MICRO-CREDIT UTILIZATION AND ITS IMPACT ON FARMERS MAIZE OUTPUT AND HOUSEHOLD FOOD SECURITY IN KADUNA STATE, NIGERIA

BY

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

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DECLARATION

I declare that thework in this thesis entitled "**Micro-credit Utilization and its Impact on Farmers Maize Output and Household Food Security in Kaduna State, Nigeria"** has been performed by me in the Department of Agricultural Economics. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

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CERTIFICATION

This thesis entitled '**MICRO-CREDIT UTILIZATION AND ITS IMPACT ON FARMERS MAIZE OUTPUT AND HOUSEHOLD FOOD SECURITY IN KADUNA STATE, NIGERIA',** by **Alhaji Sadiq, IDI**meets the regulations governing the award of the Degree of Doctor of Philosophy of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to my dearest Grandmother Hajja Bintu Bukar Kolo, who laid a great foundation for my education. To my dear Wife Yakolo Shettima, Bulama

Idi(brother) and my Lovely Children (Idris, Ahmad, Isa, Abdul Malik, Muhammad and Umar Farouk) for their Support and Prayers.

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ABSTRACT

This study investigated micro-credit utilization and its impact on farmers' maize output and household food security in Kaduna State. The specific objectives of the study were to describe and compare the socio-economic characteristics of beneficiaries and non-beneficiaries of microcredit; investigate and compare productivity efficiency of the farm enterprises of beneficiaries and non-beneficiaries of microcredits; determine and compare profitability of the farm enterprises of beneficiaries and non-beneficiaries of micro-credits; determine and compare the food security status of beneficiaries and non-beneficiaries of microcredit; examine the impact of microcredit utilization on farmers maize output and household food security; identify and discuss the constraints faced by beneficiaries and non-beneficiaries of microcredit in the study area. Primary data were collected from two categories of farmers; beneficiaries and non-beneficiaries of micro-credit through the use of structured questionnaire. A multi-stage sampling procedure was adopted to collect primary data from four LGAs namely Zango-Kataf, Chikun, Lere and Giwa. The data for analysis was based on 2015 farming season and were analyzed using descriptive statistics, stochastic production frontier**,** budgetary analysis, cost-of-calorie index, Binary choice models (Logit) and Propensity Score Matching model. The findings revealed that, there was a higher level of technical inefficiency among non-beneficiaries of micro-credit than beneficiaries of micro-credit with the output of non-beneficiaries dropped by 3% from the maximum feasible level of 1.00 due to technical inefficiency. Maize production enterprise is a profitable venture with an average rate of return of ₦ 1.33 and ₦ 0.90 by beneficiaries and non-beneficiaries of micro-credit, respectively. It was found that 104(31%) maize farming households were food secure while 232(69%) were food insecure. Furthermore, 69 percent of the sampled maize farming households fell short of the recommended daily calorie requirement of 2700

kcal/persons/day.The logit regression analysis revealed that socio-economic characteristics– sex, age, marital status, household size, education and land size were the significant factors influencing the food security status of maize farming households in the study area.The results from Propensity Score Marching estimator revealed that micro-credit utilization had a positive and statistically significant impact on maize output and food security among maize farming households. Specifically, the Nearest Neighbour marching (NNM) shows that an additional maize output and per capita income of 2,920.47kg (29%) and ₦254, 080.94 (29%) on average was achieved, by maize farming household who used microcredit during the production period under study. Both beneficiaries and non-beneficiaries of micro-credit ranked low output price as foremost constraints faced. The study reveals that majority of the farming households (69%) were found to be food insecure. Further, the Binary Logit Model results reveal that sex, age, marital status, household size, education and land size were the factors influencing the food security status of maize farming households in the study area. Food insecurity coping strategies adopted by the farming households have short term effect. Therefore, there is the need to increase the volume of food production, improve access on income generating activities that are more sustainable as well as provision of input such as weedicides, fertilizer, improves seeds and others to motivate farming households and increase their productivity.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Since its introduction in the mid-1970s, microcredit has been considered a major tool for development and poverty reduction (Fisher and Sriram, 2002). By the end of 2007, microcredit programmes reached over 154 million clients worldwide, notably women in developing countries. Proponents of microcredit claimed that it help poor people to reduce risk, raise productivity, obtain high returns on investment, increase income, and improve the quality of their lives and that of their defendants (Robinson, 2001; Goldberg, 2005). It is further believed that microcredit can play a major role in assisting the poor to improve out of poverty by providing start-up capital which they have been unable to access historically because financial markets are underdeveloped in poor countries (Getaneh, 2004). There is, however, no consensus among academicians about the actual impact of microcredit on poverty reduction and household food security (Fisher and Sriram, 2002; Weiss and Montgomery, 2005; Banerjee, Duflo, Glennerster, andKinnan,2009). Karlan and Zinman (2010) argued that, despite claims about the role of microcredit in lifting the poor out of poverty, there is little agreement as to whether credit does borrowers more good than harm.

Studies have shown that people living in poverty devise mitigation measures to overcome their economic vulnerability (Yunus, 2004). Microcredit (MC) is one such measure to reduce the burden of poverty among households in many of the developing countries of the world, including Nigeria. Microcredit means the easily repayable small loans that low income earners get informally from friends, relatives and people in the

same network and from formal credit lending institutions like banks and microfinance institutions.

Microfinance pertains to the lending of small amount of capital to poor entrepreneurs in order to create a mechanism to alleviate poverty by providing the poor and destitute with resources that are available to the wealthy, albeit at a small scale. According to Anyanwu (2004), a microfinance bank do not just provide capital to the poor, but also aims at combating poverty at an individual level and also seeks to create institutions that deliver financial services to the poor who are continuously ignored by the formal banking sector.

In Africa and other developing regions, microfinance institutions (MFIs) are regarded as the main source of funding micro-enterprises (Anyanwu, 2004). Formal credit and savings institutions for the poor are also available around the globe providing customers, who were traditionally neglected by commercial banks, a way to obtain financial services through cooperative and development finance institutions. The inability of formal financial institutions to provide financial services to the urban and rural poor, coupled with the un-sustainability of government sponsored development financial schemes led to the growth of private sector led microfinance in Nigeria. The gap filled by microfinance institutions has made it to become part of the formal financial system of a country and so can access the capital market to fund their lending portfolios, allowing them to dramatically increase the number of poor people they can reach.

The federal government of Nigeria adopted microfinance as the main source of poverty reduction in Nigeria and mandated the Central Bank of Nigeria (CBN) to develop appropriate policy and framework for the operations of MFIs. Despite this, the number of beneficiaries of microfinance banks is an insignificance proportion of the people in need of microfinance services. According to Wali (2009), microcredit has insufficiently penetrated the poor strata of society who comprise of the marginalized and deprived category of people living below the poverty line. About 90% of the poor people in developing countries don't have access to financial services for either credit or savings (Mohammed, 2008). This limits their capacity to access capital which affects productivity, domestic savings and the ability of households to engage in businesses which would improve their household income (Sawyer, 1995; and Mohammed, 2008).

Microcredit institutions have largely ignored borrowers' characteristics such as education, collateral, character and credit worthiness. Educational level determines usage of credit positively or negatively (Thapa, 2007). Collateral availability increases the borrower's chances of getting credit and reduces the risk of microcredit institutions losing the borrowed funds whereas the character of borrowers and their credit worthiness play a big role in utilizing credit and its eventual pay back. This study attempts to address microcredit utilization and its impact on farmers' output and household food security.

Maize is widely grown across Nigeria. All of the 36 states and the FCT (Federal Capital Territory) grow maize. Those states with the highest maize area are Niger, Kaduna, Ogun, Kogi, Taraba, Katsina, Oyo, Plateau, Ondo, and Kano. Together, these account for nearly 57% of the total area. In a similar fashion, Kaduna, Niger, Plateau, Borno, Kano, Ondo, Ogun, Taraba, Kogi, and Bauchi together account for close to 60% of

maize production in the country.The productivity of maize is extremely variable among the states. Greater rates of growth (ROG) were reported for 15 of the 36 states and FCT between 1994 and 2012. Notable among these were Yobe (ROG = 7.5%), Katsina (4.8%), Jigawa (4.2%), Zamfara (2.9%), and Oyo (2.5%). By contrast, 22 states had negative growths over the same period – with Kaduna (-6.0%), Taraba (-5.1%), Delta (-5.1%), Imo (-3.9%), and Plateau (-3.7%), showing the highest negative growth rates between 1994 and 2012(International Institute of Tropical Agriculture IITA,2014).

1.2 Statement of the Problem

With high and rising food prices and inadequate availability of food, food security in Nigeria is increasingly threatened. Also, low income and periodic collapse of purchasing power through loss of jobs in certain areas of Nigeria, has greatly reduced affordability of food. So, it has become imperative to devise means to tackle this situation. Increasing food production and attaining food security in Kaduna require timely and adequate supply of agricultural inputs including agricultural credit. The farmers in the rural areas require financial support from institutional and non-institutional sources to meet the expenses of various agricultural activities. Although agriculture is practiced everywhere, small holder farmers are still engrossed in abject poverty. These farmers are characterized by low productivity, low income, large family size, lack of formal education, low savings and investment, lack of access to credit facilities, inefficient use of abundant resources and continued use of crude implements (Panwal, Noble and Joseph,2006).

Maize is an important food and feed crop in Nigeria and remains an important crop for rural food security. The production of the crop must be increased in order to ensure food

and income security through the development of improved maize varieties and technologies. Maize is a staple food of great socioeconomic importance in developing countries and it has a wide range of uses these include; baking, brewing industries and livestock feed. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals. Green maize (fresh on the cob) is eaten parched, baked, roasted or boiled; playing an important role in filling the hunger gap after the dry season and serving as a staple diet for 200 million people (Directorate Agricultural Information Services in cooperation with ARC-Grain Crop Institute, 2003), while in developed countries, maize is consumed as second-cycle produce in the form of meat, eggs and dairy products. The importance of maize cannot be overemphasized, with Nigeria producing 43% of maize grown in West Africa. Maize is the most important staple food in Nigeria. It accounts for about 43% of calorie intake (Nweke et al., 1983; NARP, 1994). Maize has consumption quantity of 53.20g/capital/day Federal office of statistics (FAOSTAT, 2007).

According to FAO data, the area in which maize was planted in West and Central Africa alone increased from 3.2 million hectares in 1961 to 8.9 million hectares in 2005. This phenomena expansion of the land area devoted to maize resulted in increased in production from 2.4 million metric tonnes in 1961 to 10.6 million metric tonnes in 2005. In Nigeria, between 2004 and 2007, the quantity of maize produced ranged from 5,567,000 tonnes to 7,800 tonnes (FAO, 2008). Production per hectare is still very low (1.3 tonnes per ha) in most developing countries. The poor performance in the agricultural sector has led to decline in agricultural production and overall low economic growth. This has called for the intensification of agriculture through development of improved varieties and production technologies (FAO, 1986).Maize

production in Nigeria has not been sufficientenough to meet the needs of people and livestock.Supply has not been able to meet demand despite the introduction of improved packages (Babatunde et al., 2008).

Considering credit as a crucial factor in ascertaining sustainable development of the agricultural sector, it is necessary to find ways in which farmers' access to credit can be ensured. As small farmers (cultivating more than 1ha) have little or no access to formal sources of credit, microcredit can provide them access to purchase of inputs like seed, fertilizer and irrigation at proper times. This, in turn, helps use of new production technologies thereby increasing food production and ensuring food security.

Access to credit plays a prominent role in poverty reduction particularly among the rural poor. For instance, access to microcredit of a peasant farmer can assist him/her to procure materials that can serve as input for improved productivity. In the like manner, accessibility of microcredit to rural/urban artisan can enable him/her to increase the working capital that can boost the trade with improved customer satisfaction, increased income and eventually escape from poverty trap;all this can lead to increase in output and household food security (Todaro and Smith, 2011).The question would then be the extent to which microcredit has been utilized and whether or not it has empowered the beneficiaries. Hence, the systematic evaluation of the impact of microcredit utilization on household maize output and food security are uneven and thus inadequate. Consequently, this study set out to analyze the impact of microcredit utilization onfarmers' maize output and household food security in the study area and to address the following research questions:

i. What are the socio-economic characteristics of the beneficiaries and non-beneficiaries of micro-credits in the study area?

ii. Are farm enterprises in term of technical efficiency of beneficiaries of microcredit better than those of non-beneficiaries?

iii. Are farm enterprises in term of profitability of beneficiaries of microcredit better than those of non-beneficiaries?

iv. Are households of microcredit beneficiaries more food secured than those that did not?

v. What is the impact of micro-credit utilization on household farm output and food security?

vi. What are the constraints encountered by beneficiaries and non-beneficiaries of micro-credits in the study area?

