ANALYSIS OF PRODUCTIVITY AND LIVELIHOOD OF FARMERS: A CASE OF USAID-MARKETS MAIZE PROJECT IN KADUNA STATE

BY

Esther Afor IBRAHIM
Ph.D/AGRIC/44610/ 2012-13

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL ECONOMICS

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY
FACULTY OF AGRICULTURE
AHMADU BELLO UNIVERSITY
ZARIA, KADUNA STATE
NIGERIA

FEBRUARY, 2016

DECLARATION

I declare that this thesis titled "**Analysis of Productivity and Livelihood of Farmers: A Case of USAID-MARKETS Maize Project in Kaduna State**" has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another Degree or Diploma in this or any other institution. All borrowed information have been duly acknowledged in the text and a list of references provided.

____________________________ _________________________

Esther Afor IBRAHIM **Date**

Student

CERTIFICATION

This thesis titled **"Analysis of Productivity and Livelihood of Farmers: A Case of USAID-MARKETS Maize Project in Kaduna State, Nigeria"** by Esther AforIBRAHIM meets the regulation governing the award of the degree of Doctor of Philosophy (Agricultural Economics) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

________________________ ________________________

Prof S. A. Sanni **Date**

Chairman, Supervisory Committee

________________________ ________________________

DrM.A.Damisa **Date**

Member, Supervisory Committee

________________________ ________________________

Prof S.J. Auta **Date**

Member, Supervisory Committee

________________________ ________________________

Prof Z. Abdulsalam **Date**

Head of Department of Agricultural Economics and Rural Sociology

________________________ ________________________

Prof. K. Bala **Date**

Dean School of Postgraduate Studies

DEDICATION

This work is dedicated to the Holy Trinity (God the Father, God the Son and God the Holy Spirit). Thank you for the strength and grace to finish this work.

ACKNOWLEDGMENTS

My greatest and sincere appreciation goes to God Almighty for the life, strength and enablement to carry out this work. To you alone be all the glory.

I am most grateful to my supervisors; Prof. S. ASanni, Dr. M.A. Damisa and Prof. S. JAutafor their invaluable assistance, close supervision, constructive criticisms, suggestions and pieces of advice that aided the completion of this research work. God will bless and reward you.To my sweet husband and lovely children, thank you for the support and encouragement. God bless you.To my dear parents (Late Peter Alfa Igonohand Mrs. JummaiIgonoh) thank you for your love for education. Thank you.

I will like to appreciate Sasakawa Africa Association for being my employer and for the financial support to carry out this work through the Norman Bourlaugh Scholarship funds for staff. God bless you. I will not fail to appreciate my bosses at the country and regional levels. Dr. J.Rwalemira, Prof. S.A. Miko and Engr. L. Halos-Kim you all taught me that hard work really pays. God bless you. To all my colleagues in Sasakawa, I say a big thank you for your support and encouragement.

I will also like to use this opportunity to thank the Head of Department Agricultural Economics and Rural Sociology Prof Z.Abdulsalam for his support and all my lecturers in the department for allowing me to tap from your wealth of experiences. To ProfT.K. Atala, Prof. D.FOmokore, Dr. O Yusuf, Prof Akinola and Mal.Salisu Suleiman, I lack words to appreciate you, but God who sees in the secret will reward you for your support. Dr. (Mrs.) E. Adamu, Mr. and Mrs. Elias Akubo, Mr.and Mrs. AbubakarObaje, Pastor and Mrs. Omede thank you for your encouragement and support, God bless you.

To my siblings; Sunday, Simon, Eke and Abodiya, I say thank you for your prayers and encouragement. God bless and keep you all in Jesus name. I love you so much. I will also not fail to say a big thank you to my brothers-in-Law; Mr. Coleman Labija and Mr. Alex Ibrahim, God bless you.There are too many people to appreciate, even if your name was not listed, God who sees in the secret will surely bless you. Thank you all and God bless.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

Figures **Pages**

LIST OF APPENDICES

Appendix **Pages**

ABSTRACT

The broad objective of the study is to analyze the detailed impact of the intervention of USAID/MARKETS on the productivity of the farmers and assess the extent to which the intervention has improved upon their maize productivity and livelihood. Multi-stage sampling technique was employed in the selection of the sample respondents. A total of 334 farmers were included in the study (237 participant farmers and 97 non participants representing 5% of the list of farmers selected at random. The data collected includes production and socio-economic data of the farmers. The data was analyzed using descriptive statistics, Gross- Margin analysis, and inferential statistics such as Stochastic Frontier Production and Malmquist Productivity index. The study revealed that about 79% of the participant farmers and 15% of the non-participants had technical efficiencies score above 81% while 38% of the participants and 10% of the non-participants had allocative scores of 81% and above. The economic efficiency scores exceeding 60% were attained by 51% of the participant farmers and 2% of the non-participant farmers. The results of the analysis generally implies that, the participant farmers were more economically efficient than the non- participant farmers. Age, level of education, household size, land size and extension contact were factors that influenced farmers efficiencies. The Gross Margin analysis reveals that maize production for both participants and non-participants was profitable with a gross margin of ₦ 129,972.5 and ₦ 29,829 respectively. The benefit cost ratios of 3.5 and 1.61 was obtained for participants and non-participants respectively. The analysis also shows that, for every ₦ 1.00 invested by the participants' farmers in maize production yields a return of ₦ 2.5 while for non-participants the rate of returns was 0.61.The MARKETS project employed several empowerment strategies to improve the productivity and livelihood of the farmers. About 87% of the farmers showed their satisfaction on the effectiveness and timeliness of the trainings and demonstration on the use of improved seed. Similarly, 82% and 100% of the participant farmers also reported that they were satisfied with the level on extent of training received on improved agronomic practices. Access to credit and linkage to markets for their maize were some of the major constraints identified as 85.6% and 50% of the farmers reported their dis-satisfaction with the intervention in these two areas respectively. Considering the Malmquist Productivity index, the result of the analysis shows a progress in the total factor productivity growth of both categories of farmers with the MARKETS farmers having a higher growth rate of 71.8% as compared to 47.7% by the non-participant farmers. Analyzing the level of participation of the MARKETS farmers in the project reveals that 98.7% of the farmers indicated their involvement and participation in the project was strong and 1.3% had weak involvement as either members of the group or lead farmers. Further analysis showed that 97% of the farmers continued to put into practice all the technological packages introduced during the project lifespan. The remaining 3% also showed partial practice of the introduced innovation in maize production. The study revealed some constraints faced by the farmers. The farmers reported linkage to markets (Off-Takers/Processors), reliable markets with good price for produce and poor input support. The study recommended that, up-scaling farmers' productivity and livelihood should not be left to external donors alone. There is the need for government to intensify in agricultural empowerment programmes by strengthening the public-private partnership linkages.

CHAPTER ONE

INTRODUCTION

Background to the Study

Despite the economic importance of maize to the teeming populace in Nigeria, its production is insufficient to meet food and industrial needs of the country. This could be attributed to low productivity from maize farms due to non-adoption of improved technologies for maize production by farmers. Maize production in Nigeria has not been sufficient enough to meet the needs of people and livestock. Supply has not been able to meet demand despite the introduction of improved packages (Onuk*et al*., 2010).

In Nigeria maize is the third most important cereal crop after sorghum and millet (Ojo, 2000), the demand for maize as a result of various domestic uses shows that a domestic demand of 3.5 million metric tonnes outstrips supply production of 2 million metric tonnes (Akande, 1994;Ogunsumi*et al*., 2009).Maize production in the country was until early 1970s confined to the forest zone. In the savanna, maize production has since been transformed from the status of a minor crop by being grown around the homestead to a major commercial grain crop, competing with sorghum and millet as a strategic crop in the grain economy of the nation (Elemo, 1993). Infact, about 70% of the maize in Nigeria is produced in the savanna zone.

In 2010, about 5,256,430 hectares of maize were planted in Nigeria with a total production of 8,800 million tons (NBS, 2010). Report shows that, in 2011 5.150 million hectares were under maize cultivation in Nigeria, with production of 9.250

million tons per annum, giving a yield of 1.8 tons per hectare (USDA, 2012). This showed that even though there was a decrease in the total hectares under maize cultivation in 2011 compared to 2010, the production in 2011 is greater than that of 2010. According to (FARA, 2014) the overall positive productivity effects observed in the sub-regions have implications for national and regional maize policy development in Africa.That sub-regions need to support their member's states to increase productivity rather than acreage cultivated if they are to respond to the challenges being faced by maize growers. Maize is grown in all the ecological zones of the entire country; however, Guinea Savannah zone provides the best ecological condition for maize cultivation. In Nigeria maize is usually intercropped with other crops such as yam, cassava, guinea corn, rice, soybeans, cowpea and groundnut.

Maize is a staple food crop whose consumption is widespread across the country and among households. Maize is prepared as pap, tuwo, pwate, and donkunu, with the cereal cooked, roasted, fried, ground, pounded or crushed form (Abdulrahaman, 2006). In an attempt to increase maize production extensive research works on maize have been carried out by National Agricultural Research Institutes (NARI) and International Institute of Tropical Agriculture (IITA). Research focus was to develop and introduce improved maize varieties that are disease resistant and high yielding. Consequently maize production has since the mid-1980s increased more than tripled.
Many maize technologies have been developed in national and international research stations but most of these are yet to be adopted by farmers. This has led to a large yield gap between the researchers' and the farmers' fields. High quality seed is in short supply because the seed sector is not adequately organized. Farmers also need

improved access to fertilizers, crop protection products and other inputs (USAID/ MARKETS, 2010).

The ability of the Nigerian agriculture to perform its role in agricultural development according to Ogunsumi*et al* (2005) has been on decline in the last three decades. Hence the reason why Nigerian government adopted different agricultural programmes and policies (Farm Settlement Scheme (1960s), National Accelerated Food Production Programme (1972); Agricultural Development Projects (1972); Food Security and Poverty Alleviation Programme and Agricultural Transformation Agenda)aimed at raising productivity and efficiency of agricultural sector.

A key goal of the Agricultural Transformation on maize is to increase maize production to 20Million metric tons in Nigeria. The agenda is to focus on thecommercialization and deployment of high yielding, stress tolerant and nutrient efficient maize hybrids and varieties, promotion of optimal fertilizer usage along with appropriate crop and resource management practices targeted to maintain the soil base and enhance agricultural productivity. Others includes modification of policies which impede the growth of private sector input companies including, seeds, fertilizer and other inputs, as well as the marketing of maize grain both in-country and for export, Identification and development of new uses for maize in order to drive demand for thecrop and create additional market.

The Federal Government as well pursue other developmental programs such as the Special Program for Food Security (SPFS) beginning in 2001, the Fadama II Program established in 2003 and the recapitalization of the Nigerian Agricultural, Cooperative and Rural Development Bank (NACRDB) which was launched in 2004. The National Food Security Program (NFSP) includes trade policies, such as import substitution, marketing/price policies, and the promotion of modern agricultural practices. The National Investment Plan (NAIP) was established in 2011-2014. The 5-Point Agenda is coopted in the NAIP and is characterized by five main pillars: (1) Developing Agricultural Policies and Regulatory System (DAPRS); (2) Agricultural Commodity Exchange Market (ACCOMEX); (3) Raising Agricultural Income with Sustainable Environment (RAISE); (4) Maximizing Agricultural Revenue in Key Enterprises (MARKETS); and (5) Water, Aquaculture and Environmental Resource Management.Although maize was excluded from the focus crops of the Presidential Initiative in 2002, it was indeed included among the commodities selected for special focus in the NAIP; those crops include cassava, rice, millet, sorghum, wheat, maize, sugar, cowpeas, soya beans, tomato, cotton, cocoa, and oil palm. Three initiatives generally impacted on maize, through current public expenditure. This includefertilizer policy (procurement and distribution), the National Special Program for Food Security (NSPFS) and the buyer-of-last-resort grain purchase. These represent respectively 43%, 22% and 26% of spending in 2008, with capital expenditure that mainly focused on the purchase of agricultural inputs. However, there are two categories of policies directly impacting maize, namely the price support and input subsidies measures, with view to increasing maize productivity in the country.

MARKETS Project is funded by the United States Agency for International Development (USAID). MARKETS (Maximizing Agricultural Revenues and Key

Enterprises inTargeted Sites) has been expanding economic opportunities in the agricultural sector byincreasing jobs, sales, and investment for farm and non-farm agricultural businesses. Bypromoting commercial agriculture, improved productivity, value-added processing andexpanding final product markets, MARKETS is therefore having an impact on improving ruralhousehold livelihoods and reducing poverty.

From 2010 and 2012, USAID/Nigeria implemented theMARKETS project in Kaduna state on Maize. MARKETS I and Bridge to MARKETS 2 (BMt2) focused on expanding economic opportunities in the agricultural sector by increasing agricultural productivity, enhancing value-added processing, and increasing commercialization through private-sector led and market-driven growth and development. MARKETS worked on a number of value chains. It sub-contracted with Sasakawa Africa Association (SAA), to network and train farmers in an out-grower scheme to produce some commodities for an already available market (buyers). The **target areas are Igabi and Lere**Local Government Areas in Kaduna State.

A total of 5000 farmers were networked and trained on the best agronomic practices for improved maize production and supply of quality maize grain (especially in drying, threshing, cleaning) to meet standards set by the buyer (Grand Cereals Oil Mills, Limited , Jos). The economic and agricultural transformation policies in Nigeria have further put maize in a prominent position in the country's food economy. The ban placed on importation of rice and wheat flour further makes maize a very important raw material being sought after by several feed mills, flourmills and breweries in Nigeria. The key point is that significant maize productivity gains are possible for all classes of farmers, provided they have access to the technological components.

Problem Statement

Maize is Nigeria most important and highly cultivated crop. It is the number one source of income for most farmers in Northern Nigeria and is a key staple food crop. Yet despite the importance of maize production that is accorded in Nigeria, farmers continue to face a number of challenges. Maize farmers lack access to quality inputs and the technical knowledge needed to improve farm production. As a result, farmers aren't able to realize economies of scale and formal linkages with financial and advisory services providers are not leveraged to their fullest extent to enhance performance and maize post-handling techniques. In addition, lack of collective marketing initiatives and storage facilities as well as viable market outlets contribute to a glut of maize plus the years agricultural productivity has been a major concern for agricultural policy because of its influence on development. Agricultural productivity has seriously declined over the past two decades and as a result, rural poverty is rampant. World bank (2011) data shows that more than 70% of Nigerians live below the poverty line (which is less than $1.25/ day) implying that there has been an astronomical growth in the levels of poverty of Nigerians most of whom are engaged in agriculture from independence till today.

Farming population comprises predominantly resource-poor peasants, cultivating an average of about two hectares of land usually on scattered holdings with low and declining productivity. Weak growth in agriculture is generally attributed to low productivity and commercialization in the sector as a result of limited use of improved inputs (MAAIF, 2010).The current study is to evaluate an economic analysis of maize farmers' performance in terms of total productivity growth and its determinants and their effect on the farmers' livelihood in Kaduna State under the USAID/MARKETS maize project. Consequently, the following research questions are proposed:

i. What are the socio-economic characteristics of the farmers?

ii. What are the levels of economicefficiencies in maize production by farmers in the study area?

iii. What factors influence farmers' economic efficiency levels?

iv. What are the cost and returns to the maize farmers in the study area?

v. What is the impact of the USAID/MARKETS Project on the livelihood pattern of farming households participating in the project?

vi. What is the level of farmers' participation in the USAID/MARKETS Project?

vii. What are the main constraints faced by maize farmers in the study area?

Objectives of the Study

The broad objective of the study was to analyze the impact of the intervention of USAID/MARKETS on the productivity of the maize cultivation and assess the extent to which the intervention on maize technology has improved upon the livelihood of farmers in Kaduna State.The specific objectives were to:

i describe the socio-economic characteristics of the farmers;

ii determine the economic efficiency of the maize farmers in the project;

iii analyze the factors that influence farmers efficiency levels;

iv determine the cost and returns to the maize farmers under the project;

v determine the impact of the USAID/MARKETS Project on the Productivity and livelihood of farmers in the study area;

vi assess the level of participation of the farmers in USAID/MARKETS Project;

vii Identify the main constraints of maize farmers in the study area.

Justification for the Study

Countries that have witnessed momentous growth in agricultural productivity to a great extent used improved agricultural inputs. The green revolution observed in Asia, for example, is a result of increased use of high yielding seeds, fertilizers and irrigation water in production (World Bank, 2007). The success story of Malawi turning around from a net importer of maize grain less than five years ago to net exporter now, isattributed to increased use of improved seed and fertilizers by smallholder farmers following the implementation of an input subsidy program (Dorward*et al.*, 2008). Thus, in developing countries such as Nigeria where national development is anchored on agriculture, the role of improved technology in boosting agricultural productivity, household income and consequently national development cannot be overemphasized. For that reason, understanding the factors that influence farmers' decisions to use improved technologies on the one hand and the effect of these technologies on productivity and commercialization on the other hand, offers valuable information to promote effective use of improved technologies in agricultural production in the country.

For producers to sustainably use improved technologies, the physical and/or economic outcomefrom using such technologies should at least be better than when these technologies are not used in production (Kelly, 2006). Thus, understanding the physical and economic returns from use of improved technologies is crucial evidence for farmers as well as other people, particularly policymakers and extension agents who are engaged in promotion of increased use of improved technologies. Farmers engage in agricultural production for diverse reasons including production to satisfy home needs and/or for sale. Sale of food especially by subsistence producers is said to arise mainly from surplus production (Von *et al*., 1994). Thus, it is important to examine whether or not improved technologies use can trigger increased maizeoutput commercialization as a means of increasing household income due to increased productivity. Therefore, it is hoped that the study will provide some evidence to policymakers,farmers, and extension agents, on possible ways to increase the use of improved inputs,productivity and commercialization of maize production as well as other crops in Nigeria.This study is based on the premise that agriculture constitutes one key element, within a broad spectrum of strategies that can be adopted to reduce poverty and contribute to local economic development. The study will, therefore, contribute to an already rich body of knowledge on the subject, and provide key lessons to policy makers and practitioners engaged in agricultural development in communal settings. These include national, state, and local governments, as well as non-governmental organizations.

Research Hypotheses

Based on the objectives of the study, the following hypotheses were tested:

i. Participation in USAID-MARKETS Project has no significant effect on the resource Use efficiency of the maize farmers

ii. There is no significant difference in the productivity and livelihood of the maize farmers before and after intervention of USAID-MARKETS Project

CHAPTER TWO

LITERATURE REVIEW

Maize Production in Nigeria

Maize (*Zea mays* L.) is a member of the grass family *gramineae*. It originated from South and Central America. It was introduced to West Africa by the Portuguese in the 10th century. Maize is one of the most important grains in Nigeria, not only on the basis of the number of farmers that engaged in its cultivation, but also in its economic value. Maize is a major important cereal being cultivated in the rainforest and the derived savannah zones of Nigeria. Maize has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become a more important crop. Maize has now risen to a commercial crop on which many agro-basedindustries depend for raw materials (Iken and Amusa, 2004). Maize is the most important cereal in the world after wheat and rice with regard to cultivation areas and total production (Purseglove, 1992; Osagie and Eka, 1998). Maize can be classified according to the structure of the grain. We have sweet corn, flint corn, popcorn, dent corn, soft or flour corn and pod corn. Also there are different varieties like SAMMAZ 11,SAMMAZ12, SAMMAZ 14, SAMMAZ 16, SAMMAZ 17, SAMMAZ 19, SAMMAZ 32, SAMMAZ 33, SAMMAZ 36 , SAMMAZ 37, Western Yellow 1096BP6 (Yellow), NS – 1 (yellow), Tsolo (Yellow), N.S.5 (white), TZPB (White), TZB (white) e.t.c. According to IITA (2001) report, maize contains 80% carbohydrate, 10% protein, 3.5% fiber and 2% mineral. Iron and Vitamin B are also present in maize. Africans consume maize as a starchy base in a wide variety of porridges, pastes, grits and beer. Green maize (fresh on the cob) is eaten parched, baked, roasted or boiled and plays an important role in filling the hunger gap after the dry season.

According to Khawar*et al*, (2007), maize has a variety of uses. Its grain is a rich source of starch, vitamins, proteins and minerals. The starch extracted from maize grain is used in making confectionary and noodles. Corn syrup from maize contains high fructose and act as sweetener and retains moisture when added to certain foods. Edible oil is extracted from seeds, which is all-purpose culinary oil. Levulinc acid, a chemical derived from maize, is used as ingredient in antifreeze and is capable of replacing the toxic petroleum –based ingredients use. Plastic and fabrics are made from corn stocks. Ethanol obtained from maize can be used as a biomass fuel. Stigmas from female corn-flowers, known as corn silk, can be used as drug supplements.

Maize straw is a cheap source of energy and can be used in home-heating furnaces. Maize can be used as forage, feed for livestock and making silage after fermentation of corn stocks. Maize is used extensively as the main source of calories in animal feeding and feed formulation. Maize gives the highest conversion of dry substance to meat, milk and eggs compared with other cereal grains. Maize is a valuable feed grain, because it is among the highest in net energy content and lowest in protein and fiber content. Maize and other cereals constitute important sources of carbohydrates, proteins, vitamin B and minerals (Iken*et al.,* 2002). Maize is a stable food crop for most sub-Saharan Africans of which Nigeria is inclusive with per capital kg/year of 40 (FAOSTAT 2003). Nigeria has an annual maize production in excess of 7 million metric tons. In terms of volume produced, maize is the third most important cereal grown in Nigeria after sorghum and millet. Maize will continue to play a large and important role in Nigeria's food production. Its industrial demand is also increasing particularly in the food, beverage, and livestock feed industries (USAID/MARKETS, 2010).

