ANALYSIS OF RESOURSE USE EFFICIENCY AND PROFITABILITY OF MAIZE PRODUCTION IN SOME SELECTED AGRICULTURAL ZONES OF KADUNA STATE, NIGERIA

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS

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DECLARATION

I hereby declare that this dissertation titled **"Analysis of Resource Use Efficiency of Maize Production in Some Selected Agricultural Zones of Kaduna State, Nigeria"** was 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 has been acknowledged in the text and a list of references provided.

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CERTIFICATION

This dissertation titled **"Analysis of Resource Use Efficiency of Maize Production in Some Selected Agricultural Zones of Kaduna State, Nigeria"** by **Ayodeji Olubunmi OYE** meets the regulation governing the award of the Degree of Master of Science in Agricultural Economics of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to my beloved wife Dupe and my children Samuel and Philip.

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TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

LIST OF TABLES

Table **Pages**

LIST OF FIGURES

LIST OF APPENDICES

Abstract

The research considered the resource use efficiency and profitability of maize production in Kaduna state. Data collection was collected with a well-structured questionnaire administered on 163 maize farmers selected through purposive and random sampling techniques. The methods of analyses used were descriptive statistics, multiple regression model, marginal productivity, resource use efficiency and gross margin analysis. Results showed that majority 63% fall between age group 27-53 years. This indicated that the farmers were physically strong and mentally alert to face challenges which may face them. On the average the farmers have 25years experience in maize farming. The literacy level of the farmers was on the average (7years). 28% of total maize farmers had no formal education while, 42%, 20% and 10% had primary, secondary and tertiary education respectively. Farming was majorly on subsistence level, as the mean farm size was 1.14 hectares. Maize farming was profitable in the study area with gross margin of ₦121, 784.75. Results showed that farm operation was in stage II of the production function with rate of return to scale estimated as 0.912 and factors of production were efficiently allocated with elasticities that were positive but less than one. All the factors of production are significant and the results further showed that farm size, seed and fertilizer (underutilized) were positively related to output while labour and agrochemicals (overutilized) had negative signs. This study concluded that maize production is a profitable venture in the study area. Higher output can be realized by increasing land, seed and fertilizer and decreasing labour and agrochemicals. Also, increase in the output of maize production could be improved if solutions are found to the identified problems associated with maize production. The study recommends that farmers should increase the use of seed, farm size and fertilizer. Also, government should look into the possibilities of facilitating access to farm lands; review the land use Act Decree and pay attention on land consolidation program in view of the scarcity and fragmentized farm holdings. They could still boost their gross margin by locating better market and/or providing good storage facilities so as to sell in the off season for better profit margin.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In Nigeria, like in most developing countries, the agricultural sector is of primary importance to the economy. At the time of independence in 1960, all the country's dreams hinged solidly on the productivity of agriculture. This is because the sector has some links with some other sectors of the economy. The agricultural sector used to employ 80 percent of the total population but this has declined to 65 percent (Alabi and Esobhawan, 2006). Despite the importance of the oil sector, agriculture still contributes about 41 percent to the gross domestic product (GDP) and provides about 90 percent of the nation's total food requirements (CBN, 2002).

Maize is the second largest cereal crop grown after rice in Nigeria (Akande, 1994). In Nigeria, it is the third most important cereal crop after sorghum and millet (Ojo, 2000). It is a staple food of great socio-economic importance in the Sub-Saharan Africa of which Nigeria is inclusive with per capital kg/year of 40 (FAOSTAT, 2003). It accounts for about 11.2% of grain produced in Nigeria (Lajide *et al.*, 1998; Emeasor *et al.*, 2002). The total land area planted to maize in Nigeria is above 2.5 million hectares, with an estimated yield of about 1.4 metric tonnes per hectare (Agboola and Tijani-Eniola, 1991). In Nigeria, maize is becoming increasingly important as food crop, feed for animals and for various industrial uses. Maize remains an important crop because it has several advantages over other cereals like rice, wheat, millet and sorghum (Yayock *et. al.*, 1988). Maize produces a higher output per unit of labour input and is easiest to cultivate, harvest, store, transport and process (Yayock *et al.*, 1988).

The demand for maize in Nigeria has been on the increase due to the increasing growth in population, income levels, urbanization and associated changes in the family occupational structure (Akanji, 1995). On the contrary, the rate of supply of maize has lagged behind that of demand, leaving a wide gap between demand and supply. The reason according to Roy and Dutt (2000) include agro-ecological, technical and socio-economic constraints. Omojola *et al.* (2006) and Oluwatayo *et al.* (2008) noted that domestic production of food crop has not been able to meet the domestic demand for food. The reason for this is that there are some problems at the micro level, one of which is the relationship between inputs used in production such as seeds, land, labour and capital. The demand for maize as a result of the various domestic uses shows that a domestic demand of 3.5 million metric tonnes outstrips supply production of 2.0 million metric tonnes, hence the increase in its price (Akande, 1994). During the past two decades, the continent has witnessed some relative success stories for maize as the use of new seed and associated technologies have increased smallholder maize production in the continent (Abalu, 2001). Although the increasing trend in total maize production is encouraging, the average yield of 1.2 tonnes/hectare is of great concern to scientists. Theoretical simulation studies show that, under optimum conditions, maize grain yield can be up to 20 tonnes/hectare (Lovenstein *et al.,* 1995). In Nigeria, land area under maize cultivation peaked at 5.4mha in 1994; it has decreased lately to 4.5mha in 2004 Federal Ministry of Agriculture (FMA, 2005). Likely factors responsible for the decrease in the production of maize are because of little or no improved seed grown by farmers and low response to fertilizer by some local varieties. Ogundari *et al.* (2006) noted that high variations in annual domestic production of maize in Nigeria can be ascribed to the decline in both hectarage cultivated and the productivity or yield per hectare. According to Ojo, 2000 price fluctuations, disease and pests, storage facilities and efficiency of resource utilization are the identified causes of low maize production in Nigeria and Ondo State in particular. In view of the high demand for maize and the need for food security, there is a need to study how to raise maize productivity.

1.2 Statement of the Problem

The production potential of presently available varieties is also 5-8 tonnes/hectare, depending on the type of variety whether open pollinated or hybrid (Fakorede *et al.,* 2004). Hybrid maize was introduced on a limited scale in the tropics and the sub-tropical regions, mostly developing countries in the 1960s (Duvick, 1999). Progress in utilizing hybrids was slow at first in most of these developing countries like Nigeria with a few exceptions (Smith *et al.,* 1997). In west and Central Africa in the last two decades, there has been widespread acceptance of improved maize varieties in the savannah. This implies that maize is no longer a backyard crop grown for home consumption but for cash and food. Maize scientists in the West and Central African sub region are, therefore, faced with two formidable challenges:

(i) reduction of the yield production gap between research and farmers' production fields.

(ii) improvement of the yield potential of maize varieties (Fakorede *et al.*, 2001).

The supply of maize has also not been able to meet the demand for the crop despite the adoption of improved packages for maize production (Babatunde *et al.,* 2008). For example, improved varieties, recommended planting date, recommended fertilizer rate, recommended planting depth and spacing. Despite the introduction of hybrid maize the objectives of sufficiency and security in maize production has still not been achieved as there is still a significant drop in the output of maize (Ayinde *et al.*, 2011). According to Ojo (2000), price fluctuations, diseases and pests, lack of storage facilities, and inefficiency of resource utilization have been identified as causes of low maize production in Nigeria. Given that the rate of population growth in Nigeria is increasing rapidly, and in order to meet the demand of the growing population in maize consumption, there must be an increase in maize production (Iken and Amusa, 2004).

Since the present yield of maize has not measured up to its potential yield of 5-8tonnes/ha, it is pertinent to ascertain if the resources are efficiently utilized. This study attempts to evaluate the resource use efficiency and profitability of maize production in some selected agricultural zones of Kaduna state. The following research questions were therefore raised:

(i) what are the socioeconomic characteristics of the maize farmers?

(ii) what is the relationship between the socioeconomic characteristics of maize farmers and their maize output?

(iii) what is the technical relationship between inputs and output in maize production?

(iv) what is the resource use efficiency in maize production?

(v) what are the costs and return associated with maize production?

(vi) what are the constraints associated with maize production in the study area?

1.3 Objectives of the Study

The broad objective of the study is to evaluate the resource use efficiency and profitability of maize production in Kaduna state. The specific objectives of the study are to:

(i) describe the socioeconomic characteristics of farmers involved in maize production,

(ii) determine the relationship between the socio-economic characteristics of the maize farmers and their output,

(iii) estimate the technical relationship between inputs and output in maize production,

(iv) determine the resource use efficiency in maize production,

(v) determine the costs and return associated with maize production in the study area, and

(vi) describe the constraints associated with maize production in the study area.

1.4 Research Hypothesis

The hypothesis tested in this study was

(i) Maize production is not profitable.

1.5 Justification of the Study

Maize is among the few staple grain crops in sub-Saharan Africa for which there presently exists a fairly dependable improved technology. The presence of maize in the food basket in many West African countries has also been increasing steadily during the last two decades (Abalu, 2001). Thus, increasing maize productivity in Africa on a sustained and sustainable basis will contribute to achieving continent’s food security and poverty alleviation in the next millennium.

The challenge of meeting the demand for maize which are highly consumed by people, animals and utilized by industries depends on the knowledge of how efficient and effective the utilization of human and material resources at the farmers’ disposal are. Unless estimates of resource use efficiencies by farmers and the extent to which technical and socio-economic factors are put into consideration, evaluations made at all times remain at best an over simplification.

Therefore the findings of this study will provide some empirical data on resource-use efficiencies of maize in Kaduna state. The information from this study will also serve as a good basis for rational decisions on food production by farmers, government and other agencies directly involved in production of maize or related crops. The study will also provide useful information on profitability of maize production in the study area. It is hoped that this work will be of further assistance to other researchers who will identify areas for prioritization of research and development programmes for sustained and sustainable increase in maize productivity for the ultimate achievement of food security and alleviation of poverty in Nigeria and the African continent.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and Geographic Distribution of Maize

Maize was domesticated in southern Mexico around 4000 BC. Early civilizations of the Americas depended on maize cultivation. When the Europeans arrived in the Americas, maize had already spread from Chile to Canada. Maize was reported for the first time in West Africa in 1498, six years after Columbus discovered the West Indies. The Portuguese brought floury grain types from Central and South America to Sao Tome, from where they spread to West African coast. Portuguese and Arab traders introduced Caribbean flint maize types into East Africa in the mid-1500s, from where they spread to southern Africa. Through the trans-Saharan trade, the Arabs introduced the flinty types that had been brought to northern Africa into sub-Saharan Africa. The flinty types still predominate in the northern parts of West Africa while the floury types prevail in the southern parts, with some variation from this pattern. Maize had become a staple food in East and Southern Africa by 1930s (Brink and Belay, 2006).

Maize has an extremely wide distribution. It is grown from latitude 58^0 N in Canada and Russia, throughout the tropics, to latitude 42^o S in New Zealand and South America, and in areas below sea level in the Caspian Plain up to areas as high as 3800m in Bolivia and Peru. It is grown in all countries of Africa, from the coast through savanna regions to the semi-arid regions of West Africa, and from sea level to the mid- and high-altitudes of East and central Africa (Brink and Belay, 2006).

2.2 Trend of Maize Production in Nigeria (1980-2012)

The growing importance of maize in the Nigerian economy is attributed to its commercial and food values (Saidu, 2012). There has been a consistent increase in production of the crop in Nigeria (Table 2.1). The Table shows that the output of maize increased from 612,000 tonnes to 7,019,500 tonnes in between 1980 and 2003. This is more than a 1000% increase. The contribution of maize to total grains produced in Nigeria increased from 7,026, 000 tonnes (8.7%) in 1980 to about 32,497,400(22%) in 2003. The table also shows that the price of maize increased from ₦2, 500 per tonne in 1980 to ₦36, 000 per tonne in

2003. This increase in price is more than 14 times. Currently, a tonne of maize is ₦50, 000.00. All these data emphasize the importance of maize in the diet and economy of Nigeria (Saidu, 2012).

In trend projections of consumption and production of major foods crops in sub-Saharan Africa to the year 2000 (Von Braun, 1991), production was put at 110 million metric tons while consumption was put at 161 million metric tons, creating a deficit of 51 million metric tons. Specifically for West Africa, production was put at 42 million metric tons while consumption was put at 76 million metric tons, creating a deficit of 34 million metric tonnes. Oritiz (2003) submitted that if current trends continue, there will be approximately 300 million of malnourished people or 32percent of the total population in 2010, which will convert sub-Saharan Africa to being the region with the highest number of inhabitants who are chronically malnourished. According to Ndaeyo (2007), this lopsided relationship between food demand and supply had earlier compelled the Food and Agricultural organization of United Nations to opine that as the world population is increasing by approximately 1 million every four hours, we may have more than 3000 million people to feed by the year 2025. If they are to be fed adequately, the present food production level will have to be doubled and other strategies/approaches revised and/or encouraged. The significant imbalance between food production and the expanding population has resulted in an ever-increasing demand for agricultural products. It has also placed a serious stress on the marketing systems (Ojo and Imoudu, 2000).