1.3 Objectives of the Study

The broad objective of the study was to examine the utilization of microcredit and its impact on the farmers' maize output andhousehold food security. The specific objectives were to:

i. describe and compare the socio-economic characteristics of beneficiaries and non-beneficiaries of microcredit in the study area;

ii. determine and compare technical efficiency of the farm enterprises of beneficiaries and non-beneficiaries of micro-credits in the study area;

iii. investigate and compare profitability of the farm enterprises of beneficiaries and non-beneficiaries of micro-credits in the study area;

iv. determine and compare the food security status of beneficiaries and non-beneficiaries of microcredit in the study area;

v. examine the impact of microcredit utilization on farmers Maize output and household food security and:

vi identify and discuss the constraints faced by beneficiaries and non-beneficiaries of microcredit in the study area.

1.4 Hypotheses of the Study

The hypotheses tested in this Study are:

i. There is no significant difference between the socio-economic characteristics of beneficiaries and non-beneficiaries of microcredit in the study area;

ii. There is no significant relationship between beneficiaries' socioeconomic characteristics and their household farm input utilization, output, profitability and food security.

iii. Microcredit utilization has no impact on farm enterprise input utilization, output and profitability of the beneficiaries in the study area.

iv. Utilization of microcredit has no impact on the food security of beneficiaries in the study area.

1.5 Justification of the Study

In view of increasing concerns about the food situation as a result of world population growth and accelerated world food demand especially among low income, large population countries, the need for substantial new investment in agriculture is eminent, this will be made possible by access to credit. For the small scale maize farmers operating with virtually no capital, access to farm credit is very important as no matter how knowledgeable or well desirous he/she may be, without credit, he/she cannot adopt new technologies such as the use of improved seeds, fertilizers, herbicides, tractors, and so on.

Economists and rural development experts have acknowledged that the performance of most credit programmes have fallen short of expectations. Although various factors account for the limited success of subsidized credit programmes, the failure of these programmes can at least partially be attributed to defects within the institutions designed to carry them out and in part, to the assumptions underlying past policies (Braverman and Huppi, 1991).

The failure of many poverty and food security interventions in Nigeria have also been attributed to financial institutions and policy makers ignoring the relevance of credit in food security and income portfolios across the rural households (Adebayo, 2010). This study is, therefore, part of a growing body of literature that intends to make

policymakers provide alternative ways and forms of managing and channeling credit to rural markets that could eradicate or at least significantly reduce the problems previously encountered.

This study seeks to provide empirical data on the sources, determinants and effect of credit on the welfare of farm households as well as on the food security status and its determinants among the farm households in the study area. According to the World Bank (1994), of the many studies already conducted on farm credit, but very little is known on the extent to which farmers need agricultural credit, the uses to which borrowed funds are put and perhaps most significantly the impact of credit on farm productivity and incomes. This trend probably influenced the call by the United Nations Agricultural Credit Conference that studies should be carried out to evaluate the impact of farm credit to enable credit institutions establish successful credit programmes and credit limits for different categories of farmers.

It is envisaged that the results of the study will contribute in the design of appropriate food security policies and enhance the provision of credit services on sustainable basis to the poor with the aim of achieving the agricultural transformation agenda of increasing farm incomes, food security and poverty reduction in Nigeria.

The importance of microfinance in eradicating poverty made the federal government of Nigeria to adopt it as the main source of poverty reduction in Nigeria and mandated the CBN to develop appropriate policy and framework for the operation of MFIs. Despite this, however, the number of beneficiaries of microfinance banks is an insignificant proportion of the people in need of microcredit services. It has been estimated that formal microfinance banks only services less than one million clients in a country where

over 70% of the country's population lives below poverty line (Irobi, 2008) and is engaged in agriculture which requires a high amount of credit to increase production. It is, therefore, necessary to determine microcredit utilization and its impact on maize farmers' output and household food security in Kaduna state and consequently help in coming up with policies that will enhance better performance.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Literature

2.1.1 The concept of microfinance and microcredit

The two concepts of micro-finance and micro-credit are closely related and some scholars tend to use them interchangeably, though they are different in meaning. According to Taneja (2009), microfinance refers to providing loans and finance to poor people for self-employment. Generally, small amounts are disbursed as loans, and the timeframe for repayment of loans is longer compared to commercial banks. In contrast, micro-credit is the provision of credit services to low income clients in form of small loans for the purpose of micro-enterprises and income generating activities. Micro-loans are a financial innovation which originated in developing countries where it has successfully enabled extremely impoverished people to engage in self-employment projects that allow the poor and voiceless to generate income begin to build wealth and exit poverty (Foreman, 2001). Recognizing this, government and donors have sought to promote small firms usually through credit programs (Wali, 2009). Many developing countries have supported it because it offers the rural poor access to flexible financial services as well as improving their welfare (Okurut *et al.*,2004). Microcredit institutions enhance households' capacity by the poor.

Microcredit was invented in Bangladesh during the famine of 1974, when professor Yunus studied the lives of the poor entrepreneurs in Bangladesh. Yunus began by loaning to groups of women an equivalent of $30 to forty two basket weavers to help them purchase bamboo. Upon the advice of banks and government, he carried on giving out micro-loans and in 1983 formed the Grameen Bank. The programme proved that small loans could not only quickly improves lives of poor people, but were paid back with interest and on time and by 1997, there were 1.8 million poor borrowers in 22,000 of out 68,000 villages in Bangladesh with 830 million credits worth every month (Microcredit Summit, 1997; Yunus, 2004).

Consequently, micro-finance emerged in the 1970s as an alternative to the development finance institution to delivering financial intermediation to the poor and voiceless. The design of the financial services offered by microfinance institutions (MFI) were largely based on the mechanisms of informal sector self-help groups such as rotating savings and credit association (ROSCAs) but came to prominence after the Grameen Bank and Bangladesh Rural Advancement Committee (BRAC) in Bangladesh which were modeled on the social support of group solidarity in helping the poor households to exit their unfortunate condition of poverty.

The importance of microfinance in eradicating poverty made the federal government of Nigeria to adopt it as the main source of poverty reduction in Nigeria and mandated the CBN to develop appropriate policy and framework for the operation of MFIs. Despite this, however, the number of beneficiaries of microfinance banks is an insignificant proportion of the people in need of micro services. It has been estimated that formal microfinance bank only services less than one million clients in a country where over 70% of the country population of 140 million lives below poverty line (Irobi, 2008). It is therefore necessary to determine micro credit utilization and its impact on farmer output and household food security in Kaduna state.

Access to Credit and Participation in Formal Credit Programmes

Access to formal credit is often confused with participation in formal credit programmes. Indeed, the two concepts are often used interchangeably in many credit studies. The crucial difference between the two concepts lies in the fact that participation in a credit programme is something that households choose to do, while

access to a credit programme is a limiting constraint put upon them (e.g. availability and eligibility criteria of credit programmes). Participation is more of a demand-side issue related to the potential borrower's choice of the optimal loan size, while access is more of a supply-side issue related to the potential lender's choice of the credit limit.

The difference between the two concepts may become clearer by remembering from the arguments above that in any area with a formal credit programme, the group of non-participants can be divided into two sub-groups, the first consisting of the non-participants who were constrained through eligibility criteria and the other by those who choose not to participate because their optimal demands for formal credit were zero. If it is assumed that credit programme participants are always able to borrow, i.e. for participants, then it is clear that the second subgroup of eligible non-participant do have access to formal credit. Some may be uncomfortable to see some non-participants classified as having access to formal credit. However, this is consistent with the fact that programme participation is not a separate spontaneous decision, but is rather part of the demand for formal credit, under uncertainty, is a contingent plan (a sequence of acts contingent on the occurrence of random events) formulated well in advance of the time of possible borrowing. The decision to participate in a credit programme is just a contingent act within that contingent plan (which includes other contingent acts such as how much to ask to borrow, when to ask it, and so on) and it is implemented only if the demand for credit is not unconditionally zero and the events upon which that decision was conditioned do occur. Hence, if a non-participant does not anticipate wanting formal credit, there is no need for him to consider joining a formal credit programme, even if, he could possibly borrow from that programme, that is by definition he has access to formal credit (Diagne *et al.*, 2000).

2.1.2 The concept of food security

Food security is a concept that has evolved over time. As much literature has spiraled, many definitions and conceptual models on household food security have been presented (Smith and Simon,1992). There are approximately 200 definitions and 450 indicators of food security (Hoddinott, 1999). In Africa, food crisis in the early 1970s stimulated a major concern on the part of the international donor community regarding supply short falls created by production failures due to drought and desert encroachment (Maxwell and Frankenberge,1992). In 1983, the FAO analysis focused on food access, leading to a definition based on the balance between the demand and supply side of the food security equation: "Ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO, 1983). In the World Bank (1986) report, Poverty and Hunger, this concept of food security is further elaborated in terms of: 'access of all people at all times to enough food for an active, healthy life.'

At the 1996 World Food Summit, 182 nations agreed and adopted a still more complex definition: 'Food security, at the individual, household, national, regional and global levels. Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life' (FAO, 1998). This definition integrates stability, access to food, availability of nutritionally adequate food and the biological utilization of food. As a result, a synthesis of these definitions, with the main emphasis on availability, access, and utilization, serves as working definition in projects of international organizations.

Common to most definitions of food security are the elements of availability, access, utilization and stability or sustainability.

Availability: In this context, availability refers to the physical existence of food, be it from own production or on the markets. On national level food availability is a function of the combination of domestic food stocks, commercial food imports, food aid, and domestic food production, as well as the underlying determinants of each of these factors. Use of the term availability is often confusing, since it can refer to food supplies available at both the household level and at a more aggregate (regional or national) level. However, the term is applied most commonly in reference to food supplies at the regional or national level (Riely *et al*. 1999).

Access: Access emphasizes on having sufficient resources to obtain appropriate foods for a nutritious diet. It is the way different people can obtain the available food. Normally, we access food through a combination of home production, stocks, purchase, barter, gifts, borrowing or food aid. Food access is ensured when communities and households and all individuals within them have adequate resources, such as money, to obtain appropriate foods for a nutritious diet (Riely *et al.* 1999). Access depends normally on income available to the household, the distribution of income within the household, the price of food, and other factors worth mentioning are individuals' access to market, social and institutional entitlement/rights.

Utilization: Utilization has a socio-economic and a biological aspect. If sufficient and nutritious food is both available and accessible, the household has to make decisions concerning what food is being consumed (demanded) and how the food is allocated

within the household. In households where distribution is unequal, even if the measured aggregate access is sufficient some individuals may suffer from food deficiency.

Stability: Stability or sustainability refers to the temporal dimension of nutrition security, that is, the timeframe over which food security is being considered. In much of the food security literature, a distinction is drawn between chronic food insecurity - the inability to meet food needs on an ongoing basis—and transitory food insecurity when the inability to meet food needs is of a temporary nature (Maxwell and Frankenberger, 1992).

2.2 Theoretical Framework

2.2.1 Theoretical framework of microcredit

Microcredit allows the recipients to break the vicious cycle of poverty by creating immediate self-employment and generating income, which in turn helps the participant to achieve food security for them and their family member (Latifee 2003:5). How micro-credit can improve food security may better be assumed by understanding the concept of poverty and the mechanisms by which financial services (microcredit) can affect the lives of the poor and reduce poverty. Generally, poverty related to shortage of income (White 2012), however, Sen (2001) claims that poverty signifies the deficiency of some basic capabilities to function. The more comprehensive idea of capability deprivations helps to recognize the broader context of poverty, and explains certain social phenomena.The main argument of this thesis is that, poverty is the major driver of food insecurity and empowerment of women can help them to get rid from poverty, thus can serve as an important tool for reducing food insecurity. Hence, the Capability Approach (CA) could be used to better explain the concept of poverty alleviation,

development and empowerment of the rural Bangladeshi women. In a capability framework for poverty analysis, the standard viewpoint would come from the approach, while the specific dimensionality would be decided contextually**.** Therefore**,** in a practical way, a capability framework can contribute to the understanding of multiple deprivations within society (Hick 2012:12).