Resource Use Efficiency in Agricultural Production

Efficiency is the act of achieving good result with little waste of effort. It is the act of harnessing material and human resources and coordinating these resources to achieve better management goal. Farm efficiency can be measured in terms of all these type of efficiency: (a) Technical Efficiency (TE), (b) Allocative Efficiency (AE) and (c) Economic Efficiency (ER). The appropriate measure of technical efficiency is input saving which gives the maximum rate at which the use of all the inputs can be reduced without reducing output. Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost. Technical and allocative efficiencies are components of economic efficiency (Abdulai and Huffman, 2000).

Stochastic Frontier Model

Stochastic production frontier analysis has been widely used to study technical efficiency in various settings since its introduction by Aigner*et al* (1977), and Meeusen and van den Broeck (1977). The approach has two components: a stochastic production frontier serving as a benchmark against which firm efficiency is measured, and a one-sided error term which has an independent and identical distribution across observations and captures technical inefficiency across production units. Recent studies have generalized the one-sided error term to allow its distribution to be heterogeneous by associating various features of the distribution with firm characteristics (see Battese and Coelli 1995; Caudill *et al*., 1995; Wang, 2002; Wang, 2003). Allowing inefficiency to depend on firm characteristics enables researchers to examine the determinants of inefficiency, and to suggest policy interventions to improve efficiency. However, many policy suggestions in the previous literature have been limited for at least two reasons.

First, little is known about how to choose among competing models of efficiency, or the implications of model choice on estimation results. Second, past studies on production efficiency have mostly focused on the directions of the influence of the exogenous factors on efficiency level while the magnitudes of the partial effects have often been overlooked. This is surprising given that the magnitudes of the effects of the explanatory variables on dependent variables are often the focal point in other regression analyses.

The basic setup and notation follow Wang and Schmidt (2002). Fields are indexed by i = 1, . . . , N. Let yi be the log output; xi be a vector of inputs; and zi be a vector of exogenous variables that exert an influence on farm efficiency. Let y ∗i be the unobserved frontier which is denoted as

$Yi *= x1\, \beta + vi$-------------------------------------- (1)

Wherevi is distributed as N (0, σ2 v) and is independent of xi and zi. The actual output level yi equals y ∗i less a one-sided error, ui , whose distribution depends on zi. The model is written as

$Yi = xi\beta + vi - ui(zi , \theta), ui(zi , \theta) \geq 0$,-- (2)

where θ is a vector of parameters. It is assumed that ui and vi are independent of each other, that conditional on zi ,ui is independent of xi , and that vi is independent of xi and zi .

The frontier function itself and the inefficiency part are generally estimated in one step using maximum likelihood estimation (MLE) to achieve both efficiency and consistency. Indexing exogenous factors with k = 1, . . . , K, we take expectations conditional on xi and zi , and then take partial derivatives with respect to zik on both sides of equation (2), to get

$\partial[E(yi |xi , zi)]/\partial_{zik} = \partial[E(-ui |xi , zi)]/\partial_{zik}$.------------------------------ (3)

Where,

$\partial[E(-ui |xi , zi)]/\partial_{zik}$ can be interpreted as the partial effect of zik on efficiency −ui , and can also be interpreted as the partial effect on yi . Because yi is the log output, $\partial[E(-ui |xi , zi)]/\partial_{zik}$ is the semi-elasticity of output with respect to the exogenous factors, i.e., the percentage change in expected output change when zik increases by one unit. Similarly, we have

$\partial[V (y_i |x_i , z_i)]/\partial_{zik} = \partial[V (u_i |x_i , z_i)]/\partial z_{ik}$.------------------------------ (4)

So $\partial[V(u_i|x_i, z_i)]/\partial_{zik}$ is the partial effect of zik on the variance of both the inefficiency term ui and log output. It can be interpreted as an estimator of the partial effect of zik on production uncertainty.

Agricultural Productivity

Agricultural productivityis measured as the ratio of agricultural outputs to agricultural inputs. Its measures are subdivided into partial, multifactor and total. Partial factor productivity is the amount of output per unit of a particular input. It only considers a single input in the ratio. For example, it uses yields of crops to determine the productivity of field crops. Literature indicates that it is easy to compute as it requires limited data, but it can be hard to identify factors that cause productivity of field crops to change.

Both Multifactor productivity (MFP) and Total factor productivity (TFP) are defined as the ratio of total agricultural output to a subset of agricultural inputs.Theyutilize more than a single factor. Their measures reflect the joint effects of many factors including new technologies, economies of scale, managerial skill, and changes in the organization of production to agricultural production. TFP is preferred to MFP due to the fact that it captures the full extent of input use and output production. But due to the fact that it has proved to be a difficult method to use (OECD productivity manual, 2001) MFP is thus used as an approximation of TFP. Although the definitions of both these methodologies reflect the use of output and input quantity, in reality using general total amounts is not an option. This is mainly because it is hard to aggregate different quantities of different measurements (mass vs. volume). And even if the output and inputs can be aggregated with the hope of deflating them, this will lead to a situation where relative price ratios to that of the base year are distorted. As a result the use of indices in these methodologies are highly encouraged and preferred.

There are various types of indices. This includes the Laspeyres, Tornqvist-Theil, Paasche, Malmquist and Fisher indexing methods.Laspeyresindexing method is a weighted base index and cannot be used in productivity analysis as it distorts the relative price ratios. It is usually used for computing the consumer price index. Tornqvist-Theil indexing method is a chained divisia index and uses spliced price and quantity indices of Laspeyres type as a proxy for prices. But it is seen as not an ideal method as it involves use of logs, which is impossible when the values turn negative as is the case with inventory changes and requires aggregation of data when commodities/inputs come into use at a later stage than the base year. The Fisher indexing method is the most preferred by many OECD countries, as it does not require the taking of logs and aggregation of the underlying data when inputs/commodities come into use at the later stage than the base year (Liebenberg *et al*, 2010).

Zepeda (2001) examined agricultural investment and productivity in the contextof developing countries. The study used number of models of production growth(index numbers or growth accounting techniques, econometric estimation ofproduction relationships and nonparametric approaches) to measure the changein output, to identity the relative contribution of different inputs to output growthand to identify the Solow residual or output growth not due to increases in inputs.Results show a relatively weak relationship between physical capital and growth,as compared to investment in technology and human capital. Other factors found to be stimulants to growth included; the policy environment, political stability andnatural resources degradation. Various authors support the findings of Zepeda (2001).

Fulginiti*et al* (1998) examined changes in agricultural productivity in eighteen developing countriesover the period 1961–1985. The study used a nonparametric, output based malmquist index and a parametric variable coefficient Cobb-Douglas production function to examine, whether declining agricultural productivity in less developed countries was due to use of inputs. Econometric analysis indicated that most output growth was imputed to commercial inputs like machinery and fertilizers.Chavas (2001) analyzed international agricultural productivity using Non-parametric methods to estimate productivity indices. The analysis used FAO annual data on agricultural inputs and outputs for twelve developing countries between 1960 and 1994.

Technical efficiency indices for time series analysis results suggested that in general the technology of the early 1990s was similar to the one in the early 1960s. This showed that the improvement in agricultural production was not because of technology but because of other inputs such as fertilizer and pesticides. The general empirical results indicated only weak evidence of agricultural technical change and productivity growth both over time and across countries. There was much evidence of strong productivity growth inagriculture over the last few decades corresponding to changes in inputs

Malmquist Productivity Index Model

The Malmquist productivity index was introduced as a theoretical index by Caves *et al*. (1982), and popularized as an empirical index by Fares *et al.* (1994).It was introduced as a theoretical index based on the Shephard*et.al.* (1970). theory of Cost and production function, distance function and is widely developed and used in many fields. Malmquist indexes can be used to construct indexes of input, output or productivity, as ratios of input or output distance functions. The most commonly used method for measuring distance functions is linear programming method.

Based on the advantages of the Malmquist index over other measures of TFP growth such as the Tornqvist Thiel Index and SFA, in this study I used the Malmquist index to determine the Total Factor Productivity growth based on output distance function (DF). Using this approach does not require price data and does not require the specification or estimation of any function; it is also easy to compute (Fares *et al*, 1994). Distance functions are derived from input-output relationships based on quantity data only. Recently, Ludena*et.al*, (2007) used this method to estimate agricultural productivity growth for 116 countries. Coelli*et al*, (2005)also estimated distance function, such as the Malmquist index to measure productivity using data on output and input quantities alone.

The Malmquist productivity index is defined on a benchmark technology satisfying constant returns to scale, which is to be distinguished from a best practice technology allowing for variable returns to scale. This convention enables it to incorporate the influence of scale economies, as a departure of the best practice technology from the benchmark technology.

$$M_{oc}^{t}(x^{t}, y^{t} x^{t+1}, y^{t+1}) = \frac{D_{oc}^{t}(x^{t+1}, y^{t+1})}{D_{oc}^{t}(x^{t}, y^{t})} \text{---------------------------} (5)$$

This ratio index measures the productivity changesoriginating from changes in technical efficiency at time period t and time period t+1 under the technology in time period t. Similarly, technical efficiency changes in time period t and time period t+1 can also be measured under the technology in time period t +1. This Malmquist Index is defined as:

$$M_{oc}^{t+1} = \frac{D_{oc}^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t+1}(x^{t}, y^{t})} \text{-----------------------------} (6)$$

Where the notation ‘‘oc t’’ indicates that the distance functions comprising the Malmquist productivity index is defined on the period t benchmark technology. Defining a Malmquist productivity index on the period t+1 benchmark technology would replace ‘‘oc t’’ with ‘‘oct+1’’. Since both are arbitrary, and since the two indexes are not necessarily equal, it is conventional to define the Malmquist productivity index as the geometric mean of the two as:

$$M_{oc}(x^{t}, y^{t} x^{t-1}, y^{t+1}) = \{[M_{oc}^{t}(x^{t}, y^{t} x^{t+1}, y^{t+1}) \text{ X } M_{oc}^{t+1}(x^{t}, y^{t} x^{t+1}, y^{t+1})]\}^{1/2}$$

$$= [\frac{D_{oc}^{t}(x^{t+1}, y^{t+1})}{D_{oc}^{t}(x^{t}, y^{t})} \text{ X } \frac{D_{oc}^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t+1}(x^{t}, y^{t})}]$$

Fare *et. al*, provided an initial decomposition of the index as:

$$M_{oc}(x^t, y^t x^{t+1}, y^{t+1}) = [\frac{(D_{oc}^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t}(x^t, y^t)}] X \{[\frac{(D_{oc}^{t}(x^{t+1}, y^{t+1})}{D_{oc}^{t+1}(x^{t+1}, y^{t+1})} X \frac{D_{oc}^{t}(x^t, y^t)}{D_{oc}^{t+1}(x^t, y^t)}]\} 1/2$$

$$= TE\Delta_c(x^t, y^t x^{t+1}, y^{t+1}) X \ TE\Delta_c(x^t, y^t x^{t+1}, y^{t+1}), \text{-----------} (7)$$

Where TEΔc (x^t, y^t, x^{t+1} , y^{t+1}) measures technical efficiency change which measures the degree of catching up to the best-practice frontier for each observation between time period t and time period t+1 and TΔ(x^t, y^t, x^{t+1} , y^{t+1}) measures the geometric mean of the magnitudes of technical change which measures the shift in the frontier of technology (or innovation) along rays through (x^{t+1} , y^{t+1}) and (x^t, y^t). That is:

TFP growth = technical efficiency change x technical change (Catching up effect) (Shift in Frontier effect)

A value of Moc 1 indicates positive TFP growth from period t to period t+1 while 1 shows a TFP growth decline. Note that while the product of the efficiency change and technical change components must by definition equal the Malmquist index, those components may be moving in opposite direction. example a Malmquist index of 1.25 (which signals a productivity gain) could have an efficiency change components less than one (say, 0.5) and a technical change component greater than1(say, 2.5). Both components are measured on the benchmark technologies. Since the best practice technologies may exhibit variable returns to scale, it is desirable to redefine both components on best practice technologies, to see what is left over, and to see if what is left over can be given a meaningful economic interpretation. Fare et.al redefined one component. They decomposed the technical efficiency change component to obtain:

$$TE\Delta_c(x^t, y^t x^{t+1}, y^{t+1}) = [\frac{(D_{oc}^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t}(x^t, y^t)}] X \{ \frac{[D_{oc}^{t+1}(x^{t+1}, y^{t+1}) / D_{oc}^{t+1}(x^{t+1}, y^{t+1})]}{[D_{oc}^{t}(x^t, y^t) / D_{o}^{t}(x^t, y^t)]} \}$$

$$= TE\Delta(x^t, y^t x^{t+1}, y^{t+1}) \ \ X \ \ [\frac{SE^{t+1}(x^{t+1}, y^{t+1})}{SE^{t}(x^t, y^t)}]$$

$$= TE\Delta(x^t, y^t x^{t+1}, y^{t+1}) \ \ X \ \ SE\Delta(x^t, y^t x^{t+1}, y^{t+1}) \text{----------- (8)}$$

where $TE\Delta(x^t, y^t, x^{t+1}, y^{t+1})$ measures pure technical efficiency change on the best practice technologies, measures the change in technical efficiency under the assumption of a VRS and $SE\Delta$ $(x^t, y^t, x^{t+1,} y^{t+1})$ measures the change in scale efficiency captures the deviations between the VRS technology and CRS technology at observed inputs from period t to period t+1. That means it measures changes in efficiency due to a movement towards or away from the point of optimal scale.

In the second stage analysis to determine factors that affect total factor productivity growth Ordinary Least Square (OLS) model was used. Total factor productivity change scores obtained in the first analysis using the DEA Malmquist Index were used as the dependent variable, while factors such as research and development spending, net value of production, tractors in use, fertilizer price, labor, tractor price and rainfall were used as the independent variables that were thought to affect maize total factor productivity growth in Nigeria. The outcome of this second stage procedure could further serve as guide in designing strategic plan for maize productivity growth in Nigeria.

Many previous studies have used this approach in order to determine factors affecting efficiency (McDonald, 2008, Hoff, 2006 and Banker *etal*.2008). The regression models that could be used in the second stage procedure are the Tobit, Ordinary Least Squares (OLS) and Maximum Likelihood Estimation (MLE). However, McDonald(2008), Hoff(2006) and Banker *etal*. (2008) have reviewed thesemodels by using efficiency scores which were generated by either censoring or generated as fractions and have made suggestions under which each one is appropriate to apply. They concluded that Tobit is suitable to use in the second stage when efficiency scores are generated by data censoring process otherwise it is an inconsistent estimator (Greene, 2004). However, when efficiency scores are generated by using DEA where efficiency scores are not censored or corner solution data, but are fractional data the most suitable models are Maximum Likelihood Estimator (MLE) or Ordinary Least Squares (OLS). In this study, based on McDonald (2008), Hoff 2006 and Banker *et al*. (2008). Ordinary Least Squares (OLS) was used in the second stage to determine factors affecting total factor productivity growth in Nigeria. To determine the factors affecting total factor productivity growth the Ordinary Least Squares (OLS) model was specified as:

$$LNY = \beta_0 + \beta_1 LNX_1 + \beta_2 LNX_2 + \beta_3 LNX_3 + \beta_4 LNX_4 + \beta_5 LNX_5 + \beta_6 LNX_6 + \beta_7 LNX_7 + \varepsilon \quad \text{----------} \ (9)$$

Profitability Measurements in Agricultural Entreprises

Agriculture is recognized as one of the most challenging and risky enterprises. Hence, maximizing long-term profitability of farms is of utmost importance to farmers' well- being and competitiveness as well as the related people who engaged in this business to a larger extent. Therefore, many agricultural and economic researchers have tried to analysis the profitability of wide variety of agricultural enterprises and determine the most important associated factors on it.

In a study by Mishra *et al*. (1999), the factors affecting profitability of limited resource and farm operator household income and other small farms such as farming occupation/lower-sales farmsbut more assets and/or income than the limited resource farms, and operators report farming as their main occupation and farming occupation/higher-sales farmsand operators report farming as their main occupation in the U.S regions were investigated by using weighted least squares model. Profitability in this study was measured by net farm income andoperators' labour and management income.The results of the study showed that profitability of limited resource farms were associated with operator's age, soil productivity, debt-to- asset ratio, and ratios of variable and fixed costs of production to value of agricultural production and the profitability of other small farms were related to operator's age, farm size, farm diversification, and crop insurance.

Plumley and Hornbaker (1991) divided cash operating expense to value of farm production to calculate farm profitability in a study investigating the characteristics of successful and less successful Illinois grain farms. They found out that successful farms had a balanced composition of assets, lower debt, and higher profitability.

In another study in Illinois on grain farmers, net farm income was assumed as proxy of farm profitability and the effect of different farm sizes in three different time periods (poor, low, and moderate profitability) were studied as independent variable. It was concluded that in periods of poor to moderate profitability driven by low to moderate commodity prices, operations with more than 500 acres tended to be more profitable than farms with less than 500 acres (Kern and Paulson, 2011). Burton and Abderrezak (1988) examined the relationships between expected profit and farm characteristics using Ordinary least squares regression model in western Kansas. They also used Net Farm Income as measure of profitability in their model as the dependent variable. The findings showed that expected profit may be enhanced by increasing farm size, lease or rental of intermediate and long-term assets, using production and financial inputs efficiently, and hedging.

In a similar study, Jirgi*et al*. (2010) investigated the profitability and resources-use efficiency of millet/cowpea mixed farmers production in Niger state Nigeria by farm budgeting technique and exponential production function. The results of the regression with Net Farm Income as the dependent variable indicated that although these enterprises are profitable, farmers should use more seed, family labour, agrochemicals, less of hired labour and land in order to gain more profits.

In a growing body of research, Gross Margin was used as proxy for farm profitability. In a report by Canadian Agrifood Policy Institute (CAPI) on 2008, it was explained that Net Farm Income is not an indicator of profitability for agricultural enterprises due to the dichotomy that exists between the level and trends in “aggregate” farm income and the level and trends in farm income for different farm operators in a diverse agricultural production sector. They suggested that Gross Margin is a better measurement of farm profitability across a range of farm types and agricultural businesses. According to CAPI definition, Gross Margin is defined as operating revenues minus cost of goods sold, with cost of goods sold defined as total operating expenses excluding interest costs, labour costs, property taxes, general building and fencing repairs, miscellaneous farm expenses, and depreciation; with no extraordinary items in operating revenues.

According to Horticulture Australia (2011), as agriculture is inherently a risky business, Gross Margin can help farm operators not only to make decision about what crop to grow but also how much input such as water, fertilizer, machinery, and labour they should apply in order to maximize their profit in uncertain and risky situations. Zulu (2011) analyzed the profitability of cowpea farmers in Zambia. He used Gross Margin as the measure of farm profitability (dependent variable) and concluded that yields, land tenure and farm gate price had a positive influence on profitability whereas production costs and area had a negative influence on profitability. In a similar study, Olujenyo (2008) investigated the determinants of maize farms' profitability in Ondo-State, Nigeria. The results of regression with Gross Margin analysis showed that maize farming is profitable in this region and farmers should apply more fertilizers to improve their land quality and gain more profits.

