.R. (1996). Soil fertility research in sub-Saharan African: New dimensions, new challenges. *Commun Soil Sci. Plant Anal.*, 27,365-386.

Stoneman, P. (2002).*The economics of technological diffusion.* Oxford: Blackwell.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Thapa, S. (2007, October). *The relationship between farm size and productivity: empirical evidence from the Nepalese mid-hills.* Paper presented at the 106th Seminar of European Association of Agricultural Economists. Montpellier, France.

Tonah, S. (2006). The presidential special initiative on cassava: a bane or blessing to Ghana's smallholder farmers. *Ghana Journal of Development Studies, 3*(1), 66-84.

Udoh, A. J. & Umoh, E. (2011). Fertilizer use and measures for increased sustainable consumption by peasant farmers: Food security approach in rural Nigeria. *Journal of SAT Agricultural Research 9*, 1-8

United Nations, (2001). *World population prospects, the 2000 revision: highlights.* New York: Population Division, Department of Economics and Social Affairs.

Vanclay, F. (2004). Social principles for agricultural extension to assist in the promotion of natural resource management. *Australian Journal of Experimental Agriculture, 44*, 213 - 222

Van den Ban, A.W. & Hawkins, H.S. (1996). *Agricultural extension* (2nd Edition). London: Blackwell Science Ltd.

Van Kauwenbergh, S.J.(2006).*Fertilizer raw material resources of Africa.* Muscle Shoals, AL: IFDC

Vanlauwe, B. & Giller, K. E. (2006). Popular myths around soil fertility management in sub-Saharan Africa. *Agriculture, Ecosystems and, Environment, 116* (1-2), 34-46.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Vissoh, V. P. (1994). *Adoption of soil management practices by small scale farmers in southern Benin Republic*. Unpublished master's thesis. University of Ibadan, Ibadan, Nigeria.

Voh J.P. (1979). *An exploratory study of factors associated with adoption of recommended farm practices among Giwa farmers, Samara.* Zaria: Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria.

Von Braun, J. (2005). *Small-scale farmers in a liberalized trade environment.* Haikko, Finland: University of Helsink

Waithaka, M.M, Thorton, P.K, Sherperd, K.D, & Ndiwa, N. N. (2007). Factors affecting the use of fertilizer and manure by smallholders: The case of Vihiga, western Kenya. *Nutrient Cycling in Agro Ecosystems* 78, 211-244.

Weir, S. & Knight, J.(2004). Externality effects of education: Dynamics of the adoption and diffusion of an innovation in rural Ethiopia. *Economic Development and Cultural Change*. *53*, 93-113.

World Bank (2003). *East Asia integrate: A trade policy agenda for shared growth.* Cambodia: World Bank.

World Bank (2012). *Countries compared by agriculture; Fertilizer use.* Retrieved September 23, 2012, from http://www.nationmaster.com/country infor/stats/ Agriculture/Fertilizer-use

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Yawson, D.O., Armah, F.A., Afrifa, E.K. & Dadzie S.K. (2010). Ghana's fertilizer subsidy policy: Early field lessons from farmers in the Central region. *Journal of Sustainable Development in Africa*, 12(3), 2010.

Yim K.M (1978) *An economic analysis of factors affecting HYV and fertilizer adoption in the Province of Negeri Sembilan, Peninsular Malaysia.* Unpublished master's thesis, University of the Philippines, Los Banos, Philippines.

Yusuf, T.M., Okunmadewa, F.Y., Adenegan, K.O. & Oyekale, A.S. (2010). Productivity of women farmers in the derived savannah zone of Nigeria: Panacea to food crisis. *Journal of Research in Agriculture*, 7(2), 21-27.

Zanu, H.K., Antwiwaa, A. & Agyeman, C.T. (2012). Factors influencing technology adoption among Pig farmers in Ashanti region of Ghana. *Journal of Agricultural Technology*, 8(1), 81-92.

Zhou, Y., Yang, H., Mosler, H.J.& Abbaspour K.C. (2010). Factors affecting farmers' decisions on fertilizer use: A case study for the Chaobai Watershed in northern China. *The Journal of Sustainable Development* 4(1), 80-102.

Zubair, M., & Garforth, C. (2006). Farm level tree planting in Pakistan: The role of farmers' perceptions and attitudes. *Journal of Agro forestry systems*, 66(3), 217-229.

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University of Cape Coast https://ir.ucc.edu.gh/xmlui

APPENDICES

Appendix A: Interview Schedule for Farmers

University of Cape Coast

School of Agricultural

Department of Agricultural Economics and Extension

Dear Respondent,

Thank you for your willingness to participate and share precious time with us in an effort to bring to light factors contributing to fertilizer use by farmers in Ghana.