2.2.2Theoretical and empirical framework of food security

Availability, access and utilization are very important hierarchal pillars that ensure household level food security (Maxwell and Wiebe, 1999). Any of these pillars is necessary but not sufficient on its own for food security (Barrett 2010). Access to food either by own production or through exchange of other commodities and services (known as entitlements in Sen, 1981) depends on access to resources, production technologies, environmental conditions, market conditions, non-market food transfers and accumulated food reserves, including coping and adaptive strategies (Chavas *et al.*, 2005, Maxwell and Wiebe, 1999). Following the 1996 World Food Summit, the prevailing definition of food security agreed upon holds that it represents a situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Maxwell and Wiebe, 1999; Barrett, 2002). Such a broader definition covers more than simply household level nutritional status, capturing vulnerability to future changes in access to adequate and appropriate food as well (Barrett, 2010).

The complex nature of food security calls for constructs that are composite in order to capture the quality, quantity, vulnerability and sustainability aspects that show up often in studies Some indices that can be used include food expenditure at the household level, dietary diversity measure (considering that nutritional security is an integral part

of food security), underweight, under-nutrition and malnutrition incidences, levels of reported consumption, levels of reported food insecurity, and levels of production at the household level. In most studies, the choice among indicators involves trade-offs, so that the objective necessitating measurement commonly drives the choice of indicator.Expenditure on food is an important indicator of food security too because it also captures the concept of vulnerability to food insecurity (Farid and Wadood, 2010; Hendriks and Msaki, 2009). Higher expenditure proportions are essentially indicative of intertemporal vulnerability to food insecurity (Farid and Wadood, 2010). To capture some of the food security dimensions mentioned above, the food security variable ought to be constructed as a scale that will proxy different levels of food security. Such a scale could be computed by aggregating household level responses to questions on malnutrition incidences, food deficit incidences, future availability worries, eating of balanced diets, diversity of foods eaten per week, and weekly expenditure on foods (Guo, 2010and Bickel *et al.,* 2000). If deemed appropriate, these could be scored and aggregated into a composite index that would be monotonic where higher numbers represent food security and lower numbers represent food insecurity. Alternatively, different measures can be used in estimation and results can be compared across estimation techniques.

2.3 Empirical Literature

2.3.1 Perception and attitude toward access and utilization of microcredit

Empirical evidence shows that, among the poor, those participating in microfinance programmes who had access to financial services were able to improve their wellbeing both at the individual and household level much more than those who did not have access to financial services. It was regarded by Consultative Group to Assist the Poor

(CGAP,2003) that Bangladesh Rural Advancement Committee (BRAC) clients increase household expenditures by 28% and assets by 112% after being involved in BRAC's micro-credit program. Furthermore, it was revealed that after more than eight years of borrowing, 57% of Grameen borrower households were no longer poor as compared to 18% of non-borrower household. In Lombok, Indonesia, the average income of Bank Rakyat Indonesia (BRI) Borrowers increased by 112% and 90% of households graduated out of poverty. In Vietnam, save the children clients reduced food deficits from three months to one month. Also, at Kafo Jiginew in Mali, clients who had been with the programme for as little as one year were significantly less likely to have experience a period of acute food insecurity and those that had, had experienced a shorter period. In Bangladesh, a survey of 1,300 clients and non-clients showed that credit clients were significantly more empowered than non-clients in terms of their physical mobility, ownership and control of productive assets (including land), involvement in decision making and awareness of legal and political issues.

A World Bank study has shown evidence of wide range impacts of microcredit on the condition of the borrowers. The Grameen Bank and Bangladesh Rural Development Board (BRDB). The findings revealed that per capita expenditure and household net worth have increased due to microcredit among the borrowers of all these programmes. A BRAC research examined the impact of poverty in wider dimension and reported that 52% of the BRAC member households were below the poverty line while a higher number (69%) of the comparison households was lying below the line. The overall findings showed gradual improvement in the indicators such as wealth, revenue earning assets, value of house structures, the level of cash earned, per capita expenditure on food and total household expenditure (Nosiru, 2010).

Access to even small-scale deposit and credit services, together with other productive services, can work something close to miracles. Our experience, in a variety of conditions across the developing world, underlines that the rural poor are really bankable. We must nonetheless keep in mind not only the benefits but also the limits of microfinance as a tool. It is not enough by itself to ensure sustainable development for the rural poor. The poor equally need access to better technologies, to health and education services, to fair markets and adequate infrastructure (Fanozi, 2005).

In many rural areas of developing countries, lack of access to formal financial services has been seen as a serious constraint that prevents low income households from improving their incomes (Wali, 2009). For instance as observed by Mohammed (2008), over 500 million poor people in developing countries with small business have often cited limited access to formal financial institutions for credit as the biggest challenge to their business growth. With the success of Grameen bank, a micro-credit institution in Bangladesh where low income household have been able to access credit and as a result their household income has improved, accessing microcredit by the rural poor is therefore a viable option for the rural poor to use while improving their household income. The accessibility to credit is all aimed at improving the household income of the poor people.

The accessibility to credit by the poor people enables them to mobilize capital which supports them in starting business. This leads to increased productivity and ownership of assets which eventually improves their household income, the accessibility to credit is made easy by the credit institution defining their credit limit which refers to the

amount of credit that an institution is willing to give out to the potential borrowers (maximum and minimum). A borrower knows in advance what he or she is able to access and because of this borrowers can always plan well in advance on how best they want to access the credit (Diagne, 1998). Credit limits enable the institution to be more realistic in setting out its target towards potential borrowers accessing credit.

According to Mohammed (2008), developing countries and donors have intensified resource mobilization in order to boast the activities of the micro-credit institution. This is done through allocating more funds to the activities of MCIs, looking for grants and encouraging household to start saving. Increased activities of MCIs have helped the poor people engage in businesses that enable them to save and live a good life. CGAP (2003) observed that effective resource mobilization by micro credit institutions require reasonable levels of credit needs projection for the potential borrowers. Microcredit institutions increased resource base enables the borrowers' to access credit easily (Robinson, 2002). The easy accessibility to credit from a micro credit institution enables the borrowers to engage in business that can increase their productivity and ownership of assets (Wali, 2009). Hams (2007) and Zahid (2003) noted that microcredit institutions with limited resources affect the borrowers chances of accessing credit since the funds might be limited or not available at the time the borrowers' needs it . It is therefore crucial for a micro credit institution to successfully mobilize resources if borrowers' must continue accessing credit (Vogel, 2004). For this to have an impact on the target groups the resources mobilized should be tilled towards benefiting those who are saving. Savings by potential borrowers' do create a sense of responsibility in them as they know how hard it's to put money for an activity.

Microcredit institutions do improve the household income if they reach out to the target population through knowing and reaching out to the potential borrowers. When the MCIs reach out to the potential borrowers, it becomes easy for them to get credit and later engage in business which will improve the household's income. Sergio *et al*. (2000) noted that outreach is the social value of the output of a microcredit institution in terms of depth, quality, and worth to users, breadth, length, and scope. If these are fulfilled, it is easy for the poor people to access credit as a result. When microcredit institutions go near to the target groups with flexible terms in regard to credit the borrowers find easy to access credit.

According to Musinguzi (2000), one of the important ways of improving household incomes is through providing appropriate credit opportunities to the poor which will enable them engage in productive activities and generate income. Credit accessibility can only make sense if the services of the credit institutions reach out to the group (Hams, 2007).

The total worth of the credit institution in regard to the funds available to the potential borrowers' is a critical factor in enabling borrowers' access funds. Loan portfolio of institutions shows how much capacity in terms of money they have and can handle. Microcredit institutions with a good loan portfolio will most often serve its potential borrowers since most of the time they have funds for creditAssociation of Microfinance Institutions of Uganda (AMFIU, 2006). Loan portfolio of a micro credit institution is considered to be the most important asset, income earner and the largest source of potential risk (AMFIU, 2002). Strict monitoring of the quality of a loan portfolio of any MCI is crucial for its viability and sustainability (AMFIU, 2008). Sawyer (1995) and

Bihangamba (1995) noted that it is essential for the lender to take active interest in the borrower and monitor his continuing ability to repay the debt which has a direct relationship with the institutions loan portfolio and eventual easy accessibility to credit.

The micro credit institution have come up to provide micro services to the poor, the marginalized and the deprived, with the main focus on women living below the poverty line (Sayma *et al*. 2008). This is done through encouraging women to join groups and identify businesses that can easily enable them access credit (Yunus, 1999). The poor have started on small businesses with a clear direction on how it can help them improve on income. Micro credit institutions have their main objective as improving their access to credit (Olujide, 2008). This enables the poor to engage in productive activities which will eventually lead to increased household income (Microfinance Banker, 2005). Microcredit institution's operation is one of the most gender biased applications and effective intervention for the empowerment of women through enabling them access credit easily (Olujide, 2008; Anurekha, 2009; Mohindra *et al*., 2008). The focus on women is an important principle that has done a lot to enhance the progressive image of micro credit programs within the social development sector. Women beneficiaries from micro credit operations generally value the acceptance they receive as business partners and many are enthusiastic about their prospective independent enterprise (Olujide, 2008). From the information above we observe that accessibility to credit boasts activities that lead to improved household incomes. This signifies a relationship between the two variables.

2.4 Microcredit and Food Security

Recent literature has found an optimistic correlation between access to microcredit and food security. FAO (2013) recognize that food security in Bangladesh can be attained through increased agricultural productivity; employment and self-employment, that create income opportunities and thus allowing to buy food; social programs—including food-for-work or cash-for-work programs, other forms of productive activities within households or communities. Richard (2003:349-50) observe that microfinance can contribute to poverty alleviation and food security through supplying loans, providing other financial services that enhance investment, and creating employment opportunities for the participant. If microcredit is the way to achieve food security then Mayer certainly provide some insightful arguments about the ways by which microcredit affect food security. He mentioned three pathways -first is the poverty-alleviation path, which improves income generation. The second pathway is, access to microcredit induce changes in household assets and liabilities, improves savings and insurance service, thus, stabilize consumption. The third pathway is consumption of microcredits. Through this pathway, households attempt to use loans in immediately productive ways, thus, income and food supplies increase (Meyer 2003).

In the case of Bangladesh, microcredit programs generate a remarkable impact on rural women in the area of social empowerment, awareness and education, which helps them to be more socially liberated, and more economically sovereign in their families and localities (Afrin et al. 2010:10). Thus, it can be argue from different scholars' point of views that microcredit has a huge potential to strengthen food security for women by empowering and expanding socioeconomic opportunities. However, many scholars are also skeptical about theability of microcredit to create a sustainable positive economic

impact on the food security of the rural poor women of Bangladesh. Few studies argued that povertyis not reduced through microcredit and poor households become poorer throughthe additional burden of debt.

2.4.1 Relationship between utilizingmicrocredit, household food security and farmers' output

Proponents of microcredit claim that it helps poor people to reduce risk, raise productivity, obtain high returns on investment, increase income, and improve the quality of their lives and that of their dependents (Robinson, 2001; Goldberg, 2005). It is further believed that microcredit can play a major role in assisting the poor to move out of poverty by providing start-up capital which they have been unable to access historically because financial markets are undeveloped in poor economies.

Asmelash (2003) and Nosiru (2010) stated that another aspect of credit is its impact on agricultural productivity and household food security. Microcredit progammes aim to help rural households invest in agriculture as well as enable them to use their time effectively on their income-generating non-farm activities. The aim is to improve agricultural production and thus improve their household food security.

Latif (2001) examined the relationship between microcredit and savings of rural households in Bangladesh. He derived his data for the study from a follow-up household survey on "Credit Programmes for the Poor" jointly conducted by the Bangladesh Institute of Development Studies and the World Bank. He found that the microcredit programmes of the MFIs, targeted to alleviate poverty by supplying small credit to rural poor in self-employment activities, had a distinctly positive role in influencing household savings. The results from estimated regression models also showed that

participation in credit programmes had statistically significant and quantitatively important influence on household savings. He concluded that microcredit programmes should continue and should be extended to the landed category as well.

Hakim (2004) discussed the relationship between microcredit and agriculture. He observed that small and marginal farmers, who constitute the majority of farming population, are multi-occupational, productive and efficient. This study shows that microcredit providers should extend their priority area of lending to cover small and marginal farmers.