Table 2.1: The area planted, total grain production and percentage contribution of maize to total grain production in Nigeria (1980 – 2012)

Year	**Area planted to maize (Hectares)**	**Maize (Metric ton)**	**Total grain (Metric ton)**	**% of maize**	**Price of maize (₦/tonne)**	**CPI 1985 = 1**
1980	95600	612.0	7026.0	8.7	2500	0.41
1981	982200	720.0	7588.0	9.5	3000	0.502
1982	130600	766.0	8108.0	9.4	3000	0.546
1983	148800	594.0	7465.0	8.0	3000	0.673
1984	11200	2,058.0	10719.0	19.2	3000	0.962
1985	211600	1,190.0	10765.0	11.1	3000	1
1986	211700	1,336.0	12149.0	11.0	7000	1.1
1987	211760	4,612.0	15714.0	29.3	7000	1.95
1988	211740	5,268.0	19269.0	27.3	10000	2.98
1989	211740	5,008.0	22432.0	22.3	14000	3.08
1990	211740	5,768.0	19725.0	29.2	3000	3.459
1991	263000	5,810.0	20464.0	28.4	4000	5.068
1992	676000	5,840.0	21590.0	27.1	6000	8.002
1993	693200	6,290.0	21780.0	28.9	5500	11.746
1994	925400	6,902.0	22041.0	31.3	1300	20.177
1995	898600	6,931.0	24776.0	28.0	15500	26.465
1996	912000	6,217.0	24872.0	25.0	20000	28.556
1997	905300	6,285.0	25798.0	24.4	25000	30.565
1998	908660	6,435.0	27082.0	23.8	30000	32.465
1999	908865	6,515.0	27450.0	23.7	35000	34.225
2000	928530	6,491.0	31554.0	20.6	35000	36.177
2001	935300	6,592.0	29988.0	22.0	35000	37.175
2002	940000	6,698.0	30755.0	21.8	35000	39.445
2003	940000	7,019.5	32497.4	21.6	36000	40.02
2004	3400000	6500.0	24321.0	26.7	36000	94.9
2005	4000000	7000.0	26031.0	26.9	38000	99.73
2006	4700000	7800.0	28864.0	27.0	38200	105.36
2007	4000000	6500.0	27171.0	23.9	28600	96.17
2008	4700000	7970.0	30209.0	26.4	39000	103.14
2009	4900000	8950.0	21267.6	42.1	40000	88.36
2010	5000000	8800.0	24656.6	35.7	40500	100.20
2011	5150000	9250.0	22165.7	41.7	40900	100.63
2012	4160000	7630.0	26333.0	29.0	42000	106.23
Average	561397.29	4664.90	20066.97	21.32	14729.17	15.28

Source: Central Bank of Nigeria (2012)
CPI: Consumer price index

2.3 Uses of Maize

Maize grain is used for three main purposes: as a staple food, as feed for livestock and poultry, and as a raw material for many industrial products. In tropical nearly all maize grain is used for human food, prepared and consumed in many ways. It may be eaten fresh on the cob and simply roasted, but the grain is usually ground and the meal is boiled into porridge or fermented into beer. In tropical Africa maize is mainly consumed as thick porridge. A thin porridge (Ogi in Nigeria, koko in Ghana, uji' in East Africa) is also commonly eaten especially as weaning food. In Ethiopia local beer ('tella') and spiritual liquor ('arakie') are prepared from maize grain malt. Unripe cobs are consumed as vegetable or green maize, boiled or roasted. Maize also has a range of uses in traditional African medicine and the grain can be used for popcorn, a popular snack (Brink and Belay, 2006). Maize alone contributes about 80% of poultry feed and this has a great implication for protein intake in Nigeria (FAO, 2008).

The main industrial products obtained from maize are breakfast products such as cornflakes, starch, sugar and oil. The main product is starch that is used for human consumption or made into syrup, alcohol, but also among others as laundry starch and as a source material for many chemical products (Brink and Belay, 2006). In addition, maize is an important raw material for a number of agro – based industries, which are rapidly increasing in number and scope in the country (Tauna, 1999).

2.4 Socio-economic characteristics influencing agricultural productivity

Several authors have investigated the relationship between efficiency and various socio-economic variables (Okoruwa *et al.,* 2006, Bravo-Ureta and Pinheiro, 1997). One approach is to compute correlation coefficient to conduct other simple non-parametric analysis. The second way, usually referred to as a two-step procedure is to first measure farm level efficiency and then, to estimate a regression model where efficiency is expressed as a function of socio-economic attributes. While Okoruwa *et al.* (2006) observed that socio-economic attributes have a roundabout effect on production and hence should be incorporated into the analysis indirectly, Forsund *et al.* (1980) opines that inefficiency is typically determined by factors (socio-economic) associated with farm management practices. Despite these points of view, it is still useful to review the possible relationship between efficiency and socio-economic characteristics.

It is generally, believed that the farming population in sub Saharan Africa is declining Upton (1996). This is based on the fact that young school leavers do not want to go to the farms. They prefer going to increase the population in the urban areas in search of white collar jobs. In their study of the socio-economic characteristics and adoption trend of artisan fishers of Akwa Ibom State in Nigeria, Udoh and Nyienakuna (2008) observed that, many fishers were around fifty years old. As a result, they could not withstand problems in fishing operation.

Gender is an important variable in agricultural productivity in terms of property acquisition. For example, in some African societies, assets like land and machines are mostly inherited by the male descendants (Udoh and Nyienakuna, 2008). In their study of resource use efficiency of maize farmers in rural Nigeria, Oluwatayo *et al.* (2008) found out that only 8.5% of women in their study areas owned farms. This is in accordance with the tradition of the area that prohibits women from owning farms when the husband is alive.

Tropical farm household systems are relatively complex, involving both production and consumption. The allocation of productive resources and the choice of activities are the result of decisions made by members of the farm household. It is assumed that farmers are rational in following certain meaningful objectives. According to Upton (1996), farming communities from tropical farm households have shown that farmers have a consistent set of objectives which guide their objectives. The single most important determinant of farm size is the pool of household labour resources available for agricultural work. Hence, within the traditional sector, there is considerable variation around the average farm size of 1.5 hectares or less. In an empirical study, a positive relationship in household size implies that household labour has the potential of enhancing productivity and efficiency of resource use in production. Farm households in Africa are characterized by a high number of members and rather with a high dependency ratio (Udoh and Nyienakuna, 2008). Upton (1996) believes that dependency on hand labour is subject to constant returns to scale. As such, there may be advantages in having a large family which would be reflected in increasing returns to scale and decreasing average cost. However, a substantial amount of output will be needed for household consumption and therefore reduction in overall household income.

The bedrock of agricultural development is education. Literate farmers can increase production through the use of improved methods by reading extension leaflets. Onyenweaku and Ohiajianya (2005) found a positive relationship between farming experience and technical efficiency in rice production in their study of swamp and upland rice farms in south eastern Nigeria. Education helps the farmers to be able to choose a particular crop enterprise that will give them financial rewards. Azam and Zoebisch (2009) studied the socio-economic and land use factors involved in cropping system selection in Northeast Thailand. The studies showed that the higher educated groups are going for more market oriented crops. Amaza and Maurice (2005) carried out a study which had as objective, the identification of factors that influence technical efficiency in rice-based production systems in Nigeria. They concluded that there were wide efficiency differentials among farmers in the study area and that rice-based crop production could be increased by 20% through better use of resources. Farmer's specific factors such as education and farming experience were found to contribute positively and significantly to farmers' efficiency levels in rice–based production. They concluded that technical efficiency of the farmers could be increased through intensive use of available resources, especially land, fertilizer, water and seeds given the current level of technology. The findings agree with that of Ojo, (2002) in his study of factor productivity of egg production in Osun state. He found that there will be a significant increase in eggs if more factors such as number of birds, operating expenses and years of schooling were increased.

Farming experience is the act of gaining knowledge through constant practices of skill, which brings about specialisation. Experienced farmers have the ability to use modern farming gears and read the agricultural environment in terms of when to plant and to market the produce. In his study of socio-economic determinants of output and profit levels of small holder rice production systems in Abia State, Ezeh (2006) asserts that experience enhances more efficient use of scarce resources by small farm holders. Udoh and Nsikak-

Abasi (2007) used the stochastic production frontier in estimating the technical efficiency of cassava based farms in Akwa- Ibom stae of Nigeria. The studies showed that the development of a particular knowledge or specialization was by experience. This eventually led to improvement in production technique and higher technical efficiency level.

Membership to farmers' association has an influence on the level of efficiency of the farmer. Farmers who are members of farmers' association can be very valuable for small scale operations because it facilitates access to markets and increases the income level of the farmer as well as technical assistance. In their comparative analysis of technical efficiency in swamp and upland rice, Idiong *et al*., (2006) observes that membership of association was positively relate to efficiency and thus results to increase in output.

Despite the high rate of savings achieved by some farmers, there is little doubt that credit can improve the productivity, incomes and welfare of rural people. Short term credit may alleviate seasonal needs for working capital, or the problems arising from crop failure, sickness within the family or unexpected social commitment. Credit may be used for production or consumption though some argue that it should be restricted to production Upton (1996). The distinction is really very hard to draw since funds can be moved around between uses. Credit provided for productive purposes may simply allow the family to spend more of their own savings or equity on consumption. However, credits which are already invested in the farm or in non agricultural activities cannot be moved around uses. The importance of credit in agricultural productivity cannot be over-emphasized. It increases the ability of poor households with little or no savings to acquire inputs. Easing capital constraints through the granting of credits reduces the opportunity cost of capital intensive assets relative to family labour. This encourages adoption of labour saving high yielding technology and therefore, increasing land labour productivity. According to Iheke (2008), credit availability is a crucial factor in encouraging development, particularly in most African countries.

Well organized extension contacts enhance the acquisition and utilization of information on improved technology by the farmers as well as their innovativeness. Interacting with extension workers affords the farmers the opportunity of sharing information on modern agricultural practices. Iheke (2008) carried out a study on technical efficiency of cassava farmers in south eastern Nigeria. He found out that extension contact was negative but not significant. He was of the view that agricultural extension, and farmers' education programmes are important to improving productivity.

2.5 Input and Output Relations in Agricultural Production

The production process is one whereby some goods and services, called inputs are transformed into other goods and services, called output. In agriculture, the physical inputs with which we deal are usually land, labour, capital management, and of recent, water resources. These resources can be organized into a farm-firm or a producing unit, whose ultimate objectives may be profit maximization, or the maximization of satisfaction, or a combination of all of these motives of enterprises (Olayide and Heady, 1982). In agriculture just like in any other industry, inputs are used to produce output from which income is derived. Thus, non – input availability leads to a vicious circle of poverty where low input leads to low output and low income. Kupfuma (1993) shows that access to require inputs will affect the level of output, both in quality and quantity. He also revealed that farmers with good access to markets, better farm equipment and who use credit are most likely to use fertilizer to boost their production. Onwueme & Sinha (1991) showed that maize has a high demand for nitrogen. The statement of "No fertilizer, no maize" is a common saying of maize farmers in the savannah region of Nigeria which stems from practical experience whereby farmers harvest little or nothing if nitrogenous fertilizer is not applied on maize. Nyako (1999) in his study revealed that there is soil fertility depletion which needs to be regenerated through the use of chemical fertilizers to increase the amount of nutrient up take by plants. Ingawa (1999), further opined that fertilizer is second to labour in terms of the total cost of production. Bayene (1993), observed that the use of fertilizer by peasant farmers is generally less than their demand, despite the knowledge that it is the key input especially in the production of maize. He added that in Nigeria, upward adjustments in foreign exchange have resulted to dramatic increase in the prices of farm inputs such as fertilizer and other agro chemicals. Studies on the relationship between access to agricultural inputs on farm productivity indicated that fertilizer has often been a limiting factor in the production of maize due to inadequate availability or high price (Beyene, 1993; Kupfuma, 1993; Dlamini, 1993), in their separate studies found that for most farmers, fertilizer is a determining factor of whether to produce maize at all and the total area to put under maize cultivation. Thus, to enhance effective agricultural production, agricultural policies must focus on the effort to make farm inputs available to farmers at the right time and at subsidised rate.

Therefore, there is the need for quantitative analysis of the contribution of the inputs and the efficiency of their use by the farmer (Esoghue and Ekong 1991). Because the general welfare of the population e.g the supply of basic food, both for farm and non – farm families depends on the efficiency of the subsistence sector of agriculture, determining the efficiency status of farmers is very important for policy purposes. Efficiency measurement is very important because it is a factor of productivity growth (Bedassa and Krishnamoorthy, 1997). Hence it is very important for policy purpose (Habibullah and Ismaíl, 1994). Estimates on the extent of inefficiency can help decide whether to improve efficiency or develop new technologies to raise agricultural productivity (Habibullah and Ismail, 1994). They further added that the main concern of any economic activity is to achieve the maximum possible efficiency by transforming a set of given inputs to products. Commenting on the importance of measuring efficiency, Makinde (2000) holds that it is the first step in a process that might lead to substantial resource savings, which have important implications for welfare and food security. Because efficient farmers are more likely to generate higher output and income and they will have a better chance of surviving period of food stress.

The technical relationship between inputs and outputs in any production process is usually expressed as a production function (Olayide and Heady, 1982). In mathematical terms, this function is assumed to be continuous and differentiable, which makes it easy to estimate the rates of return. The production function stipulates the technical relationship between inputs and output in any production schema or process. In mathematical terms, this function is assumed to be continuous and differentiable. Its differentiability enables us to establish the rates of return. The first of these returns is the case of constant returns. This states that each additional unit of input results in a constant rate of increase in output. The second of these rates of return is that of increasing returns this state that each additional unit of productive resources results in a larger increase in product than the preceding unit. The last of the three returns is the case of decreasing returns. This is the case in which each additional unit of input results in a smaller increase in product than the preceding unit. Production function takes many forms and has become one of the most widely used tools in economic analysis. These different functional forms include Cobb Douglas, linear, quadratic, square root, semi-log and exponential. However, the Cobb Douglas functional form is commonly used for its simplicity and flexibility, coupled with the empirical support it has received from data for various industries and countries (Desai, 1976). The choice of any functional form will depend on its desirable characteristics. The purpose of production function is to identify and estimate how variable inputs employed explain variability in output. The explicit forms of some of these functions are:

Linear: $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 +$ ---------$b_nX_n + U$------------------------1

Semi-log: $Y = \ln b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 +$ -----$b_n\ln X_n + U$-----------2

Cobb-Douglas: $Y = b_0X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_n^{bn}U$--3

When linearized, the Cobb-Douglas is expressed as:

$\ln Y = \ln b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 +$ -------$b_n\ln X_n + U$--------------------4

Quadratic: $Y = a + b_1X_1 + b_2X_2 - b_3X^2_1 + b_4X^2_2 + b_5X_1X_2$------------------------------5

Exponential: $Y = ae^{b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5}$ ---6

2.6 Use of Production Function Concept

The production function is a concept in physical and biological sciences whose refinements have grown out of the economic science for five main reasons (Olayide and Haedy, 1982).

(i) the nature of the production function is important in economic development and in determining the extent to which national products can be increased from given resource stocks.

(ii) the magnitude of the production coefficients serve as the base for determining optimum pattern of intrastate, interregional and international trade.

(iii) the production concept is basic to certain theories in the functional distribution of income. In both the developed and the developing countries, the issues of the functional distribution of income have assumed prominence in the recent years, and the use of the production function concept in throwing light on the issues cannot be over-emphasized.

(iv) the production function provides half of one of two general categories of data that we need in determining or specifying the use of resources, and the pattern of outputs which maximize farm-firm profits.

(v) the algebraic nature of supply functions rests, in large part, on the nature of the production function.

2.7 Limitations of Production Functions

The question has been frequently raised as to relative advantages and disadvantages of describing production relationships in terms of mathematical functions found in farm, industry and process functions.