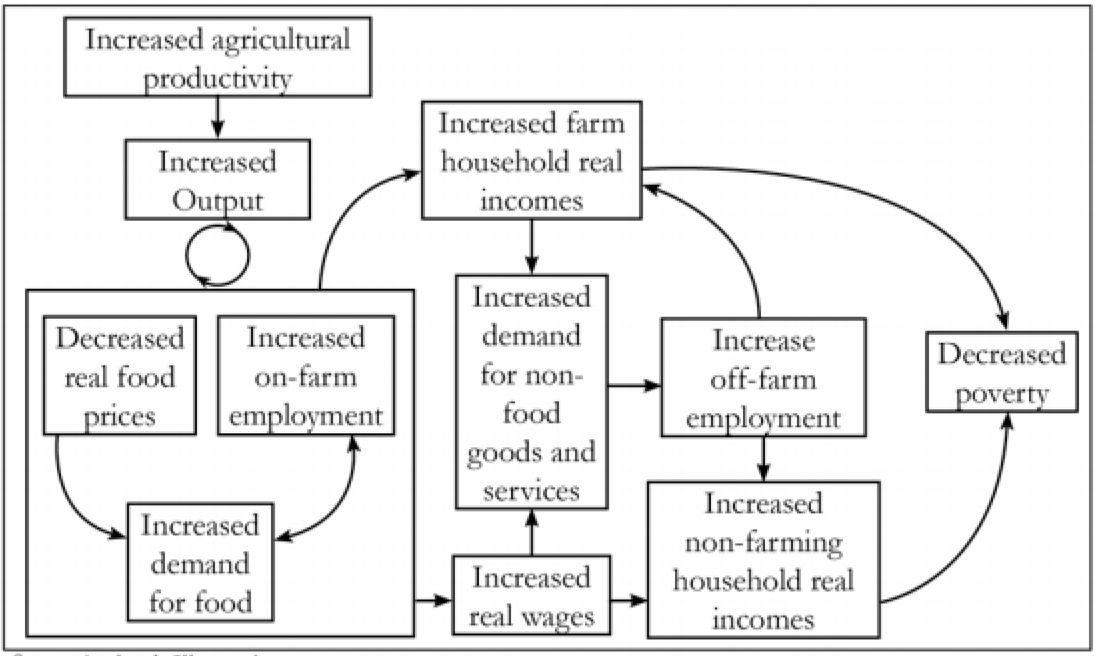
Conceptual Frame Work

The conceptual frame work for this study is based on the argument that Agricultural productivity growth can drive rural growth and catalyze a pro-poor development process (Thirtle*et al*. 2001). In theory, increasing agricultural production (output) increases incomes for poor farmers who then increase demand for the goods and services produced by the non-farming rural poor (Mellor, 1999). Higher agricultural output thus stimulates employment in the rural and urban non-farm sectors through both forward and backward linkages (Hanmer and Naschold, 2000). This in turn decreases urban poverty by slowing migration to urban areas and lowering food prices (Mellor, 1999). Thus, agricultural growth benefits poor farmers and landless laborers by increasing both production and employment, benefitting both the urban and rural poor through growth in the rural non-farm economy (Thirtle*et al*.,2003).
There are also several additional linkages and multiplier effects that may arise between increased agricultural output and other measures of welfare, however, little research has been done to verify these hypotheses or measure their impact (Irz*et al.*, 2001). Among these, Timmer (1995) theorizes that increased food production and farm incomes allow for better nutrition and increased investment in health and education. Irz*et al*. (2001) also suggest that growth in the farm sector could stimulate demand for infrastructure and generate the increased tax revenue to finance it, as well as generate social capital accumulation through increased interactions between farmers and other agents in the agricultural supply chain and related sectors.

Agricultural productivity determines the price of food, which then determines wage costs and the competitiveness of tradable goods leading to a confluence of effects that determine the real income effects of increased output for farming households

(World Bank, 2007). Increased agricultural output can change the relative prices of agricultural outputs in relation to substitute or complimentary products, as well as the costs of inputs to production (Irz*et al*., 2001). If increased output drives down product prices or the costs of production rise due to increased demand, then increased agricultural output may not translate into higher real farm income (Irz*et al*., 2001).

Output growth may not increase farm household incomes if the price effects counteract the production gain, however food price effects depend upon the tradability of the produce. Staple food crops in agriculturally based developing countries are largely non-tradable because they consist of foods (cassava, sorghum, millet, etc.) that do not have international markets and because the domestic food economy remains relatively insulated by high transport and marketing costs. Since they are non-tradable, their price is not influenced by competition in the international market (World Bank 2007). The price effects in the market for farm output determine the income effect of increased output for farm households. These price effects also send feedback to the producer that determines future desired output levels. Production decisions cause responses in the labor market that shift the demand for food as rural households can afford to consume more (or cannot afford to consume as much)(World Bank 2007).



Source: Author's Illustration

Figure 1: Path way to decreased poverty through Increased Agricultural Productivity

Declines in food prices translate to an increase in real income for net food buying households and increase the resources available for consumption. These resources may be used to increase consumption of staple foods or more diverse, nutritionally rich foods (Hazell and Haddad, 2001). Timmer (1995) suggests that increased food production and farming incomes may allow for better nutrition among rural laborers (Irz*et al*., 2001). Enhanced nutritional status can contribute to further increases in labor productivity in both current and future generations (Hazell and Haddad Agricultural Productivity and Poverty Reduction: Linkages and Pathways, 2011).

Dasgupta (1998) similarly emphasizes the positive correlation between labor productivity and nutritional status of the poor. The authors note that the majority of the impact is the result of general equilibrium agricultural sector growth, although higher wages and yields do contribute to poverty reduction on their own. Their analysis also indicates that while higher farm yields and wages improved living standards and benefitted the poor in absolute terms, the distribution of poverty in the total population remained largely unchanged (Datt and Ravallion, 1998). Growth in agricultural productivity can increase real wage rates, which both directly and indirectly contributes to poverty alleviation. Datt and Ravallion (1998) suggest that increased agricultural productivity (defined as output per unit of land) is related to poverty reduction.

Review of Empirical Studies on Agricultural Productivity and Livelihood

Previous studies on productivity measures built on the pioneer work of Farrell t (1957), on efficiency and productivity measurement, respectively. Other analytical techniques for productivity and efficiency measurements include Andy's report (2012) on maize total factor productivity growth in Liaoning and Jilin province in China. The author used DEA theoretical framework using Malmquist index calculation. The result showed that maize TFP from 1995 to 2002, average annual growth rate of 0.1%, from 2002 to 2005, with an average annual growth rate of 1.66%.Oyakhilomen*etal.* (2012) studied on assessment of the growth of maize production in the Pre-SAP, SAP and Post SAP period in Nigeria. Stochastic frontier analysis was used. The result showed that the compounded rate of growth from 1970-1985(Pre-SAP), 1986-1994(SAP period) and 1995 are 0.001%, 0.059% and 0.025% respectively. The result showed that SAP period had impact on TFP growth. Rafiee*et al.* (2012) reported on total factorproductivity growth in corn production in Iran. Data envelopment analysis (DEA) using Malmquist index was used. Average TFP growth for corn was -4.5%. Other studies visited include Onyenweaku*etal.* (2010) who reported on productivity growth in food crop production in Imo State, Nigeria using yearly survey for the period from 2001-2007. The authors used decomposition of productivity growth, a stochastic frontier production function approach and in estimating the technical efficiency change; the Translog stochastic frontier model was employed. TFP growth rates decreased from 3.5% in 2001 to 1.7% in 2007. TFP growth was decomposed into technical change, scale effect, technical efficiency and allocative efficiency revealing that the technical change was negative for the period studied.

Sehgaland*etal.* (2011) researched on Total Factor Productivity of Manufacturing Sector in India: A Regional Analysis for the State of Haryana. The authors used DEA- Malmquist Index. During 1982-1983 a lowest growth rate of TFP had been observed in comparison to the highest TFP growth of it during the year 1990-1991.During the majority of the years studied, the Malmquist Productivity Index was less than unitary and explaining the level of productivity for manufacturing sector, which is not very encouraging one. It was observed that there was productivity regress in the manufacturing sector of Haryana at the rate of -1.455% per annum. Essa*etal.* (2012) studied on factor productivity in smallholder pigeon pea production systems: Empirical evidence from Northern Tanzania. The authors used stochastic frontier approach (SFA). Household heads and membership to farmer associations increased from 13.4 to 19.5% and 18.3 to 24.9%, respectively. Female headed households in the survey increased from 10.6% in 2008 to 12.2% in 2010, farmers' access to credit improved from 4.1 to 15.5%. For the determinants of productivity human labor affected the productivity of pigeon pea positively and significantly, plot size has significant and negative coefficient and seed has significant and positive coefficient.

Nto*etal*. (2012) studied on determinants of productivity among manufacturing firms in South-Eastern Nigeria using Cobb-Douglas Stochastic Frontier Production Function Approach. Coefficients of Unskilled labour, net productive assets and major raw materials show significant effect on output of the firms. The variables had the expected positive influence at 1% probability level. Among the variables specified in the model, registration status, years of operation and size of firms were statistically significant. That showed in Nigeria not much was explored on total factor productivity growth and its determinants using Data Envelopment Analysis and Ordinary Least Squares, respectively.

An overview of several studies illustrates the variety of approaches contributing to the consistent finding that agricultural productivity is important for poverty reduction and improved livelihood. Datt and Ravallion (1998) found output per unit of land to be statistically significant as a determinant of the squared poverty gap (using national, annual Indian data). Timmer (1997) uses output per worker as the productivity measure, which Mellor (1999) agrees is a better measure of productivity to identify linkages to non-agricultural growth since it encapsulates the additional ways through which farm households earn income. Byerlee, Diao*et al*. (2009) reviewed 12 country case studies and use bivariate analysis to compare agricultural growth per worker across countries. They show that the countries with the highest agricultural growth per worker experienced the greatest rate of rural poverty reduction (Byerlee*et al*. 2009). Fan*et al*. (1999) measure the relationship between total factor productivity and poverty outcomes by investigating returns on different productivity increasing investments. They find that investments in roads, agricultural research, development, and extension had the greatest impact on both productivity and poverty reduction (Fan *et al*. 1999).

USAID/MARKETS Project

USAID/Nigeria's Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) was a multi-faceted six and a half-year pilot program designed to strengthen agricultural competitiveness and food security in Nigeria. The program began in 2005 with a budget of $24 million which later increased to $51.6 million by the time the project closed in December 2010; after which the project was extended for 16 months (January 2011 through April 2012) with an additional $9.5 million through the Bridge to MARKETS II (BtM2) project. The project was managed by Chemonics International with international and local subcontractors, MARKETS employed a private sector-led, comprehensive value chain approach that identified commercial buyers and facilitated inputs that supported farmers to meet market standards and a guaranteed buyer. By the close of the program, MARKETS had worked with 10 major commodities: rice, cowpea, aquaculture, and dairy, white sorghum, yellow sorghum, sesame, cassava, cocoa, and maize in 31 States and the FCT. Some value chains were dropped mid-project (e.g. dairy) while others were added from 2010 (maize and cocoa). Food security and nutrition, trade, transport and agricultural policy components were added in December 2008.

In June 2005, the MARKETS program was launched. Initial value chains include rice, dairy, white sorghum, cowpea, and aquaculture. August 2006, the Promoting Improved Sustainable MSME Financial Services (PRISMS) project was merged with MARKETS, adding $3.5 million to the MARKETS contract and broadening the scope of work to include microfinance and policy support. April 2008 the sesame program is launched. June 2008, MARKETS exits the dairy value chain. September 2008, PEPFAR-funded nutrition program was launched for OVCs affected by HIV/AIDS, adding $3.8 million to the MARKETS contract. December 2008, Global Food Security Response funds in the amount of $23 million were added to the MARKETS contract. The scope of work was broadened to include trade and transport, agricultural policy support, a fertilizer voucher program, cassava, and support to the West African Seed Alliance through ICRISAT. March 2009, the cassava program was launched. February 2010, the maize and cocoa programs were launched. In December 2010, MARKETS closed and the Bridge to MARKETS II program started. January 2011, Bridge to MARKETS II continued the work which began under MARKETS. In October 2011, Bridge to MARKETS II was extended through April 2012.

MARKETS is a very complex, multi-faceted, multi-million dollar economic growth project that began focused on strengthening selected agricultural value chains, added financial services through its absorption of another USAID program PRISMS, added a food nutrition program for Orphans and Vulnerable Children, and added trade, transport, agricultural policy, a fertilizer voucher program and additional value chain commodities..

CHAPTER THREE

METHODOLOGY

The Study Area

The study was conducted in Kaduna state Nigeria. Kaduna State lies in the north western part of country's agro-ecological zones. Kaduna State lies between longitude 06′00 and 09′10′East of the Greenwich Meridian between and latitudes $09^0$00 and $11^0$30 North of the Equator. Occupying an area of approximately 48,473.2 square kilometers (FOS, 2006). The mean annual rainfall shows a marked decrease from South to North (1,524mm to 635mm). Two distinct seasons, rainy and dry witnessed in the state. The relative humidity is constantly below 40 ^{0}C except in few wet months when it goes up to an average of 60^0C. The duration of dry season is 5-7 months which normally starts from October; the state is agrarian and well suited for the production of arable crops such as maize, yam, millet, and sorghum because of favourable climatic conditions. Livestock production is also practiced in the state. Rearing of goats, sheep, cattle and different classes of poultry as well as marketing of their products is practiced in the state. The people of the state live mostly in organized towns and cities (Kaduna State Government, 2012). A large variety of non-agricultural occupations also exit.

Agriculture is the main stay of the economy of Kaduna state with about 80% of the people are actively engaged in farming. The state is well suited for the production of cash and arable crops; the produce includes: maize,cotton, groundnuts, tobacco, yam, beans, guinea corn, millet, ginger, rice, cassava, sugarcane, shea nuts, cowpea, mango, kenaf, cocoyam, cassava, timber, palm kernel, banana, soya bean, corn, onions, sorghum and potatoes. Over 729.7million tonnes of maize are produced in the state at 2014 cropping season with 413.9 l hectares of land devoted for maize production (NAERLS/FDAE, 2014). The major cash crops are maize, ginger and cotton which the state has a comparative advantage in as it is the leading producer in the country. During the dry season, a considerable number of people in the state engage in irrigation farming along rivers and near dams, mainly growing vegetables. Another major occupation of the people is animal rearing and poultry farming. The animals reared include cattle, sheep, goats and pigs (World Bank, 2008a).

Kaduna State has 23 Local Government Areas of which 5LGAs were covered by MARKETS projectand its population was put at 6, 066, 526 people (National population Commission (NPC, 2006) and had a projected population of 7, 425, 428 people in 2013 using an annual growth rate of 3.2%.Agriculture accounts for an estimated 56% of Kaduna’s GDP and employs approximately 4 million people. Kaduna produces 22 percent of the country’s maize, 69% of soya bean, 36% of cotton and 10% of ground nuts (peanuts) and the State trade’s agricultural produce to neighboring States. The sector is dominated by wet season planting and an irrigated dry season planting(Kaduna State Government, 2012).

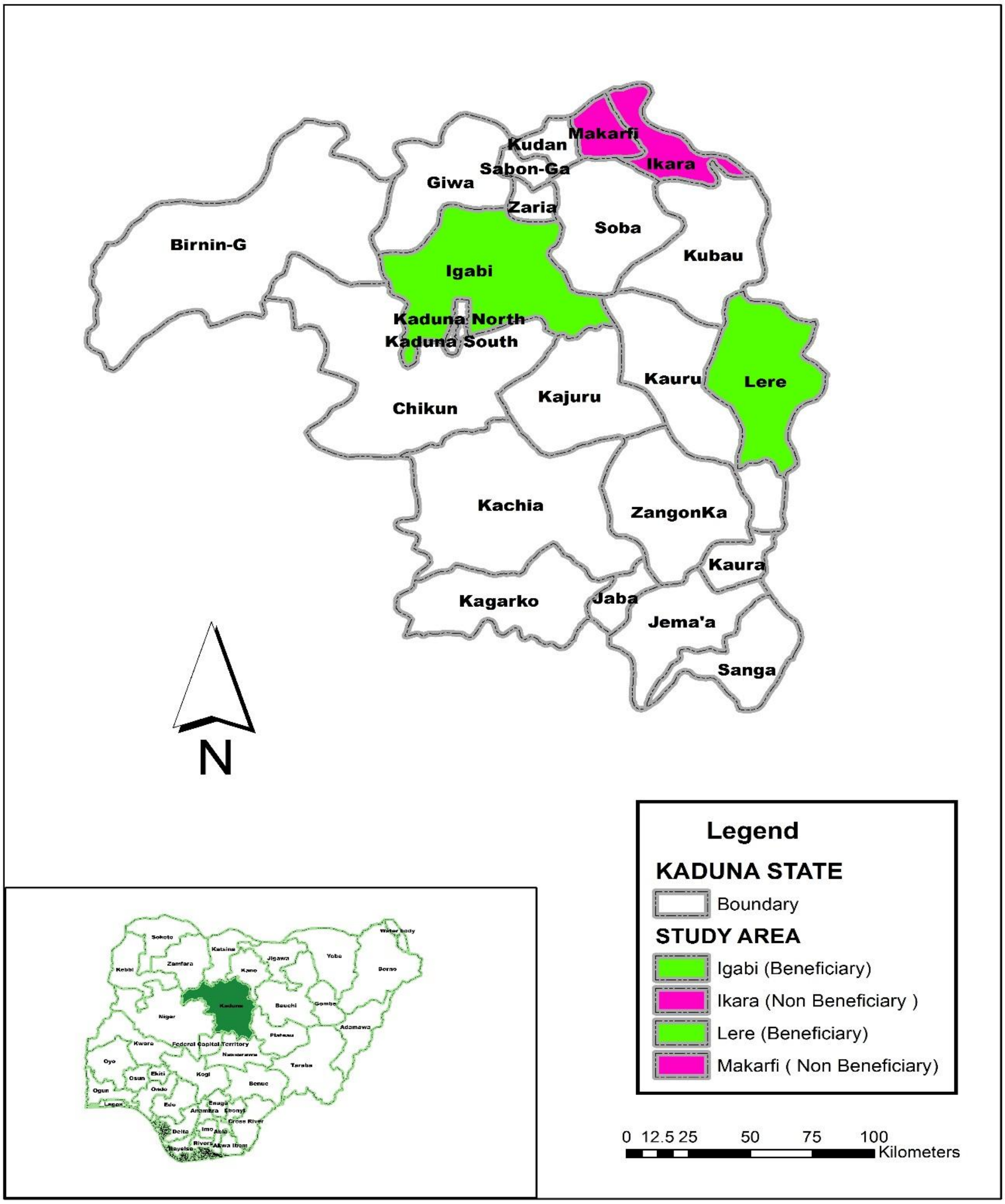


Figure 2:Map of Kaduna showing study area

Sampling Procedure and Sample Size

The population for the study is targeted on maize farmers involved in the MARKETS project. A multi-Stage sampling was used to select respondents for this study. The firststage was purposive sampling of two (Lere and Igabi) local government areas due to the fact that the project was only carried out in the two locations.The second stage involves purposive sampling of ten sites involved in the projectbased on their involvement in the project. At the third stage, a simple random sampling was employed in selecting farmers involved in the maize value chain project through the use of ballot box method. 5 percent of the sample frame (4740) of the farmers involved in the maize value chain project was used as sample size (237) respondents. In other hand, 5 percent of the sample frame (1946) of non-participating communities outside the participating Local Government Areas to also help identify the effects that may be attributed exclusively to the project was used as sample size (97) respondents.Ikara and Makarfi LGA were selected based on the volume of maize produced in those local governments. The study targeted small scale maize farmers in the study area.

Table 3.2: Sampling Technique and Sample Size

Beneficiaries LGA	**Location**	**Sample frame**	**Sample size (5%)**	**Non-Beneficiary LGA**	**Location**	**Sample frame**	**Sample Size (5%)**
Lere	Saminaka A	360	18	**Ikara**	Auchan	308	15
	Saminaka B	380	19		Jamfalan	360	18
	Danalhaji	500	25		Ikara	300	15
	Kayards	500	25				
	Yarkasuwa	500	25				
Igabi	Rigachikun	500	25	**Makarfi**	Kasuwa	320	16
	Jaji	500	25		Gubuchi	410	21
	GadarGayan	500	25		Mayere	248	12
	Turunku	500	25				
	ZangoAya	500	25				
Total		4740	237			1946	97

3.3 Data Collection

Primary data was collected to address the study. Structured questionnaire and check list for Focus Group Discussions were used to collect the primary data with the help of trained enumerators under the supervision of the researcher in April, 2015.Focus Group Discussion (FGD) was also used to generate data that supported the data gathered using questionnaires. This involved the use of the FGD guide to facilitate and ensure that the discussions are not off-track. The FGD guide was constructed based on the themes and sub-themes. The data collected include productiondata such as yield in Kilogram, farm size in hectares, quantity of inputs used in kilograms, labor used in man days, markets and credit access status, membership of farmer – based organizations (FBO), types of training received and durable assets. Also socio economic data collected were age, educational status, farming experience, and access to credit. Others includesnumber of extension visits to farmers, distance from the farmer's home to the farm etc.

3.4 Analytical Techniques and Data Analysis

The study made use of both the descriptive and inferential statistics for the data analysis. Descriptive statistics such as mean, frequency tables and percentages was employed. The stochastic production frontier and cost function was used to achieve objectives ii and iii. The Profitability analysis was used to achieve objectives iv. The Malmquist Productivity Index was used to achieve objective v. The descriptive statistics was used to achieve objective i part of v and vi.

3.4.1 Specification *of the Stochastic Frontier Model*

Estimation of the Stochastic Production Frontier requires a particular functional form of the production function to be imposed. A range of functional forms for the production function frontier are available, with the most frequently used being a translog function, which is a second order (all cross-terms included) log-linear form. This is a relatively flexible functional form, as it does not impose assumptions about constant elasticities of production nor elasticities of substitution between inputs. It thus allows the data to indicate the actual curvature of the function, rather than imposing *a priori* assumptions. In general terms, this can be expressed as:

$$LnQ_{j,t}=\beta_0+\sum\beta_1+\ln X_{j,i,}\beta_t+\frac{1}{2}\sum\sum\beta_{j,i,t}\ln X_{j,i,t}\ln X_{j,K,t}-u_{j,t}+v_{j,t}\ldots\ldots\ldots\ldots (10)$$

The stochastic frontier that was applied in the analysis is defined as in Coelli, Battese and Rao (1998):

$$\ln Yit=\ln f(X_{it};t,\beta)+V_{it}-U_{it}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

Where:

X_{it} – is a vector of the logarithm of input quantities

t – is a time trend

V_{it} – is white noise, assumed to be normally and identically distributed N(0, 2 σ v)

U_{it} – is a non-negative random variable, associated with the technical inefficiency of Production, assumed to be identically and half normally distributed, N(μit , 2 σ u)

β = regression coefficient

Y= maize output

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + (Vi\text{-}Ui) \qquad (12)$$

Where

Y = Maize yield (Kg/ha).