Javed *et al*. (2006) evaluated the impact of microcredit on productivity of wheat and sugarcane in Faisalabad, Pakistan. Results of the study showed that microcredit was effective in increasing crop production and improving the living standard of the farmers in the selected areas. Regression analysis indicated that credit and fertilizer significantly affected production. They concluded that microcredit facilities should be expanded to a greater number of crop producers.

Omonona and Agoi (2007) studied food security situation among Nigerian households using primary data. They found that the food insecurity incidence for the study area was 0.49. Food insecurity incidence increased with increase in age of household heads. They also found that food insecurity decreased as income increased. Another interesting result of their study was that food insecurity decreased with increase in the level of education.

Akinsanmi and Doppler (2005) examined various aspects of food insecurity of Nigerian households. They particularly looked into ownership and access to resources such as land, labour and capital, and the impact of these on family living standard and

household food security (supply and access). They found that the farming systems in highly populated areas had relatively smaller resources and capacity base, were crop oriented and had a lower living standard. They sold more of their outputs but purchased less to meet household food supply. The farming systems located in low/medium populated areas spent more on market supply purchases though they had more land resources.

Zaman (1999) explored the relationship between microcredit and the reduction of poverty and vulnerability by focusing on BRAC, one of the largest microcredit providers in Bangladesh and argued that microcredit contributes to mitigating a number of factors that contribute to vulnerability, whereas the impact on income-poverty is a function of borrowing beyond a certain loan threshold and to a certain extent contingent on how poor the household is to start with.

Islam (2008) evaluated the impact of microfinance on household consumption using cross-sectional data set from Bangladesh. The richness of the data and programme eligibility criterion allow the use of a number of non-experimental impact evaluation techniques, in particular instrumental variable (IV) estimation and propensity score matching (PSM). Estimates from both IV and PSM strategies have been interpreted as average causal effects that are valid for various groups of participants in microfinance. The overall results indicate that the effects of micro loans are not robust across all groups of poor household borrowers. It appears that the poorest of the poor participants are among those who benefit most. The impact estimates are lower, or sometimes even negative, for those households marginal to the participation decision. The effects of participation are, in general, stronger for male borrowers. These results hold across

different specifications and methods, including correction for various sources of selection bias (including possible spill-over effects).

Adebayo and Adeola (2008) examined the role of credit in the agricultural economy and its constraints which can affect farmer's investment behaviour in Surulere Local Government area of Oyo State. The study found that most of the respondents obtained loans through informal sources with co-operative societies being the most popular source. The results also showed that payment for labour wages consumed the larger percentage of the credit obtained by most of the respondents. Accessibility to agricultural credit was constrained by certain factors identified in the study. However, to ensure effective utilization of available sources of credit, establishment of agricultural and community banks in the rural areas with simple procedures of securing loans was recommended. Also, mobilization of farmers into formidable groups in order to enjoy the benefit of collective investment of group savings was also recommended.

Fengxia *et al.* (2010) stated that access to credit is always a key factor for improving farm profits and rural living standards in developing countries. He also reported that credit had a positive impact on production and can be expected to reduce the pattern of structurally unbalanced growth of agriculture in Nicaragua.

A study carried out by Siyoum *et al*. (2013) reported that access to credit did not enable poor households to increase their agricultural productivity and household food security. The majority of the poor invested most of their loan in immediate consumption need and therefore, credit had no impact on long-term productivity and household food security as poor households are risk averse and this prevents them from using their loans

to invest in agricultural productivity to improve their food security. Large numbers of better-off households, on the other hand, reported positive impact of credit on agricultural productivity compared to the poor household. Credit enabled better-off household to buy additional oxen, seed and fertilizer which helped them to increase their productivity. According to information obtained from household interviews, there are four major factors that determine the role of credit in agricultural productivity and household food security which are the availability of land, labour and livestock and extent of loan diversion. In terms of the availability of land, survey results indicated that about half of the poor own less than half a hectare of land or no land at all. The above study also indicated that, the impact of credit on labour-rich and better-off household's agricultural productivity and household food security is different. The labour-rich households benefit more from credit than labour-poor households in terms of increasing agricultural productivity.

The above literatures show that increases in agricultural productivity and improved household food security is not only determined by access to credit but also by multiple factors including access to land, livestock and household labour.

2.4.2 Relationship between microcredit utilization and production efficiency

There are very few works that have formally linked credit and efficiency performance of farms (Battese and Broca, 1997). For example, for a sample of wheat farmers in Pakistan, Battese and Broca (1997) found education level to be positively related to technical efficiency, and tenancy and credit availability negatively related. However, other results examining the effect of microcredit utilization on farm level efficiency in the literature are mixed.

Onoja *et al.* (2009) econometrically analyzed the causality between credit and farm technical efficiencies and revealed that when family labor and farm credit size increase, output also increases. They also found that hired labor, quantity of inorganic fertilizer, quantity of seed planted affect agricultural output negatively. Land size also gave a negative coefficient implying that land expansion may not bring marginal returns given the way they are combining their resources.

Nosiru (2010) used Cobb-Douglas production function to analyze microcredit and agriculture productivity and found that land size and capital are important variables affecting agricultural output positively among microcredit non-beneficiaries. Land also has a positive effect on output among microcredit beneficiaries.

Islam (2011) also suggested ensuring access to microfinance to increase technical efficiency in agricultural production. Unfortunately, small farmers cannot get access for bank credit in many countries because of mortgage, high formality, lengthy procedure and unavailability of concerned institutes at farmers' close position. Hence, microfinance emerged as a noble substitute for informal credit and is considered to be a powerful instrument for poverty alleviation among people (Morduch and Haley, 2002). Yet, conventional approaches to agricultural finance from development banks have been difficult as commercial banks have shrieked due to perceived risks and costs (Miller, 2011). Girabi and Mwakaje (2013) concluded that lack of information, inadequate credit supply and high interest limit small farmers' access to microfinance in Tanzania. There are many non-institutional sources of credit provider like local money lender. Malik *et al.* (1989) proved that institutional sources of credit play better role than non-

institutional sources for farm sector development. Though recently, some microfinance institutions have come forward to assist the farmers, their terms to repay the credit may not be congenial for poor farmers. Shah *et al.* (2008) finds positive relationship between credit and productivity and suggested that government should patronize microcredit for poor farmers as procedures for obtaining credit from typical providers are complex and is attainable at a high interest rate.

Wadud (2013), using the Cobb-Douglas stochastic frontier model and the Data Envelop Model in his study of the impact of microcredit on agricultural farm performance and food security in Bangladesh, indicated that farms are operating at decreasing returns to scale and inefficiency effects were significant in explaining total variability in output. The study revealed that microcredit, as well as experience and education of farmers helped them utilize inputs more efficiently and that the level of efficiency of microcredit receiving farms is, on an average, one per cent higher than the microcredit non-receiving farms and concluded that farms could, on an average, reduce their production cost around 19 per cent if they could operate at full efficiency levels and hence increase farm output. This contributes to the increase in farm output which increases food supply on the one hand and increases purchasing power on the other hand and thus, strengthens food security.

Andersson *et al.* (2008) studied efficiency in shrimp farming in a rural region in Bangladesh where formal micro-lending is well established, but where more expensive informal micro-lending coexists with the formal schemes. Both farmers who exclusively use formal loans and those who also use informal loans, are credit constrained; both types over-utilized labour in order to reduce the need for inputs that require cash at the

beginning of the season, creating inefficiencies in production. However, the credit constraint is actually milder for the informal borrowers; the implicit shadow price of working capital is substantially higher in the group that only takes formal loans than in the group that also uses informal loans.

2.5 Theoretical Framework for Analytical Tools

In this section a review of analytical tools that have emerged in recent studies are discussed. The review will include discussion on simple descriptive statistical analytical tools, the Stochastic Frontier model, the Gross Margin analytical technique, Household Food Security Analytical tools (the Cost-of-Calorie Index and Binary choice models(logit and Probit), the Propensity Score Matching analytical technique.

2.5.1 Theoretical basis of stochastic frontier model

The stochastic frontier production function was independently proposed by Aigner *et al*. (1977) and Meeusen and van den Broeck (1977). The stochastic frontier model assumes an error term with two additive components; a symmetric component that accounts for pure random factors and a one-sided component which captures the effects of inefficiency relative to the stochastic frontier (Omonona and Agoi, 2007). The stochastic production function is defined by:

$Y_i = f(X_i, \beta_i)E_i$ ..... (1)

With,

$E_i = V_i - U_i$ ..... (2)

Where,

Y_i is the observed output of the i^{th} sample farm, $f(x_i, \beta_i)$ is a suitable functional form, β_i is vector of the unknown parameters to be estimated, E_i is the error term made up of two

component; V_i is the random error term having zero mean which is associated with random factor outside the farmers control such as topography, weather, measurement errors, disruptions of supplies and is assumed to be independently and identically distributed normal $(0,\delta^2 v)$ random variable and an independent U_i. On the other hand, U_i is a non-negative truncated half normal random variable associated with farm specific factor, which lead to the i^{th}farm not attaining maximum efficiency of production. U_i is associated with technical inefficiency of the farm and range between zero and one and follows an identical and independent half normal distribution $N(0,\delta^2 v)$ with N representing the number of farms involved in the cross sectional survey. The technical efficiency of an individual farm from above can be defined in terms of ratio of the observed output to the corresponding frontier output, given the available technology. The technical efficiency, is thus, empirically measured by decomposing the deviation into a random component, U_i (Ojo, 2004). In that case:

Technical efficiency (TE) = Y/Y^* ..... (3)

$= f(X_i, \beta_i)\exp(V_i - U_i)/f(X_i, \beta_i)\exp(V_i) = \exp(-U_i)$ **……..** (4)

Where Y_i is the observed output and Y* is the frontier output.

This is such that so $0 \leq TE_i \leq 1$.

The stochastic frontier production function model is established using the maximum likelihood estimation procedures (MLE). The strength of the stochastic frontier approach is that it deals with the stochastic noise and permits statistical test of hypotheses pertaining to the structure and degree of inefficiencies.

2.5.2 Gross margin analysis

Gross margin analysis formed the basis for farm profitability analysis. The objective or goal of farm firms is to maximize profit and/or minimize cost. Profit can be defined as the total value of production less the total cost of production, while the total value of production is the product of total yield and price. The total cost of production comprises of two components the operating or variable costs and fixed costs. Variable costs vary according to output and are incurred on variable inputs or are incurred at each production process. Examples are seeds, labour and fertilizer. Fixed costs are those that do not vary with output in the short run as in the long run, all inputs become variable. The gross farm income or total revenue is the total physical product per unit price of the product. The difference between the gross farm income and total variable cost is referred to as the gross margin. The gross margin is used in determining the net farm income and building partial budget on the farm (Bernard, 2003; Olukosi and Erhabor, 2006). Olukosi and Erhabor (2006) referred to gross margin as a very useful tool in a situation where fixed capital is a negligible portion of the farm enterprise. The Gross margin is not gross profit because it does not take into account overhead or fixed costs such as depreciation, interest payment rates, power, water, insurance or mortgage cost (Quinlan, 2004). Essentially, gross margin is a budgeting tool needed to estimate total variable costs of production and total revenue. The gross margin model is specified as follows:

$$GM = GR - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (5)$$

Where,

$$GM = Gross\ Margin$$

$$GR = Gross\ Revenue$$

$$TVC = Total\ Variable\ Cost$$

The gross margin analysis can be used in two ways; to diagnose the weaknesses of the existing farm business and to prescribe for reorganization of the farm business. Gross margin analysis is very important for comparing performance of farm enterprises. If a farm enterprise records a relative low gross margin, it may be due to either Unfavourable input costs relative to product prices, low output associated with low variable cost (pointing to inadequate expenditure on variable cost such as feed, fertilizer, labour and machine expenses), excessive inputs relative to value of production and an inadequate or otherwise unsuitable type of production technology.

2.5.3 Approaches to measurement of food security and insecurity

A number of methods have been used to gain an understanding of food security and insecurity. Traditionally, there are qualitative and quantitative approaches to the measurement of food security and insecurity. The quantitative approaches include: the Food and Agricultural Organisation (FAO) method, Household Income and Expenditure Survey and Household Food Survey. The FAO method developed an Aggregate Household Food Security Index which incorporates the availability and stability of food supplies and access to them (Oyewole, 2012).