Usually, production functions derived for enterprises, farm, plant or industry are used as a tool for planning production programs in those areas. The usefulness of such functions will, to a large extent, depend on the accuracy with which the relationships specified in them are described, most especially with respect to the inputs or variables. Such an accurate picture will also depend on the accuracy of the data employed in the empirical analysis. Furthermore, it is difficult to find situations in practice where the production functions are so very well established as to permit a clear and precise definition of the point of optimal output. Empirical production functions have not been able to take account of the innumerable factors that affect production, since most of these multitudinous factors are not quantifiable, whilst knowledge of many biological factors is still too scanty to permit definitive interrelationship. This situation is true of fertilizer studies, meat and milk production functions and many others (Olayide and Heady, 1982).

The real test of a production function estimate is, therefore, its value in interpreting the economic implications of inadequate and usually unrepresentative data. Thus the conditions under which a fitted function will serve as an error-free guide to the economic allocation of resources are extremely rare. To be a useful guide, the estimated functions have the following features. It must

(i) account for the essential inputs or factors affecting the production process,

(ii) cover the relevant range of input and output levels required,

(iii) specify the production parameters and estimate the magnitude of the errors of the estimate,

(iv) take account of the relevant prices with reasonable degree of certainty,

(v) assess fairly accurately the level of inputs that are not under the operator's control, and

(vi) make available functions for other forms of resource use.

Apart from the sixth feature which is probably superfluous, most of these features can be fairly satisfactorily met in a well-designed and well conducted research, whose data will be fitted to production function estimates. Price ranges, selected from points within the floor and ceiling over time, can be used to estimate/minimize risks and uncertainties reflected in price variability. The greatest danger in using production function lies in its employment as the basis for planning similar farms, since no two farms are exactly alike in resource utilization, technology and management (Olayide and Heady, 1982).

2.8 Resource Productivity and Efficiency

2.8.1 Resource productivity

Agricultural productivity may be defined as the index of the ratio of the value of total farm output to the value of the total inputs used in farm production. Since one of the chief objectives of any society is the attainment of an optimally high level of living with a given amount of effort, any increase in productivity of resources employed in farm production amounts to progress. Increases in agricultural productivity will contribute to the well-being of the economy as a whole. Aggregate measures of productivity in production economics analyses will add to the sum of our knowledge by (a) serving as barometers of economic progress, (b) serving as guides to adjustment of resources, (c) providing a framework for formulating and evaluating policy and (d) indicating problem areas that need further research. The final objective of our interest in productivity should be to find ways of increasing output per unit of input, and of attaining desirable inter-firm, intra-firm and inter-sector transfers of production resources, thereby providing the means for raising our economic level of living (Olayide and Heady, 1982).

The input-output process of farm production is important in at least four major problem areas. These are the distribution of income, the allocation of resources, the relation between stocks and flows, and the measurement of efficiency or productivity. In the productivity concept, a meaningful assessment will depend upon a clear and precise definition of input and output in such a way that their movements over time are not equal. We should also seek to determine which inputs and outputs are consistent with the particular productivity concept in question. Thus, we are faced with separate and distinct conditions when we direct our efforts, to say, the measurement of labour or capital, or land or water or management productivity. In other words, resource productivity is definable in terms of individual resource inputs or in terms of a combination of them. Thus we shall define labour productivity as the ratio of total output to labour inputs. Similarly, "land", "capital", "water" and "management" productivities can each be defined as the ratio of total output to inputs of land, capital, water and management respectively. Using this definition as a bench-mark, change in productivity over time will depend upon changes in both the "included" and "excluded" components and maximum resource productivity will imply obtaining the maximum possible output from the minimum possible set of input. In this context, optimal productivity of resources implies an efficient utilization of resources in the production process. (Olayide and Heady, 1982).

An increase in farm output will result from one of three forces. First, it will result from an increased quantity of inputs, with no change in output per unit of input. Second, it will result from increased productivity of inputs with no change or a decrease in quantity of inputs. Thirdly, it will result from a combination of changes in inputs and productivity (Olayide and Heady, 1982).

2.8.2 Resource use efficiency

A number of studies have been carried out on resource use efficiency in agricultural productivity in Nigeria. Aboki (2007) carried out a comparative analysis of the productivity of improved and local varieties of cassava in selected Local Government Areas of Taraba State. The result revealed the technical efficiency of the farmers with the best and least practice for improved varieties to be 0.9873 and 0.394 respectively. The ones for the local varieties were 0.9705 and 0.2970 for the best and least practiced farmers respectively. Shehu (2007) carried out a comparative economic analysis of small-holder rain-fed and irrigated rice production in selected Local Government Areas of Adamawa State and found out that for rain-fed rice husbandry, land, seeds, hired labour, fertilizer and herbicides were under-utilized while family labour was overutilized. For the irrigated system of rice production land and seeds were optimally utilized while family labour, fertilizer and herbicides were under-utilized and hired labour was over-utilized.

Some of the factors responsible for Nigeria's food insufficiency are low crop yields, use of unimproved crop varieties, inconsistent macroeconomic policies, pest and disease outbreak, wrong choice of enterprise combination and cropping system. The food demand – supply gap that has been created resulted in increased food imports and high rate of food prices due to supply deficit despite food importation. Several schools of thought exist when it comes to strategies to bring about significant increase in food production (Jirgi *et al.*, 2010). A school advocates for effective contribution of measures aimed at increasing the level of farm resources, making efficient use of resources already committed to the food subsector and combining the enterprises in an optimal manner (Alam *et al*.,1995, Tanko, 2004). Another school of thought affirms that it is ideal to lay emphasis on allocating and distributing adequate resources inputs, investment in research and eliminating the bottle necks to efficient resource utilization at the farm level (Jirgi *et al.,* 2010)

2.9 Measurement of Profitability in Farming

2.9.1 Gross margin analysis

Gross margin analysis forms the basis for farm profitability analysis. It involves accurate collection of costs of variable inputs and the gross income obtained from a particular enterprise so as to obtain the net returns (Bernard, 2003). Essentially, gross margin is a budgeting tool used to estimate total variable costs of production and total revenue. Gross margin analysis, according to Olukosi and Erhabor (1988), involves evaluating the profitability and efficiency of an agricultural enterprise or farm. Gross margin is the difference between gross income and total variable cost. The model is:

Gross Margin (GM) = GI – TVC---1

Where:

GM = Gross margin (Naira/hectare)

GI = Gross Income (Naira /hectare)

TVC= Total Variable Cost (Naira/hectare)

2.10 Elasticity of Production and Return to Scale

The fifth measure of the physical relationship between output and a single variable input is the input elasticity, also known as the partial elasticity of production. This is defined as the percentage change of output resulting from a given percentage change in the variable input:

$$E = \frac{\%\ change\ in\ output}{\%\ change\ in\ input} = \frac{dy/y}{dx1/X1} = \frac{dy}{dx1}.\frac{X1}{Y} = MPP\ .\frac{1}{APP} = \frac{MPP}{APP}$$------------------------------------1

The point about elasticity is that by taking the ratio of two proportional changes it obtains a measure of the impact of one variable on another which is independent of the physical units in which the variables are denominated. The relationship between the input elasticity, the MPP and the APP should be noted. The era of diminishing marginal returns on the production function occurs when MPP < APP, but is not negative, i.e. when E is between 1 and zero:$0 < E < 1$

Returns to scale are defined as what happens to output when both (or all) are increased in the same proportion. This demonstrates constant returns to scale, i.e. an equal percentage increase in both results in the same percentage increase in output. Increasing return to scale is when successive isoquants representing equal increases in output move closer together. Decreasing returns to scale is when they move further apart. Thapa (2007) observed that whatever the nature of returns to scale, there exist differences in factor use intensities and output among the different classes of farms. He concluded that output per hectare was inversely related to farm size and directly related to input used per hectare. Aunsakul (1980) in his study of scale economies on rice-peanut farms in North-East Thailand observed that differences exist in the intensities of resource use and elasticities of production of input factors for small and large farms. He observed that while the small farms used labour-intensive production techniques, the large farms used more capital-intensive techniques. He further stated that the elasticities of land and labour were higher on small farms than large farms, while the elasticity of production of capital on large farms was higher than on small farms.

CHAPTER THREE

METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Kaduna State. There are 23 Local Government Areas (LGAs) in Kaduna State. The State lies between latitudes 11^0 32' and 09^0 02' North of the equator and longitudes 80^0 50' and 06^0 15' East of the Prime Meridian (Kaduna State Statistical Year Book, 1996). The State occupies an area of approximately 48,473.2 square kilometres and has a population of about 6, 066,562million people (NPC, 2006) and a projected population of 8,054895.57 million in 2015 at 3.2% population growth rate. The entire land structure consists of an undulating Plateau, with major rivers in the State as River Kaduna, River Wonderful in Kafanchan and River Gurara.

Kaduna State lies within the Derived Guinea Savannah zone of Nigeria. The State extends from the Guinea Savanna in the South-Central to the Sudan Savanna in the North Central. The grassland is a vast region covering the southern part of the State. There are two marked seasons in the State: the rainy (wet) season and the dry windy season. The wet season is usually from May to October with great variations in different areas of the state from 600mm to 1500mm.On the average, the State enjoys a rainy season of about five months. The length of the growing periods varies from 100 to 200days. The dry season starts from November to April. Temperature in the state ranges between 28^0C and 34^0C (Kaduna State Metrological Station, 2012).

Farming is the main occupation of the people, with emphasis on the crops grown which include maize, sorghum, rice, millet, wheat, cotton, yam, cassava, pigeon pea, cowpea, soya bean and groundnut. They also grow vegetable crops like tomato, pepper, onion and carrot. Livestock is also important in the economy of the state and the livestock kept include cattle, sheep, goats and poultry.

3.2 Sampling Techniques and Sample Size

A multi-stage sampling technique was used to select the respondents for the study. In the first stage, three out of the four agricultural zones in the state were purposively selected. The reason is that maize production is relative higher in these three selected than in the fourth zone. The zones selected were Samaru Kataf, Maigana and Lere zones. In the second stage, one block was randomly selected from each of the three agricultural zones. In the third stage, three villages were randomly selected from Zango Kataf and Kudan and four villages were selected from Lere (this was because the villages were of ratio 7:8:11 in each block respectively). Finally, proportional sampling was used to select 163 respondents from the selected villages (Table 3.1).There is low maize production in Birnin Gwari zone due to the rocky nature of the terrain which does not encourage agricultural mechanization.

Table 3.1: Distribution of maize farmers in the study area.

	Selected Agricultural Zones in Kaduna state	Agricultural Blocks	Villages	Sample Frame *	Number of farmers selected (20%)
1.	SamaruKataf	ZangoKataf	Balfigora	124	23
			Gora gan	115	22
			Sabon-garigora	94	18
2.	Lere	Lere	Garukurama	125	23
			Kakukurama	112	21
			Jura kurama	94	18
			Jura yarkasuwa	55	10
3.	Maigana	Kudan	Hunkuyi	65	12
			Kudan	49	9
			Doka	40	7
	Total 3	**3**	**10**	**873**	**163**

*Source: Kaduna State Agricultural Development Programme (KADP)

3.3 Method of Data Collection

Primary data were used for the study. These data were collected by interview method, using structured questionnaire. The primary data covered:

(i) demographic information such as age, farming experience,

(ii) marital status, educational level, household size, extension contact, membership of associations and farm size.

(iii) production information on maize such as inputs used (land, seed, labour, fertilizer and agro-chemicals) and output obtained.

(iv) market information like prices of inputs and quantities bought and price of output and quantity sold.

(v) constraints to maize production.

3.4 Analytical Techniques

3.4.1 Descriptive Statistics

This was used to achieve objectives i and vi. The descriptive statistics involved the use of percentages, means and frequency distribution tables.

3.4.2 Regression model

Multiple regression analysis was used to achieve objective ii. The regression equation was expressed as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + U \text{-------------------------} 1$$

Where:

Y = Output of maize (kg)

X_1 =Age of the farmer (years)

X_2 =Farm size (hectares)

X_3 = Household size (number of persons in the household)

X_4 = Farming experience (years)

X_5 = Education (years of formal schooling)

X_6 = Membership of cooperatives (years)

X_7= Amount of credit received (Naira)

X_8= Extension contact (Number of contacts)

U = Error term

b_0 = Constant term

$b_1 – b_5$ = Coefficients to be estimated

3.4.3 Production function

Production function was used to achieve objectives iii and iv. To estimate the technical relationship between inputs used in maize production and the output of maize, different functional forms were tried in order to select the form that gives the best fit for the data. The different functional forms tried were the linear, semi-log, and Cobb-Douglas. The most appropriate function was selected as the lead equation based on the apriori expectation (significant level of F-value, coefficient of determination (R^2), the appropriateness of the signs of the regression coefficients and significance of t-value).