X_1= seeds(kg/ha)

X_2= fertilizer (Kg/ha)

X_3= Agro chemicals(litres/ha)

X_4= Labour (man−days/ha)

Y, X_1 *to* X_4 *are* already defined in the implicit form.

a = constant term; e = error term

ln = natural logarithm

β = regression coefficient

v_i= random error outside farmer's control

u_i =technical inefficiency effects

The Cobb-douglas form was the lead equation.

Estimation of Technical and economic Efficiency:

This studyadopted the one-step approach of estimating individual farmers' technical efficiency indexes. The inefficiency effects were alsodetermined. The inefficiency effects were estimated through a truncated normal distribution, which is a non-neutral frontier model (Huang and Liu, 1994).

Therefore the model can be explicitly written as:

$$-U_i = \delta_0 + \delta_1 1nZ_1 + \delta_2 \ln Z_2 + \delta_3 \ln Z_3 + \delta_4 \ln Z_4 + \delta_5 \ln Z_5 + \delta_6 \ln Z_6 \qquad \textbf{(13)}$$

(Where μ represents the technical inefficiency effects and this are the unknown parameters to be estimated. The Zs are variables that determine technical efficiency among the farmers. The Zs include Z_1 (age in years); Z_2 (educational status); Z_3 (Gender); Z_4 (Household size); Z_5 (Farming experience in years); Z_6 (total farm size in hectares); Z_7 (number of extension visits to farmer). Ln = natural logarithm

TE_j is measured on a scale of 0 to 1. A value of 1 indicates that farm j displays complete technical efficiency while a value of less than 1 indicates a level of inefficiency. TEj is, in effect, an expression of the farmer's capacity to achieve results comparable to those indicated by the production frontier. Technically efficient farms are those that operate on the production frontier and the level by which a farm lies below its production frontier is regarded as the measure of technical inefficiency. In technical efficiency analyses, a positive coefficient of the determinant of technical efficiency indicates by how much a farmer's level of technical efficiency decreases as a result of a unit or percentage increase in the explanatory variable. On the other hand, a negative coefficient indicates an increasing level of technical efficiency as a result of a unit or percentage increase in the explanatory variable

3.4.2 The Profitability Analysis

The Farm Budgetary technique was used to achieve objectives iv. The Model specification is given below:

GM = TR-TVC …………………………………………………………… (14)

Where;

GM= Gross Margin (₦)

TR = Total revenue (₦)

TVC= Total variable cost (the cost of variableinputs) (₦)

Olukosi and Erhabor (1988) maintained that grossmargin is a good approximation of net farmincome, since small-scale farmers usually havenegligible fixed costs.

Efficiency of maize enterprise will be calculated by dividing Total Cost by Total Revenue and multiplying by 100 (TC ÷TR X 100).

3.4.3. The Malmquist Productivity Index Model

The Malmquist Productivity Index was used to achieve objective v. The data envelopment analysis (DEA) based Productivity index was used to measure productivity change over time (2010-2014).Total Factor Productivity (TFP) growth measures how much maize is harvested relative toeconomic inputs used. This model calculates output oriented Malmquist indices of TFP, technical change and technical efficiency. The TFP is said to have increased if the Malmquist Productivity Index is greater than 1 and declines if the Malmquist Productivity index is less than 1.To calculate the index we must calculate the four component distant functions, which will involve four linear programming programs for each of the farmer in each pair of adjacent time period. For example the constant- return to scale, output-oriented. The Model is specified below

$$M_{oc}(x^t, y^t x^{t+1}, y^{t+1}) = [\frac{(D_{oc}^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t}(x^t, y^t)}] X \{[\frac{(D_{oc}^{t}(x^{t+1}, y^{t+1})}{D_{oc}^{t+1}(x^{t+1}, y^{t+1})} X \frac{D_{oc}^{t}(x^t, y^t)}{D_{oc}^{t+1}(x^t, y^t)}]\}1/2$$

$$= TE\Delta_c(x^t, y^t x^{t+1}, y^{t+1}) X \;\; T\Delta_c(x^t, y^t x^{t+1}, y^{t+1}), \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(15)}$$

TFP growth = technical efficiency change x technical change

Where:

TEΔc $(x^t, y^t, x^{t+1}, y^{t+1})$ measures technical efficiency change between time period t and time period t+1

TΔ$(x^t, y^t, x^{t+1}, y^{t+1})$ measures the geometric mean of the magnitudes of technical change

x= Vector of Inputs (fertilizer, seed, labour and agrochemical)

y= Output of maize in Kg/ha

t= time trend (2010-2014)

3.4.4Chow test statistic

Impact of the USAID programme on maize production, income and livelihoods of the participant and non-participants was achieved using Chow-test statistic. A Chow test is a particular test for structural change; an econometric test to determine whether the coefficients in a regression model are the same in separate sub-samples. According to Chow (1960) “the standard F test for the equality of two sets of coefficients in linear regression models” is called a Chow test. Dougherty (2007) stated that chow-test statistics is often used in programme evaluation to determine whether the programme has impacts on different sub-group of the population. It requires the sum of squared residuals from three regressions, one from each sample group and one for the pooled data. If the F-chow is greater than the F-table, then there was programme impact on the participants otherwise no impact. This is expressed mathematically as:

$$F = \frac{(RSSR - SSR1 - SSR2)/\ k}{(SSR1 + SSR2)/\ n - 2k} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (16)$$

Where;

RSSR = the sum of squared residuals from a linear regression in which b_1 and b_2 are assumed to be the same, b has dimension k, and there are n observations in total.

SSR_1 = the sum of squared residuals from a linear regression of sample 1.

SSR_2 = the sum of squared residuals from a linear regression of sample 2.

The total number of observation is $n = n_1 + n_2$ and the number of parameters is k.

3.5 Definition of Variables and Expected Signs of Determinants Efficiency

3.5.2 Technical efficiency variables

Output (Y): This variable is defined as the total output of the produce in kilogramme accruing to the respondent during the season per hectare. It will be measured in this study as Kilogramme per hectare (Kg/ha). The a priori expectation of output is that a unit increase of variable inputs will increase the output of maize.

Fertilizer (X_1): This refers to the quantity of inorganic fertilizer used for maize production. It was measured in kilogram and was expected to have a positive relationship with the dependent variable

Seed (X_2): The total maize seed planted and was measured in kilogram. This was included in the model to show how variability in quantity of seed used affects output. The a priori expectation for quantity of seed was expected to be positive; this implies that, a unit increase in quantity of seed will bring about increase in output.

Labour (X_3): This includes total family and hired labour employed in maize production activities. Labour is a vital resource used in agricultural production. The availability of labour is expected to have a positive effect on productivity. If this labour is allocated to crop production, the higher labour intensity will probably be reflected in higher yields and greater per hectare crop income. This was measured in man-days/ha

Agrochemical (X_4): This is the quantity of herbicides used on the farm and it was measured in litres.

3.5.2 Inefficiency variables

Age of household head (Z_1): Age is the number of years of the household head on earth. It may be difficult to anticipate how the age of the household head will affect the different indicators of productivity. Since older farmers may be experienced farmers, it is expected that the value of crop income per hectare will be higher. The effect on productivity and efficiency is however ambiguous. Age is expected to have a negative effect on technical inefficiency. On one hand, age may be associated with accumulation of skill in one activity.

Education (Z_2): This was measured in years spent in formal schools. Thus, it is expected that higher education will be associated with a higher output. It is expected to have a negative sign.

Gender(Z_3): Gender is an integral and inseparable part of rural livelihoods. Men and women have different assets, access to resources, and opportunities. Women rarely own land, may have lower education due to discriminatory access as children, and their access to productive resources as well as decision-making tend to occur through the mediation of men. Women typically confront a narrower range of labour markets than men, and lower wage rates. In general, therefore, increased productivity is more of an option for rural men than for women. In this sense, increased income from improved productivity can improve household livelihood security while at the same time trapping women in customary roles. This was measured by scoring female headed household as 2 and male headed household as 1.It was expected to have a negative sign.

Size of Household (Z_4): This means the total number of people in the house which includes the wives, children and dependents that reside within the same house. Since food requirements increases with the number of person in the household and also because land and finance to purchase agricultural inputs are limited. Increasing family size, according to Brown (2004), tends to exert more pressure on consumption than the labour it contributes to production. The larger the family size the more favorably disposed will be the members to participate in maizeproductionoperation. The estimated coefficient of household size was expected to have negative sign on the technical inefficiency model. This was measured as numbers of people living together and eating from same pot. The *a priori* expectation for household size was expected to be positive; this implies that the household size of the farmer is increasing technical efficiency.

Farming Experience (Z_5): This is the number of years a farmer has actively engaged in maize production. It was recorded in years and expected to have a negative relationship with technical inefficiency.

Farm size (Z_6): This is measured by area of the land put under maize production. It is a measure of the availability of land for agricultural production. Land ownership, is a good measure of land availability (Minot et.al, 2006). It is expected that the farmers with more lands will have a higher crop yield and more marketable surplus. This was measured in hectares of total land under cultivation. It was expected to a direct relationship with output.

Extension Contact (Z_7): This is the number of times farmers had contacts with extension agents or number of times the extension agents visited farmers to provide extension services on their farming activities. This was measured in numbers and it is expected to have a negative sign.

CHAPTER FOUR

RESULTS AND DISCUSSION

The results presented here are obtained from the data collected andanalysedas well as observations made during the study. The order of presentation is as follows: first, a general overview of the respondents' socio-economic characteristics is given. Followed by breakdown of the resource use efficiencies of the farmers and factors that influences their economic efficiency, impact of the project on the farmers'livelihood andfinally, results from the regression and the gross margin analysis are presented.

4.1 Socio-Economic Characteristics of Respondents

The socio-economic variables of the farmers were studied to determine their influence on the efficiencies of the farmers. The socio-economic variables studied include age, education, gender, household size, farming experience, farm size, access to extension services, source of funds for farming activities, membership of cooperative, use of improvedtechnology and labour utilization.

4.1.1 Age of respondents

Age is a very important variable in determining the degree of activeness of an individual in an economic activity. It affects their mental attitude to new ideas and techniques. Table 4.1.1 shows distribution of farmers based on age. The mean age for both the participants and non- participants surveyed was 41.4 and 40.9 respectively. The minimum and maximum for both groups was 21-68 years for participants and 20-60 years for the non-participants. The result shows that majority of respondents were in the productive age bracket (20-49 years) for both participants (83.1%) and non-participants (81.5%).This shows that both groups are active andmay be able to stand the demands for maize production. What is worrying however is that there were a number of ageing respondents between the ages of 50 and 69 constituting 17% for participating farmers and about 19% for the non- participating farmers were engaged in farming activities. The implication of this finding is that governments should institute policies that would attract young people into the agricultural sector since their technology adoption behaviours are crucial to improvement in agricultural productivity.

Table 4.1.1: Distribution of Farmers Based on Age

	Beneficiaries		**Non Beneficiaries**	
Age (years)	**Frequency**	**Percentage**	**Frequency**	**Percentage**
20-29	22	9.3	10	10.3
30-39	102	43.0	25	25.8
40-49	73	30.8	44	45.4
50-59	35	14.8	16	16.5
60-69	5	2.1	2	2.1
Total	237	100.0	97	100.0
Min	21		20	
Max	68		60	
Mean	40.8		40.5	
Std	9.01		9.02	

4.1.2 Educational qualification of farmers

Education is considered to play a vital role in human resource development. It influences the pace of development by providing skills, knowledge and problem solving techniques. Educational level of the respondents helps in judging the quality of human resources and developing stage of society as it broadens thevision of the community. Education is an important factor which has a positive influence on humanbehavior either directly or indirectly. Educated people are expected to have more favorable attitudetowards agricultural skills, knowledge and information as compared to uneducated ones (Hassan, 1991). Therefore, it was necessary to collect the data about this aspect to visualize the picture of educational level.

The level of education which is measured in years is important as it is directly related to ability to acquire new skills. The study revealed that both categories of maize farmers have one form of education or the other. The result of the analysis shows that about 35% of the participants had no form of education while 74% of the non-participants had no education at all (Table 4.1.2).

More of the participants (65%) had formal education as compared to(21%) of the non-participants. Formal education tends to promote formation of cognitive skills and abstract reasoning ability as well as changes in attitudes.Education may have both cognitive and non-cognitive effects upon labour productivity. Cognitive outputs of schooling include the transmission of specific information as well as the formation of general skills and proficiencies. Education also produces non-cognitive changes in attitudes, beliefs and habits. Increasing literacy and numeracy may help farmers to acquire and understand information and to calculate appropriate input quantities in a modernizing or rapidly changing environment. Improved attitudes, beliefs and habits may lead to greater willingness to accept risk, adopt innovations, save for investment and generally to embrace productive practices.

Table 4.1.2: Distribution of Farmers Based on Level of Education

	Beneficiaries		**Non Beneficiaries**	
Education	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Primary	66	27.8	3	3.1

Secondary	74	31.2	9	9.3
Tertiary	7	3.0	5	5.2
Adult education	Nil	Nil	11	9.9
None	84	35.4	72	74.2
Total	237	100	97	100

4.1.3 Farming experience of farmers

The farming experience shown on Table 4.1.3 of the respondents is measured based on years of involvement in farming activities. About 39% of the participants have been farming for the last 11-20 years while most of the non-participants(58%) have been farming for about 1-10 years. The mean farming experience by the participants was 24 years while for non-participants was almost 23 years. The farming experience influence farmers' productivity due to accumulation of skills over time by older farmers can lead to higher crop productivity.This findings is in line with Ajani (2000) on productivity in food farming in northern area of Oyo State which revealed that years of farming experience increased agricultural productivity among farming households in Nigeria.

Table 4.1.3: Distribution of Farmers Based on years of Farming Experience

Farming Experience (Years)	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
1-10	30	12.7	56	57.7
11-20	93	39.2	16	16.5
21-30	84	35.4	12	12.4
31-40	30	12.7	13	13.4
Total	237	100	97	100
Min	4		2	

Max	51	40
Mean	24	23
Std	12.45	11.18

4.1.4 Gender of respondent

The result of the analysis shows that out of the farmers' randomly selected 91% male and 9% female were involved in the USAID/MARKETS project. Similarly, 91% male and 9% female were equally involved in maize production in the non-participant category.The gender of an individual playimportant role in determining access to productive resources. Empirical studies on farm household productivity outcomes by Okoye*et al*., 2009, Dimelu*et al*., 2009) have yielded evidence of inefficient allocation of resources and low productivity along gender lines and to the detriment of women.Therefore, for effective transfer and adoption of technologies for increase food production in the rural areas, gender has become the most important determinant of the distribution of rights, resources and responsibilities among individuals, families and communities (Ironkwe*et al*., 2009). It is estimated that if women and men had equal rights to land, and if women had equal access to fertilizer, profits per hectare would double (FAO, 2008). Technical efficiency refers to the ability to produce the highest level of output with a given quantity of inputs (Onyenweaku and Nwaru, 2005). However, production system and efficiency in resources use in the farm determine the nature and amount of agricultural technologies that should be made available to the female farmers to enhance their productivity. Considering resource management at farm levels, Saito *et al*, (1994) reported that female farmers were equally as efficient as male farmers.

4.1.5 Household size of farmers

The result of the study as presented in Table 4.1.5 below show that majority of the respondents had household size of between 1-10 persons which accounts for 68% of the participants and 86% for the non-participants. About 7% of the participants had household size of 20 and above and the non-participants had only close to 2% in this category. The mean household sizes of 9 and 6 were recorded for participants and non-participants respectively. Generally a large household may imply high labour availability for different activities especially with high proportion of working adults and also more mouths to feed.According to the report of Oluwatayo*et al.*, (2008), there is a positive and significant relationship between household size and farmers' efficiency in production. However, the absolute number of people in a certain family cannot be used to justify the potential for productive farm work. This is because it can be affected by some important factors namely; age, sex and health status. Essentially, it is the composition of the household that determine labour supply for the accomplishment of farm operations.

Table 4.1.5: Distribution of Farmers Based on Household size

Household Size	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
1-10	162	68.4	83	85.6
11-20	58	24.5	12	12.4
21-30	17	7.2	2	2.0
Total	237	100	97	100
Min	5		2	
Max	26		24	
Mean	9		6	
Std	4.555		4.753	

4.1.6 Farm size of farmers

Farm size was measured by area of crops grown. It is the measure of availability of land for agricultural production. The result on Table 4.1.6 shows that majority (57.8%) of the participants and (53.6%) non-participants have land holding of between 0.1 hectares – 2.0 hectares. The analysis further revealed that the mean farm sizes recorded during the survey for both participants and non-participants was 2.2 and 2.3 respectively. These farmers still fall within the range of smallholder farmers (Geofrery, 2004

Table 4.1.6: Distribution of Farmers Based on Farm Size

Farm Size	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
0.1-1.0	51	21.5	39	40.2
1.1- 2.0	86	36.3	13	13.4
2.1-3.0	54	22.8	12	12.3
3.1-4.0	35	14.8	16	16.5
4.1-5.0	11	4.6	17	17.5
Total	237	100	97	100
Min	0.5		0.2	
Max	4.5		5.0	
Mean	2.2		2.3	
Std	1.94		2.08	

4.1.7 Access to extension services

The extension agents serve as a link between the research institutes and farmers. The study revealed that the MARKETS project participants (100%) had access to extension services while about 28% of the non-participants reported they had access to extension services. In many rural settings, access to adequate knowledge, improved technology, financial services and other relevant social services (e.g. drinking water, education and health services) remain a critical issue. There are still significant challenges in providing extension and advisory services (EAS) in these areas. These range from insufficient funds for supporting public extension, poor resourcing, high extension to farmer ratio, limited involvement of rural farmers and populations in extension processes to the lack of appropriate strategies for effective research and adequate extension methods (IFPRI–World Bank 2010).The MARKETS project used the extension Agents from the KADP to facilitate it activities to improve the productivity of the participating farmers.

Table 4.1.7: Distribution of Farmers Based on Access to Extension Services

Extension Contacts	Beneficiaries Frequency	Percentage	Non Beneficiaries Frequency	Percentage
Yes	237	100	27	27.8
No	Nil	Nil	70	72.2
Total	237	100	97	100

4.1.8 Source of funds for farming activities

The study revealed in Table 4.1.8 that about 90% of the participants and 88% of the non-participants farmers sourced their funds for their farming activities through their own savings. The result also shows that a reasonable number of the participating farmers 9.7% and non-participants (12.4%) patronized the informal finance and or credit institutions. This can be attributed to long and rigorous procedures involved in accessing formal credits for agricultural production.

Table 4.1.8: Distribution of Farmers Based on Sources of Funds for farming activities

Source of Funds	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Personal Savings	214	90.3	85	87.6
Informal savings/credit group	23	9.7	12	12.4
Total	237	100	97	100

4.1.9 Membership of farmers' cooperative

The result on Table 4.1.9 reveals that all (100%) of the participant maize farmers are members of farmers group or cooperatives. For the non- participants, majority (82.4%) do not belong to any farmers' cooperative.International Cooperative Alliance (ICA) (2010), defines cooperative as an autonomous association of persons unified voluntarily to meet their common economic, social and cultural needs through a jointly-owned and democratically controlled enterprise. In Nigeria, most agricultural interventions are now geared towards encouraging farmers to belong to cooperative groups for easy access to intervention. A dynamic and functional farmer based organization is very useful tool that enables farmers to access bank loans, collective marketing, bulk purchase of agricultural inputs and access to one form of assistance or the other from the government.

Table 4.1.9: Distribution of Farmers Based on Membership of Farmers' Cooperative

	Beneficiaries		**Non Beneficiaries**	
Membership of Cooperative	**Frequency**	**Percentage**	**Frequency**	**Percentage**

Yes	237	100	18	18.6
No	Nil	Nil	79	82.4
Total	237	100	97	100

4.1.10 Use of improved seed

Table 4.1.10 below shows that 100% of the participants and 12% of the non-participants used improved varieties. Further analysis showed that 58% of the participant farmers sourced their seeds from Agro-dealers, 20% from KADP, 20% from IAR and 2% recycledowned seed. For the non-participants, 12% sourced their seed from agro-dealers, 11% from IAR while majorities (77%) buy their seed from the open market.

Planting of improve seed is very important component of the variable inputs required to achieve increased yield in maize production. As reported by Zeng *et.al* (2013) that improved varieties of maize are associated with substantial increases in productivity and incomes of farmers. Maize varieties can be grouped into three categories: hybrids, improved open-pollinated varieties (OPVs), and local OPVs. Hybrid maize has the highest yield, but requires the purchase of new seeds each cropping season to maintain hybrid vigor (heterosis), and the seeds cost more than for the OPVs. OPVs generally have lower yields than hybrids (through higher in turn have yield than for the local varieties) but the seeds can be recycled for up to three seasons. One major setback of use of OPVs is they easily get contaminated through cross fertilization.