Aggregate Household Food Security Index

The Aggregate Household Food Security Index uses FAO's estimates of the prevalence of under-nutrition in developing countries and regions as its primary building blocks. It combines these estimates with measures of the extent of the food gap between under-nourished people and the national average requirements for dietary energy, the inequality in the distribution of food gaps and the instability in the annual availability of dietary energy (Adebayo, 2010).

Household Income Expenditure Survey (HIES) and the Food Intake Survey (FIS)

TheHousehold Income Expenditure Survey (HIES) and the Food Intake Survey (FIS) estimate dietary intake and try to relate energy and protein needs. The measurement is typically indirect intake and based on food balance sheet and national income distribution, and consumer data linking hunger and nutrition (FAO, 2002).

Coping strategy index (CSI)

The coping strategy index (CSI) measures frequency and severity of a household's coping strategies for dealing with shortfalls in food supply. Its uniqueness as a measure of household food insecurity lies in its ability to query household behaviours directly and factor in the severity of different behaviours (Maxwell et al., 2008a). It is calculated by combining the means of scoring the relative frequency with the severity of the various coping strategies used by households during food deficiency period. The relative frequency is measured by determining how many days per week a household had to rely on various coping strategies and the perceived severity of behaviour is usually determined by community members in focus groups. Weighted scores are combined into an index that reflects current and perceived future food security status (CARE/WFP, 2003 and Maxwell et al., 1999).

Most researchers adoptedCost-of-calorie indexas a measure of food security status of an individualbecause it produces the most accurate measures of individual caloric intake (and other nutrients) and data are collected on an individual basis, it is possible to determine whether food security status differs within the household. Oluyole et al. (2009) examined the food security status among cocoa farming households of Ondo

State, Nigeria and employed Cost-of Calorie (COC) function proposed by Greer and Thorbecke, (1986). This method was also used in similar studies (Ojogho, 2010; Adenegan and Adewusi, 2007).

This study adopted cost of calorie index to classify the beneficiaries and non-beneficiaries of micro- credits into food secure and food insecure households in the study areas.

Food Security Cost-of-Calorie Index

The cost-of-calorie index method as employed by Amaza *et al.* (2004), Amaza *et al.* (2009),and Omotesho et al. (2006) followed by the use of binary logistic regression model to identify the major determinants of household food security for both beneficiaries and non-beneficiaries of microcredit. The cost-of-calorie index method yields a threshold value that is usually close to the minimum calorie requirement for human survival. Two steps, identification and aggregation, are involved in constructing the index. Identification is the process of defining a minimum level of nutrition necessary to maintain healthy living. This minimum level is referred to as the 'food insecurity line'. In the context of this study, the food insecurity line will be the calorie level below which people would be classified as being food insecure or subsisting on inadequate nutrition in the study area. Calorie adequacy would be estimated by dividing the estimated calorie supply for each household by the household size, adjusted for adult equivalent and using the consumption factors for various age-sex configurations.

Following from above, the food insecurity line is given as:

$$lnX = a + bC \qquad (6)$$

Where X is the adult equivalent food expenditure andC is the actual calorie consumption per adult equivalent in a household. The recommended minimum daily calorie requirement per adult equivalent is 2700 kcal and this will be used to determine the food insecurity line, using the equation:

$$S = e^{(a+bL)} \quad (7)$$

Where S = cost of buying the minimum calorie intake (food security line)

a = intercept

b = slope

L = recommended minimum daily energy (calorie) level 2700 kcal (Olabisi *et al*. 2014)

Based on the S calculated, households will be classified as food secured or food insure, depending on which side of the line they fall.

2.5.4 Theoretical basis of Propensity Score Matching model

Impact assessment requires a group affected by the programme (such as microcredit) intervention, and a control group not receiving microcredit to compare the outcomes. Then, the difference between the two groups is defined as the impact of the programme. Using Propensity Score Matching (PSM) techniques, the average income of individuals that received microcredit to that of control groups can be compared.

Matching has become a popular approach to estimate causal treatment effects. It is widely applied when evaluating labour market policies (Heckman *et al.* 1997 and 1998; Dehejia and Wahba, 1999), but empirical examples can be found in very diverse fields of study as it applies for all situations where one has a treatment, a group of treated individuals and a group of untreated individuals. The nature of treatment may be very diverse. For example, Perkins *et al*. (2000) discussed the usage of matching in

pharmaco-epidemiologic research. Hitt and Frei (2002) analyzed the effect of online banking on the profitability of customers and Davies and Kim (2003) compared the effect on the percentage bid–ask spread of Canadian firms being inter-listed on the US Stock Exchange, whereas Brand and Halaby (2006) analyzed the effect of elite college attendance on career outcomes. Ham *et al*. (2004) studied the effect of a migration decision on the wage growth of young men. Bryson *et al*. (2002) analyzed the effect of union membership on wages of employees.

Every micro-econometric evaluation study has to overcome the fundamental evaluation problem and address the possible occurrence of selection bias. The first problem arises because we would like to know the difference between the participants' outcome with and without treatment. Clearly, we cannot observe both outcomes for the same individual at the same time. Taking the mean outcome of non-participants as an approximation is not advisable, since participants and non-participants usually differ even in the absence of treatment. This problem is known as selection bias and a good example is the case where high-skilled individuals have a higher probability of entering a training programme and also have a higher probability of finding a job.

The matching approach is one possible solution to the selection problem. It originated from the statistical literature and shows a close link to the experimental context. Its basic idea is to find in a large group of non-participants who are similar to the participants in all relevant pretreatment characteristics X that being done, differences in outcomes of this well selected and thus adequate control group and of participants can be attributed to the programme.

The key advantage of matching over standard regression methods is that it is less demanding with respect to the modeling assumptions. Specifically, matching does not require functional form assumptions for the outcome equation (it is non-parametric). Further, with matching, there is no need for the assumption of constant additive treatment effects across individuals. Instead, the individual causal effects are unrestricted and individual effect heterogeneity in the population is permitted. Since conditioning on all relevant covariates is limited in the case of a high dimensional vector X('curse of dimensionality'), Rosenbaum and Rubin (1983) suggested the use of so-called balancing scores $b\,(X)$ i.e. functions of the relevant observed covariates X such that the conditional distribution of X given $b\,(X)$is independent of assignment into treatment. One possible balancing score is the propensity score, i.e. the probability of participating in a programme given observed characteristics$X$. Matching procedures based on this balancing score are known as propensity score matching (PSM).

Let Yibe the outcome that would result if an individual receives microcredit and $Yo$the outcome that would result if the same individual does not receive microcredit. Let D = (0, 1) denote the binary indicator of microcredit (D = 1 if microcredit, 0 otherwise). For a given individual i, the observed household income is then

$$Yi = Y0i + Di\,(Y1i - Yoi).$$

Following Heckman *et al.* (1997 and 1998) and Sianesi (2001), we can attempt to identify the effects of microcredit given below:

The average treatment effect: $E\,(Yi - Yo)$is the average income difference between the two groups;

b) The average treatment effect on the treated is $E\,(Yi - Yo/D = 1)$. This parameter is the one receiving most attention in the evaluation literature and measures

the average income difference between the income that the entrepreneurs who received microcredit earned and the income that they would get if they had not received credit;

c) The average treatment effect on the non-treated: $E\ (Yi - Yo/\ D = 0)$ is the average income difference between the potential or expected income that the entrepreneurs who did not receive microcredit $(D = 0)$ would get if they had $(E\ (Yi))$ and the real income that they earned(Yo).

Matching is a widely-used non-experimental method of evaluation that can be used to estimate the average effect of a particular programme. This method compares the outcomes of programme participants with those of matched non-participants, where matches are chosen on the basis of similarity in observed characteristics. Suppose there are two groups of farmers indexed by participation status P = 0/1, where 1 (0) indicates farms that did (not) participate in a programme. Denote by Y_1 the outcome (performance of farm) conditional on participation (P = 1) and by Y_0 the outcome conditional on nonparticipation (P = 0).

The most common evaluation parameter of interest is the mean impact of treatment on the treated,

$ATT = E\ (Yi - Yo\ p =\ 1) =\ E\ [\ (YiP = 1)] - E\ [Yo\ p$=1],

which answers the following question: 'How much did farms participating in the programme benefit compared to what they would have experienced without participating in the programme?' Data on $E[(Yi\ p = 1)]$are available from the programme participants. An evaluator's 'classic problem' is to find $E\ [Y_0p$ = 1], since data on non-participants enables one to identify $E\ [Yo\ p = 0]$only. So the difference between $E[(Yi\ p = 1)]\ and\ E\ [Yo\ p = 1]$ cannot be observed for the same farm. The

solution advanced by Rubin (1977) is based on the assumption that given a set of observable covariates X, potential (non-treatment) outcomes are independent of the participation status (conditional independence assumption - CIA): $Y_0 \perp S\, X$. Hence, after adjusting for observable differences, the mean of the potential outcome is the same for P = 1 and P = 0; this is $[E\,(Yo\ P = 1, X) = E(YoP = 0, X)]$. This permits the use of matched non-participating farms to measure how the group of participating farms would have performed, had they not participated.

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

The study was conducted in Kaduna State of Nigeria which is in the North-West zone of Nigeria and has 23 Local Government Areas (LGAs) with Kaduna as its capital. The State lies between Latitudes 11°32‟ and 09°02‟ N and longitudes 08°50‟ and 06°15‟ E (Kaduna state government, 2012) and shares common borders with Zamfara, Katsina and Kano States to the North, Niger State to the West, Bauchi and Plateau States to the East and the Federal Capital Territory, Abuja and Nassarawa State to the South. Kaduna State occupies an area of approximately 48,473.3km^2 and has a population of 6,066,512 (NPC, 2006) resulting in a projected population of 8,054,828.721 in 2015 at a growth rate of 3.2 percent per annum. The entire land structure consist of an undulating plateau with major rivers in the State including River Kaduna, River Wonderful in Kafanchan, River Kagom, River Gurara and River Gaima.

There are two marked seasons in the State, the dry windy season and the rainy (wet) seasons. The wet season is usually from April through October with great variations as you move northwards while the dry season sets in, in late October and ends in March of the subsequent year. On the average, the State enjoys a rainy season of about six (6) months. There is heavy rainfall in the southern parts of the State like Kafanchan and northern parts like Zaria with an average rainfall of about 1016 mm. Relative humidity varies between 20% and 40% in January, and 60% and 80% in July. The mean annual temperature ranges between 34° and 28°C.

The State extends from the tropical grassland known as Guinea Savannah in the South to the Sudan Savannah in the North. The grassland is a vast region covering the

southern part of the State to about Latitude 10^0N of the equator. The prevailing vegetation of tall grass and big trees are of economic importance during both the wet and dry season.

Agriculture is the main stay of the economy of Kaduna state with about 80% of the people actively engaged in farming both cash and food crops such as yam, cotton, groundnut, tobacco, maize, cowpeas, sorghum, millet, ginger, rice, soybean and cassava, though trade and commerce are undertaken on small to medium scale, especially in agricultural goods, livestock and other consumer goods. Agriculture is predominantly practiced by Small-scale farmers. The cropping systems in the area are also dominated by mixed cropping, although sole cropping is practiced. In addition, significant parts of the population are involved in livestock keeping which depends on grazing (Oguntolu, 2005) and poultry farming. The nomadic Fulanis predominantly do the grazing and livestock rearing. The animals reared include cattle, sheep, goats and pigs.

Kaduna State is a metropolitan as well as a cosmopolitan industrialized State with over 80 commercial banks and manufacturing industries (Kaduna State, Nigeria, 2015,). The choice of Kaduna State as the study area is because it has many micro-credit institutions (MFIs) such as Borni MFB Zaria, ATYAP MFB Zangon-kataf, Bajju MFB Zonkwa, Barnawa MFB, and Fahimta MFB among others which extend a variety of financial services to the poor people in the area.

According to the Kaduna State Agricultural Development Project (KADP, 2012), the State is divided into 4 operational zonal offices and they are Maigana, Samaru Kataf, Birnin Gwari and Lere zones.