The explicit forms of the three functions (linear, semi-log, and Cobb-Douglas) are given below:

Linear: $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + U$---1

Semi-log: $Y = lnb_0 + b_1lnX_1 + b_2lnX_2 + b_3lnX_3 + b_4lnX_4 + b_5lnX_5 + U$--------------------------2

Cobb-Douglas: $Y = b_0X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4} X_5^{b5}U$--3

When linearized, the Cobb-Douglas becomes:

$lnY = lnb_0 + b_1lnX_1 + b_2ln X_2 + b_3lnX_3 + b_4ln X_4 + b_5ln X_5 + U$----------------------------------4

Where:

ln = Natural logarithm

Y = Output of maize (kg)

b_0 = Constant term (intercept)

$b_1 – b_5$ = Coefficients of parameters estimated

X_1 = Farm size (in hectares)

X_2 = Seed (kg)

X_3 = Labour (man-days)

X_4 = Fertilizer (kg)

X_5 = Agrochemicals (litres)

U = Error term

The apriori expectation of the parameters is that $b_1, b_2, b_3, b_4, b_5 > 0$

To measure resource use efficiency in the production of maize, the Marginal Value Product (MVP) of the resources used were estimated by multiplying the Marginal Physical Products of the inputs with the price of the output. The values were then compared with the costs of the resources (marginal factor costs) (MFC) in order to make inference on efficiency of resource use. The following was estimated to determine the efficiency of resource use:

$$r = {}^{MVP}/_{MFC}$$

Where:

r= efficiency ratio

r=1 means resources employed by the farmer were efficiently utilized.

r □ 1 means resources employed by the farmer were under-utilized, and

r <1 means resources employed by the farmer were over-utilized

The MPP_s and MVP_s were derived as follows:-

Linear: MPP = $\frac{dy}{dx}$ = b_i; MVP = b_i .Py--1

Semi-log: MPP $=\frac{bi}{\bar{\bar{x}}}$; MVP $=\frac{bi}{\bar{\bar{x}}}$. Py---2

Double-log: MPP $=\frac{bi}{\bar{\bar{x}}}$; MVP $=\frac{bi}{\bar{\bar{x}}}$. Py---3

The elasticities of production (Ep) of inputs were estimated using the equation below:

Ep=$\frac{\Delta Y}{\Delta X} * \frac{X}{Y}$---4

Where:

Ep=Elasticity of production of input X

ΔY = Change in output

ΔX= Change in input

X = Input

Y=Output

The returns to scale were measured as: $\frac{-b_2x_1}{b_2x_2}$---5

3.4.4 Gross margin analysis

This was used to estimate the costs and returns, that is, to achieve objective (v). It is a very useful planning tool in situations where fixed capital is a negligible portion of the farming enterprises as is the case in subsistence agriculture (Olukosi and Erhabor, 1988). It evaluates the profitability of an individual enterprise. It is given as:

GM = TR – TVC--1

Where:

GM = Gross Margin (N/hectare)

TR = Total revenue (N/hectare)

TVC = Total Variable Cost (N/hectare).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Maize Farmers

4.1.1 Age Structure of Maize Farmers

Age is the number of years a person has lived. it could have important influence on individual experience, authority and resources (Dahunsi, 2015) The age distribution of the maize farmers (Figure 4.1) shows that 10% were in the age range of 17-26 years, 21% between 27-35 years, 25% between 36-44 years and the least 2% were between 72-80 years. The average age of maize farmers was 44 years. This implies that maize production in the area was done by relatively young men and women. These results are similar to those obtained by Onuk *et al.* (2010) in their work on economic analysis of maize production in Mangu Local Government Area of Plateau State, Nigeria. They reported the dominant (34%) age group to be between 31- 40 years of age. Age is very important in agricultural production. Adubi (1992) argued that age, in correlation with farming experience, has a significant influence on the decision-making process of the farmers with respect to risk aversion, adoption of improved agricultural technologies and other production-related decisions. Dercon and Krishnan (1996) also argued that age affects the rate of household adoption of innovations, which, in turn, affects household productivity and livelihood improvement strategies. Age is associated with skill enhancement (experience), accumulation of resources and extensive social capital that ought to contribute positively to well-being (Oyewole 2012).

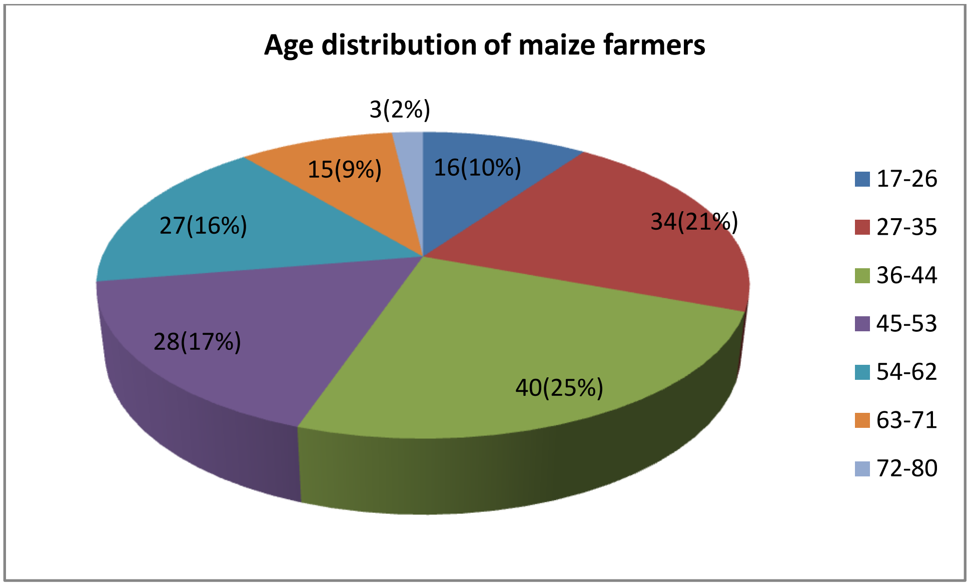

Figure 4.1: The Age distribution of maize farmers.

4.1.2 Sex

Sex refers to the character of being male or female (Dahunsi, 2015). The results of sex distribution in Figure 4.2 reveal that 90% of respondents were males while 10% were females. This indicates that maize production was basically male-dominated and the reason could be related to the nature of farm work as it requires much energy. This result is similar to that obtained by Oluwatayo *et al.* (2008) in their study of resource use efficiency of maize farmers in rural Nigeria, where it was found that majority of their respondents were males.

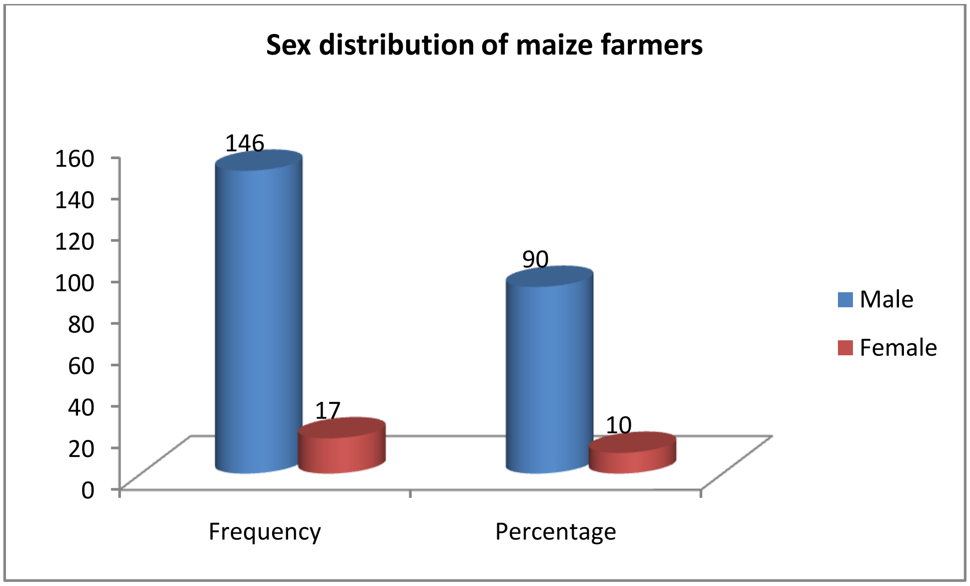

Figure 4.2: The Sex distribution of maize farmers.

4.1.3 Marital Status of the maize farmers

Marital status refers to the character of being single or married (Dahunsi, 2015). The results of distribution of maize farmers according to marital status in Figure 4.3 show that 7% of the respondents were single and 93% were married.The significance of marital status in agricultural production can be explained in terms of supply of family labour. According to Amaza *et al.* (2006), it is expected that family labour will be more available where the household heads are married. Marital status influences the size of households, as married farmers tend to have larger household sizes than unmarried ones which may mean increased labour force and enhanced agricultural production by married farmers.

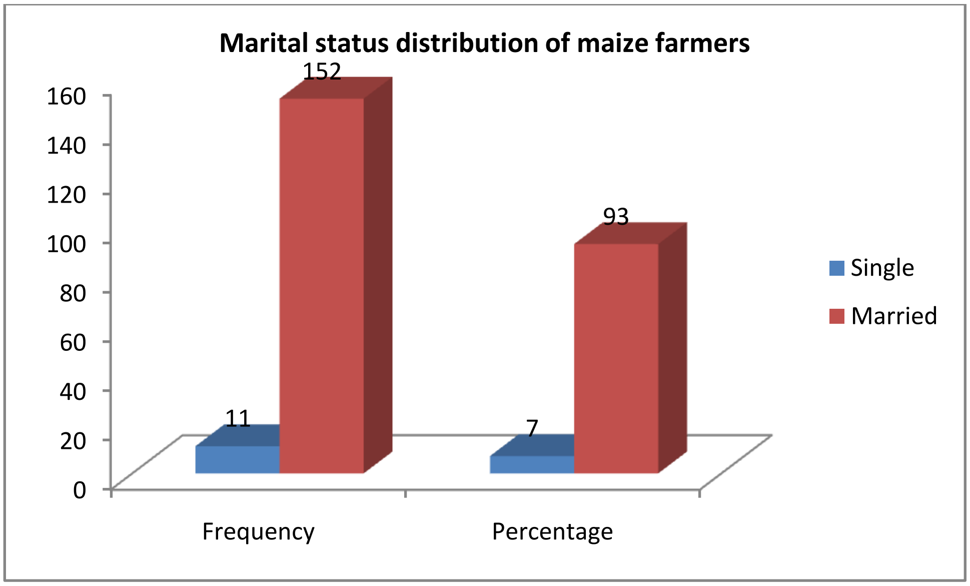

Figure 4.3: The marital status distribution of maize farmers

4.1.4 Household size

A household comprises all persons who generally live under the same roof and eat from the same pot (FOS, 1985). For the purpose of this study, a household comprises the head, the wife/wives, children and other dependents that live in the same house. The household size distribution of the respondents in Figure 4.4 shows that the majority of the farmers (82%) had household size between 1-10 persons. Some 10% had 11-20 persons, 5% had 21-30 persons and 3% had 31-40 persons. Maize farmers in the study area had a mean household size of 8 persons. The result is the same with what was obtained by Oladejo and Adetunji (2012) in their study of economic analysis of maize production in Oyo state, where it was found that 74% of farmers had a household size of 1-10.The significance of household size in agriculture hinges on the fact that the availability of labour for farm production, the total area cultivated to different crop enterprises, the amount of farm produce retained for domestic consumption, and the marketable surplus are all determined by the size of farm household (Amaza *et al.*, 2006). Size of the household may enhance labour availability that can be used for different activities (Oyewole, 2012).

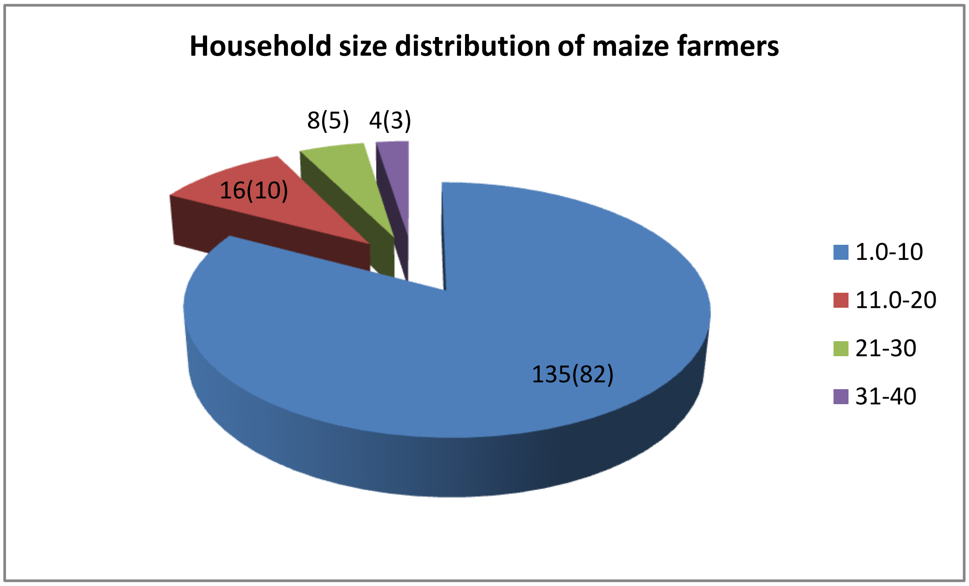

Figure 4.4: The household size distribution of maize farmers

4.1.5 Farming experience of the maize farmers

Farming experience is the length of time a farmer has been in farming system (Dahunsi, 2015). The distribution of maize farmers by farming experience in Figure 4.5 shows that 28% have been in maize production for between 11-20 years, 24% for between 21-30 years, 19% for between 31-40 years and 4% for between 51-60 years. The mean years of farming experience was found to be 25 years. Productivity increases with years of experience in farming as farmers master the techniques of production and avoid previous mistakes. Experienced farmers are likely to make better decisions to enhance productivity and income. Farming experience is an important factor determining both the productivity and the production level in farming activities. But the effect of farming experience on productivity and production may be positive or negative (Oyewole, 2012). Generally, it would appear that up to a certain number of years, farming experience would have a positive effect; after that, the effect may become negative. The negative effect may be due to aging or reluctance to change from old and familiar farm practices and techniques to those that are modern and improved (Amaza *et al.*, 2006). The result obtained is similar to that of Saidu (2012) in his work on Economic Analysis of Small and Large-Scale Maize Production in Soba Local Government area of Kaduna State, Nigeria where maize farmers 31% had 11-20 years of farming experience.

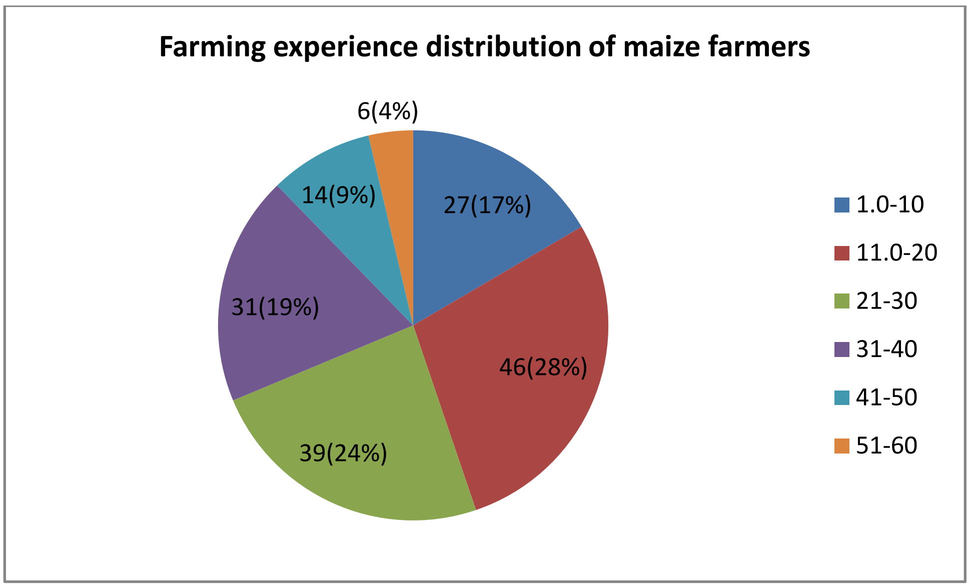

Figure 4.5: The farming experience distribution of maize farmers.