The purpose of this study is to enlighten policy makers on the challenges facing the fertilizer industry so that they can based on issues raised, formulate sound and effective policies for implementation.

Also the results will be used to assist top management of MOFA, the District Assembles, NGOs research institutions and other public and private sector development partners to make informed decisions for improvement in agricultural training and development programmes for farmers.

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SECTION A: Farmer Characteristics

Please tick [√] the appropriate box, fill in the blank spaces or provide appropriate responses where applicable

1. Region .....
2. District .....
3. Name of community
4. Sex a. Male [ ] b. Female [ ]
5. Age (at least birth day)..... years.
6. Level of Education

No Formal Education [ ]

Primary Education [ ]

Middle School Certification [ ]

Junior High School [ ]

General Certificate (O' Level/A' Level) [ ]

Senior High School [ ]

Technical School/Vocational/Commercial [ ]

Tertiary (Diploma), Degree, Postgraduate [ ]

7. Marital Status

Single [ ]

Married [ ]

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Divorced [ ]

Separated [ ]

Widowed [ ]

8. How many members are there in your household? .....

9. How many years have you been farming? .....

10. Category of Farming

Full time [ ] Part time [ ]

11. Please indicate your other major occupation apart from farming.

.....

12. What are the major crops on your farm? List in order of importance and indicate acreage.

Crop	Approximate acreage
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

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13. Do you practice mixed cropping

Yes [1] No [2]

14. If yes, kindly indicate the mixed crops and acreage of the farms

Crop mixtures	Approximate acreage
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

15. Please state reason(s) for practicing mixed cropping

.....

.....

.....

.....

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16. Please state the income you earn from the crops you produce

Season	Crops income(GH₵)
Major Season	
Minor Season	

17. How do you classify your income level based on the income accrued from crops produced? Please tick.

Low [ ]

Medium [ ]

High [ ]

SECTION B: Accessibility to Fertilizer

18. Which of these fertilizers have you heard of or seen before (aware of)?

(Multiple response possible)

NPK [ ]

Urea [ ]

Sulphate of Ammonia [ ]

Muriate of Potash [ ]

Diammonium Phosphate [ ]

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Asaase Wura [ ]

Others (Specify)

.....

19. Which factors influence your decision of applying fertilizer?

Factors	Choice
Knowledge or information about effectiveness of fertilizer	
Price of fertilizer	
Type of crop being cultivated	
Crop performance	
Type being used by neighbours	
Promotion of fertilizer companies	
Recommendation by (AEA, FBO, or NGO)	
Recommendation by input dealer	
Information from other sources like radio, newspaper, etc	
Others (specify)	

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20. Are fertilizers available to you when you need them?

Never [ ]

Sometime [ ]

Often [ ]

Always [ ]

21. What are your sources of obtaining fertilizer (Multiple response)

Agro input dealer (Retailer) [ ]

Other farmers [ ]

Market [ ]

Distributor (Wholesale) [ ]

AEA [ ]

Others (Specify).....

22. State the distance to source(s) of Fertilizer from your farm

.....

23. What is your opinion about the cost of fertilizer

Low [ ]

Moderate [ ]

High [ ]

Very high [ ]

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24. Are you able to buy the fertilizer you need? Please tick

Never [ ]

Sometimes [ ]

Often [ ]

Always [ ]

SECTION C: Farmers' Orientation towards Fertilizer use

OPINION OF REFERENCE PEOPLE

25. Whose opinion concerning fertilizer use is relevant to you? Please tick the most important person. Using the scale below indicate the opinion of the reference people listed by ticking your view of each of them.

1.Very Unfavourable 2.Unfavourable 3. Favourable 4 Very Favourable

Reference People	Tick	1	2	3	4
Assembly man					
FBO Executives					
Other Farmers					
Husband/Wife					
Agric Extension Officer					
Fertilizer Dealers					
Others(Please indicate)					

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ATTITUDE TOWARDS FERTILIZER USE

26. Please respond to the following statements by using the scale below (Please tick).

Strongly Disagree 2. Disagree 3. Agree 4.Strongly Agree

Fertilizer use Beliefs	1	2	3	4
Fertilizer use can improve soil fertility				
Fertilizer use can conserve soil moisture				
Fertilizer use can make crop mature early				
Fertilizer use can improve quality of produce				
Fertilizer use can make produce store better				

SECTION D: Fertilizer Use among Farmers

27. Do you use fertilizer on your farm?

Yes [ ] No [ ]

28. If yes to Q27, why do you use fertilizer?

.....

.....