Table 4.1.10: Type of Maize Seed Planted

Type of seed Planted	Beneficiaries Frequency	Percentage	Non Beneficiaries Frequency	Percentage
Local Variety	Nil	Nil	81	88.5

Improved Variety(OPV)	237	100	16	11.5
Total	237	100	97	100

4.1.11 Type and use of fertilizer

Fertilizer is very important input in crop production.Most of the soils are nitrogen deficient. There is always need to add fertilizers in soil to fulfill nutrients deficiency to get maximum production. A balanced used of fertilizer with desire level of nutrients is very necessary if one wants to get maximum production (Muhammad, *et.al*, 2011).

Table 4.1.11 below shows the distribution of farmers based on type of fertilizer used. The result of the analysis showed that 99% of the participant farmers applied a combination of NPK and Urea and about 91% of the non-participants. Further analysis showed that the mean quantity used per hectare was 276Kg for the participants and 160.6Kg for non-participants.The use of fertilizer in maize production is very crucial. The fertilizer application looks at the quality, dosage and method of application. Maize is a heavy feeder and requires high nitrogen nutrient for maximum yield (Ugbabe*etal*, 2007). Maize production requires the use of combination of NPK and Urea at appropriate stages.

Table 4.1. 11: Distribution of Farmers based on Fertilizer Usage

Type of Fertilizer	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
NPK	2	0.8	9	9.3
NPK+Urea	235	99.2	88	90.7

Total	237	100	97	100
Mean	276		160.6	
Max	750		364.3	
Min	100		20.0	
Std	123.62		87.6	

4.1.12. Labour usage

Labour is an important input used in maize production. Labour was measured in Man-days. This study reveals the use of both family and hired labour. The result on Table 4.1.12 shows that only 0.8% of the participant farmers employed only family labour, 25% used only hired labourand majority (74%) of the farmers used a combination of both hired and family labour. Similarly, about 5% of the non-participant farmers employed only family labour, 12% only hired labour and over 82% used a combination of both hired and family labour for maize production.

Table 4.1.12: Distribution of Farmers based on Labour utilization

Labour	**Beneficiaries**		**Non Beneficiaries**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Family Labour	2	0.8	5	5. 2
Hired Labour	60	25.3	12	12.4
Family + Hired Labour	175	73.8	80	82.4
Total	237	100	97	100

4.1.13. Yield of maize

The average yield of maize obtained (Table 4.1.13) by the participating and non-participating farmers was 3308.9Kg/ha and 1425Kg/ha respectively for the 2014 cropping season. This gives over 100% increase in yield compared to the baseline 1200kg/ha in Kaduna state (USAID/MARKETS, 2012). This was possible may be due to adoption of almost balanced fertilizer use and implementation of timely management practices as indicated in the demonstration package of the USAID?MARKETS Project

Table 4.1.13: Distribution of Farmers Based on Maize Yield

Labour	Beneficiaries		Non Beneficiaries	
	Frequency	**Percentage**	**Frequency**	**Percentage**
1001-2000	20	8.4	53	54.6
2001-3000	81	34.1	44	45.4
3001-4000	90	38.0	0	0.0
4001-5000	39	16.5	0	0.0
5001-6000	7	3.0	0	0.0
Total	237	100	97	100
Mean	3308.9		1425	
Max	5700		2017	
Min	1066.7		1008	

4.2 Technical Efficiency of MaizeFarmers

Efficiency of resource use, which is defined as the ability to derive maximum output per unit of resource, is the key to effectively addressing the challenges of achieving increased maize productivity. Raising productivity of maize farmers in Kaduna state to improve their income and livelihood through use of improved crop productivity technologies and access to markets is the major aim of the MARKETS project.The Maximum likelihood Estimates (MLE) of the parameters of the stochastic frontier production models for the MARKETS farmers and non- participants were estimated using the software Frontier 4.1. Table 4.2.1 below gives the descriptive statistic of the variables include in the model

4.2.1 Description of the variables included in the technical efficiency Model

The variables used in the efficiency model are given on Table 4.2.1. The variables used for the efficiency model includes fertilizer, seed, agro chemicals and labour. The inefficiency variables are Age, education, gender, household size, farming experience, farm size and extension contact.

Table 4.2.1: Descriptive Statistics of Variables

		Beneficiaries				**Non Beneficiaries**			
Variables	**Unit**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
Yield	Kg	1066	5700	3309	922.309	1008	2017	1425	416.78
Seed	Kg	4	60	21.4	0.903	8	79	35	18.45
Fertilizer	Kg	100	750	276	123.6	20	364.25	160.62	87.58
Labour	Man-days	2.5	166	28.56	9.450	5.0	108	43.5	26.385
Agro-chemical	Litres	0	8	0.9	1.262	0	14	1.99	2.967
Age	Years	21	68	41.4	8.721	20	60	40.9	9.647
Education	Dummies 0- 5	0	4	1.88	0.894	0	5	1.99	0.871
Gender	Dummy	1	2	1.08	0.284	1	2	1.07	0.265
Household size	Number	5	35	9.7	6.721	2	24	6.7	5.101
Farming Experience	Years	4	51	23	10.104	1	40	17	12.456
Land Size	Hectare	0.5	13	2.7	1.709	0.2	15	3.6	2.908
Extension Contact	No of visits	2	36	15	10.592	2	10	5.3	1.667

4.2.2 Technical efficiency in maize production

The appropriate measure of technical efficiency is input saving which gives the maximum rate at which the use of all the inputs can be reduced without reducing output. Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. The variance parameters of the stochastic frontier production function are presented by sigma (δ) and gamma (γ). The sigma squared for the MARKETS Participants was (0.41) and for the non- participants (0.43) which were both significantly different from zero at 1% level of probability. This indicates good fit and correctness of the specified assumption of the composite error term. Observed significance of sigma (δ) at 1% level of probability for participating farmers (t-value= 3.075) and at 1% level of probability for non-participating farmers (t-value =9.054) showed that there were some measurable inefficiencies in maize production by both farmers that participated in the MARKETS project and the non-participating farmers.

The value of 0.617 of the gamma for the participating farmers and 0.987 for the non-participating farmers were both statistically significant at 1%. This means that 62% of the total variation in output of the participating farmers and 99% of the total variation for the non- participating farmers were as a result of factors within the control of the farmers and that variation in maize output could be attributed to technical inefficiency. This might also be interpreted to mean that the differences between actual (observed) and frontier output had been dominated by technical inefficiency (that is, factors (weeding, fertilizer application) within the control of the farmers).

The first term variables, with the exception of labour, were all statistically significant at 1% for beneficiary while only labour was significant at 5% for non-beneficiary farmers.

The estimated coefficient for seed was 0.423 for beneficiary is positive and statistically significant at 1% level. The estimated 0.423 elasticity of seed implies that increasing seed by 1% will increase maize output of the beneficiary by 42% which means, all things being equal the output is inelastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality seeds are not used, output will be low even if other inputs are in abundance. This is in line with the findings of Shehu*et al* (2010) who observed that the estimated coefficient of seed was positive as expected and significant at 1% level which implies that the more seed is applied the better the output of maize. While the estimated coefficient 0.166 of seed for non-beneficiary was positive and not significant.

The coefficients of fertilizer (-0.089) and labour (-0.912) were negatively related to the output of the beneficiary farmers but fertilizer was significant at 1% probability level while labour was not significant. This implies that a unit increase in the quantity of fertilizer and labour will decrease the output of the farmers by 8.9% and 91.2% respectively and this could be attributed to over utilization or misapplication of these resources. Labour was not expected to be negative because peasant farmers depend on labour in the absence of machine. This unexpected result could stem from inappropriate usage of the variables (labour and fertilizer).The negative relationship between labour and output agrees with the finding of Baruwa and Oke (2012) who reported that labour was negative and significant at 5% probability level in a study on Technical Efficiency of Small-holder Cocoyam Farms in Ondo State, Nigeria.In terms of non-beneficiary only coefficient of labour (-1.617) was negative and significant at 5% level.Labour was not expected to be negative because peasant farmers depend on labour in the absence of machine.

The coefficients for agrochemical (0.672) was positive and significantat 1% for beneficiary. For the non- beneficiary farmers the coefficient (-0.241) were negative and statistically not significant, agro-chemicals which had partial production elasticity of -0.672 for beneficiary, would increase output by 67.2%, when this production inputs was increased by 100%.

According to Ugbabe*et.al* (2007)fertilizer(access, quality, method of application and use) remain a major challenge to increasing maize output. Maize is a heavy feeder and requires high rate of fertilizer application (136KgN, 20KgP, and 37KgK ha^{-1}).

Table 4.2.2: Maximum Likelihood Estimates of the Stochastic Frontier production

	Beneficiaries		**Non- Beneficiaries**	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Constant	0.512 (0.984)	0.520	0.148 (0.845)	0.175
Seed (X_1)	0.423 (0.089)***	4.752	0.166 (0.180)	0.922
Fertilizer(X_2)	-0.089 (0.021)***	-3.952	0.136 (0.119)	1.143
Labour (X_3)	-0.912 (0.564)	-1.617	0.067 (0.26)**	2.549
Agrochemical (X_4)	0.672(0.154)***	4.364	-0.241(0.506)	-0.476
Sigma square(δ)	0.409(0.133)***	3.075	0.425 (0.014)***	9.054
Gamma (γ)	0.617(0.072)***	8.569	0.987 (0.254)***	3.886
Log likelihood function	-77.231		-43.084	
LR test	24.987		84.950	
Mean	0.87		0.49	

***P<0.01, ** P<0.05 and * P<0.1.

The mean technical efficiencies for the participant maize farmers and non-participant maize farmers were 87% and 49% respectively (Table 4.2.2). This implies that on the average, the participant farmers were able to obtain almost full potential production output from a given mix of production input. While the non-participant farmers obtained less than half of their production potential. The implication therefore, is that the MARKETS participant farmers are more technically efficient than the non-participant farmers. But for both the participant farmers and non-participant farmers to achieve full production potential of maize, there is need to increase production by 13% and 51% respectively by adoption fully the improved production packages which includes; fertilizer application, use of hybrid seed, best agronomic practices and other management techniques.

4.2.3 Allocative efficiency in maize production

Allocative efficiency is estimated in order to determine how maize farmers allocate inputs like labour, fertilizer, agro-chemicals and seeds.The maximum likelihood estimates of the cost frontier for maize production for the participant and non-participant farmers shows that the variance ratio ($\gamma = 0.997$) and total variance ($\sigma 2 = 0.232$) and ($\gamma = 0.954$) and ($\sigma 2 = 0.275$) respectively are statistically significant at 1% level (Table 4.2.3). Total variance estimates goodness of fit and the correctness of the specified distributional assumption of the composite error term. The variance error of 0.997 implies that 99.7% of disturbance in the system is due to allocative inefficiency.

Maximum likelihood estimates of theparameters of the stochastic cost frontier model as presented in Table 4.2.3 All the parameter for the participants estimate havethe expected signs with the cost of fertilizer; agro-chemical, seed and labour are highly significant at 1% level meaning that these factors are significantlydifferent from zero and thus are important in maize production. For the non-participants, only labour and agrochemical were significant at 1% and 10% level respectively with labour having a negative sign and agro chemical with a positive coefficient. The cost elasticises with respect to allinput variables used in the production analysis are positive for the participant farmers and imply that an increase in the cost of seed, cost of fertilizer, cost of agro-chemical and cost of labour increases totalproduction cost. The results of the analysis shows that increase 1% increase in the cost of seed increased total cost of production by 3%, 1% increase in the cost offertilizer will increase total cost by 92%, 1%increase in the cost of agrochemical will increase totalcost by 47%, 1% increase in the cost of labour willincrease total cost by 5%. With the mean allocative efficiency of 72% for the participants and 53% for the non-participants it clearlyshows that the MARKETS farmers allocate resources more efficiently than the non-participating farmers.

Table 4.2.3: Maximum Likelihood Estimates of the Stochastic Cost function (Allocative efficiency)

Variable	Beneficiaries Coefficient	t-value	Non-Participant Coefficient	t-value
Constant	1.009 (0.123) ***	8.226	4.505(4.547)	0.991
Seed	0.003 (0.002)**	2.311	-0.0114(0.1345)	-0.085
Fertilizer	0.928 (0.009)***	98.563	0.0433(0.1870)	0.232
Labour	0.005 (0.001)***	9.174	-0.353(0.0320) ***	-3.111
Agrochemical	0.469 (0.249)*	1.883	0.468(0.2489)*	1.883
sigma-squared(δ)	0.232(0.0319) ***	7.272	0.275(0.05842) ***	4.707
Gamma (γ)	0.997 (0.0057) ***	176.104	0.954(0.098) ***	9.672
log likelihood function	173.056		-472.612	
LR test	14.374		9.842	
Mean Efficiency	0.716		0.531	

***P<0.01, ** P<0.05 and * P<0.1.

4.2.4 Farm level efficiency of farmers from the stochastic frontier model

Efficiency measurements involve a comparison of actual performance with optimal performance located on relevant frontier. Since the true frontier is unknown, an empirical approximation is required. The approximation is normally called a "best-practice" frontier. Farm level efficiency is an important factor in productivity growth. In an economy where resources are scarce and opportunities for new and improved technologies are inadequate. The result on Tables 4.2.4.1 and 4.2.4.2 presents the deciles range of frequency distribution of the technical, allocative and economic efficiency estimates of maize farmers in Kaduna state obtained from the stochastic frontier model.

4.2.4.1 Technical*efficiency estimates (Indices) of participants and non-participating Farmers*

The estimated technical efficiency scores for both MARKETS participants' farmers and non-participants farmers ranged from 0.264 to 0.954 for the participants and 0.103 to 0.908 with a mean of 0.865 and 0.487 respectively. Table 4.2.4.1 shows that majority (79%) of the participants had technical efficiency score of between 0.81-1.00 and majority of the non- participants (31%) had technical efficiency scores of less than 0.20. The mean technical efficiencies for both categories of farmers indicates that the farmers are not fully technically efficient as the observed output for participant farmers and non-participants are 13% and 51% less than the maximum output. The maximum and minimum technical efficiencies of the participant farmers were 95.4% and 26.4% respectively, while that of the - non-participants were 90.8% and 10.3%. Generally, the Technical efficiency of the participants is higher than that of the non-participants considering the high number (79%) of the farmers in the modal class of the efficiency scores and the mean efficiency score.

4.2.4.2 Allocative efficiency estimates (Indices)of participants and non-participant Farmers

The result in Table 4.2.4.1 shows that about 41% of the participants and 10% of the non-participants had allocative scores of 81% and above. The mean efficiencies of the participants and non-participants were 71.6% and 53% respectively. This reveals that the farmers were able to obtain about 71.6% and about 53% of their potential output respectively from a given combination of cost of inputs for maize production. The analysis further shows that both categories of farmers are not fully efficient as the observed output is 28.4% and 47% less than the maximum output respectively. From the result shown on Table 4.2.4.1, the Participants of the MARKETS project have a higher allocative efficiency as compared to the non-participants farmers.

Table 4.2.4.1: Frequency distribution of Technical and Allocative Efficiencies of Farmers

	Technical Efficiency				**Allocative Efficiency**			
Efficiency Score	Beneficiaries Frequency	%	Non-Beneficiaries Frequency	%	Beneficiaries Frequency	%	Non-beneficiaries Frequency	%
≥0.2	0	0.00	30	30.92	0	0.00	0	0
0.21-0.40	1	0.40	22	22.68	26	10.97	26	26.80
0.41-0.60	3	1.27	25	25.77	35	14.0	36	37.11
0.61-0.80	46	19.4	10	10.31	87	34.8	25	25.77
0.81-1.00	187	78.9	10	10.31	89	40.8	10	10.31
Total	237	100	97	100	237	100	97	100
Mean efficiency(%)		86.5		48.6		71.6		53
Maximum efficiency(%)		95.4		90.8		99.2		90.1
Minimum efficiency (%)		26.4		10.3		23.4		20.1
Mode efficiency		86.4						

(%)	49.0	93.7	42.2

4.2.4.3 Economic efficiency of maize farmers

According to Ogundari and Aladejimoku (2006) economic efficiency is a situation where there are both technical and allocative efficiency. The simultaneous achievement of both efficiency conditions occurs when price relationship is employed to denote maximum profits for the farmer or when choice indicators are employed to denote the maximization of other economic objectives. So, economic efficiency refers to the choice of the best combination for a particular level of output which is determined by both output and input prices.

The results on Table 4.2.4.2 shows that majority (51%) of the participant farmers had economic efficiencies above 60% , while about 2% of the non-participant farmers had economic efficiency scores exceeding 60%. Further analysis reveals that the economic efficiencies range from a minimum score of 13.6% to a maximum score of 93.8% for the participant farmers with a mean efficiency of 61.6%. The non-participants farmers' scores ranged from minimum score of 2.6% to 68.0% maximum score and a mean of 24.2%.The range of frequency distribution of technical, allocative and economic efficiencies range from about 26 -95% with mean of about 87%, about 23 -99% with a mean of 72% and from 14-94% with a mean of about 62% for the participant farmers. Also, for the non-participant farmers, their efficiencies ranged from 10-90.8% with a mean of 49%, 20-90% with a mean of 53% and 3-68% with a mean of 24% for technical, allocative and economic efficiencies respectively. The results of the analysis generally implies that, for the participant farmers to be economically efficient, they will need to reduce cost by 38% and for the non- participants farmers by about 76%.

Table 4.2.4.2: Frequency distribution of overall Economic Efficiency of the Farmers

	Economic Efficiency			
Efficiency Score	**Frequency of Beneficiaries**	**%**	**Frequency of Non-Beneficiaries**	**%**
≥0.2	2	0.84	45	46.39
0.21-0.40	36	15.15	30	30.93
0.41-0.60	61	25.74	20	20.62
0.61-0.80	121	51.05	2	2.06
0.81-1.00	17	7.17	0	0.00
Total	237	100	97	100
Mean efficiency (%)		61.6		24.2
Max efficiency (%)		93.8		68.0
Min efficiency (%)		13.6		2.6
Mode efficiency (%)		75.7		24.2

4.3 Factors Influencing Farmers Efficiency Level

The factors influencing the farmers' efficiency or the sources of technical inefficiency of the farmers are presented in Table 4.3 below. In these work socio-economic variables (Z_1-Z_7) such as age, education, gender, Household size, farming experience, land size, and extension contact were used to assess their effect on farmer's efficiency. A negative sign on a parameter means that the variable increases farmer's technical efficiency, while a positive sign means that the variable reduces technical efficiency. The result on Table 4.3 reveals that age, level of education, household size, land size and extension contact had negative signs. This suggests that these factors reduce technical inefficiency of the MARKETS Farmers. The implication is that these factors increase their technical efficiency.

Similarly, age, education, gender, household size, land size and extension contact had negative coefficients it therefore suggest that these factors decrease technical inefficiency or technical efficiency of the non-participant farmers. For the participant farmers, gender had a positive coefficient this implies an increase in these variable increases the technical inefficiency of the farmers.

The educational level of both participants and non-participants had negative coefficient and are statistically significant at 5% and 10% respectively. This implies that the more educated the farmers, the higher the technical efficiency. This was expected and agrees with the finding of Shafiq and Rehman (2000) and Chirwa (2007) who found a positive relationship between higher numbers of years spent in school and high level of technical efficiency. This could be due to the fact that educated farmers may have better access to extension services, financial institutions and market information. Furthermore, such farmers respond fast to new technologies and adopt use of correct management practices like timely sowing and weeding, the recommended amount, time and method of fertilizer application, recommended seed rate and other improved farm management practices.

Table 4.3 Stochastic production estimates showing inefficiency estimates

	Beneficiary		Non-beneficiary	
Variable	Coefficient	t-value	Coefficient	t-value
constant	-0.407(0.833)	-0.488	2.825 (0.227)	12.449
Age (Z_1)	-0.008 (0.012)	-0.070	-0.011(0.008)	-1.357*
Education(Z_2)	-0.435 (0.189	-2.292**	-0.057 (0.035)	-1.627*
Gender (Z_3)	0.318 (0.156)	2.035**	-0.119 (0.141)	-0.846
Household-Size(Z_4)	-0.020 (0.021)	-0.985	-0.155 (0.010)	-1.515*
Farming experience (Z_5)	0.010 (0.009)	1.072	0.0009 (0.006)	0.014
Land size (Z_6)	-0.306 (0.070)	-4.340***	-0.339(0.011)	-30.561***
Extension(Z_7)	-0.372 (0.126)	-2.937***	-0.055(0.019)	-2.895***
Sigma square (δ)	0.373 (0.133)	2.0489	0.166 (0.018)	9.054
Gamma (γ)	0.823 (0.072)	11.438	0.999 (0.025)	3.989
Log likelihood function	-58.55		-23.091	
LR test	17.218		82.590	
Mean	0.87		0.49	

The coefficient of gender is positive and significant at 5% for only the participant farmers. The result was expected to be negative as the majority(91%) of the respondent were male farmers that are wealthier and can acquire more productive and expensive technologies faster (Betty 2005). Female farmers constituted only 9% of the participating farmers. The regression produced a positive coefficient indicating the tendency for female farmers to have lower technical inefficiency scores. Hence, an indication that the female participant are more efficient than the male farmers. This could be because women are more aware or concerned with the food requirements of the family (Thomas, 1990).They may therefore be more likely than men to recognize the advantages of cost saving technologies and are hence able to produce at lower costs. In addition female household heads are normally members of farmer groups that regularly attend meetings organized by extension workers. This makes them more knowledgeable and certain to adopt new technologies.