4.1.6 Educational Level

This is defined as the extent to which a respondent has gone in term of normal schooling (Dahunsi, 2015). Table 4.6 shows the distribution according to level of education of the respondents in the study area. The results show that 28% of the maize farmers had no formal education, 42% had primary education and those who had secondary and tertiary education were 20% and 10% respectively. This indicates that about 72% of the farmers were literate. The literacy level of the farmers was on the average of 7 years. Educational level of farmers is very important in farm management as a high literacy level of the respondents would afford them the opportunity to understand and adopt modern farm practices, thereby enhancing productivity and profitability. Najafi (2003) noted that educational attainment is very important because it could lead to awareness of the possible advantage of modern farming techniques and diversification of households' income, which in turn, would enhance household food security. This result is similar to what was obtained by Ugwuja *et al.* (2011) in their study on socioeconomic characteristics of farmers as correlates of fertilizer demand in Ekiti State of Nigeria where the majority of the farmers (62%) were found to have primary education.

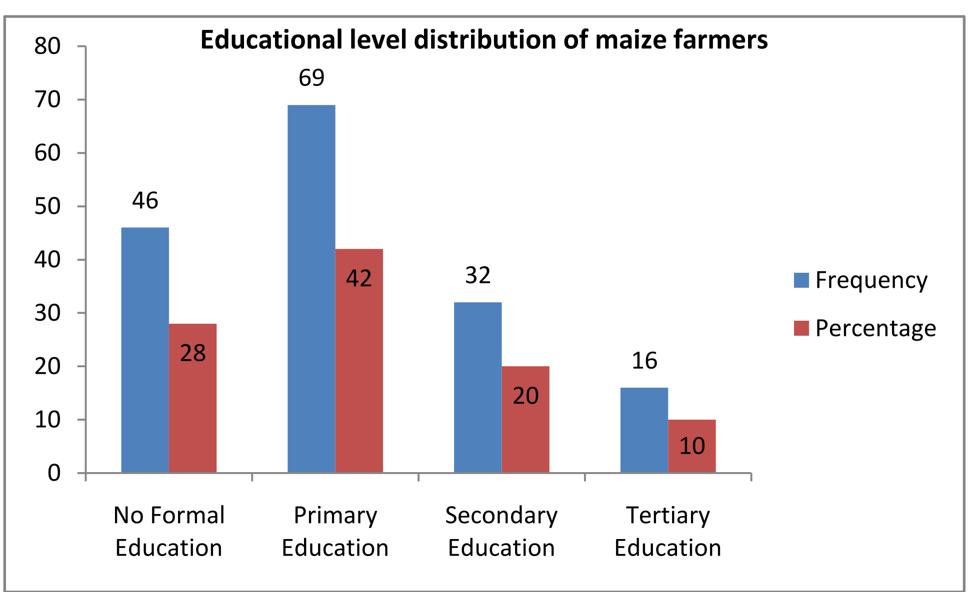

Figure 4.6: The educational level distribution of maize farmers.

4.1.7 Amount of credit received

This is the amount of loan a farmer is able to receive to finance farm production activities (Dahunsi, 2015). The results presented in Figure 4.7 show that majority (95%) of farmers did not receive credit. Three percent received credit between ₦50, 000 -₦100, 000, 1% received between ₦151,000-₦ 200,000, and 1% received credit above ₦ 200,000.00. The mean credit received was ₦198, 750. Sincerely 5% of the farmers had obtained credit. It means that most of the farmers may have had difficulty in the expansion of their farms and purchase of farm inputs. This result is similar to that obtained by Oladejo and Adetunji (2012) in their study on economic analysis of maize production in Oyo State of Nigeria, where the majority of maize farmers (64%) did not receive credit from any external source and had to rely on their personal savings. According to Ogunfowora *et al.* (1972), many innovations in farming inevitably increase the capital requirements of farmers and the low rate of adoption of improved practices is partly due to inadequate financial resources in implementing it. Majority of farmers, he argued, produce at subsistence level and there is usually small surplus out of which savings for future investment can be made. The seasonal nature of farm production and income generation, they further argued, creates need for short-term and medium-term loans for financing production activities. According to them, the supply of loan would strengthen the farmer's position in the disposal of his produce and help the farmer expand the scale of farm operations and introduce supplementary enterprises, which could increase labour utilization and promote steady flow of income. Accessibility of farmers to credit facilities may increase farmers' access to agricultural inputs which may increase food production, thereby increasing their income and food security status (Oyewole, 2012).

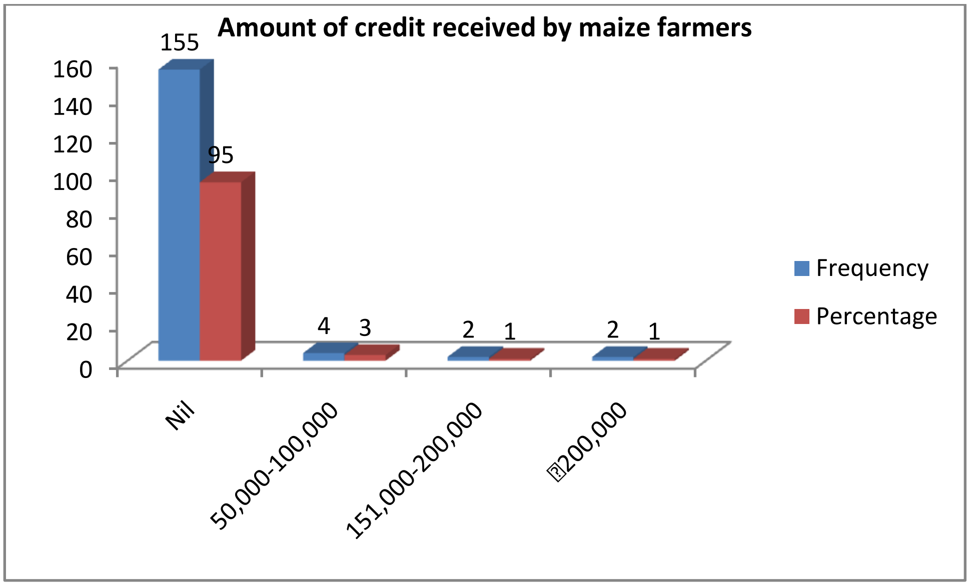

Figure 4.7: The distribution of amount of credit received by maize farmers

4.1.8 Membership of farmers' associations

This is the social groups a farmer belonged (Dahunsi, 2015). The distribution of maize farmers by membership of farmers' associations in Figure 4.8 shows that majority of the maize farmers (90%) were members of associations while the remaining 10% did not belong to any farmers' association. Membership of associations is believed to enhance the sharing of information on improved technologies through interactions as well as ease input acquisition and utilization constraints faced by farmers. Membership of associations can enhance the accessibility of farmers to credit facilities and serve as a medium for exchange of ideas that can improve both farm and non-farm activities (Oyewole, 2012).

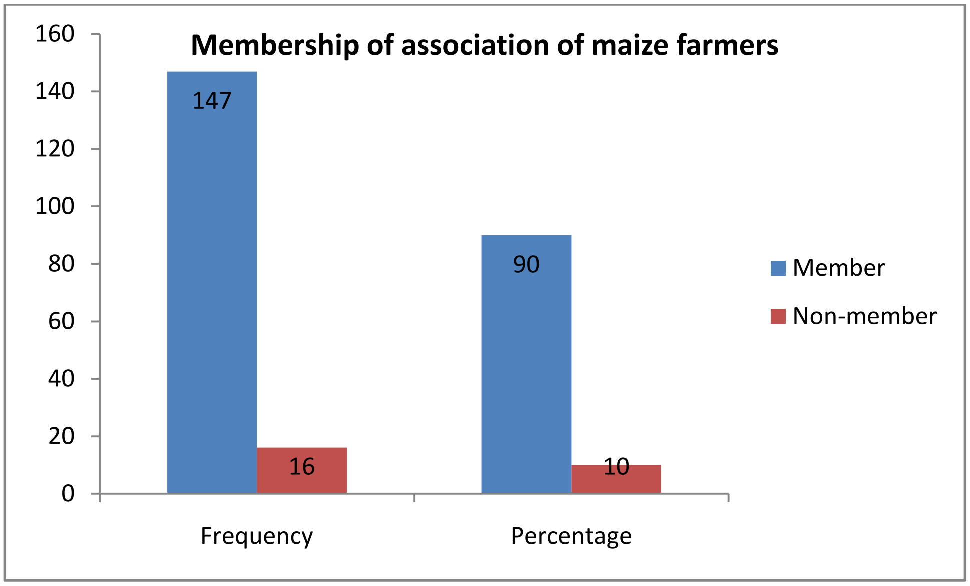

Figure 4.8: The distribution of membership of maize farmers' association.

4.1.9 Farm size

Farm size is the size of farm operated by the farmers (Dahunsi, 2015). The results of farm size distribution in Figure 4.9 show that majority (73%) cultivated between 0.25-1.25 hectares, 15% of the farmers cultivated between 1.26-2.25 hectares, 10% cultivated between 2.26-3.25 hectares, 1% cultivated between 3.26-4.25hectares and 1% cultivated between 4.26-5.25 hectares. The mean farm size was 1.14 hectares. This implies that maize farmers in the study area were predominantly small-scale farmers. According to Olayide (1980), small scale farms range from under 0.1 hectare to 5.99 hectares. Small farm size is an impediment to agricultural mechanization because it will be difficult to use farm machines on small and fragmented individual farms. The result is consistent with that of Gani and Omonona (2009) in their work on resource use efficiency among small-scale irrigated maize producers in northern Taraba State of Nigeria, where a mean farm size of 1.28 hectares was reported. The result is also similar to that obtained by Saidu (2012) in his study on economic analysis of small and large-scale maize production in Soba Local Government Area of Kaduna State, Nigeria, where it was found that majority of the small-scale farmers cultivated less than 2.0 hectares.

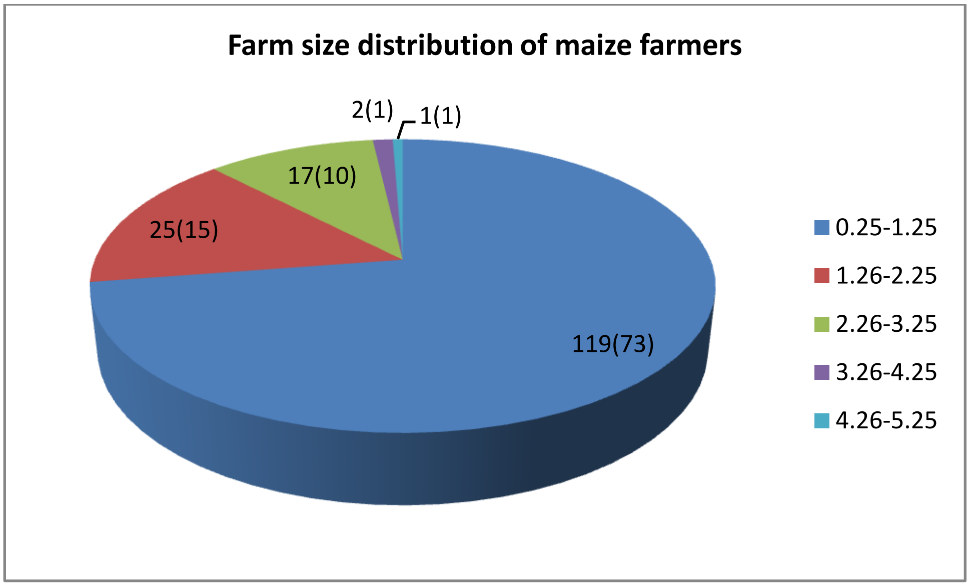

Figure 4.9: The farm size distribution of maize farmers.

4.1.10 Mode of land acquisition

It is the act at which farmers acquire their farm land. The results of distribution of respondents by mode of land acquisition presented in Figure 4.10 show that majority of the farmers (68%) acquired their lands through inheritance, 23% through purchase and 7% through renting. The implication of the dominance of inheritance as the mode of land acquisition is that land may be shared among the heirs of a deceased and this leads to fragmentation of landholdings and makes the holdings smaller (Ogungbile *et al.*, 1999). This result is similar to that obtained by Saidu (2012) in his study on economic analysis of small and large-scale maize production in Soba Local Government Area of Kaduna State of

Nigeria where they found that majority (66%) of maize farmers acquired land through inheritance.

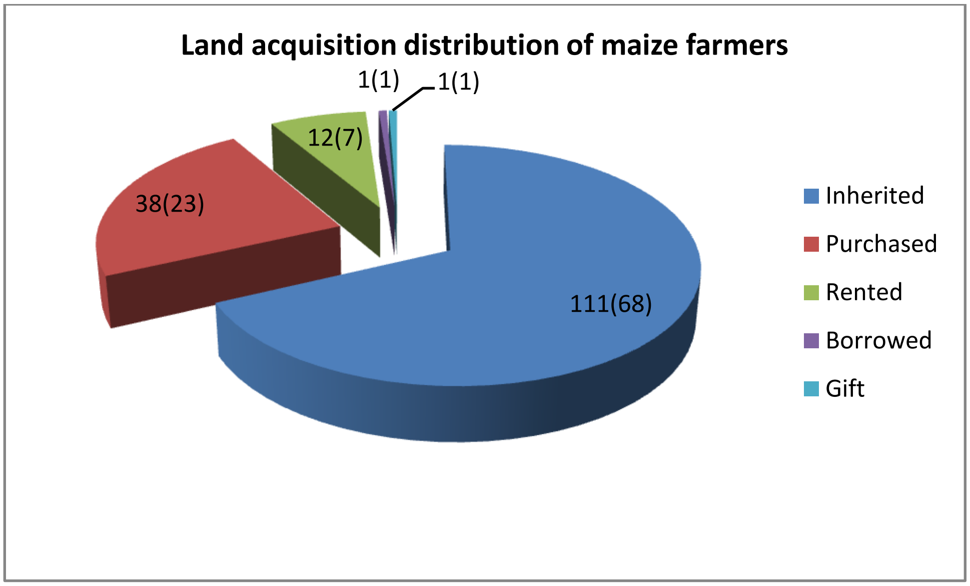

Figure 4.10: The land acquisition distribution of maize farmers.