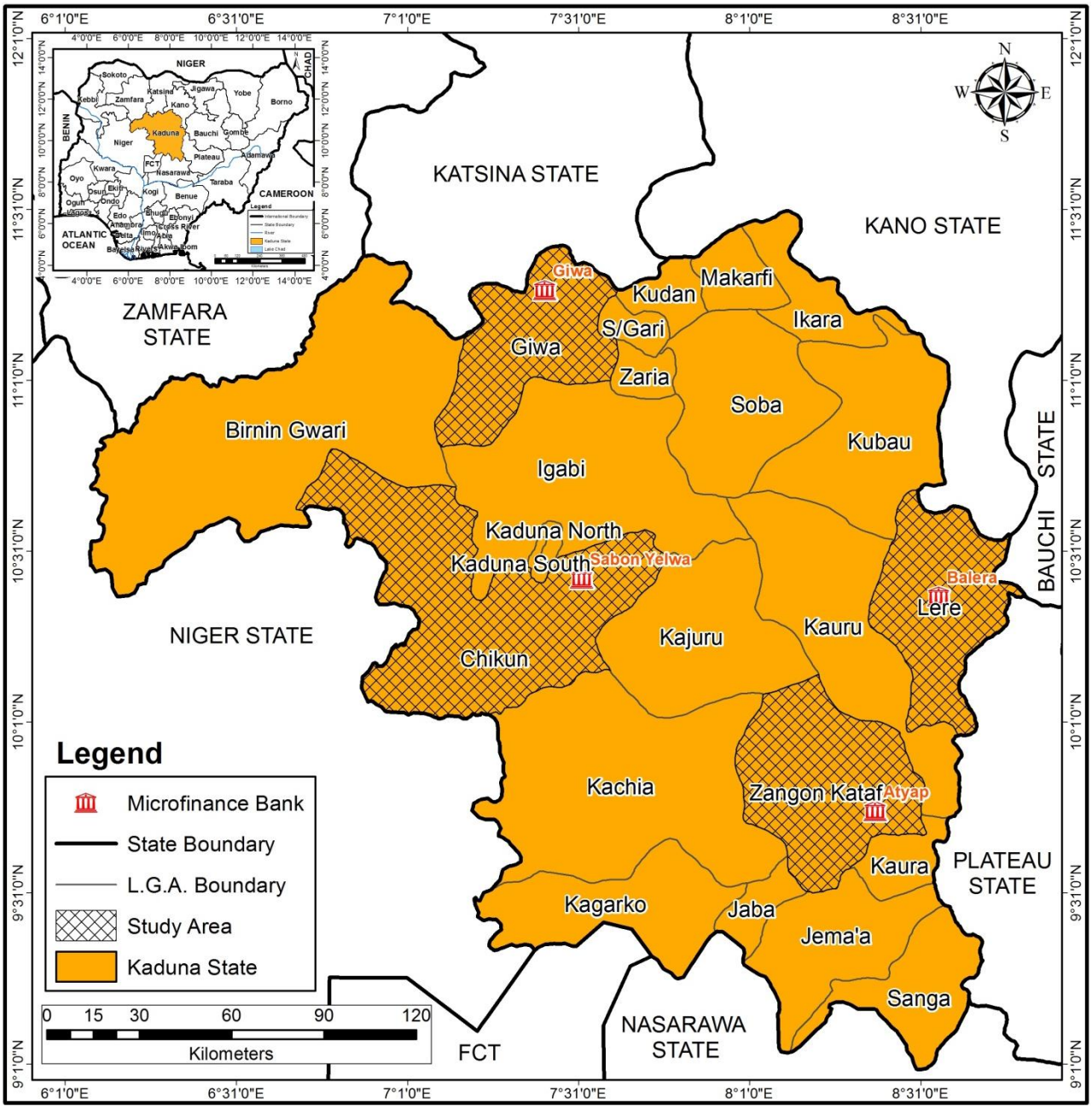


Figure 1: Map of Kaduna State showing the Study Area
Source: Modified from the Admintrative Map of Kaduna State(2015)

3.2 Sampling Procedure and Sample Size

A multi-stage sampling technique was employed in this study to select the appropriate sample size of beneficiaries and non-beneficiaries of microcredit in the study area. According to the Kaduna State Agricultural Development Project (KADP, 2012), the State is divided into 4 operational zonal offices and they are Maigana, Samaru Kataf,

Birnin Gwari and Lere zones. Consequently, the first stage was the stratification of the study area into four (4) zones in line with the KADP subdivision of the State.

The second stage was the purposive selection of one local government area within each of the 4 operational zonal offices of the KADP in the State. This selection was based on the number/predominance of both formal and informal microcredit institutions that grant agricultural credit/funds to individuals and/or households in the local government areas. Based on a reconnaissance survey, Zango-Kataf, Chikun, Lere and Giwa Local Government Areas of the State were selected for the purpose of the study.

The third stage involved the random selection of one microfinance bank (MFB) from each of the LGAs selected for the study. The selected microfinance banks were the Atyap Microfinance Bank Limited in Zango-Kataf LGA, the Sabon Yelwa Microfinance Bank Limited in Chikun LGA, the Balera Microfinance Bank Limited in Lere LGA and the Giwa Microfinance Bank Limited in Giwa LGA. These four MFBs are noted for their strong bias towards lending of agricultural credit to small scale farmers.(KADP, 2014)

A sampling frame, provided by these four MFBs, was established before selecting the sample size. The number of total beneficiaries of agricultural loans is as shown in Table3.1 below.

Table 3.1: Distribution of Agricultural Credit Beneficiaries by selected MFBs in the State

Local Govt. Area	**Microfinance Bank**	**Beneficiaries**
Chikun	Sabon Yelwa MFB	423
Giwa	Giwa MFB	457
Lere	Balera MFB	406

Zango-Kataf	Atyap MFB	390
Total		1,676

Source: Reconnaissance Survey (2015)

Ten (10) percent of the sampling frame (1676) was randomly selected from the Four Microfinance Banks to give a total of 168 Micro-Credit beneficiaries and which was used as respondents for the Study. On the other hand, an equal number of non-beneficiaries of Micro-Credit were randomly selected from a list of households obtained from the respective Zonal KADP resulting in a total number of 336 respondents for the entire Study (Table 3.2).

Table 3.2: Sampling size of respondents

Local Government Area	**Beneficiaries**	**Non-beneficiaries**
Chikun	42	42
Giwa	46	46
Lere	41	41
Zango-Kataf	39	39
Total	168	168

Source: Reconnaissance Survey (2015)

3.3 Method of Data Collection

Primary data were collected through the use of structured questionnaires schedule administered on both beneficiaries and non-beneficiaries of microcredit with the help of trained enumerators under the supervision of the researcher. The data collected covered household demographic characteristics in terms of marital status, gender of farmer, household size, age of farmer and his/her level of education, employment status of the head of household, the level of food self-sufficiency of the household, size of family labour, size of hired labour, household production enterprise portfolio, that is, inputs, outputs, and so on, total household farm size, access to agricultural extension services,

access to microcredit – type, amount, duration, interest rate, collateral (if any), degree of diversification in farm production and period of farm cultivation, and so on.

Data on institutional factors such as membership of cooperative societies as well as data on vulnerability factors such as the level of valuable and disposable assets owned by a household were collected from both beneficiaries and non-beneficiaries of microcredit in the study area. Data on respondents' membership of associations like the seed growers association, yield and production estimates, current sources of farm inputs and quantities, major buyers of farm produce, improved technologies and practices in use and so on were also collected.

Focus Group Discussion (FGD) was also used to generate data that supported the data gathered using questionnaires.

3.4 Analytical Techniques

Various analytical tools were used to analyze the data collected from both beneficiaries and non-beneficiaries of microcredit in the study area. These include descriptive statistics, stochastic production frontier**,** budgetary analysis, the Cost-of-Calorie Index and Binary choice models (logit), multiple regression and Propensity Score Matching

3.4.1 Descriptive statistics analysis

For household socio-economic analysis, simple descriptive statistics such as mean, standard deviation, frequency distribution, percentages were used. The specific socio-economic characteristics of the farming households were analyzed using these descriptive statistics to achieve objective one (1) which describe and compare the socio-

economic characteristics of beneficiaries and non-beneficiaries of microcredit in the study area and objective Six (6) which is to Identify and discuss the constraints faced by beneficiaries and non-beneficiaries of microcredit in the study area.

3.4.2 Stochastic production frontier

In a stochastic frontier production model, output is assumed to be bounded by a stochastic production. The essential idea behind the stochastic frontier model is that error term is composed of two parts, a systematic and a one-sided component. Stochastic frontier is an econometric analytical technique which allows for variation of output of individual producers from the frontier of maximum achievable level to be accounted for by the firm. This technique was used to analyze productivity efficiency of beneficiaries and non-beneficiaries of microcredit (objective 2).

A general stochastic frontier production model following Aigner *et al.* (1977) is expressed implicitly as:

$$Yit = \exp(xit\beta + Vit - Uit \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (8)$$

Where

Y_{it} denotes the output for the ith firm in the t^{th} time period;

x_{it} representsa(1×K)vectorwhosevaluesarefunctionsofinputsandotherexplanatory variables for the i^{th} firm in the t^{th} time period; β is a (K × 1) vector of unknown parameters to be estimated;

the V_{it}s are assumed to be independent and identically distributed random errors which have normal distribution with mean zero and unknown variance, σ_v^2; and the U_{it}s are non-negative unobservable random variables associated with the technical

inefficiency of production, such that, for the given technology and levels of inputs, the observed output falls short of its potential output.

The stochastic frontier production model to be specified by the Cobb-Douglas frontier production function which is defined by:

$$lnY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + V_i - U_i \ldots\ldots\ldots (9)$$

Where, the subscript i indicates the ith farmer in the sample; Y_i = Maize Output of farmers in kilogramme (Kg); β_0= constant term or intercept; β_i= unknown scalar parameters to be estimated; X_1= quantity of Maize seed in Kg; X_2= farm size in hectares (ha); X_3= total labour in man-hours; X_4= pesticides in litres; X_5= fertilizers in Kg; V_i= random errors; and U_i= technical inefficiency effects predicted by the model.

The technical inefficiency effects predicted by the model, U_i, is affected by the socio-economic characteristics of the respondents and is defined as:

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Where, α_0= constant term or intercept; α_i= unknown scalar parameters to be estimated; Z_1= the age of the *ith* respondent in years; Z_2= years of farming experience of the *ith* respondent in years; Z_3= is a dummy variable for level of education of respondents which has value of 0 for no formal educational attainment, 1 for those with Arabic and/or Adult education, 2 for those with primary school education, and 3 and 4 for those with secondary as well as those with tertiary education respectively; Z_4= household size

of respondents; Z_5= is a dummy variable for sex of the *ith* respondent with 1 for male and 2 for female. These were included in the model to indicate their possible influence on the technical inefficiencies of the farmers.

Baltese and Coelli (1995) stated that the technical efficiency (TE) of a farmer is between zero (0) and one (1) and is inversely related to the level of the technical inefficiency. Technical efficiency is defined as the ratio of observed output to maximum feasible output. When $TE_i = 1$, it shows that the *ith* firm obtains the maximum feasible output and when the $TE_i < 1$, it provides a measure of the shortfall of the observed output from the maximum feasible output.

The TE_i is estimated as:

$$TE_i = \exp(-U_i)$$

That is, $TE_i = {}^{Y_i}/_{exp(\beta_i X_i)}$

$$TE_i = {}^{Observed\ Output}/_{Frontier\ Output}$$

Therefore,

Technical inefficiency = 1 – TE.

The model for this study is as specified by the Cobb-Douglas frontier production function which is given as:

$$TE_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + V_i - U_i\ /\beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(11)}$$

All the variables are as previously defined.

3.4.3 Farm budgetary analysis

For the purpose of evaluating the profitability of farm production activities of both beneficiaries and non-beneficiaries of microcredit in the study area, farm budgetary analyses involving the computation of Gross Margin (GM) and Returns per Naira (RPN) invested in the farm enterprise was conducted. This was carried out for maize production activities for beneficiaries and non-beneficiaries. The monetized value of variable inputs and incidental production costs was subtracted from the Gross Revenue (GR) to arrive at GM estimate for maize enterprise. The RPN would be calculated by finding the ratio of the GM to the Total Variable Cost (TVC). That is,

$$GM = GR - TVC \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (12)$$

$$RPN = {}^{GM}/_{TVC} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (13)$$

This was used to achieve objective 3 which states that, investigate and compare profitability of the farm enterprises of beneficiaries and non – beneficiaries of micro – credits in the study area.

3.4.4 Household food security analysis

For household food insecurity analysis, combinations of tools were used. To analyze the food insecurity status of households, a cost-of-calorie index was constructed followed by the use of binary Logit model toidentify the major determinants of household food security for beneficiaries and non - beneficiaries of microcredit. This was used to

achieve objective 4(to determine and compare the food security status of beneficiaries and non-beneficiaries of microcredit in the study area.