Household size had a negative sign but was not significant for the participants but was significant at 10% and had a positive coefficient for the non- participants. A large household size may lead to a decrease in technical efficiency because families with more dependents are likely to be more financially constrained and hence unable to spare resources for the purchase of fertilizer and certified hybrid seed for maize production.

Farming experience for both categories of farmers was positive and was not significant. This result is contrary to theapriori expectation and several findings (Ojo and Ajibefun, 2000, Shamsudeen*et al*, 2013, Gifty*etal*, 2013, Lapple, 2010, Oyewol, 2009 and Abdulai and Huffman,2010) who all argued that farmers with many years of experience were more technically efficient than those with few years and that increase in farming experience provides better knowledge about the production environment in which decisions are made.

Farm size was also included as an explanatory variable in this study. Several studies have looked at the relationship between farm size and efficiency. Mixed results have been reported where some have shown a negative relationship while others have shown positive relationship. This study shows a positive relationship between farm size and efficiency. Increasing the size of the field by one hectare increased the level of technical efficiency by 3 percent for both the participant and non- participant farmers. The relationships were significant at 1% for both categories of farmers. This results are consistent with findings by Kaiser (1988) and Sharma *et al*. (1 999).

Extension contact by agricultural extension agents to the participants and non-participants farmers was negative and statistically significant at 1% level of probability.The negative and significant coefficient of extension contact shows that farmers who have frequent contact with extension agents increase technical efficiency. Extension agents serve as communication links between researchers and farmers, thus transmitting new innovations from researchers to farmers; likewise a link for sending farmers problems to researchers. Farmers who have contact with extension agents avail themselves to new innovations, techniques and practices and thus apply these to their farming activities and therefore enhances their efficiency. Other researchers that obtain similar findings are Parikh *et al* (1995) and Seyoum*et al* (1998)reported that extension service is very essential to the improvement of farm productivity and efficiency among farmers

4.4 Profitability of Maize Entreprise

The gross margin analysis was used to determine the profitability of the maize entreprise. Table 4.4 gives the statistics of materials used and revenue generated from the entreprise. One of the objectives of the MARKETS project is to increase productivity and quality of output of farmers that can meet market requirement and for the farmers to obtain premium prices for their produce and raise their income.

The recommend maize varieties are mostly improved opened pollinated (OPV) varieties and the hybrids. The expected outputs from OPV is 3-4 tons/ha while hybrid is 5-6 tons/ha (CADP, 2011). The MARKETS farmers had an average output of 3.3 tons/ha as compared to the 2.7ton/ha for the non-.participating farmers. The seed rate recommended for maize is 20Kg/ha (CADP, 2011). The MARKETS farmers on the average use 21Kg/ha while the non-participating farmers used 35kg/ha. Maize has a high demand for Nitrogen. Maize should be fertilized adequately especially hybrids to reach its fullest expression.

The fertilizer recommendation for maize is 11bags (550Kg/ha) when using NPK 15:15:15 and 10 bags (500Kg) when using NPK 20:10:10 (CADP, 2011). Both categories of farmers on the average do not use the recommended fertilizer dosage. The use of herbicides for weed control requires about 3-4litres/ha which both categories of farmers do not adhere to. The result as shown on Table 4.4 confirms the result on Table 4.2.1 and 4.2.2 which reveals that there are still some levels of inefficiencies in the use of inputs by farmers.

Table 4.4.1: Material inputs for Maize Production per hectare- 2014 cropping season

		Beneficiaries Statistics				Non Beneficiaries Statistics			
Variables	Unit	Max	Min	Mean	SD	Max	Min	Mean	SD
Yield	Kg	5700	1066	3308.7	922.309	2017	1100	1425	416.78
Seed	Kg	60	4	21.4	0.903	69	3	35	11.362
Fertilizer	Kg	750	100	276	123.6	478.26	77	160.6`	91.58
Labour	Man-days	166	2.5	28.56	9.450	108	5.0	43.5	26.385
Herbicide	Litres	8	0	0.9	1.262	14	0	1.99	2.967

The total cost incurred on the various production inputs and total revenue generated from maize entreprise is shown on Table 4.4.2. The analysis of the costs and returns reveals that maize production for both participants and non-participants were both profitable with a gross margin of ₦129, 972.5 and ₦29,829 respectively.

The benefit cost ratios of 3.5 and 1.61 was obtained for participants and non-participants respectively. Further analysis also shows that, for every ₦1.00 invested by the participants' farmers in maize production yields a return of ₦ 2.5 while for non-participants the rate of returns was 0.61 which implies that the farmers benefit almost equal the cost. The non- participant farmers were breaking even. This was done to evaluate the financial consequences of business investments on the crops selected.

Table 4.4.2: Average Cost and Returns of Maize Production/hectare

Beneficiaries Variables	Non-Beneficiaries Qty.	Unit Price (₦)	Value (₦/ha)	Qty.	Unit Price (₦)	Value (₦/ha)
Gross Return (Output *Price)	3308.7	55	**181,978.2**	1425	55	**78,375**
TVC			**53,264**			**49,050**
Seed(Kg)	21.4	200	4,280	28	72	2016
Fertilizer(Kg)	276.9	100	27,600	160.6	100	16,060
Labour(Man-days)	28.56	600	17,136	43.5	600	26,100
Agro-chemical (L)	0.9	1000	900	1.99	1000	1990
Other cost			2000			2380
Gross Margin			**129,972.5**			**29,829**
BCR			**3.5**			**1.61**
ROI			**2.5**			**0.61**

4.5 Impact of USAID-MARKETS Project on the Productivity and Livelihood of the Farmers

To understand the extent of the impact of MARKETS Project on the productivity and livelihood of the farmers it was important to analyze the activities of the project with the farmers, their performance over time (2010-2014), sources of income, assets and those who were able to continue with the project activities till date.

4.5.1 MARKETS technical and business supports to famers and impact on yield

The project employed different strategies in order to improve the productivity and livelihood of the farmers through increased yield and income. Table 4.5.1 below shows the technical support and maize production practices provided to the farmers. The results show that demonstration on the use of improved seed varieties with ascertained quality was a good intervention by the MARKETS project. About 87% of the farmers showed their satisfaction on the effectiveness and timeliness of the training and demonstration of improved varieties of seed. Similarly, 82% and 100% of the farmers also reported that they were satisfied with the level on extent of training received on fertilizer use and application and weed control respectively. The result also showed that, access to credit and linkage to markets were among the problematic areas as 85.6% and 50% were not satisfied with the intervention in these two areas respectively. These could reduce income and if access to markets improves the reverse may be the case.

Table 4.5.1: Farmers perception on the Interventions of the MARKET Project

Technical Supports (Trainings, demonstrations & Linkages)	**Farmers Perception**			
	VS	**S**	**NS**	**NR**
Agri-Business Planning	87.2%	12.8	-	
Land Preparation	72%	25.6%	-	2.4%
Access and Use of Improved Seed	60.8%	26%	13.2%	-
Planting (Time, Spacing & Seed Rate)	80.8%	19.2%	-	-
Access & Use of fertilizer	2%	80%	18%	-
Fertilizer application (calculation & Method)	98%	2%	-	-
Weed Control	96%	2%	-	2%
Pest & Disease Control	100%	-	-	-
Post-Harvest Handling &Storage Management	90%	-	-	10%
Linkage to Market	32%	18%	50%	-
Linkage Source of Credit	3.2%	-	85.6%	11.2%
Grant support	2%	-	-	-
Total Number of Farmers =237				

Note: VS= Very satisfied, S= Satisfied, NS= Not satisfied and NR= No response

4.5.2Farmers productivity growth and performance

Total factor productivity (TFP) measures how much maize is produced by the farmers relative to the amount of economic inputs used. When there is more yield relative to the quantity of economic input employed in maize production, then TFP has grown or increased. Therefore, TFP growth measures how much productivity grows or declines overtime. The change in productivity reflects how well a farmer has adopted technical change and adapted to the maize production environment. The DEAP Malmquist Productivity Index was used to analyze the TFP of the participants and non- participant farmers from 2010- 2014. The rule is MPI 1 implies an increase and MPI>1 implies a decline. The empirical results indicates that the mean annual total factor productivity growth was positive for both categories of farmers at 71.8%[1] for participants and 47.7%[1]for the non-participant farmers. The growth was due to both technical efficiency change (11.9%) and the technical change (53.5%) for the participants and 11.3% and 32.6% for the non-participants (Table 4.5.2). This shows that the MARKETS farmers still have the highest TFP change (71.8%) as compared to the non- Participants (47.7%). This can be attributed to the continuous adoption of the innovation as promoted by MARKETS on Table 4.5.2.

Table 4.5.2 Malmquist Index Summary of Farmers Means

	Beneficiary			Non-beneficiaries		
Year	Technical efficiency change	Technical change	Total factor productivity change	Technical efficiency change	Technical change	Total factor productivity change
2010	1.398	1.506	2.105	1.276	1.076	1.373
2011	1.257	1.575	1.981	1.218	1.180	1.437
2012	1.000	1.577	1.577	1.113	1.480	1.647
2013	1.000	1.487	1.487	0.990	1.543	1.527
2014	1.000	1.533	1.533	1.000	1.414	1.414
Mean	1.119	1.535	1.718	1.113	1.326	1.477

[1] implies subtracting1from the number on the table gives average increase or decline per annum. Multiplying by 100 gives percentage annual change.

4.5.3 Farmers sources of income

To examine the income sources, the farmer's income was divided into five categories: crop income, Livestock income, and wages from regular employment, casual employment and running own business. The total mean income of the farmers studied was found to be about ₦150, 498 with minimum of ₦78, 500 and maximum of ₦1, 800,000.00 for the participating farmers. Similarly, the mean income of the non-participating was ₦124, 089.7 with a minimum of ₦ 45,000 and maximum of ₦1, 140,100. The average income for various income sources are given in Table 4.5.3 below. The farmers have diverse income sources with sales of crop (maize) as their major source of income.

Table 4.5.3: Distribution of income sources and their mean income

Income Source	Beneficiaries Frequency	Beneficiaries %	Beneficiaries Average Income (₦)	Non Beneficiaries Frequency	Non Beneficiaries %	Non Beneficiaries Average Income (₦)
Sale of crop	237	100	113,287	97	99.2	90,280
Sale of Livestock & Products	41	16.4	82,962.96	85	72.0	83,738
Regular Employment	56	22.4	240,000	12	10.2	200,000
Casual Employment	118	47.2	108,183.00	90	76.3	120,000
Running own business	28	11.2	56,750	29	24.6	46,135

4.5.4 Acquisition of productive assets

The list of assets owned by the participants is presented in Table 4.5.4.One indicator to assess change in livelihood is the capacity to acquire productive assets. The information gathered from the field shows that there was increase in the number of assets owned by the respondents as a result of increased income generated from increased yield of maize. Further analysis shows about 73% increase in number of assets acquired by the Participant farmers and compared to the non-participants who maintained a constant level.

Table 4.5.4: List of assets owned by respondents

Types of Assets	Beneficiaries		Non-Beneficiaries	
	Number owned before	**Number owned now**	**Number owned before**	**Number owned now**
Crop Production				
Hoe, cutlass and machetes	5	8	3	3
Draft bulls	0	2	3	3
Ox plough	0	2	2	3
Tractor	0	1	1	1
Assets/Vehicles				
Cars	1	2	1	1
Bicycles	1	2	2	2
Motorcycles	2	3	2	2
Mobile phone	2	4	4	4
Wooden chair	2	4	2	3
Wooden bed	3	4	3	3
Television& radio	2	4	2	3

Total	15	36	25	25

4.5.5 Impact of USAID MARKETSproject on yield of maize farmers

The impact of USAID programme on the maize yield of the participants and non-participants in the study area was achieved using chow test statistics. The chow test is a test that determines if the coefficients from two regression analyses are the same. However, three different linear regressions were carried out comprising of the pooled samples of participants and non-participants, and separate linear regression for participants and non-participants respectively. The residual sum of square of each of the three regressions was used to compute the chow test. The decision rule was that if Chow F-statistics is greater than that of F-table, there is impact of USAID programme on maize production and structural differences between the participants and non-participants in terms of maize output, if otherwise there is no impact of USAID programme in the study area.

Table 4.5.5: Impact of USAID MARKETS project on output of maize farmers

Group Sample	R^2	Residual sum of square	N	K	F-cal	F-tab
Pooled Samples	0. 69	101042.3	334	8	4.61	2.80
Participants	0.61	80959.42	237			
Non-participants	0. 54	10824.25	97			

R^2 = regression coefficient, N = numbers of observation and K = numbers of parameters

The result from Table 4.5.5 revealed that the Chow F calculated was 4.61, while F table value at 7 degree of freedom with sample size of 334 was 2.80 at 5% level of probability implying a significant impact of USAID MARKETS project on the maize output in the study area since the F calculated was greater than the F tabulated. Hence, we reject the null hypothesis that there is no significant impact of USAID MARKETS project on the productivity of the participating farmers in the study area and accept the alternative hypothesis.

4.5.6 Impact of USAID MARKETS project on income of maize farmers

The result from Table 4.5.6 revealed that the Chow F calculated was 15.58, while F table value at 7 degree of freedom with sample size of 370 was 2.80 at 5% level of probability implying a significant impact of USAID MARKETS project on income of the participants in the study area since the F calculated was greater than the F table. Hence, we reject the null hypothesis that there is no significant impact of USAID MARKETS project on income of the participating farmers in the study area and accept the alternative hypothesis.

Table 4.5.6: Impact of USAID MARKETS project on income of maize farmers

Group Sample	**R^2**	**Residual sum of square**	**N**	**K**	**F-cal**	**F-tab**
Pooled Samples	0.38	4856141E+06	334	8	15.58	2.80
Participants	0.46	2050848 E+06	237			
Non-participants	0.34	1247981 E+06	97			

R^2 = regression coefficient, N = numbers of observation and K = numbers of parameters

4.5.7 Impact of USAIDMARKETS project on livelihoods of maize farmers

The result from Table 4.5.7 revealed that the Chow F calculated was 3.94, while F table value at 7 degree of freedom with sample size of 368 was 2.80 at 5% level of probability implying a significant impact of USAID MARKETS project on livelihoods of the participants in the study area since the F calculated was greater than the F table. Hence, we reject the null hypothesis that there is no significant impact of USAID MARKETS project on livelihoods of the participating farmers in the study area and accept the alternative hypothesis.

Table 4.5.7: Impact of USAID MARKETS project on livelihoods of maize farmers

Group Sample	R^2	Residual sum of square	N	K	F-cal	F-tab
Pooled Samples	0.57	3248109E+07	334	8	3.94	2.80
Participants	0.43	2426267 E+07	237			
Non-participants	0.14	7294023 E+06	97			

R^2 = regression coefficient, N = numbers of observation and K = numbers of parameters

4.6 Level of Involvement of Farmers in the MARKETS Project

The level of involvement of the farmers and participation in the maize value chain project was also analyzed. Tables 4.6.1and 4.6.2 below.

4.6.1 Farmers participation in intervention activities

The analysis on Table 4.6.1 reveals the participation in all the trainings and other technical support activities carried out under the USAID/MARKETS Project. For all the training activities, farmers' participation from their attendance show full (100%) participation. The full participation was encouraged as farmers were given opportunity to be involved in activity planning and decision making during the preseason trainings. This contradicts the claim of FarshidAref (2011)who found out the farmers are not involved in planning and decision making in agricultural development programs.

Financial incentives in the form of transportation, feeding during the trainings and on farm demonstrations were also among the economic factors that encouraged farmers' participation in the MARKETS project. Financial incentives are extremely important, and may be the most important factor, in obtaining voluntary participation in the activities of a project. A significant barrier to participation of farmers to the MARKETS project is poor economic status of producers. Which is taken care of by the project. The farmer's trainings are usually supported with on farm demonstrations. On-farm demonstrations can be used effectively to educate farmers about new technologies (Deanna *et al*. 1995). For other high technical intervention activities like linkage to markets, linkage to credit source and access to grants had low participation by the farmers. Only 36.5% of the farmers sold their maize collectively to the buyers. The MARKETS project in its intervention fosters the linkage of farmers to agro-processing company majorly Grand cereals. However, in the context of monopolization of processing, credit, marketing and technical capabilities by agribusiness companies,smallholders have been entering a commercial relationship that has been fundamentally inequitable.

Table 4.6.1: Farmers Participation in the USAID/ MARKETS Project

Technical Supports (Trainings, demonstrations & Linkages)	**Farmers Participation**	
	Frequency	**%**
Preseason training and planning	237	100
Agri-Business Planning	237	100

Land Preparation	237	100
Access and Use of Improved Seed	237	100
Planting (Time, Spacing & Seed Rate)	237	100
Use of fertilizer	237	100
Fertilizer application (calculation & Method)	237	100
Weed Control	237	100
Pest & Disease Control	237	100
Post-Harvest Handling &Storage Management	237	100
Linkage to Market	89	37.6
Linkage Source of Credit	8	3.4
Grant support	0	0
Total Number of Farmers =237		

4.6.2 Farmers level of involvement in the USAID/MARKETS project

Table 4.6.2 below reveals that 61.6% of the farmers indicated their involvement and participation in the project was very strong, about 37.1% reported strong involvement and 1.3% had weak involvement as either members of the group or lead farmers. Further analysis showed that 97% of the farmers continued to put into practice all the technologcal packages introduced during the project lifespan. The remaining 3% also showed partial practice of the introduced innovation in maize production.

Table 4.6.2: Distribution of Farmers based on their involvement in the Project

Level of involvement of Farmers	Frequency	%
Very Strong	146	61.6
Strong	88	37.1
Weak	3	1.3
Total	237	100

4.7 Farmers Constraints and Challenges

Despite the intervention of the MARKETS project in the project sites, farmers still recorded some constraints which are production and market related. Table 4.7 below gives that linkage to markets (Off-Takers/Processors) was very poor as it ranked first, reliable markets with good price for produce ranked second, with poor input support third and lastly of the issue of selfishness on the part of cooperative members was also reported for the participant farmers.

The five (5) constraints enumerated by the farmers are all linked together. The economic environment within which rural poor farmers operate is characterized by unpredictability, uncertainty and risk; and agricultural markets in particular (IFAD, 2003). The implication of this constraints is that with inadequate market for increased produce, the sale and income accrue to the farmers will be affected. This further confirms that Grand cereals alone is not capable of buying all the maize produced by the farmers. Lack of reliable market and poor prices ranked second in the constraints enumerated by the farmers. According to reports of study by IFAD in 2003, rural producers who face difficulties in reaching markets often become dependent on traders coming to the village to buy their agricultural produce and to sell those inputs and consumer goods. However, especially in remote areas, a trader may not arrive reliably or at all, and producers are often faced with little choice but to accept the first offer of the first trader who shows up, however unfavorable it might be. This is in line with the findings of the study where 64.4% of the farmers had to sell the produce individually to available market within their locality.

Access to inputs ranked third among the constraints faced by the famers. In developing countries such as Nigeria, the input market is more problematic. Input companies have limited retail network and are only just beginning to develop their network of agents. The result of the study reveal that farmers have to travel on the average about 6 Kilometers to purchase their inputs. Apart from the distance, high transport costs, lackof competition among distributors, and farmers' lack of ability to negotiate favourable terms affects farmers' access to inputs.

The MARKETS project works with farmers who are in groups in other to strengthen their capacities and negotiating powers. Commercially oriented organizations of poor rural producers (groups, associations, cooperatives) can enable producers to pool their input requirements as well as their outputs. This reduces the cost of doing business, and can lead to increased profits both for the producers and the other participants of the marketing chain. As shown on Table 4.7, selfishness of cooperative leaders ranked 4th among the constraints faced by the farmers. This is in line with the finding of Malthus (1999) who identified some of the problems facing cooperatives in Nigeria to include; shortage of skilled personnel, inadequate financing, excessive government control and lack of trust among members. Onje (2003) also added that the problem of dishonesty among cooperative leaders is another factors retarding the growth of cooperative in Nigeria

Table 4.7: Problems Faced by Farmers

Nature of problem	**Frequency of Beneficiaries**	**Rank**	**Frequency of Non-Beneficiaries**	**Rank**
Inadequate reliable Market	51	2	20	3
Poor price for our commodity	51	2	20	3
Poor Market Linkage	124	1	48	1
Access to Inputs	18	3	30	2
Selfishness of cooperative leaders	6	4	-	

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study analyzed the productivity and livelihood of famers under the USAID/MARKETS project in Kaduna State, Nigeria. A multi-stage sampling technique was employed in the selection of samples. A total of 334 farmers were included in the study (237) participant farmers and 97 non-participants representing 5% of the sample frame.The broad objective of the study is to analyze the impact of the USAID/MARKETS project on the productivity of the farmers and assess the extent to which the intervention has improved the livelihood in the study.

The study involved the use of questionnaire and focus group discussions for data collection. The data collected includes productionand socio economic data. The data was analyzed using descriptive statistics, inferential statistics and gross margin analysis, the stochastic frontier production and malmquistproductivity index.