4.1.11 Extension visit

This is the frequency of visits by the extension agent to the farmers (Dahunsi, 2015). The results of distribution of respondents by contact with extension services in Figure 4.11 show that 43% of the farmers had 1-5 contacts with extension services, 43% had 6-10 contacts, 4% had 11-15 contacts, 1% had 16-20 contacts, and 9% had no extension contacts. Maize farmers in the study area had a mean extension contact of five. This implies that majority of the farmers (95%) had access to information on the potential gains of adopting new technologies for improved agricultural productivity. Contact with extension can lead to improvement in food production as a result of access to information on improved agricultural technologies. According to Oyewole (2012), limited extension contact may reduce farmers' accessibility to information on improved farm technologies.

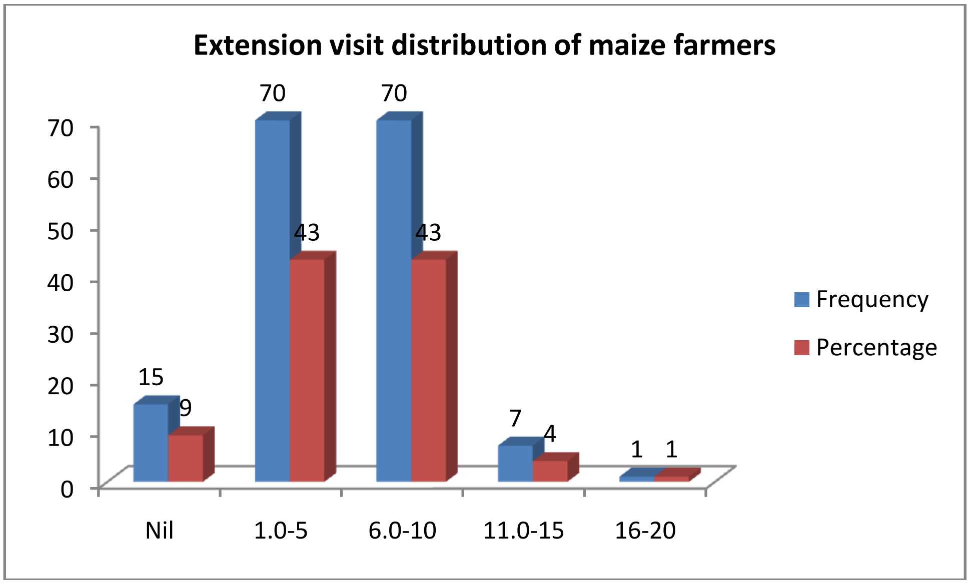

Figure 4.11: The extension visit distribution of maize farmers.

4.2 Relationship between Maize Farmers' Socio-economic Characteristics and their Output

The results of the relationship between the socio-economic characteristics of the maize farmers and their output (Table 4.1) show that farmers' age, household size and extension contact were significantly related with their output. The R^2 value of 0.27 means that 27% of the variation in output was explained by the socio-economic factors included in the model. Age was negatively related to output but household size and extension contact were positively related to output. The negative coefficient obtained for age implies that an increase in age would decrease maize output. The reason is that the older the farmer, the lesser the willingness to take risk and try innovations that may increase maize output

(Philips and Stenthal, 1977). According to Voh (1979) older farmers seem to be somewhat less inclined to adopt new form of practices for increasing maize output than younger ones. Household size was positive, which implies that increase in household size would increase maize output. The reason is that the increased supply of farm labour from larger household size would translate into increased maize production. Extension contact was also positive, which implies that as farmers' contact with extension increases, maize output also increase. Umar *et al.* (2009) argued that higher extension contacts would increase adoption of improved farm production technologies which increase maize production. According to Obeta and Nwagbo (1991), extension agents supply information on the mode of application or usage of the technologies as well as the availability of technological inputs and that frequent contact between extension and farmers is likely to minimize doubts among farmers and ensure timely procurement of inputs which would increase maize production.

Table 4.1: Relationship between socio-economic characteristics and maize output

Variables	**Estimated Coefficients**	**Standard Error**	**t-value**
Intercept	3.560	0.1313	27.113
Age (X_1)	-0.0088	0.0027	-3.259 **
Farm size (X_2)	0.1605	0.0694	2.313*
Household (X_3)	0.0096	0.0031	3.097 **
Farming experience(X_4)	0.0032	0.0029	1.103
Education level (X_5)	-0.00211	0.0042	-0.502
Membership (X_6) of associations	0.0042	0.0058	0.724
Credit (X_7)	0.000000232	0.00000034627	0.670
Extension contact (X_8)	0.0224	0.0066	3.394 **

R^2 = 27%, F-value = 6.28**, **p□ 0.01,*p□ 0.05

4.3 Production Function of Maize Production

The Cobb-Douglas production function was selected as lead equation or line of best fit. The results of the Cobb-Douglas production function for maize production presented in Table 4.2 show that the R^2 value which measures the proportion of the variation in dependent variable that is explained by the independent variables included in the model was 98%.The F-value was 1370 and significant (p□ 0.01) This implies that the independent variables included in the model were all important in explaining the variation in the dependent variable. Farm size was positive (0.069) and significant (p□ 0.05) meaning that an increase in farm size by one unit will increase output by 0.069 units. Seed was positive (0.476) and significant (p□ 0.01) meaning an increase in seed by one unit will increase maize output by 0.476 units. Labour was negative (-0.059) and significant (p□ 0.05) meaning that an increase in labour by one unit will decrease maize output by 0.059 units. The negative indicates that labour has been over used and now has diminishing return. Fertilizer was positive (0.478) and significant (p□ 0.01) meaning an increase in fertilizer by one unit will increase maize output by 0.478 units. Agro-chemicals were negative (-0.059) and significant (p□ 0.05) meaning that one unit increase in agrochemicals will result in 0.059 unit decrease in the output of maize. The negative indicates that agro-chemicals used exceeded optimum level and have been over used.

These results agree with those of Ayinde *et al.* (2011) in their work on efficiency of resource use in hybrid and open pollinated maize production in Giwa Local Government of Kaduna State, Nigeria, where farm size, seed and fertilizer had positive relationship with output. Also, the results of Saidu’s (2012) study on economic analysis of small and large-scale maize production in Soba Local Government Area of Kaduna State of Nigeria, showed that labour (-0.145) and agrochemicals (-0.511) had negative relationship with output while farm size (0.251), seed (0.927) and fertilizer (0.123) had positive relationship with output for large-scale maize production.

Table 4.2: Production function results for maize production.

Variables	Coefficients	Standard error	t- value
Constant (a)	1.929	0.045	43.097 **
Farm size (X_1)	0.069	0.034	2.043*
Seed (X_2)	0.476	0.026	18.534***
Labour(X_3)	-0.059	0.025	-2.048*
Fertilizer (X_4)	0.478	0.012	39.884**
Agro-chemicals (X_5)	-0.059	0.027	-2.180*

R^2=98%, R^2adjusted = 97%, F-value = 1370***, ***p□ 0.001, **p□ 0.01, *p□ 0.5

4.4 Resource Use Efficiency in Maize Production

The results of resource use efficiency in maize production in the study area presented in Table 4.3 showed that labour and agrochemicals were over-utilized in the production of maize, while farm size, seeds and fertilizer were under-utilized, meaning that increasing labour and agrochemicals will bring about a relative decrease in output while increasing farm size, seeds and fertilizer will achieve relative increase in output. The results are consistent with those of Saidu (2012) where farm size, seed and fertilizer were underutilised while labour and agrochemicals were over-utilised by large-scale maize farmers.

Table 4.3: Resource use efficiency in maize production

Variable inputs	$\bar{X}$	MPP	MVP	MFC	MVP/MFC

Farm size	1.14	310.46	13,970.7	5,240.91	2.67
Seeds	20.37	119.86	5,393.7	157.3	34.29
Labour	90.31	-2.95	-132.7	600.0	-0.22
Fertilizer	498.47	4.92	221.4	95.0	2.33
Agro-chemicals	5.3	-56.46	-2,540.7	800.0	-3.18

Price of maize per kg (P_y)=₦45

4.5 Elasticity of Production and Returns to Scale in Maize Production

The results presented in Table 4.4 show the elasticities of production of the inputs for maize production. In the Cobb-Douglas model, the production function coefficients are direct elasticities of the variables. The estimated input elasticities of production for farm size, seed and fertilizer were positive but less than one, indicating that output (5,129.28kg/ha) increases less than proportionate increase in input and that too little of variable inputs were used given the level of fixed inputs that were available. The elesticities of production of labour and agro-chemicals were negative indicating that output decreases with increases in use of inputs and that too much variable input was used relative to the set of fixed inputs. The sum of the partial elasticities of the inputs was 0.912 and a value less than unity implies decreasing returns to scale. This indicates that an equal percentage increase in all the inputs in the production function model will result in a less than proportionate increase in output. The result is consistent with that of Gani and Omonona (2009) in their study on resource use efficiency among small-scale irrigated maize producers in northern Taraba State of Nigeria, where the return to scale was found to be 0.961.

Table 4.4: Elasticities of production of input variables in maize production

Variable	Elasticity (Ep) =bi
Farm size (X_1)	0.069
Seed (X_2)	0.476
Labour (X_3)	-0.052
Fertilizer (X_4)	0.478
Agrochemical (X_5)	-0.059
$\sum_{i=1}^{n} bi$	0.912

4.6 Costs and Return in Maize Production

The results in Table 4.5 indicate that the total variable cost was ₦109, 032.85/ha, the total revenue was ₦230, 817.6/ha and the gross margin was ₦121, 784.75/ha. This implies that the maize production is profitable in the study area. This showed that maize production in the study area is profitable. Hence, we reject the null hypothesis that states that maize production is not profitable, and accept the alternative that maize production is profitable.

Table 4.5: Costs and return in maize production

Variable Input	Cost (N/ha)	%TCV
Seed (kg)	3,204.20	3
Labour (man-day)	54,186	50
Fertilizer (kg)	47,354.65	43
Agrochemical (litres)	4,288	4
Total (A)	**109,032.85**	
Gross Return (D)	230, 817. 6	
Gross margin (D-A)	121, 784.75	

4.7 Problems Associated with Maize Production in the Study Area

The results presented in Table 4.6 shows the problems associated with maize production in the study area. High cost of fertilizer ranked first (30%). The high cost of fertilizer has been a major constraint to its use. This may be due to poor fertilizer a distribution system which has prevented grass root farmers from getting fertilizer at the subsidized prices (Ogungbile *et al*., 1999). For instance, it was reported by Wedderburn (1989) that in times of scarcity, illegal fertilizer markets flourish where fertilizer retail prices could be four times the official price. The cost of fertilizer, therefore, constitutes a serious obstacle to its use by farmers (Obasi *et al*., 2005). This result is similar to that obtained by Saidu (2012) where high cost of fertilizer was the leading constraint among the problems in maize production in Soba Local Government Area of Kaduna State.

Poor market for maize ranked second (22%) among the problems facing the farmers. This may be due to the lack of agro-allied market as well as industries and appropriate processing facilities in rural locations (Ogungbile *et al*., 1999). As a result, most of the farmers sold their sold their products at harvest time when there is excess supply in the market which depresses prices. Also, in most of the markets, the farmers do not sell directly to the final consumers but to middle men.

High cost of labour (21%) ranked third among the problems facing maize farmers. Labour is costly and scarce at peaks of farm work during the farming season (Fakayode *et al.*, 2004). The high cost of labour may be due to scarcity of labour caused by the migration of able-bodied men from rural areas to urban centres. The labour problems perhaps explain why respondents cultivated small farm plots of maize.

Inadequate animal manure (13%) ranked fourth. This could be as a result of the seasonal and spatial variability in supply of organic manure and the bulkiness of the manure which hampers the transport of organic materials. High interest rate on loan ranked fifth (8%). This may be due to the risky nature of agricultural investments which makes financial institutions charge higher rates of interest on loan to farmers who they perceived as high-risk borrowers.

High cost of land ranked as the sixth problem (4%). This may be as a result of increasing population and high rate of urbanization (Ogungbile *et al.*, 1999). Climatic uncertainty ranked seventh (2%). The variability and unreliability of rainfall as well as drought and floods were climatic problems facing the people in the area. This finding agrees with that of

Fakayode *et al*. (2004) in their study on economic assessment of Fadama maize production in Kwara State, Nigeria, where flood was identified as one of the problems facing maize farmers.

Table 4.6: Problems associated with maize production in the study area

Constraints	**Frequency***	**Rank**
High cost of fertilizer	59	1^{st}
Poor market	43	2^{nd}
High cost of labour	41	3^{rd}
Inadequate animal manure	25	4^{th}
High interest rate on loans	16	5^{th}
High cost of land	8	6^{th}
Climatic uncertainty	4	7^{th}
Total	**196**	

*Multiple responses were allowed

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study was conducted in Kaduna state. The broad objective of the study was to evaluate the resource use efficiency and profitability of maize production. Questionnaires were the main instruments for collecting data. They were administered by the researcher, with the help of enumerators from KADP, on a sample of 163 farmers who were randomly selected. The data were analyzed using descriptive statistics, multiple regression, production function and gross margin analysis.

The results of the socio-economic characteristics of the farmers showed that 25% were within the ages of 36-44 years. Ninety percent of maize producers were male and 10% female. Ninety three percent of the maize farmers were married and 7% were single. Eighty-two percent of the maize farmers had household size of 1-10. Twenty-eight percent had 11-20 years of farming experience. Forty-two percent of the maize farmers had primary education, 20% had secondary school education, 10% had tertiary education, and 28% had no formal education. The results further revealed that 95% of the farmers in the study area did not receive credit. Ninety percent of the respondents were members of associations and 49% of farmers cultivated less than 1ha of maize. Land was mostly acquired by inheritance (68%). Majority of the farmers (91%) had access to extension services.

The results of the relationship between the socio-economic characteristics of the farmers and their maize output show that farmers' age, gender, household size and extension contact were significant. Age was negative but gender, household size and extension contact were positively related to output.