Food security cost-of-calorie Index

The cost-of-calorie index method as employed by Amaza *et al.* (2004), Amaza *et al.* (2009)and Omotesho et al. (2006) as well as adapted by Manza (2014) was used to determineFood insecurity line. The cost-of-calorie index method yields a threshold value that is usually close to the minimum calorie requirement for human survival. Two steps, identification and aggregation, are involved in constructing the index. Identification is the process of defining a minimum level of nutrition necessary to maintain healthy living. This minimum level is referred to as the 'food insecurity line'. In the context of this study, the food insecurity line will be the calorie level below which people would be classified as being food insecure or subsisting on inadequate nutrition in the study area. Calorie adequacy was estimated by dividing the estimated calorie supply for each household by the household size, adjusted for adult equivalent and using the consumption factors for various age-sex configurations.

Following from above, the food insecurity line is given as:

$$lnX = a + bC \quad \text{.....(14)}$$

Where X is the adult equivalent food expenditure and C is the actual calorie consumption per adult equivalent in a household. The recommended minimum daily calorie requirement per adult equivalent is 2700 kcal and this will be used to determine the food insecurity line, using the equation:

$$S = e^{(a+bL)} \quad \text{.....(15)}$$

Where

S = cost of buying the minimum calorie intake (food security line)

a = intercept

b = slope

L = recommended minimum daily energy (calorie) level 2700 kcal (Olabisi *et al*. 2014)

Based on the S calculated, households will be classified as food secured or food insure, depending on which side of the line they fall.

Determinant of Household Food Security

The binary Logit model was used to analyze the relationship between the food security status and its determinants.The cost of calorie intake was used to disaggregate Maize producing households into food secure and food insecure. In other words, the dependent variable in this case, food security, was a binary variable which took a value of one (food secure) if a household cost of calorie intake was below the food security line of 2700 kcal, and the value of (food insecure) if a household cost of calorie intake was equal or greater than the food security line of 2700kcal.

$$\Pr\left[Yj = \frac{1}{Xj}\right] = \frac{1}{1+\exp(-\beta 0 - \beta j Xj)} \quad \text{..... 16}$$

$$\Pr\left[Yj = \frac{0}{Xj}\right] = 1 - \Pr[\text{Yj} = \frac{1}{Xj} \quad \text{..... 17}$$

It is a logit model because

$$\Pr\left[Yj = \frac{1}{Xj}\right] = F(\beta 0 + \beta j Xj) \quad \text{..... 18}$$

Explicitly, this model can be linearized as:

$$\text{Fi} = + \beta 0 + \beta 1 X1 + \beta 2 X2 + \beta 3 X3 + \beta 4 X4 + \beta 5 X5 + \beta 6 X6 + \beta 7 X7 + \beta 8 X8 + \mu j \quad \text{.... 19}$$

Fi = 1 if household is food secure, 0 if otherwise

Xj is the vector of explanatory variables and βj is the vector of parameters.

The logit model computes the maximum likelihood estimated of βj given the non-linear probability distribution of the random error μj

The explanatory variables are:

X1 = Sex of Household Head – Male =1, Female = 0)

X2 = Age of Household Head in years

X3 = Marital Status of household Head – Married =1, Otherwise=0)

X4 = Household size

X5 = Education level of Household Head (Number of years of formal education)

X6 = Association membership (member = 1, non-member= 0)

X7 = Land (Smalland Medium scale)

X8 = Micro-credit status of household head

β_i = parameters to be estimated

μ = error term

3.4.5 Propensity score matching

To examine this causal effect of beneficiaries of micro-credit on output and food security status by smallholder maize farmers, the matching approach was employed. This was used to achieve objective 5 which states that, examine the impact of microcredit utilization on farmers' Maize output and household food security.Theestimatedpropensity scoresarethenusedtoestimate the AverageTreatmentEffectontheTreated(ATT)whichisthe parameterofinterestas

$\delta \equiv E\{Y_i^1 - Y_i^o / D_i{=}1\}$ =E {E $\{Y_i^1 / D_i = 1, \text{P}(Z_i)\}$-E $\{Y_i^o / D_i{=}0, \text{P}(Z_1)\}$/ $D_i = 1\}$ ... ... (20)

Where;

$P\ (Z_i)$ is the *P-Score, Y_i and Y_i are the potential outcomes* (*maize output and food security status)* in the twocounterfactualsituations of receivingtreatment (beneficiaries of micro-credit)andno treatment(non-beneficiaries of micro-credit).

Two important properties of the *P-score*matching are the balancing property and conditional independenceassumption (CIA).Testingforthis property isimportanttoascertain ifmaizefarmers' behaviour withineach groupisactuallysimilar. Relatedtothebalancingof *P-score* isCIA,whichstatesthat participating in micro-credit israndomanduncorrelatedwiththemaizeoutputorfood security statusby the farmer,oncethesetofobservablecharacteristics,Z arecontrolledfor.Afurtherrequirementist hecommon

supportconditionwhichrequiresthatpersonswiththesamevaluesofcovariates*Z* havepositiv epossibilities of being bothbeneficiaries andnon- beneficiaries (Heckman,*etal*.,1999). Thus,allindividualsin thecommon supportregionactuallycanexistinall state (0<*P (D=1/Z<1)*.

3.4.6 Hypothesis testing

Z-test

Z-Test is used to compare the means of two populations. It assumes normal distribution under null hypothesis. It is performed on a large number of data or on a population data. It was used to test hypotheses i, ii and iii. The model is specified as follows:

$$z = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1}{n_1} + \frac{S_2}{n_2}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (21)$$

Where z = calculated z-value

$\overline{X}_1$ = Mean value of beneficiaries' Maize output and profitability.

$\overline{X}_2$ = Mean value of non-beneficiaries' Maize output and profitability.

S_1= Variance of beneficiaries.

S_2 = Variance of non-beneficiaries.

n_1= Sample size of beneficiaries.

n_2 = Sample size of non-beneficiaries.

3.5 Operational Definitions and Measurement of Variables

Age (*Xi*):This refers to the number of years an individual attained from his/her birth and it is believed to be capable of influencing the perception, view, interest and conduct of the person. This was measured in years.

Literacy Level (X_2): This is the ability of an individual to read and write acquired in a formal or informal organized means or through schooling. The role of education is considered very important in the perception of new farm practices/technologies. This was measured on the scale of 0 – 4. Thus a farmer was scored 0 when no formal education is attained, 1 with Arabic and/or Adult education, those with primary school education was scored 2 and those with secondary as well as those with tertiary education was scored 3 and 4 respectively.

Family Size (X_3): This refers to the number of individuals in the household which include the wife (s), children and dependents who reside within the same family and eat from 'the same pot'. It was measured in number of persons under one household unit and scored on a scale of 1 - 4. The family unit from 1 – 5 was scored 1 while those with family size from 6 – 10 were scored 2 and families with 11 – 15 and 16 and above was scored 3 and 4 respectively.

Farm Size (X_4): This refers to the total amount of land area under cultivation owned by individuals. Small-holder farmers are prone to using traditional methods of farming while large-holder farmers tend to us improved technologies. It will assist in determining the extent to which it explains the variability in output. Farm size was measured in hectares.

Years of Farming (X_5): this refers to the actual number of years in farming business by the target respondent. It is expected that farmers will gain more experience as they spend more years in farming activities. This was measured on a scale scored 1 – 4. Years of farming experience from 1 – 5 years was scored 1 while those with 6 – 10 years was scored 2 and respondents with 11 – 15 years and 16 years and above was scored 3 and 4 respectively.

Output(Y): This variable is defined as the total yield of the produce in kilogramme accruing to the respondent during the season per hectare. It was measured in this study as Kilogramme per hectare (Kg/ha).

Membership of Association (X_6): This refers to the joining of individuals into a group of farmers for interaction and sharing of ideas for a common goal attainment. Thus, it would influence the attitude of members toward community developmental programmes. It measured was number of years a respondent spent as a member and on a scale of 1 – 4, that is, from 1 – 5 years was scored 1, those with 6 – 10 years was scored 2 and those with 11 – 15 years and 16 years and above was scored 3 and 4 respectively.

Access to Microcredit (X_7): This refers to those respondents who were able to source and were granted credit by the MFBs. It is believed that respondents' access to microcredit will assist them in reducing their risk, raise productivity, obtain high returns on investment, increase income, and improve the quality of their lives and that of their defendants. Access to microcredit was measured as either 0 or 1

with non-beneficiaries of microcredit scored 0 and beneficiaries of microcredit assigned 1.

Extension Contacts (X_8): This refers to the frequency of time that extension agent (s) visits the farmer (s). Personal contact is an indispensable method in extension. Its impact, widespread and forms will also be determined. Extension contacts were measured on scale 0 – 3. Farmers with no contact were scored 0. Those with weekly contacts were scored 1 and those with fortnightly and monthly contacts were scored 2 and 3 respectively.

Farm Income (X_9): This refers to the amount of money generated by the respondents from the sale of their produce above the cost of production. It was obtained by multiplying the quantity of produce by its unit price less the total cost of production. Income is expected to increase significantly for the beneficiaries of microcredit vis-à-vis non-beneficiaries of microcredit

CHAPTER FOUR

RESULTS AND DISSCUSSION

4.1 Socio-economic Characteristics of Sampled Maize Farmers

The socio-economic characteristics of beneficiaries of micro-credit and non-beneficiaries of micro-credit of microfinance bank described in this study are presented in this section. These include age, sex, household size, educational level and farming experience.

4.1.1 Age

The results in Table 4.1 show that76% of beneficiaries of micro-credit were within the age brackets 29-48 years with an average age of 42 years, while 81% of non-

beneficiaries of micro-credit were within the age brackets 29-48 years with an average age of 40 years. The results of the z-statistics confirmed that there is a significant difference between the mean age of credit beneficiary and non-beneficiaries of micro-credit at 1% level of probability. The difference was expected because the age of the respondents has nothing to do with the use of credit. The pooled mean age (41years) shows that large numbers of respondents were young, active and are likely to be more productive, such as given adequate level of farming resources; the farmers have the potential to minimize their farm output. Age of household head is considered an important variable in terms of experience and responsibility. Households headed by older individuals are more likely to have experience in agricultural production, which may account for higher levels of farm profits (Oyedele *et al.,* 2009). However, the households headed by younger individuals are often associated with more risk-taking behaviour. This implies that their tendency to demand credit is higher (Oyedele *et al.,* 2009). Younger respondents are expected to be users of microfinance credit service than that of old due to better awareness and knowledge related with benefits of micro credit service. In addition, younger and adult age respondents were believed to be in favour of taking a calculated risks unlike that of old age respondents. Berhanu (1999) result also reported that age of household to have positive impact on microfinance credit service utilization.

Table 4.1: Distribution of respondents according to age in the study areas

Characteristics	**Beneficiaries**		**Non – Beneficiaries**		**Pooled**		**Z-statistic**
	Frequency	%	Frequency	%	Frequency	%	
Age							**2.91*** **
29-38	55	33	75	45	130	39	
39-48	73	43	61	36	134	40	
49-58	36	21	31	18	67	20	
59-68	4	2	1	1	5	1	

Total	**168**	**100**	**168**	**100**	**336**	**100**
Mean	42		40		41	
Standard deviation	7.38		8.11		7.84	
Minimum	29		24		24	
Maximum	62		59		62	

Note ***P<0.01 level of probability

4.1.2 Sex

It was found that 82% of the beneficiaries of micro-credit were male while 18% were female. Also, 89% of non- beneficiaries of micro-credit were males while 11% were female. The results of the z-statistics also confirmed that there is a significant difference between the sex of credit beneficiary and non-beneficiaries of micro-credit at 5% level of probability. The difference was expected because sex of the respondents has nothing to do with use of credit. From the pooled result it can therefore be inferred that beneficiaries of micro-credit and non-beneficiaries of micro-credit among male and female was highly skewed towards the male farmers. The predominance of male farmers is an indication that agribusiness is generally labour intensive and still a strenuous enterprise in Nigeria (Babalola, 2014). Furthermore, the tedious and time-consuming nature of the cultural practices involved in arable cropping discourages most prospective female entrances into the business.The finding of this research is in line with the findings of Assefa (2009) who found sex of respondents to significantly affect and distinguish borrowers from non-borrowers. The study of Meehan (2001) also indicated that there were clear differentials in utilization of micro credit related both to gender. Women took consistently lower loans than men. In another study, an empirical study made in Guyana by Hunte (2006) showed that male more likely participate in micro credit service than female. Whereas, in contrast to the above report the finding of Yaqub (1995) showed that female were better than their male counter parts in micro finance credit service utilization. This finding is in disagreement to the findings of

Adisa and Okunade (2005) who reported that female contribute 60 % of the labour force, produce 80 % of the nation's food, earn 10 % of the money income but own only 1% of the farm assets.