The study showed clearly the socio-economic characteristic of the respondents. The mean age of the respondents surveyed was about 41 years for both participants and non-participants. Majority (65%) of the participant farmers had formal education training compared to 21% for the non- participant.The farming experiences of the respondents were measured in years. The average farming experience was 24 years for the participants and 23 years for non-participants. It is also interesting to note that both male (91%) and female (9%) participant maize farmers were involved in the MARKETS Project. This was also the same for the non-participant farmers.The respondentsalso had mean household sizes of 9 persons and 6 persons for participants and non-participants respectively. The results also showed that 57.8% of the participant farmers and 53.6% of the non- participant farmers have land holdings of between 0.1 hectares to 2.0 hectares with mean of 2.2 and 2.3 for participant and non-participants respectively. This is evidentthat the farmers still fall within the range of smallholder farmers.

Both participants and non-participants had benefited from extension services. All (100%) the participants' farmers had extension contact while only 28% non-participant farmers had extension contact. The result of the analysis shows that the major source of finance for agriculture for both categories of the farmers was from their personal savings. Only 3% of the participating farmers accessed loan from the bank.All (100%) participants maize farmers in Kaduna state belong to a cooperative groups. For the non-participants only 19% were members of a cooperative group.The result of the analysis shows that 100% of the participants and 12% of the non-participants used improved seeds.

The result of the analysis also showed that 99% of the participant farmers applied a combination of NPK and Urea and about 91% of the non-participants. Further analysis showed that the mean quantity used per hectare was 276Kg for the participants and 161Kg for non-participants.The result shows that both categories of farmers used a combination of both hired and family labour for their maize farm operations. Only 25% of the participants and 5% of the non-participants used hired labour.

An average yield of 3308.9Kh/ha and 1425Kg/ha for the participants and non-participant was recorded respectively for the 2014 cropping season.The average technical efficiencies for participants maize farmers and non-participants maize farmers were about 87% and 49%. This implies that on the average the participant farmers were able obtain almost full potential production output from a given mix of inputs while the non-participants were able to obtain below half of its production potential. This shows that the MARKETS farmers were more technically efficient than the non-participating farmers.With the mean allocative efficiency of 72% for the participants and 53% for the non-participants it clearly shows that the MARKETS farmers are more efficient allocatively than the non-participating farmers.

About 79% of the participating farmers and 15% of the non-participants had technical efficiencies score above 81%. Majority of the non-participant had technical efficiency score less than 20%. The mean technical efficiencies for both categories of farmers 87% and 49% indicates that the farmers are not fully technically efficient as the observed output for participant farmers and non-participants are 13% and 51% less than the maximum output respectively.

About 38% of the participants and 10% of the non-participants had allocative scores of 81% and above. With an average of 71.6% and 53% for the participants and non-participants respectively it shows that the both categories of farmers are not fully efficient as the observed output is 28.4% and 47% less than the maximum cost of production respectively. Farm level economic efficiencies of the farmers' reveals that the economic efficiencies range from a minimum score of 13.6% to a maximum score of 93.8% for the participant farmers with a mean efficiency of 61.6%. The non-participants farmers' scores ranged from minimum score of 2.6% to 68.0% maximum score and a mean of 24.2%. The results of the analysis generally implies that, for the participant farmers to be economically efficient, they will need to reduce cost by 38% and for the non- participants farmers by about 76%.

Further analysis reveals that age, level of education, household size, land size and extension contact had negative signs. This suggest that these factors reduce technical inefficiency of the MARKETS Farmers. The implication is that the invariably increase their technical efficiency. Similarly, age, education, gender, household size, land size and extension contact had negative coefficients it therefore suggest that these factors decrease technical inefficiency and increase the technical efficiency of the non-participant farmers. For the participant farmers, gender had a positive coefficient this implies an increase in technical efficiency and a decrease in technical efficiency of the participant farmers.

The Gross Margin analysis reveals that maize production for both participants and non-participants was profitable with a gross margin of ₦ 129,973 and ₦29,829 respectively. The benefit cost ratios of 3.5 and 1.61 was obtained for participants and non-participants respectively. Further analysis also shows that, for every ₦ 1.00 invested by the participants' farmers in maize production yields a return of ₦ 2.5 while for non-participants the rate of returns was 0.61.

The MARKETS project employed several empowerment strategies to improve the productivity and livelihood of the farmers. The results shows that demonstration on the use of improved seed varieties with ascertained quality was a good intervention by the MARKETS project. About 87% of the farmers showed their satisfaction on the effectiveness and timeliness of the trainings. Similarly, 82% and 100% of the farmers also reported that they were satisfied with the level on extent of training received on fertilizer use and application and weed control respectively. Access to credit and linkage to markets were the problematic areas as 85.6% and 50% of the farmers reported their dis-satisfaction with the intervention in these two areas respectively.

Considering the Malmquist Productivity index, the result of the analysis shows a progress in the total factor productivity growth of both categories of farmers with the MARKETS Farmers having a higher growth rate of 71.8% as compared to 47.7% by the non-participating farmers. The positive growth was due to both technical efficiency change and technical change.

Analyzing the level of participation of the MARKETS farmers in the project reveals that 61.6% of the farmers indicated their involvement and participation in the project was very strong, about 37.1% reported strong involvement and 1.3% had weak involvement as either members of the group or lead farmers. Further analysis showed that 97% of the farmers continued to put into practice all the technological packages introduced during the project lifespan. The remaining 3% also showed partial practice of the introduced innovation in maize production. The study revealed there were some constraints faced by the farmers. The farmers reported linkage to Markets (Off-Takers/Processors) was very poor as it ranked first, reliable markets with good price for produce ranked second, with poor input support third and lastly of the issue of selfishness on the part of cooperative members was also reported for the participant farmers.

5.2 Conclusion

The strong increase in the total productivity and income of the farmers in the study area are a strong confirmation of the support by the MARKETS Project. Despite the support of the MARKETS project, the farmers did not reach full potential efficiency.

The estimated mean technical efficiency of 87 percent, allocative efficiency mean of 71.6 percent and mean economic efficiency of 61.6% for the participant farmers shows that there is a difference in the efficiency of resource use by the farmers. The implication of this is that there is room for increased productivity and income through more efficient use of resources in maize production.

Furthermore, maize production in Kaduna state is a viable and profitable entreprise, and MARKETS project has contributed immensely to this achievement by increasing the productivity of the farmers.

5.3 Contribution to Knowledge

i. USAID/ MARKETS intervention in the study area improved the efficiency of the beneficiary farmers. The farmers who benefited from the project showed higher efficiencies (87%) than the non-participating farmers.

ii. Empowering Maize farmers technical know- how through capacity building and linkage to improved inputs sources greatly increased the total productivity of the beneficiary farmers by about 72%.

iii. USAID/MARKETS intervention in the study area affected the yield of the participating farmers positively and this also showed in their gross margin of ₦ 129,973 compared to the non- participating farmers who obtained ₦ 29, 829

5.4 Recommendations

The study on the analysis of the productivity and livelihood of maize farmers empowered by MARKETS project shows that there is an increase in total productivity of the farmers and invariably there is an increase income from the increased yield in the study area. Based on the findings of this study the following recommendations are deduced for further action and improvement in maize production:

i. All empowerment projects towards farmers' productivity in Kaduna state from both donor agencies and government should consider developing the markets linkages for effective results and better income for the farmers.

ii. For future projects, both government and non- governmental organizations need to assist in diversifying market outlets for farmers to increase competition.

iii. Very few farmers had access to formal credit facilities. Agricultural financing is very important in achieving the goal of improved productivity and livelihood. Farmers have little knowledge and understanding of bank credit requirements such as business plans and procedures involved in acquiring loans. Therefore more trainings is required to enlighten farmers. This can be supported by the public-Private partnership.

iv. Even though the MARKETS farmers had higher productivity and technical efficiency, there are still some levels of inefficiencies from the farmers. Farmers should be encouraged to mechanize production and post -harvest -

activities in maize production for expansion and improved quality of product in order to access better market.

v. Accessing inputs like improved seeds and fertilizer and agro-chemicals is not just enough to improve productivity of the farmers, training on method of application of fertilizer and right quantity recommendation is important to avoid over and underutilization of this input. It is also important to encourage farmers to improve their soil nutrient through integrated soil fertility Managements.

vi. Seed is a vital input to farmers. Enhancing farmers' access to quality seed was an integral component of the MARKETS activities as seen by the response of the participating farmers. The generality of farmers still use local varieties or recycle old seeds overtime. Purchasing of seeds from the open market should be discouraged. There is also need for extension officers to monitor seed quality and the time of planting of the seed.

vii. Also for sustainability sake, the public-private partnership linkage should be strengthened by involving relevant stakeholders (research institutes, inputs dealers, seed and fertilizer companies, agro-machinery companies and credit and financial institutions) in training programs to increase their commitment to the achievement made so far.

viii. The inclusion of women in agricultural empowerment programs should be increased by government and donor agencies. Despite the contribution of women to agricultural production, there is still inequalities in terms of access to productive resources some barriers to improved productivity and income include: low level of education, poor access to productive resources, finance, improved technologies and access to extension delivery system. The quota of women should be increased in order tap from the technical trainings and linkages to inputs and markets

REFERENCES

Abdulai, A. and Huffman, W., (2000). Structural Adjustment and Economic Efficiency of Rice Farmers in Northern Ghana.*Economic Development and Cultural Change*, pp.504-519.

Abdulrahaman A.A.I and Kolawole O.M (2006). Traditional Preparations and Uses of Maize in Nigeria EthnobotanicalLeaflets10: 219-227.C:\Users\cadoni\Documents\MAFAP\MAIZE NIGERIA\Literature\Traditional Preparations and Uses of Maize in Nigeria.mht

Aigner DJ, Lovell CAK, Schmidt P (1977). Formulation and Estimation of Stochastic Frontier Production Functions. Journal of Econometrics 6: 21-37.

Akande S. O. (1994). Comparative Cost and return in maize production in Nigeria. National Institute of Social and Economic Research (NISER) Ibadan, Nigeria

Ajani, O.I.Y. (2000) Resource productivity in food crop farming in the northern area of Oyo state,Nigeria. Unpublished PhD Thesis, Department of Agricultural Economics, University of Ibadan.

Alamu, J.F. (2001). Economic Analysis of Maize Production Using Two Technologies in KadunaState. J. Arid Agric., 11, 125-129.

Andy, Studies on maize total factor productivity in Liaoning and Jilin province (2012). Downloaded from website:http://www.economics-papers.com

Aref, F. (2011**)**. Agricultural Cooperatives for Agricultural Development in Iran.Journal 2011; 8(1):82-85. (ISSN: 1097-8135). http://www.lifesciencesite.com.

Banker R.D. and Natarajan R. (2008). Evaluating contextual variables affecting productivity using data envelopment analysis. *Journal of Operations Research 56*, 48-58.

Barrett C. (1996). On Price Risk and the Inverse Farm Size - Productivity Relationship. *Journal of Development Economics* 51: 193-216.

Battese, G.E. and T.J. Coelli. (1995). "A model for technical inefficiency effects in a stochastic frontier production for panel data". Empirical Economics, 20: 325–32.

Battese, G.E. and G.S. Corra. (1977). "Estimation of a production frontier model: with application to the pastoral zone of eastern Australia". *Australian Journal of Agricultural Economics,* 21: 283–94. Central Bank of Nigeria.

Betty, W. K., (2005). Technical Efficiency in Kenyan's Maize Production: An Application of the Stochastic Frontier Approach. Msc. Dissertation. Colorado State University Fort Collins, Colorado.

Burton RO Jr., and Abderrezak A (1988). Expected Profit and Farm CharacteristicsContribution No. 89-32-D, Agr. Exp. Sta., Kansas State University, Manhattan.

Byerlee, D., Diao, X., & Jackson, C. 2009). Agriculture, Rural Development, and Pro-poor Growth: Country Experiences in the Post- Reform Era. doi: 10.1146/annurev.resource.050708.144239.

Cooperative for Assistance and Relief Everywhere-CARE International (2006). The Courage to Change: Confronting the limits and unleashing the potential of CARE's programming for women. Synthesis Report: Phase 2. CARE International Strategic Impact Inquiry on Women's Empowerment

Commercial Agricultural Development Project (2011). World Bank Assisted Maize Production Guide. By CADP Kano Project

Caves, D.W, Christenson, A and Dawert, W.E (1982). Multilateral Comparison of output, input and Productivity using Superlative index Number. "Economic Journal, .99(1982)73-86.

Caudill SB, Ford JM, Gropper DM. (1995). Frontier Estimation and Firm Specific Inefficiency Measures in the Presence of Heteroskedasticity. *Journal of Business and Economic Statistics* 13: 105-111.

Chavas, J. (2001).An International Analysis of Agricultural Productivity**.** FAO Corporate Document Repository, Economic and Social development Department, 2001.

CBN (2000). Statistical Bulletin. Central Bank of Nigeria, Abuja, Nigeria. Chambers, R.G. 1994. Applied Production Analysis: A Dual Approach. Cambridge University Press, Cambridge.

Chirwa E. W. (2007).*Sources of Technical Efficiency among Small holder Maize Farmers in Southern Malawi*, AERC Research Paper 172, African Economic Research Consortium, Nairobi November 2007

Chow, Gregory C. (1960). "Tests of Equality between Sets of Coefficients in Two Linear Regressions". *Econometrica*28 (3): 591–605. doi:10.2307/1910133. JSTOR 1910133

CIMMYT (1999). International Maize and Wheat Improvement Centre. "People and Partnerships: Medium-Term Plan of the CIMMYT".

Coelli, T.J. (1994). "A Guide to FRONTIER Version 4.1: A computer program for stochastic frontier production and cost function estimation". Mimeo. Department of Econometrics, University of New England, Armidale.

Coelli, T. J., D. S. P. Rao, C. J. O'Donnell and G. E. Battese (2005). An Introduction to Efficiency and Productivity Analysis. Second ed. New York: Springer

Dasgupta, P. (1998). The economics of poverty in poor countries. The Scandinavian journal of economics, 100(1), 41-68. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12294308.

Datt, G., &Ravallion, M. (1998). Farm productivity and rural poverty in India. Journal of Development Studies, 34(4), 62-85. doi: 10.1080/00220389808422529.

Deanna L. Osmond and Judith A. Gale (1995). **Farmer Participation in Solving the Nonpoint Source Pollution Problem*The Rural Clean Water Program Experience.*** NCSU Water Quality Group.**North Carolina State UniversityCollege of Agricultural & Life Sciences**

Dimelu, M. U; Okoye, A. C., Okoye, B. C, Agwu, A. E, Aniedu, O. C. and Akinpela, A. O. (2009). Determinants of gender efficiency of small-holder cocoyam farmers in Nsukka Agriculture Zone of Enugu State. Scientific research and Essay. Academic Journals 4(1). Pp 28-30

Dorward, A., Ephraim Chirwa, E., Kelly, V., Jayne, T., Slater, R. and Boughton, D., (2008): Evaluation of the 2006/7 Agricultural Input Subsidy Programme, Malawi. Final Report, Ministry of Agriculture and Food Security, Malawi.

Dougherty, Christopher (2007). *Introduction to Econometrics*. Oxford University Press. p. 194. ISBN 0-19-928096-7.

Edache, O.A. (1999). “Agricultural policy in relation to sustainable maize production in Nigeria”. In J.A. Valencia, A.M. Falaki, S. Miko and S.G. Ado, eds., Sustainable Maize Production in Nigeria: The Challenge in the Coming Millennium. Proceedings of National Maize Conference, ABU, Zaria, Nigeria: 24–32

Elemo, K.A. (1993). Maize (*Zea mays* L.) agronomy research in the Nigerian savanna. In: Fakorede MAB, Alofe CO &Kim SK (eds)Maize: Improvement, Production, and Utilization in Nigeria, pp 105–117. Maize Association of Nigeria, Ibadan, Nigeria

Essa C.M., Franklin S., and Gidon O. (2012). Factor productivity in smallholder pigeonpea production systems: Empirical evidence from northern Tanzania. *Journal of Agricultural Economics and Development 1. (6*), 2012, 138-144

Evans School Review – Vol 1, No 1, Spring 2011

Fan, S., Hazell, P. &Thorat, S. (1999). Linkages between government spending, growth, and poverty in rural India (Research Report No. 100). Washington, D.C.:International Food Policy Research Institute. Retrieved from http://www.ifpri.org/ sites/default/files/publications/rr110.

Food and Agriculture Organization (2003). FAOSTAT.http://faostat .fao.org/default.htmm

FAO (2011). The State of Food and Agriculture 2010-11**.** Women in agriculture: Closing the gender gap for development.FAO, Rome, Italy

FAO (Food and Agricultural Organization of the United Nations) (2008). Women and sustainable food security towards sustainable food security publication. Women and population division (SD Special).

FARA (2009). Pattern of Change in Maize Production in Africa: Implication for Maize Policy Development. Networking Support Function 3 Regional Policies and Markets 2009

Fare. R., Grosskopf. S., Norris, M., Zhang Z. (1994). Productivity growth, technical progress, and efficiency change in industrialized countries.American Economic Review, 84 (1994), pp. 66–83

Farell, M.J., 1957. "Measurement of Productive Efficiency" J. Royal statistical Soc. Series, 3: 253-290

FarshidAref (2011):Farmers Participation in Agricultural Development: The Case of Fars Province Iran. Indian Journal of Science and technology, vol 4 No.2(Feb, 2011) pp 155.158

Fulginiti, L.E. and Perrin, R.K. (1998).Agricultural productivity in developing countries.Elsevier Science B.V. Agricultural Economics, 19 (1998), p 45-51

Friis-Hansen, E. (2003). Notes on Farmer Experimental Learning and Empowerment: The FFS Approach in Tanzania

Gale, J.A., D.E. Line, Osmond, D.L. Coffey, S.W. Spooner, J. Arnold, J.A. Hoban, T.J. and Wimberley, R.C.. (1993). Evaluation of the Experimental Rural Clean Water Program. NCSU Water Quality Group, Biological and Agricultural Engineering Department, North Carolina State University, Raleigh, NC, EPA-841- R-93-005, 559p.

Geoffrey N. C. (2004). Factors Affecting Smallholder Farmers' Adoption of Soil And Water Conservation Practices In Zambia. A Thesis Submitted to Michigan State University in Partial Fulfillment of the Requirements for the Degree of Master of Science Department of Agricultural Economics 2004

Greene W.H. (2003). *Econometric analysis fifth edition,* Prentice Hall, Upper Saddle River, New Jersey, England 2003

Greene W.H. (2004). Interpreting Estimated Parameters and Measuring Individual Heterogeneity in Random Coefficient Models. Department of Economics, Stern School of Business, New York University,
May 6, 2004

GiftySienso, Samuel Asuming-BrempongAndAmegashie, D.P.K (2013). Estimating The Efficiency of Maize in Ghana. *Contributed Paper prepared for presentation at the 4th International Conference of the AAAE, Cape Town, Hammamet, Tunisia, 22 - 25 September, 2013*

Hanmer, L., &Naschold, F. (2000). Attaining the International Development Targets: Will Growth Be Enough? Development Policy Review, 18(1), 11-36. doi: 10.1111/1467-7679.00098

Hassan, J. (1991). Influence of NPK fertilizer on thetechnological qualities of plant cane, Varietty CB. Intl. Sug. J. 84(3): 76-82.

Hassan, Y., Abdullah, A.M., Ismail, M.M. and Mohamed, Z.A. (2014). Factors Influencing The Total Factor Productivity Growth Of Maize Production In Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 7, Issue 4 Ver. II (Apr. 2014), PP 34-43 www.iosrjournals.org*

Hazell, Peter, & Haddad, L. J. (2001). Agricultural research and poverty reduction (Food, Agriculture, and the Environment Discussion Paper 34). Washington, D.C.: International Food Policy Research Institute. Retrieved from http://www.ifpri.org/sites/default/files/publications/2020dp34.pdf

Huang, C.J. and J.T. Liu (1994). "A non-neutral stochastic frontier production function". Journal of Productivity Analysis, 5: 171–80.

Hoff A. (2006). Second stage DEA: comparison of approaches for modeling the DEA scores. *European Journal of Operational Research 181,* 2006, 425-435

Horticulture Australia. (2011). Gross Margins: Using VegTool. Retrieved from http://ausveg.businesscatalyst.com/ Jirgi AJ., Ogundeji AA., Viljoen G., and Adiele MA (2010): Resource Use Efficiency of Millet/ Cowpea Intercropping in Niger State, Nigeria. 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa.

ICA. (2010). International Cooperative Alliance. Retrieved 1, October, 2011 from http://www.ica.coop/.ss

International Fund for Agricultural Development (IFAD) (2003).Promoting Market Access **for** the Rural Poor in Order to Achieve the Millennium Development Goals Roundtable Discussion Paper for the Twenty-Fifth Anniversary Session of IFAD's Governing Council February 2003

IFPRI–World Bank.(2010). *Gender and governance in rural services: Insights from India, Ghana, and Ethiopia.* Agriculture and Rural Development. Washington, DC, USA: The World Bank.

IITA (2001). International Institute of Tropical Agriculture, Ibadan, Oyo State. Annual Report on Maize Production.

Iken J.E, Amusa N.A, Obatolu VO (2002). Nutrient composition and weight evaluation of some newly developed maize varieties in Nigeria. J. Food Tech. Africa (Kenya) 7:25-28.