The results of the Cobb-Douglas production function for maize production showed that farm size was positive and significant (p□ 0.05). Seed was positive and significant (p□ 0.01) Labour was negative and significant (p□ 0.05) Fertilizer was positive and (p□ 0.01) Agrochemical was negative and significant (p□ 0.05)

The results of efficiency of resource use in maize production showed that labour and agrochemicals had resource use efficiency ratios less than unity, meaning that these inputs or resources were overutilized in the production of maize. However, farm size, seeds and fertilizer had resource use efficiency ratios greater than unity, meaning that these inputs were underutilized. The sum of the partial elasticities of the inputs is 0.912 and a value less than unity implies decreasing returns to scale. This means that output increases less than proportionately with increase in input. The results obtained from maize profitability showed that the results obtained from maize profitability showed that gross margin was N121, 784.75

The ranking of problems associated with maize production in the study area showed that high cost of fertilizer was the most important. This was followed by poor market for maize and high cost of labour. The least important was climate uncertainty.

5.2 Conclusion

This study has shown maize production to be a profitable venture in the study area. Since resource inputs were not optimally utilized, it then means that increases are required in resources that were underutilized and decreases to those that were over-utilized. Higher output can be realized by increasing land, seed and fertilizer and decreasing labour and agrochemicals. Also, increase in the output of maize production could be improved if solutions are found to the identified problems associated with maize production.

5.3 Recommendations

The recommendations for this study are:

(i) It was found that majority of the respondents were small scale maize farmers which impeded them from practicing mechanization. Knowing that farm size has positive relationship with output, government should look into the possibilities of facilitating access to farm lands; review the land use Act Decree and pay attention on land consolidation program in view of the scarcity and fragmentized farm holdings.

(ii) The positive and significant relationship between farm size, seed and fertilizer imply that increasing the levels of utilization of each of these inputs will results in an increase in the level of maize production. Farmers should therefore increase the use of these inputs.

(iii) Though it was found that maize production was profitable despite the challenge of poor market, maize farmers could still boost their gross margin by locating better market and/or providing good storage facilities so as to sell in the off season for better profit margin.

5.4 Contribution of the Study to knowledge

i. The study revealed that maize production in the study area is profitable with gross return and margin of ₦ 230,817.6 and ₦ 121,784.75 respectively despite the problems identified.

ii. The study established that age, gender, household size and extension contact were the major determinants of maize output among respondents.

iii. The study found that labour and agrochemicals were over-utilized while farm size, seeds and fertilizer were under-utilized.

REFERENCES

Abalu, G. I. (2001). "Policy Issues in Maize Research and Development in sub-Saharan Africa in the Next Millennium". In Badu-Apraku, B., Fakorede, M.A.B., M. Ouedraogo, and R.J. Carsky, (eds.), 2001. Impact, Challenges and Prospects of Maize in West and Central Africa: Proceedings of a Regional Maize Workshop, IITA-Cotonou, Benin Republic, 4-7 May, 1999. WECAMAN/IITA.

Aboki, E. (2007). Comparative Analysis of the Productivity of Improved and Local Cassava Varieties in Nigeria. M. Sc. Thesis, Unpublished, Yola: Federal University of Technology Yola.

Adubi, A. A. (1992). An Empirical Analysis of Production Risk and Attitude of Small Scale Farmers in Oyo State, Nigeria. Unpublished Ph.D. Thesis, University of Ibadan, Nigeria.

Agboola, A. A. and Tijani, E. (1991). Sustainability of Maize Production through Appropriate Farming Systems and Practices. Proceedings of Conference of Maize Association of Nigeria, IITA, Ibadan.

Akande, S. O. (1994). Comparative Costs and Returns in Maize Production in Nigeria. Nigerian Institute of Social and Economic Research (NISER). Individual Research Project Report, Ibadan:1-35.

Akanji, (1995). Hedonic-Price Analysis of the Demand for Grain Crops in Nigeria. The Care of Rice and Cowpea. Ph.D Dissertation, Department of Agricultural Economics, University of Ibadan, Ibadan Nigeria.

Alabi, R. A. and Esobhawan, A. O. (2006). Relative Economic Value of Maize-Okro Intercrops in Rainforest Zone, Nigeria.*Journal of Central European Agriculture,* 7(3):433-438.

Alam, M. S., Elias, S. M. and Rahman M. M. (1995). "Optimum Land use Pattern and Resource Allocation in a Growing Economy: A closed model approach". *Bangladesh Journal of Agricultural Economics* XVIII 2, 15-37

Amaza, P.S. and Maurice, D.C. (2005). Identification of Factors That Influence Technical Efficiency in Rice-Based Production systems in Nigeria, International Institute of Tropical Agriculture: Paper Presented at a Workshop on Policies and Strategies for Promoting Rice Production and Food Security in Sub-Saharan Africa. 7-9 November.

Amaza, P. S., Umeh, J. H. and Adejobi, A. O. (2006). Determinants and Measurement of Food Security in Nigeria: Some Empirical Policy Guide. Contributed Poster prepared for presentation at the International Association of Agricultural Economics Conference, Gold Coast, Australia.

Aunsakal, A. (1980). "Scale Economics on Peanut-Rice Farms in North-East Thailand. Staff Paper No. 106, Department of Agricultural Economics, University of Kentucky, Kentucky, USA.

Ayinde, T. B., Omolehin, R. A. and Ibrahim, U. (2011). Efficiency of Resource Use in Hybrid and Open Pollinated Maize Production in Giwa Local Government of Kaduna State, Nigeria. *American Journal of experimental Agriculture. 1(3): 86-95.*

Azam, M. G and Zoebisch, M. A. (2009). Socio-Economics and land-Use Factors Involved in Cropping Systems Selection: A Case Study from North West Thailand. *Journal of Agriculture and social sciences*. **5**:13-17.

Babatunde, R. O., Fayode, S. and Band, O. A. A. (2008). Fadama Maize Production in Nigeria: A Case Study from Kwara State. *Res. J. Agric. Biol. Sci.,* 4(5): 340-345.

Bedassa, R. and Krishnamoorthy S. (1997). Raising and Sustaining Productivity of Small Holder Farming Systems in the Tropics. Agbe Publishing, Singapore.

Bayene H. (1993). The Input Supply System and Technology Adoption Constraints for Wheat Production in the Holetta red Soil Zone of Ethiopia.

Bernard, C. H. (2003). Economic Analysis of Cassava- Based Cropping Systems in a Crude-Oil Producing Area: A Case Study of Rivers State, Nigeria. Unpublished Ph. D. Dissertation, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria. Nigeria, pp.166

Bravo-Ureta and Pinheiro, A. E. (1997). Technical Efficiency and Allcative Efficiency in Peasant Farming: Evidence from the Dominican Republic. Development Economicss, **35**:48-67.

Brink, M. and Belay, G. (2006). Plant Resources of Tropical Africa 1. Cereals and Pulses. PROTA Foundation Wageningen, Netherlands/Backhuys Publishers, Leiden, Netherlands/CTA, Wageningen, Netherlands.

Central Bank of Nigeria (2002). *Annual Report and Statement of Accounts.*

Dahunsi, O. M. (2015). Determinants of Participation in Taungya Agroforestry Practices among Farmers in Ekiti Stae, Nigeria. Unpublished M.Sc. Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria.

Dercon, S. and Krishnan P. (1996). Income Portfolio in Rural Ethiopia and Tanzania: Choice and Constraints, *Journal of Development Studies.* 32(6): 850-875.

Desai, M. (1976).*Applied Econometrics*, Philip Allan Publishers Ltd, Deggington, Oxford, pp:52-60.

Dlamini, S. M. (1993). Factors Associated with the Adoption of based fertilizers among Swanhi Nation Land (SNL) farmers.

Duvick N. D. (1999). Commercial Strategies for Exploitation of Heterosis, For presentation to 'The Genetics and Exploitation of Heterosis in crops, An international Symposium' 17-22 August 1997, Mexico City, Mexico, CIMMYT.

Emeasor, K. C., Emosairue, S. O. and Mmegwa, V. C. (2002). Toxicological Assessment of Some Nigerian Seed Powders Against the Maize Weevil, *Sitophilus zeamais (Motsch).African Journal of Applied Zoology and Environmental Biology*. 4:82-86.

Esoghue, O. A. and Ekong, S. M. (1991). Technology Transfer System for Improve Management Lessons for Future, In J. R. Andersen (ed) Agricultural Technology Policy Issues *A. B.* International U.K.

Ezeh, C. I. (2006). Socioeconomic Determinants of Output and Profit Levels of Smallholder Rice Production in Abia State, Nigeria. *Journal of Research in Agriculture.* **3**:44-50.

Fakayode, S. B., Omotesho, O. A, Olorunsanya, E., Babatunde, R. O. and Obafemi, A. A. (2004). Economic Assessment of Fadama Maize Production in Kwara State, Nigeria. Department of Agricultural Economics and Farm Management, University of Ilorin.

Fakorede, M. A. B., Badu-Apraku, B. ,Coulibaly O. and Fajemisin J. M. (2004). "Maize Research and Development Priorities in Sub-Saharan Africa in the next millennium".*In Impact Challenges and Prospect s of Maize Research and Development in West and Central Africa*, Badu-Apraku, B., M. A. B. Fakorede, M. A. B., Ouedraog, M. and Carsky, R. F. (eds.), Proceedings of a Regional Maize Workshop held at IITA Cotonou, Benin Republic, May 4-7.

Fakorede, M. A. B. Badu-Apraku, B., Coulibaly, O. and Fajemisin, J. M. (2001). In Badu-Apraku, B., M.A.B. Fakorede, M. Ouedraogo and R. J. Carsky (eds.) 2001. Impact, challenges and prospect of maize research and development in West and Central Africa. Proceedings of a Regional Maize Workshop IITA Cotonou, Benin Republic 4-7 May 1999 WECAMAN/IITA. Pp. 31-58.

Federal Office of Statistics (FOS) (1985). *Federal Republic of Nigeria, National Integrated Survey of Household (N.I.S.H).* Lagos, Nigeria: The Nigeria Household 1983/84.

FMA (Federal Ministry of Agriculture). (2005). Annual Report, Federal Ministry of Agriculture and Natural Resources, Abuja.

Food and Agricultural Organization (2008). Global Information and Early Warning System on Food and Agriculture. World Food Programme (GIEWS), Special Report on markets, prices and food situations for Benin, Niger and Nigeria.

Forsund, F. R. , Lovell, C. A. K. and Schmidt, P. (1980). A Survey of Frontier Production Functions and their Relationship to Efficiency Measurement. *Journal of Econometrics.* **13**:5-25.

Gani, B. S. and Omonona, B. T. (2009). Resource Use Efficiency among Small Scale Irrigated Maize Producers in Northern Taraba State of Nigeria. *Journal of Human Ecology*. 28(2):113-119.

Habibullah M. S. and Isma'il M. M., (1994). Production Frontier and Technical Efficiency: the Case for Bee Keeping Farms in Malaysia. Bangladesh *J. Agric. Econs. XVIII, I and 2 (1994): Pp.31 – 34*

Idiong, C. I., Agom, D. I and Ohen, S. B. (2006). Comparative Analysis of Technical Efficiency in Swamp Rice and Upland Rice Production Systems in Cross River State Nigeria: Proceedings of Farm Management Association of Nigeria from 18-21 Sep.

Ingawa, S. A. (1999). Socio-Economic Considerations in Maize Production in Nigeria. In Valencia J. A., Falaki, A.M, Miko, S and Ade, S.G (eds). Sustainable Maize Production in Nigeria: the Challenge in the coming Millennium Proceedings of the SG/2000/IAR/FMARD/ADPs. National Maize Production Workshop 22nd to 24th July 1999 held at ABU Zaria. Pp71

Iheke, O. R. (2008). Technical Efficiency of Cassava Farmers in South Eastern Nigeria: Stochastic Frontier Approach. Agricultural Journal **3**(2):152-156.

Iken, J. E. and Amusa N. A (2004). Maize Research and Production in Nigeria. African Journal of Biotechnology 3(6): 302-307.

Jirgi A. J., Ogundeji, A. A., Viljoen G. and Adiele M. A. (2010). Resource use Efficiency of Millet/cowpea intercropping in Niger State, Nigeria. Paper presented at the Joint African Association of Agricultural Economist (AAAE) and 48th Agricultural Economist Association of South Africa (AEASA) Conference, Cape Town South Africa, September 19-23.

Kupfuma, H. B. (1993). Fertilizer Use in the Semi-Arid Communal Area of Zimbabwe.

Lajide, L., Adedire, C. O., Muse, W. A. and Agele, S. O. (1998). Insecticidal Activities of Some Nigerian plants Against the Maize Weevil (Sitophilus Zeamais). *ESN Occasional Publication*, 3(1):277- 235.

Lovenstien, H., Lantinga, E. A., Rabbinge, R. and Van kouden H. (1995).*Principle of Production Ecology* Wageningen Agricultural University, Netherland.

Makinde, O. K. (2000). Determinants of Food Security in Bauchi Area of Northern Guinea Savannah of Nigeria: PhD Thesis Faculty of Agric. and Forestry University of Ibadan.

Najafi, B. (2003). An Overview of Current Land Utilization Systems and their Contribution to Agricultural Productivity. Report of APO Seminar on Impact of Land Utilization System on Agricultural Productivity Organization, Islamic Republic of Iran Asian.

National Population Commission (2006). National Population and Housing Survey. National Population Commission, Abuja.

Ndaeyo, N. U. (2007). Assessing the Contributions of Homestead Farming to Food Security in a Developing Economy: A Case Study of Southeastern Nigeria. *J. Agri. Soc. Sci.,* 3 (1):11-16.

Nyako, (1999). Sustainability of Soil Fertility and Water Management for Higher Maize Production from Farmers Experience": Valencia J. A., Falaki, A.M, Miko, S and Ade, S.G (eds). Sustainable Maize Production in Nigeria: The Challenge in the Coming Millennium. Proceedings of the National Maize Production Workshop 22nd to 24th July 1999 held at ABU Zaria Pp.14

Obasi, P. C., Dimkpa, T. R and Onyeka, U. P. (2005). Fertilizer procurement, distribution and subsidy policies in Nigeria. International *Journal of Agriculture and rural development.* (6): 58-65.

Obeta, M. E., and Nwagbo, F. C. (1991). The Adoption of Agricultural Innovations in Anambra State, Nigeria: A Case Study of Improved IITA Cassava Technology Package. Proceedings of 4th Conference of National Farming System Network Calabar, Nigeria.

Ogunfowora, O., Essang, S. M. and S. O. Olayide (1972). Capital and Credit in Nigerian Agricultural Development. Nigerian Rural Development Study paper No. 6, University of Ibadan, Ibadan, Nigeria.

Ogundari, K., Ojo, S. O. and Ajibefun, I. A. (2006). Economics of Scale and Cost Efficiency in Small Scale Maize Production: Empirical Evidence from Nigeria. *Journal of Social Science.* 13(2): 131-136.