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29. If no to Q27, why do you not use fertilizer

.....

.....

.....

.....

30. What is the common fertilizer package size on the market ..... kg

31. Do you have any problem(s) with the common fertilizer package size Yes [ ]

No [ ]

32. If yes to Q31 state your

problem(s).....

.....

33. If yes to Q31, state the fertilizer package size you

prefer.....kg

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34. Which constraints influence your use of fertilizer?

Constraints	Tick
Knowledge or information about fertilizer	
Cost of fertilizer	
Capital availability	
Lack of credit	
Distance from source	
Package size	
Availability of fertilizer	
Late arrival of fertilizer	
Information from other sources like radio, newspaper, (specify).....	

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35. Please state crop(s) you use fertilizer on, area under cultivation, type of fertilizer used and amount of fertilizer used per season

MAJOR SEASON			
Crops	Area under cultivation (ac)	Type of fertilizer used	Amount used (bag or kg)

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MINOR SEASON			
Crops	Area under cultivation (ac)	Type of fertilizer used	Amount used (bag or kg)

SECTION E: Contribution of Institutional Factors to Farmers Access and Use of Fertilizer

36. Have you ever heard of any Fertilizer Policy

Yes [ ] No [ ]

37. Using the statements and the scale below indicate whether or not you are benefiting from Government policies.

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1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree

Statements	1	2	3	4
Fertilizer prices are reduced				
Fertilizer prices are affordable				
Fertilizer is available always				
Fertilizers are supplied on time				
Fertilizers shops are closer to farms				
Fertilizers farmers buy are of quality				

38. How beneficial do you find the Government Policy Support for Fertilizer.

Please tick one of the ratings below.

Not Beneficial [ ]

Slightly Beneficial [ ]

Beneficial [ ]

Very Beneficial [ ]

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39. What would you expect Government to do through its Agencies to improve fertilizer availability, accessibility and use in Ghana?

.....

.....

.....

.....

40. Do you have access to credit

Yes [ ] No [ ]

41. Do you solicit for credit to purchase agro input (fertilizer)?

Yes [ ] No [ ]

42. Do you face problems in the acquisition of credit

Yes [ ] No [ ]

43. How difficult is it to get credit when most needed?

Very easy

Easy

Difficult

Very difficult

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44. In your opinion which of these factors is a problem in the acquisition of credit?

Please indicate the level of seriousness by the ratings below:

1-Not a problem

2-Not serious

3-Moderately serious

4-Serious

5-Very serious

Factor	Level of seriousness				
	1	2	3	4	5
(i) Delays in the release of credit					
(ii) Demand for collateral					
(iii) Cumbersome processing procedures					
(iv) High interest rate					
(v) Others (Specify)					

45. Have you ever had any information on fertilizer use

Yes [ ] No [ ]

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46. Please indicate your most important source of information on fertilizer use.

Please tick only one.

Information Source	Tick
Agric Extension	
Fertilizer Dealer	
Fertilizer Company	
Research/Universities/Educational Institutions	
Other farmers	
Print Media(Newspaper, Journals etc)	
Radio	
Television	
Internet	
Others (Specify	

47. Have you ever attended any training on fertilizer use?

Yes [ ] No [ ]

48. How useful is the Extension Information Support on Fertilizer use provided by Extension Officers? Please use the ratings below;

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1-Not Useful 2-Slightly Useful 3-Useful 4-Very Useful

Extension Information	Usefulness			
	1	2	3	4
Selection of Fertilizer				
Recommended Application Rate				
How to apply Fertilizer				
Storage of Fertilizer				
Impact of Fertilizer on the Environment				

49. Please tick your perceived level of Extension Information Support for fertilizer use.

1. Very Poor [ ]
2. Poor [ ]
3. Fair [ ]
4. Good [ ]
5. Very Good [ ]

50. List any additional information and services you require on fertilizer and fertilizer use

.....

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51. Make recommendations for improvement of information support for fertilizer use

.....

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Appendix B: Davis' convention

Davis' convention for describing Magnitude of correlation Co-efficients

No.	Magnitude of Correlation Co-efficients (r)	Description
1	1.0	Perfect
2	0.70 – 0.99	Very High
3	0.50 – 0.69	Substantial
4	0.30 – 0.40	Moderate
5	0.18 – 0.29	Low
6	0.01 – 0.09	Negligible

Source: Davis (1971)