Iken J.E, AmusaN.A(2004). Maize Research and Production in Nigeria. Afr. J. Biotechnol., 3(6): 302–307 Key, N., E.

Ironkwe, A. G, Asumugha, G. N. Ekwe, K,C. and Okoye, A. C. (2009). Gender inequalities in technical efficiency among small-holder cassava farmers in Enugu State, Nigeria. The Nigerian Agricultural Journal. Volume 40 (nos1 and 2).

Jirgi AJ., Ogundeji AA., Viljoen G., and Adiele MA (2010). Resource Use Efficiency of Millet/ Cowpea Intercropping in Niger State, Nigeria. 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa.

Irz, Xavier, Lin, Lin, Thirtle, Colin, & Wiggins, Steve. (2001). Agricultural Productivity Growth and Poverty Alleviation. Development Policy Review, 19(4), 449-466. doi: 10.1111/1467-7679.00144

Kaiser, Harry M. (1988). Relative Efficiencies of Size and Implications for Land Redistribution Programs in the Dominican Republic. *Applied Agricultural Research 3 (3):144–52.*

Kelly, V.A., (2006). Factors Affecting the Demand for Fertiliser in Sub-Saharan Africa. *Agriculture and Rural Development Discussion Paper 23*. The WorldBank. Washington DC

Kern, M., and Paulson. N. (2011). Profitability and Farm Size on Grain Farms in Illinois. Retrieved from http://farmdocdaily.illinois.edu/2011/05/profitability-and-farm-size-on.html

KhawarJabran, Zahid Ata and Muhammad Farooq, (2007). Maize: Cereal with a Variety of Uses. DAWN–Business.http://wwwdawn.com/2007/03/12/ebr5.htm

Lapple D (2010). Adoption and Abandonment of Organic Farming: An Empirical Investigation of the Irish Drystock Sector. J. Agric. Econ. 61(3):697-714.

Liebenberg, F. and Pardey, P.G. (2010). South Africa Agricultural Production and Productivity Patterns. The Shifting Patterns of Agricultural Production and

Productivity Worldwide. The Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames, Iowa, 2010.

Ludena, C.E, Hertel T.W., Preckel, P.V., Foster, K and Nin, A. (2007). Productivity growth in crop, ruminant and non-ruminant production: Measurement and forecasts. *Agricultural Economics 37(2007) 1-17*

MAAIF, (2010). *Agriculture for Food and Income Security: Agricultural Sector Development Strategy and Investment Plan 2010/11 – 2014/15. MAAIF,* Entebbe,Uganda.

McDonal J. (2008). Using least squares and Tobit in second stage DEA efficiency analysis. *European Journal of Operational Research 197,* 792-798.

Meeusen W, van den Broeck J. (1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. International Economic Review 18: 435-44.

Mellor, J. (1999). Faster, More Equitable Growth – The Relation between Growth in Agriculture and Poverty Reduction Agricultural Policy Development Project (Research Report No. 4). Washington, D.C.: United States Agency for International Development. Retrieved from http://www.abtassociates.com/reports/19998977199472.pdf

Minot, N, Epprecht, M., Tran,Thi Tran Anh and LeQuangTrung (2006). Income Diversification and Poverty in the Northern Uplands Vietnam. Research Report No.145 IFPRI Washington DC.

Mishra AK., El-OstaHS., and Steele CJ (1999). Factors Affecting the Profitability of Limited Resource and Other Small Farms. Retrieved from http://naldc.nal.usda.gov/catalog/39009

NAERLS/FDAE (2014), Agricultural Performance Wet Season in Nigeria Survey of 2014 National Report. Federal Ministry of Agriculture and Rural Development, Ahmadu Bello University, Zaria and Federal Department of Agriculture and Extension. 2408-7459. Pp 206

National Bureau of Statistic -NBS (2010). The Review of the Nigerian Economy 2010 Edition

Nordhaug, Kristen (1996). State and U.S. Hegemony in Taiwan's Economic Transformation,unpublished PhD, International Development Studies, Roskilde University Centre andCentre for Development and the Environment, University of Oslo.

Nto P. O.O, Igberi C. O and Mbanasor J.A (2012).Determinants of Productivity among Manufacturing Firms in South-Eastern Nigeria: Cobb-Douglas Stochastic Frontier Production Function Approach

OECD, (1998). DAC Source Book on Approaches and Concepts Linked to Gender and Equality. OECD. Paris.

OECD, (2001). The OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity

Ogundari K. and Aladejimokun O. A (2006). Resource-use and Technical Efficiency of Small Holder Cocoa Producers in Ondo State, *Nigeria; A Stochastic Frontier Analysis, Agricultural Journal* Vol. 1 No. 4; Medwell Online. 2006

Ogunsumi LO, Ewuola SO, Daramola AG (2005). "Socio-Economic Impact Assessment of Maize Production Technology on Farmers' Welfare in South West, Nigeria." J. Central Eur. Agric., 6 (1):15-26.

Ojo S. O. (2000). Factor productivity in maize production in Ondo State, *Nigeria Applied Tropical Agriculture* V11:57-63

Ojo,S.O and Ajibefun, I.A. (2000). Effect of Training on Labour Productivity and Efficiency in oil palm Production in Ondo State, Nigeria. *Journal of Sustainable Agriculture and Environment, 2: 275-279*

Okoye, B. C, Okoye, A. C. Asumugha, G. N., Dimelu, M. U. and Agbaeze, C. C. (2009). Determinants of gender productivity among small-holder cocoyam farmers in Nsukka Agricultural Zone of Enugu State, Nigeria. Nigerian Journal of Rural Sociology (in press) vol. 9(1).

Olukosi,J.O and Erhabor,P.O.(1988). Introduction to Farm Management Economics: Principles and Applications. Zaria AGTAB Publishers Ltd.

Olujenyo FO (2008). The Determinants of Agricultural Production and Profitability in Akoko Land, Ondo-State,Nigeria.Retrieved from http://www.thefreelibrary.com/The+determinants+of+agricultural+production+and+profitability+in...-a0182288515

Onuk E. G., Ogara I. M., Yahaya H and Nannim N (2010). Economic Analysis of Maize Production in Mangu Local Government Area of Plateau State, Nigeria.*PAT June, 2010; 6 (1): 1-11 ISSN: 0794-5213 pp 2*

Onje, S. O. (2003). Introduction to Cooperative Studies. Lokoja: Howard Publishers. Pp 68.

Onyenweaku. C.E. Nwachuku. , I.N and. Opara .T.C (2010). Productivity growth in food crop production in Imo State, Nigeria. *African Crop Science Journal, 18(.3)*, 2010, 89-95

Onyenweaku, C. E. and Nwaru, I. C. (2005). Application of a stochastic frontier production function to the measurement of technical efficiency in food crop production in Imo state, Nigeria. *Nigerian Agric Journal* 36: 1-10

Osagie AU, Eka OU (1998): Nutritional Quality of Plant Foods.Post-Harvest Research Unit, University of Benin, Benin pp.34 – 41.

Oyakhilomen O., Omadachi, U.O. and. Zibah R.G (2012): Assessment of the growth of maize production in the Pre-SAP, SAP and Post-SAP Periods in Nigeria: Lesson for sustainable rural economy. *Journal of Sustainable Development in Africa. 4(5),* 2012, 18-24

Oyewol O (2009): Determinants of Maize Production among Maize Farmers in Ogbomoso South Local Government in Oyo State, Nigeria. Agric. J. 4(3):144-49

.

Parikh, A. and K. Shah, (1995). "Measurement of Technical Efficiency in the North-West Province of Paskitan", *Journal of Agricultural Economic*s, no.45, pp 133-137.

Plumley G.O and Hornbaker R.H (1991). Financial Management Characteristics of Successful Farm Firms. Agricultural Finance Review 51: 9-20.

Purseglove JW (1992). Tropical Crops: Monocotyledons Longman Scientific and Technical, New. York. Pp.300 – 305

Rafiee H., Zangeneh M. and Peykani G.H. (2012). Total factor productivity of corn production in Iran. Scientific Information Data based (SID) 2012

RMRDC (2004). Maize. Report on Survey of Selected Agricultural raw Materials in Nigeria. Abuja: RMRDC

Saito, K. A, *et al*. (1994). Raising the productivity of women farmers in sub-saharan Africa. World Bank discussion paper no.230. Africa Technical Department Series. Pp 20 – 28

SehgalandS. H. and Sharma. S.K, (2011). Total factor productivity of manufacturing sector in India: A regional analysis for the State of Haryana. *Int. J. Manag. Bus. Res., 1(.4),* 2011, 241-256

Seyoum, E. T, G. E. Battese and E. M. Fleming, (1998). Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia: A Study of Farmers within and Outside the Sasakawa-Global 2000 Project. *Agricultural Economics* (19): 341-348.

Shafiq, M. and T. Rehman, (2000). The Extent of Resource use Inefficiencies in Cotton Production in Pakistan‟ s Punjab: An Application of Data Envelopment Analysis. *Agricultural Economics. Vol 22, pp 321-330.*

ShamsudeenAbdulai, Paul K. Nkegbe and Samuel A. Donkoh (2013). Technical

Efficiency of maize production in Northern Ghana. *African Journal of Agricultural Research, Vol. 8(43), pp. 5251-5259, 7 November, 2013*.

Sharma K.R.,P. Leung and H.M. Zaleskib. 1999). Technical, Allocative and Economic Efficiencies in Swine Production in Hawaii: A Comparison of Parametric and Nonparametric Approaches. *Agricultural. Economics. 20 (I), 23-35.*

Simonyan, J.B, Olukosi, J.O and Omolehin, R.A. (2010). Socio-Economic Determinants of Farmers Participation in Fadama II Project in Kaduna State, Nigeria. Journal of Food and Fibre Production. Vol 3(1):592-601.

Susan Chiona (2011). Technical and Allocative Efficiency of Smallholder Maize Farmers in Zambia. A thesis submitted to the University of Zambia in partial fulfillment of the requirements of the degree of Master of Science in Agricultural Economics. The University of Zambia Lusaka, 2011.

Taiwo B. A, Omolehin, R. A. and Ibrahim U (2011). Efficiency of Resource Use in Hybrid and Open-Pollinated Maize Production in Giwa LGA of Kaduna State, Nigeria. *American Journal of Experimental Agriculture1 (3): 86-95, 2011*.

Thirtle, C, Lin, L, &Piesse, J.(2003). The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America. World Development, 31(12), 1959-1975. doi: 10.1016/ j.worlddev.2003.07.001.

Thirtle, C., Irz, X., Lin, Lin, Mckenzie-hill, V., & Wiggins, Steve. (2001). Relationship between changes in agricultural productivity and the incidence of poverty in developing countries (Report No. 7946). London: Department for International Development.

Thomas, D. (1990). Intra-household Resource Allocation: An Inferential Approach. *Journal of Human Resources* 25: 635–664.

Timmer, P. (1995). Getting agriculture moving: Do markets provide the right signals? Food Policy 20(5): 455–472. Udry, C. Forthcoming. The economics of agriculture in Africa: Notes toward a research program. World Development. Retrieved fromhttp://www.econ.yale.edu/~cru2//pdf/agdevmombasa2009paperc.pdf

Timmer, C. Peter (1997). How well do the Poor Connect to the Growth Process@.CAER Discussion Paper No. 178. Harvard Institute for International Development (HIID), Cambridge, MA.

Ugbabe, OO, Ahmed, B, Manyong, VM, Olukosi, JO & Yusuf, O, (2007). Economic analysis of balanced nutrient management technologies for maize production in Kaduna State, Nigeria. Journal of Applied Sciences 7(1), 132–6.

USAID/MARKETS (2010). Improved Package Practice for Maize Production: A production Manual for Agricultural Extension Workers in Nigeria.

USAID/MARKETS (2012). The Evaluation Report for Maximizing Agriculture Revenue and Key Enterprises in Targeted Sites (MARKETS)

USDA-United States Department of Agriculture (2012). Census of Agriculture

Von Braun, J. and Kennedy. E., (Eds.), (1994). *Agricultural Commercialization, Economic Development, and Nutrition.* Published for IFPRI by Johns Hopkins University Press,

Wang H.J. (2002). Heteroscedasticity and Non-Monotonic Efficiency Effects of a Stochastic Frontier Model. Journal of Productivity Analysis 18: 241-253. 28[33]

Wang HJ. (2003). A Stochastic Frontier Analysis of Financing Constraints on Investment: The Case of Financial Liberalization in Taiwan. Journal of Business and Economic Statistics 21: 406-419. [34] Wang HJ, Schmidt P. 2002. One-Step and Two-S

Wang, W. S., Schmidt, P., 2002**.** One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency Levels**.** Journal of Productivity Analysis, 18, 129–144, 2002 C 2002 Kluwer Academic Publishers. Manufactured in TheNetherlands

Wang, W. S., Schmidt, P., (2008), On the distribution of estimated technicaleffciency in stochastic frontier models. Journal of Econometrics, 148, 36-45.

World Bank, (2007). *World Development Report 2008: Agriculture for Development*. Washington, D.C.

Yörük, B.K Zaim O. (2005). Productivity growth in OECD countries: A comparison withMalmquist indices, *Journal of Comparative Economics*,33, pp. 401-420

Zeng, D., Alwang, J., Norton, G. W., Shiferaw, B., &Jaleta, M. (2013). Ex-post impacts of improved maize varieties on poverty in Ethiopia. Washington, DC: IFPRI (Unpublished manuscript).

Zepeda, L. (2001). Agricultural Investment, Production Capacity and Productivity**.** FAO Corporate Document Repository, originated by: Economic and Social Development department, 2001.

Zulu ET (2011). Profitability of Smallholder Cowpea Production in Zambia. Retrieved from http://valuechains.k-state.edu/thesisabstracts.html

APPENDIX: QUESTIONNAIRE FOR THE STUDY

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY. FACULTY OF AGRICULTURE, AHMADU BELLO UNIVERSITY, ZARIA, KADNUNA STATE.
QUESTIONNAIRE

Topic Analysis of Productivity and Livelihood of Farmers: A Case of USAID-MARKETS Maize Project in Kaduna State.

Dear Respondent, Please provide answers to the following questions with utmost sincerity. Every information provided by you will be kept confident. Thank you.

SECTION A: Background Information

1. Name of Farmer___________________________________
2. Local government area: ____________________________________
3. District/ward/village: _______________________________________
4. Age of Farmer --
5. Level of education:
   (a) None [ ]
   (b) Formal [ ]
      (i) Primary education
      (ii) Secondary education
      (iii) Tertiary education
   (c) Adult education
   (d) Others specify ______________________________________
6. Marital status
   (a) Married [ ] (b) single (c) widowed (d) others ________
7. Sex: (a) Male (b) Female
8. Gender of farmer: (a) female (b) male
9. Household size ____
10. How long have you been farming? _______________

Section B.Data on Labour Utilization

1. Source of Labour use for farm activities
   (a) Family labour
   (b) Hired labour

12. **If family Labour was used, fill the table below:**

	Family Labour					
Farm operation/work	**Adult**		**Children**		**Total number of hours worked**	**Total plot size under operation**
	No	**Hr/per Day**	**No**	**Hr/per Day**		
Land preparation						
Fertilizer/manure application						
Weeding						
Harvesting and threshing						

13**. If hired Labour was used, fill the table below:**

	Hired					
Farm operation/work	**Adult**		**Children**		**Total number of hours worked**	**Total plot size under operation**
	No	**Hr/per Day**	**No**	**Hr/per Day**		
Land preparation						
Fertilizer/manure application						
Weeding						
Harvesting and threshing						
Storage						

Land ownership and Utilization

14. How did you acquire land you are presently using for farming?
(a) Inherited (b) Rent (c) Leased (d) Purchased (e)others (specify) ______

15. Total land holdings (hectare)

a. Land currently under cultivation__________

b. Land under fallow _________________________________

c. Land rented out ___________________________________

d. Law rented from other ______________________________

e. Law other uses specify ______________________________

16. Do you have problem in acquiring land for farming?

(a) Yes [ ] (b) No [ ]

17. If yes, what are the problems? ______________________________

____

House Assets

18. Do you have access to the following equipment's and how many do you have?

Types of Asset	Before the project	After the project
Hoes, cutlass, machetes		
Draft horse		
Ox-ploughs		
Tractors and tractor ploughs		
Car		
Bicycle		
Motorcycle		
Television, radio		
Mobile phone		
Others		
Type of roofing		
Wooden Chairs/ tables Upholstery chairs Cane chairs/tables Wooden cupboard		

Cane cupboard Wooden bed Metal bed		
House ownership: Owns house Rents house		
Number of rooms: 1-2 More than 2		
Farmland Ownership: Owns farmland Rents farmland Does not own farmland		
Trading: Trades Does not trade		

19. **General access to inputs**

1. How would you rate your access to the following inputs from 2010 till date?

	Type of inputs	**(a) common source**	**(b) distance from house to regular source (km)**	**(c) cost per unit**	**(d) unit**	**(e) Perception of accessibility[1]**	**(f) other constraints to access[2]**

1.	Fertilizer (i) NPK (ii) Urea (iii) Others						
2.	Herbicides						
3.	Fungicides						
4.	Pesticides						
5.	Manure						
6.	Certified seed						
7.	Seed dressing						
8.	Post- harvest insect control						
9.	Farm equipment						
10.	Others						

[1.] **Perception on accessibility:** 1= Highly accessible, 2= Accessible, 3= Poor accessibility, 4= Not accessible

[2]. **Other constraints:** 1= Too expensive, 2= Not available on time, 3= Quantity sold not enough, 4=High transportation cost, 5= Poor roads or lack transportation equipment, 99= others (Specify)

Inputs use for 2010- 2014 cropping season

20. What is the total cost for land preparation including hired labour?
21. What is the total cost of hired Labour other than land preparation ______________________
22. Quantity of fertilizer/type used ________________________________
23. What is the total value (N) _____________________________________
24. Quantity of organic fertilizer __________________________________
25. What is the total value (N) _____________________________________
26. Quantity of pesticide/insecticide used___________________________
27. What is the total value in (N) __________________________________
28. Quantity of seed(s) used _____________________________________
29. What is the total value (N) _____________________________________
30. **Marketing of Agricultural produce**

Crop	**Quantity harvested 2010-**	2011	2012	2013	**2014**	**Quantity sold**	**Quantity consumed/ or given as gift(please use**	**What type of market did you sell**	**What price did you get for**	**Did you sell individually or collectively**

							producti on units)		**what you sold**	
Maize										

31. Household income and expenditure by Maize farmers

What are major sources of income and what is the income estimate from these sources for the last 12 months?

Income source	**Do you get income from these sources?**	**How regularly do get income from these source**	**What is the estimated amount that you get from these sources in the last 12 month**	**What importance would you gives this source in term on contributing to household income [1]**
i. Sales of maize crop				
ii. Sales of livestock				
iii. Sales of other products e.g. firewood, trees				
iv. Regular employment				
v. Casual employment (agricultural related)				
vi. Casual employment (non-agricultural water)				
vii. Running own business				
viii. Others				
[1]**Level of importance** 1= Highly important, 2= Important, 3= Not too important, 4= Not important				

32. Do you have access to credit? ____

33. What are the sources?

(a) Credit from the bank (b) informal savings/credit group

(c) Money lender (d) government (e) relative (f) friends

34. What is the amount borrowed in the last 12 months? __________________

35. What was your purpose of borrowing?

36. Do you belong to any to any association?

(a) Yes [ ] (b) No [ ]

37. If yes, which of the following association do you belong?

(a) ____

(b) ____
(c) ____
(d) ____
(e) ____
38. Did you derive any benefit for been a member of this association or group? (a) Yes (b) No
39. If yes, what were the benefits?
i. ____
ii. ____
iii. ____
iv. ____
v. ____

39. Which of the following activities did you benefit from under the USAID/MARKETS PROJECT?

Intervention	**Type**	**Accessibility**	**Timeliness**	**Effectiveness**	**Efficiency**	**Satisfaction**
trainings						
Quality seed						
Quality fertilizer						
Linkage to Markets						
Agro-chemicals (pesticide & Herbicides)						
Agricultural machineries						
Others						

40. .Did you obtain grant from the project? (a) Yes (b) No
41. In what form did you obtain grant from USAID/MARKETS Project
(a) Provision of inputs

(b) Marketing services
(c) Provision of storage facilities
(d) Provision of Post- Harvest and Agro-Processing Machines
(e) Others (specify) ____

42. How involved were you in the USAID/MARKETS Maize Project
(a) Very strong (b) strong (c) very weak (d) weak (e) neutral

43. What was your role in the Project? ____

44. Did you continue with the activities of the project after the exit of the project? (a) Yes (b) No

45. Apart from the USAID/MARKETS Maize Project, were you involved in other development Programmes? (a) Yes (b) No

46. If yes, what activities are carried out under this programmes?
____

47. Do you have access to extension information and Agents? (a) Yes (b) No

48 If yes, in the course of the project life span how many extension contacts did you have per year?

49. What are the constraints to effective participation in USAID MARKETS Maize project? (Use a table to list the constraints and rank in terms of severity

50. What are the possible recommendations you would give to enhance the service delivery under the USAID MARKETS Maize project?
____
____