Ogungbile, O. A., R. Tabo and N. V. Duirenbooden (1999). Multi-scale Characterization of Production System of Prioritize Research and Development in the Sudan Savanna Zone of Nigeria. International Crop Research Institute for the Semi-Arid Tropics in Collaboration with Institute for Agricultural Research Information Bulletin No. 55 pp. 25-32.

Ojo, S. O. (2000). Factor Productivity in Maize Production in Ondo State, Nigeria. School of Agriculture and Agricultural Technology, FUTA, Akure, Ondo State, Nigeria. *Applied Trop. Agric.,* 5 (1): 57-63.

Ojo, S. O. (2002). Analysis of Factor Productivity of Egg Production in Osun State, Nigeria: Proceedings 27th Annual Conference, Nigerian Society For Animal Production (NSAP), 17-27 March.

Ojo, S. O. and Imoudu P. B. (2000). Efficiency Measurement of Palm Oil Marketing in Ekiti State of Nigeria. *African Journal of Business and Econ. Res., 1 (2):7-12.*

Oritiz, R. (2003). Plant Breeding Successes in African Rural Development.

Okoruwa, V. O., Ogundele O. O. and Oyewusi, B. O. (2006). Efficiency and Productivity of Farmers in Nigeria: A Study of Rice Farmers in North Central Nigeria, Poster Paper Prepared for Presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, 12th-18th August.

Oladejo, J. A. and Adetunji, M. O. (2012). Economic Analysis of Maize Production in Oyo State of Nigeria. *Agricultural Science Research Journals.* vol. 2(2) pp.77-83.

Olayide, S. O. (1980). Characteristics, Problems and Significance of Small Farmers in Nigeria – Problems and Prospects. In: S. O. Olayide, J. A. Eweka , VE Bello CARD Publisher, pp. 43.

Olayide, S. O. and Heady, E. O. (1982). *Introduction to Agricultural Production Economics.* University of Ibadan Press, Nigeria.

Olukosi, J. O. and Erhabor, P. O. (1988).*Introduction to Farm Management Economics: Principles and Application,* Agitab Publishers Limited, Zaria,114pp.

Oluwatayo, I. B., Sekunmade, A. B. and Adesoji, S. A. (2008). Resource Use Efficiency of Maize Farmers in Rural Nigeria: Evidence from Ekiti State. *World Journal of Agricultural Science.* 4(1):91-99.

Omojola, J. T., Effiong, J. A. L. and Pepple, T. D. (2006). Analysis of the Demands for Locally Processed Rice in Niger State, Nigeria. *J Agric Soc Res. 6:22-26.*

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

Onwueme, I. C. and Sinha, T. D. (1991). *Field Crop Production in Tropical Africa,* CTA (The Technical Centre for Agricultural and Rural Co-operation), The Netherlands,pp1-480.

Onyenweaku, C. E. and Ohajianya, D. O. (2005). Technical Efficiencyof Swamp and Upland Rice Farms in South Eastern Nigeria. *Journal of sustainable tropical agricultureal Resources;* **14**:64-70.

Oyewole, S. O. (2012). Analysis of Income Diversification Strategies and Food Security Status of Farmers in Oyo State of Nigeria. Unpublished M.Sc. Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria.

Philips, L. and Sternthal, B. (1977). Age Differences in Information Processing: a perspective on the aged consumer, *Journal of Marketing Research*, **14**(4), 444-457.

Roy, B. C. and Ditt K. R. (2000). Rice Wheat System in Harryans. Prioritizing Production Constraints and Implication of Future Research. Indian Journal of Agricultural Economics. 5655(4): 671-682.

Saidu, H. (2012). Economic Analysis of Small and Large-Scale Maize Production in Soba Local Government Area of Kaduna State, Nigeria. Unpublished M.Sc. Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria.

Shehu, J. F. (2007). Comparative Economic Analysis of Small-holder Rain-fed and Irrigated Rice Production in Selected Local Government Areas of Adamawa State. M. Sc. Thesis, Unpublished, Yola: Federal University of Technology Yola.

Smith, J., Weber, G., Manyong, V. M. and Fakorede M. A. B. (1997). Fostering sustainable increases in maize productivity in Nigeria. Chapter 8 *in* Africa's emerging maize revolution, edited by D. Byerlee, and C.K. Eicher, Lynne Rienner Publishers, London, UK.

Tanko, L. (2004). Optimum Combination of Farm Enterprises in Kebbi State, Nigeria: A Linear Progrmming Approach, "Unpublished Phd Dissertation, Department of Agricultural Economics, Micheal Okpara University of Agriculture Umudike Nigeria

Tauna, A. H. (1999). Contributions of Women in Maize Production, Prospects and Constraints. Valencia, J. A., Falaki, A.M., Miko, S., Abubakar, I.U. Jaryum, J and Ado, S. G. (eds). Proceeding of the SG/2000/IAR/FACU/ADPs National Maize Workshop 15th August, held at Hassan Usman Katsina House, Kaduna Pp. 62

Thapa, S. (2007). The Relationship between Farm Size and Productivity: Empirical Evidence from the Nepalese Mid-Hills. Unpublished Ph.D Dissertation, Department of Economics and Resource Management, Norwegian University of Life Sciences, Norway.

Udoh, A. J. and Nsikak-Abasi, A. E. (2007). Application of Stochastic Production Frontier in the Estimation of Technical Efficiency of Cassava Based Farms in Akwa Ibom State, Nigeria. *Agricultural journal* **2**:(6): 731-735.

Udoh, A. J. and Nyienakuna, M. G. (2008). Examining Socioeconomic Characteristics and Adoption Trend of Artisanal Fisheries of Akwa Ibom state of Nigeria, *Journal of Agricultural Science*, **4**:141-146.

Ugwuja, V. C., Adesope, O. M., Odeyemi, T. J., Matthews-Njoku, E. C., Olatunji, S. O., Ifeanyi-Obi, C. C. and Nwakwasi, R. (2011). Socioeconomic Characteristics of farmers as correlates of fertilizer Demand in Ekiti State, Southwest Nigeria: Implication for Agricultural Extension. *Greener Journal of Agricultural Science. 1(1) pp: 48-54.*

Umar, S. I., Ndanitsa, M. A. and Olaleye, S. R. (2009). Adoption of Improved Rice Technologies among youth farmers in Gbako Local Government area, Niger State.Journal of Agricultural Extension. 13(1): 1-8.

Upton, M. (1996). The Economics of Tropical Farming Systems, Cambridge University Press, P 374.

Voh, J. P. (1979). An Exploratory Study of Factors Associated with Adoption of Recommended Farm Practices among Giwa farmers. Samaru Miscellaneous Paper 73, Institute for Agricultural Research. Ahmadu Bello University, Zaria, Nigeria.

Von Braun, J. (1991). A Policy Agenda for Famine Prevention in Africa. Food Policy Report. The International Food Policy Research Institute. Washington, D.C. p. 3

Wedderburn, S. (1989). Cost-Benefit analysis of fertilizer use in Nigeria. Towards better harvest for rural farmers. Proceedings of the first fertilizer workshop held in Durbar Hotel, Kaduna, June 5-7.

Yayock, J. Y., Lombin, G. and Owonubi, J.J. (1988). Crop Science and Production in Warm Climates. Macmillan Publishers Limited. London and Basingtoke.

APPENDIX 1

DEPARTMENT OF AGRICULTURAL ECONOMICSAND RURAL SOCIOLOGY, AHMADU BELLO UNIVERSITY SAMARU, ZARIA.

FARMERS RESEARCH QUESTIONNAIRE

TOPIC: ECONOMIC ANALYSIS OF MAIZE PRODUCTION IN KADUNA STATE

Dear Respondent,

This questionnaire will be used by a student in the above- named department. Please, provide the necessary information required in the questionnaire.

All information will be treated with utmost confidentiality and will strictly be used for accademic purposes.

Thanks for your cooperation.

Name of Farmer...

Village..

(A)Socio-Economic Characteristics

1. Age of Farmer (years)
2. Gender: (a) Male ( ) (b) Female ( )

3. Marital Status: (a) Single ( ) (b) Married ( ) (c) Divorce ( )
4. Household Size (Number)………………………..
5. Farming Experience………………………..Years.
6. What is your highest educational level
   (a). No formal education
   (b). Primary education. -------------------------------- (years)
   (c). Secondary education.------------------------------. (years)
   (d). Tertiary education. ---------------------------------. (years)

7 Do you have access to credit? Yes ( ) No ( )

(c) Did you obtain any credit last season? Yes ( ) No ( )

(d) What was the source? (i) Friends ( )(ii) Relatives. ( ) (iii) Commercial Bank ( ) (iv) Co-operative Bank ( ).(v) Others (Specify) ______________________________

(e) How much credit did you obtain?₦ ………………………………..

8. Do you have access to extension services? Yes ( ) No ( )

Number of times visited by extension agents last season). ------------------------------

9. Are you a member of farmers association? Yes ( ) No ( )

If yes for how long................................ Years

If no why are you not a member of a farmers association? ---

10. What system of cropping did you used? Sole cropping ( ), Mixed cropping ( )

If mixed cropping what other crop(s) did you plant --------------------------

Inputs Used.

(I). Farm Size (ha)

i) How many maize farm plots do you have and what are their sizes?

Plots	Farm size (ha)	Mode of acquisition
I		
II		
III		

Mode of acquisition of your farmland? (a) Inheritance (   ) (b) Lease (   ) (c) Rent (   ) (d) Purchase ( ) (e) Gift ( ) (f) Borrowed ( )(g) Government allocation (   )

iii. What is the rentage for a hectare of land per season ? ₦.....................

II. Labour Used

i. Hired Labour**.**

	ADULT MALE			ADULT FEMALE			CHILDREN			TOTAL
	Number	Days	Wages rate	Number	Days	Wages rate	Number	Days wages	rate	Man-days
Land Preparation										
Planting										
Fertilizer Application										
Weeding										
Harvesting										
Packing										
Threshing and Bagging										
Transportation										

Adult is 18 years and above.

ii. Family Labour.

	ADULT MALE		ADULT FEMALE		CHILDREN	
	Number	Days	Number	Days	Number	Days
Land Preparation						
Planting						
Fertilizer Application						
Weeding						
Harvesting						
Packing						
Threshing & Bagging						
Transportation						

i. What is the cost of adult labour per day? ₦ --------------------

ii. Fixed Cost

Fixed items	**Number**	**Cost/unit**	**Total cost**
Tractor			
Hoes			
Cutlass			
Sprayer			
Warehouse/store			

If you hire tractor how much do you pay per day ₦---------------

III. Seed

Plots	**Quantity of seed (kg)**	**Cost/kg**	**Sources**
I			
II			
III			

Sources

i). ADP (ii) Seed Company (iii) Open Market (iv) Own.(v) Others (Specify)________________

IV. Fertilizer

Plot I

Type	Quantity used (No of bags)	Total Quantity (kg)	Cost per Bag (₦)	Total Cost (₦)
N.P.K				
CAN (Urea)				
SSP				

ANIMAL MANURE				

Plot II

Type	Quantity used (No of bags)	Total Quantity (kg)	Cost per Bag (₦)	Total Cost (₦)
N.P.K				
CAN (Urea)				
SSP				
ANIMAL MANURE				

Plot III

Type	Quantity used (No of bags)	Total Quantity (kg)	Cost per Bag (₦)	Total Cost (₦)
N.P.K				
CAN (Urea)				
SSP				
ANIMAL MANURE				

V. Agrochemicals.

Plot I

	Quantity	Total Cost (N)
Herbicide		
Pesticide		

Plot II

	Quantity	Total Cost (N)
Herbicide		
Pesticide		

Plot III

	Quantity	Total Cost (N)
Herbicide		
Pesticide		

VI. Farm Output & Income Level.

Quantity Harvested (bag of 100kg)	Total Quantity (Kgs)	Unit Price Per Bag (N)	Total Revenue (N)

VII. Production Constraints:

List by ranking the problems you face in producing maize and the cropping system adopted.

No	Problem	Cropping system
1		
2		
3		
4		
5		
6		

Suggest ways of improving maize production in your community

1.--

2.--

3. --

APPENDIX 2

Marginal Value Productivity and Resource Use Efficiency in Maize Production

Marginal Physical Product (MPP)

$$MPP = b_i \frac{\bar{y}}{\bar{x}}$$

Farm size = (0.069 * 5129.28) / 1.14

= 310.46

Seed = (0.476 * 5129.28) / 20.37

= 119.86

Labour = (-0.052* 5129.28) / 90.31

= -2.95

Fertilizer = (0.478 * 5129.29) / 498.47

=4.92

Agrochemicals = (-0.059 * 5129.28) / 5.36

= -56.46

Marginal Value Product (MVP)

$$MVP = b_i \frac{\bar{y}}{\bar{x}} p_y = MPP * P_y$$

Farm size = 310.46 * 45 = 13,970.7

Seed = 119.86* 45 = 5,393.7

Labour = -2.95 * 45 = -132.75

Fertilizer = 4.92* 45 = 221.4

Agrochemicals = -56.46 * 45 = -2,540.7

Variable inputs	$\bar{X}$	MPP	MVP	MFC	MVP/MFC
Farm size	1.14	310.46	13,970.7	5,240.91	2.67
Seeds	20.37	119.86	5,393.7	157.3	34.29
Labour	90.31	-2.95	-132.75	600	-0.22
Fertilizer	498.47	4.92	221.4	95	2.33
Agrochemicals	5.3	-56.46	-2,540.7	800	-3.18

Price of maize per kg (P_y)= ₦45

Output = 5129.28kg/ha

APPENDIX 3

Depreciation

Depreciation (D) is the difference between the purchase value (P) and the salvage value (S), divided by the number of years of life of the asset (N). This is expressed as:

$$D = \frac{P-S}{N}$$

	Calculation	**Cost**
(N/ha)		
Total purchase value on hoes (344,050)	344,050 / 163	2,110.74
Salvage value (10%)	(2110.74-211.07) / 2	
Life of asset (2years)	1899.67 / 2	
Depreciation on hoes		949.83
Total purchase value on cutlass (55,990)	55,990 / 163	343.50
Salvage value (10%)	343.5-34.35 / 2	
Life of asset (2years)	309.15 / 2	
Depreciation on cutlass		154.57
Total purchase value on sprayers (994000)	994,000 / 163	6,098.16
Salvage value (10%)	6,098.16- 609.82 / 5	
Life of asset (5years)	5,488.34 / 5	
Depreciation		1,097.67