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Appendix C: Sampled districts and farming communities

a) Upper East Region / Sudan Savannah

DISTRICTS	FARMING COMMUNITIES
Talensi Nabdam	Tongo-beo, Balungu, Dakota, Pelungu, Zanlerigu
Bongo	Soe, Adbboya, Nyariga, Yorigo, Namon, Zorko, Via-Gowrie
Garu Tempane	Akara Teshie Natings, Ziseri Benwoko, Tariganga, Novmboko
Bawku West	Sapeliga, Tanya, Timonde, Binaba, Boya
Bawku Municipal	Kuka, Megog,Binduri, Bazua Kpalore, Gumbo, Baribari, Zabugu
Kassena Nankana	Zenga, Bio, Gaani, Nania Korania

Source: Field survey, 2012

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Appendix C: Sampled districts and farming communities

b) Northern Region / Guinea Savannah Zone

DISTRICT	FARMING COMMUNITIES
Tamale	Taha, Togu, Jarigu
	Foshegu
Gushegu	Galwei, Kpatinga, Wantugu
	Nayugu, Katani
Karaga	Gaa, Pigu, Guna
	Gunayili, Asafoyili, Nabrugu
Tolon/Kumbugu	Dalon, Kuli, Kasoyili
	Gbulung, Wantugu
Savelugu	Nabogu, Dipale, Bunlung
	Nyolugu, Libga
Yendi	Sepke, Afayili, Gunsi
	Kulkpegni, Sanzee

Source: Field survey, 2012

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Appendix C: Sampled districts and farming communities

c) Brong Ahafo Region / Transistional Zone

DISTRICT	FARMING COMMUNITIES
Atebubu/Amantin	Afrefreso, Patuda, Kokofu
	New Konkrompe, Sanwakyi
Kintampo Municipal	Asantekuro, Gulumpe, Jelusalem
	Kawampe
Nkoranza South	Asonkwaa, Babiabi, Bonsu
	Brahoho, Bredi
Pru	Abua, Ankran-Kuka, Beposo
	Matukwa
Sene	Bantama, Kalipo, Laila
	Mempeasem, Mframa
Tain	Attakrom, Brohani, Dagadu
	Munamunaso, Nsawkaw

Source: Field survey, 2012

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Appendix C: Sampled districts and farming communities

d) Ashanti Region / Forest Zone

DISTRICT	FARMING COMMUNITIES
Atwima Nwabigya	Jankoban, Nerebehi, Dabaa
	Esaase, Akropon
Amansie Central	Numereso, Abuakwa, Fenaso
	Twankumi, Abuntunso
Bosomtwe	Borodekwanso, Oyoko, Beposo
	Ponkorko, Piase
Adansi South	Akutriso, Praso, Twetweboaso
	Menang, Asarekrom
Bosome Freho	Asiwa, Morontuo, Nsuaem
	Nsuta
Bekwai Municipal	Ntinanko, Anwia Nkwanta,
	Kokofu, Bekwai

Source: Field survey, 2012

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Appendix C: Sampled districts and farming communities

e) Western Region / Rain Forest Zone

DISTRICT	FARMING COMMUNITIES
Bibiani	Bibiani, Aohwiaso, Bekwai
	Chirano
Sefwi Wiawso	Akontombra, Nsawora, Asafo
	Buako, Wiawso
Tarkwa Nsuaem	Simpa, Banso, Pataho
	Iduaprim, Nsuaem
Juabeso	Mafia, Nkwanta, Suiano
	Afere, Elluibo
Bia	Asuopiri, Essam, Kwamebikrom
	Kwametawiakrom, Adabokrom
Asankrangwa	Breman, Asankrangwa,
	Sika Nti, Wassa Dunkwa,
	Mosiaso

Source: Field survey, 2012

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Appendix C: Sampled districts and farming communities

f) Central Region / Coastal Savannah Zone

DISTRICT	FARMING COMMUNITIES
Kommenda-Edina-Eguafo-Abrem District	Kissi, Ayensudo, Ataabadze, Abrem
Abura-Asebu-Kwamankese District	Asebu, Ayeldo, Edunfa Abakrampa, Nyamedom
Mfanteman District	Anomabo, Dominase Yamouransa, Afranqua
Gomoa West	Tarkwa, Ankamu, Kokofu Eshiem, Oguaa, Kyiren, Dawurampong
Awutu-Senya District	Bawjuase, Breku, Ofaakor, Kwaman
Gomoa East	Afransi, Potsin, Dominase, Buduatta, Ekwamkrom

Source: Field survey, 2012

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Appendix D: Fertilizer type and cost per 50 kg bag

Type of Fertilizer	Price per bag (GHC)	
	Subsidized	**Non-Subsidized**
NPK	30	56
Urea	29	51
S/A	25	40
Muriate of Potash	-	80
Diammonium Phosphate	-	85
Asaase Wura	30	-

N=720

Source: Field Survey Data, 2012

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