Table 4.2: Distribution of respondents according to sex in the study areas

Characteristics	Beneficiaries		Non –Beneficiaries		Pooled		Z-statistic
	Frequency	%	Frequency	%	Frequency	%	
Sex							**2.02****
Male	137	82	150	89	287	85	
Female	31	18	18	11	49	15	
Total	**168**	**100**	**168**	**100**	**336**	**100**	

Note **P<0.05 level of probability

4.1.3 Household size

The household size is the number of persons belonging to one household. This could include extended family members or other persons putting up with the family. The influence of this variable can be understood in various ways. Households with many members may encourage youths to migrate to the areas where they can work as laborers in order to generate additional income to support their families (Yirga, 2007). On the other hand, large household size is usually associated with abundant labour endowment. According to Croppenstedt *et al.* (2003), households with large size are more likely to adopt agricultural technology and use it efficiently at peak times. According to Croppenstedt *et al. (*2003), households with larger number of laborers are able to accomplish various agricultural tasks (Family labour contributes to the agricultural activities and increase profit in agricultural production). The study revealed that by pooling the respondents' together 39% had between 8-13 persons with mean household size of 10 persons per households. Approximately 40% of beneficiaries of micro-credit had 8-13 persons with mean household size of 12 persons per households. Also, 43% of non- beneficiaries of micro-credit had 2-7 persons with mean household size of 9

persons per households. The Average household size among respondents in the study areas was greater than 6 members. This is above the national average of approximately 5 (Babalola, 2014; NBS, 2009). The results of the z-statistics confirmed that there is no significant difference between the mean household size of credit beneficiary and non-beneficiaries of micro-credit. The larger household size of beneficiaries of micro-credit (household size is 12) could be of advantages in terms of ready labour supply assuming all are productive or have less dependency ratio, a view that conform to Kareem *et al*. (2008) findings , while smaller size observed with non- beneficiaries of micro-credit (mean household size is 9) could be attributed to emigrational effect in search of other sources of income as a way of taking care of their credit needs, due probably to their inability to access credit facility. This agrees with (Chavas *et al.* 2005) findings in a study in Gambia. The large household size among respondents may be a result of their increased labour need for their expanded farming operations. Dipeolu *et al.* (2000) was of the view that a larger household may serve as an important source of farm labour supply and consequently increased productivity. The finding is consistent with the study of (Onojah et. al., 2013) who found out that household heads in maize farming belonged to family with an average of 12 members

Table 4.3: Distribution of respondents according to household size in the study areas

Characteristics	Beneficiaries		Non –Beneficiaries		Pooled	
	Frequency	%	Frequency	%	Frequency	%
Household size						
2-7	43	26	72	43	115	34
8-13	67	40	64	38	130	39
14-19	44	26	23	14	67	20
20-25	14	8	9	5	24	7
Total	**168**	**100**	**160**	**100**	**336**	**100**
Mean	12		9		10	
Standard deviation	5.44		4.89		5.35	
Minimum	2		2		2	
Maximum	22		25		23	

4.1.4 Educational level

Education which Ajibefun and Daramola (2000) claimed has strong relationship with level of technical efficiency. It was found that pooling the respondents together 8% had no formal educational qualification, 29% had primary educational qualification. Within the beneficiaries of micro-credit, 5% had no formal educational qualification, 42% had secondary educational qualification. Also, 36% had primary educational qualification. It indicates that pooling the respondents together approximately 92% had some form of educational qualification, 95% of beneficiaries of micro-credit had some form of educational qualification while 89% of non-beneficiaries of micro-credit had some form of educational qualification. The results of the z-statistics confirmed that there is a significant difference between the mean educational qualification of credit beneficiary and non-beneficiaries of micro-credit at 5% level of probability. Research has shown that, access to education enables households in the rural area to adapt to new agricultural methods, cope with risk, and respond to market signals and consequently improve agricultural productivity (Rosalyn, 2002). This finding is in line with a similar study on microfinance Scheme in Western Nigeria by Oke *et al.*, (2007) in which they reported that 81 % of the respondents had formal education and it concluded that the high level of literacy was likely to afford respondents better managerial skills in handling their businesses.

Asiabaka (2002) reported that the resultant effect of lack of formal and informal education is acute resistance to change especially in the spread of information. Some studies indicated that a high level of education contributes significantly to the level of agricultural profitability of the households (Oyedele *et al.*, 2009; Foltz,

2004).Therefore, households with higher education levels are able to get credit from formal institutions and more likely to manage their businesses successfully.

Table 4.4: Distribution of respondents according to educational level in the study areas

Characteristics	Beneficiaries		Non –Beneficiaries		Pooled		Z-statistic
	Frequency	%	Frequency	%	Frequency	%	
Educational level							**2.36****
No formal education	9	5	19	11	28	8	
Adult education	20	12	54	32	74	22	
Primary education	38	23	60	36	98	29	
Secondary education	70	42	21	13	91	27	
Arabic education	26	15	10	6	36	11	
Tertiary education	5	3	4	2	9	3	
Total	**168**	**100**	**168**	**100**	**336**	**100**	

Note **P<0.05 level of probability

4.1.5 Farming experience

It was found that pooling the respondents together, 46% had less than 10 years of farming experience with a mean of 24 years. Within the beneficiaries of micro-credit, 40% had 11-15 years of experience with a mean of 25 years. Also, within the non-beneficiaries of micro-credit, 58% had less than 10 years of farming experience with a mean of 23 years. The results of the z-statistics confirmed that there is a significant difference between the mean farming experience of credit beneficiary and non-beneficiaries of micro-credit at 5% level of probability.

The number of years of farming (farming experience), according to Rougoor *et al*. (1998) and Tijani (1993), will impact positively on the farmer's production efficiency due to prudent resource allocation as he must have acquired practical knowledge through trial and error over time, hence experience and not age, according to Rahji (2005), is of policy relevance as it is amenable to manipulation than age. The economic

postulate is that the more experienced a farmer is, the better he is to utilize the loans advanced to him judiciously. This is likely to impact positively on the effective management and organization of farms and enhances loan repayment (Nwankwo, 2004). Oluyole *et al.* (2009) also reiterated that an experienced farmer is likely to have higher productivity and hence be able to provide more food for his household members. This finding is in tandem with the findings of kebbeh *et al*. (2003) which found an average of 21 years of farmers' experience in rice farming in Kaduna and Niger States of Nigeria.

Table 4.5: Distribution of respondents according to farming experience in the study areas

Characteristics	Beneficiaries		Non –Beneficiaries		Pooled		Z-statistic
	Frequency	%	Frequency	%	Frequency	%	
Farming Experience							**2.03****
Less than 10years	59	35	97	58	156	46	
11-15years	67	40	26	15	93	28	
16-20years	23	14	31	18	54	16	
21-25years	14	8	9	5	23	7	
Greater than 26years	5	3	5	3	10	3	
Total	**168**	**100**	**168**	**100**	**336**	**100**	
Mean	25		23		24		
Standard deviation	13.05		11.1		10.08		
Minimum	5		3		3		
Maximum	45		43		43		

Note **P<0.05 level of probability

Test of hypothesis I

The null hypothesis which states that there is no significant difference between the socio-economic characteristics of beneficiaries and non-beneficiaries of micro-credit was subjected to Z-test. It was found that there is statistically significant difference between beneficiaries and non-beneficiaries of microcredit with respect to socio-economic variables such as age, sex, educational level and farming experience while marital status and household size were not statistically significant (Table 4.6). Therefore, based on the result the null hypothesis that there is no significant difference

between the socio-economic characteristics of beneficiaries and non-beneficiaries of micro-credit is rejected in favour of hypothesis that stated that there is significant difference between the socio-economic characteristics of beneficiaries and non-beneficiaries of micro-credit.

4.2 Technical Efficiency Analysis

The maximum likelihood (ML) method using Frontier 4.1 software developed by Coelli (1995) are presented in Table 4.6. The appropriate measure of technical efficiency is input saving which gives the maximum rate at which the use of all the inputs can be reduced without reducing output. The variance parameters of the stochastic frontier production function are presented by sigma (δ) and gamma (γ). The sigma squared for the beneficiaries was (0.409) and for the non-beneficiaries of micro-credit (0.525) which were both significantly different from zero at 1% level of probability. This indicates good fit and correctness of the specified assumption of the composite error term. Observed significance of sigma (δ) at 1% level of probability for beneficiaries farmers (t-value= 3.075) and at 1% level of probability for non-beneficiary farmers (t-value =4.605) showed that there were some measurable inefficiencies in maize production by both beneficiaries and non-beneficiaries of micro-credit.

The value of 0.418of the gamma for the beneficiaries and 0.796 for the non-beneficiaries farmers were both statistically significant at 1%. This means that 42% of the total variation in output of the beneficiary farmers and 80% of the total variation for the non-beneficiary farmers were as a result of factors within the control of the farmers and that variation in maize output could be attributed to technical inefficiency. This might also be interpreted to mean that the differences between actual (observed) and

frontier output had been dominated by technical inefficiency (that is, factors (weeding, fertilizer application) within the control of the farmers).

The first term variables, with the exception of labour, were all statistically significant at 1% for beneficiary while only labour was significant at 5% for non-beneficiary farmers. The estimated coefficient for seed was 0.950 for beneficiary and 0.678 for non-beneficiary were positive and statistically significant at 1% level. The estimated 0.950and 0.678 elasticity of seed for beneficiary and non-beneficiary respectivelyimplies that increasing seed by 1% will increase maize output of the beneficiary by less than 1% which means, all things being equal the output is inelastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality seeds are not used, output will be low even if other inputs are in abundance. This is in line with the findings of Shehu *et al* (2010) who observed that the estimated coefficient of seed and labour inputs were positive as expected and significant at 1% level which implies that the more seed is applied and the more labour employed the better the output of maize. While the estimated coefficient (0.166) of seed for non-beneficiary was positive and not significant.

The coefficient for agrochemical (0.672) was positive and significant at 1% for beneficiary. For the non- beneficiary farmers the coefficient (-0.241) were negative and statistically not significant, agro-chemicals which had partial production elasticity of -0.672 for beneficiary, would increase output by 67.2%, when this production inputs was increased by 100%.The coefficients of fertilizer (-0.089) and labour (-0.008) were negatively related to the output of the beneficiary farmers but fertilizer was significant at 1% probability level while labour was not significant. This implies that fertilizer and

labour were over utilized in the production.Even though labour intensive, but, use of animal traction could minimize the use labour. Increasing use of organic fertilizer could reduce the application of inorganic fertilizer.Labour was not expected to be negative because peasant farmers depend on labour in the absence of machine. This unexpected result could stem from inappropriate usage of the variables (labour and fertilizer). The negative relationship between labour and output agrees with the finding of Baruwa and Oke (2012) who reported that labour was negative and significant at 5% probability level in a study on Technical Efficiency of Small-holder Cocoyam Farms in Ondo State, Nigeria. In terms of non-beneficiary only coefficient of labour (-1.617) was negative and significant at 5% level. Labour was not expected to be negative because peasant farmers depend on labour in the absence of machine. This unexpected result could stem from inappropriate usage of the variables (labour and fertilizer). A major reason for this despite the use of improved seed may be attributed to adhering to proper plant density for maximum output. The production input with the highest partial elasticity was Fertilizer. According to Ugbabe *etal.* (2007) fertilizer (access, quality, method of application and use) remain a major challenge to increasing maize output. Maize is a heavy feeder and requires high rate of fertilizer application (136KgN, 20KgP, and 37KgK ha^{-1}).

Table 4.6: Maximum likelihood estimates of the stochastic frontier production function

Variable	Parameter	**Beneficiaries**		**Non-beneficiaries**	
		Coefficient	Standard-error	Coefficient	Standard-error
Functional Model:					
Constant	β_0	1.136	0.407	2.140	0.413
		(2.792)		(5.182)	
Seed	β_1	0.950***	0.071	0.678***	0.075
		(13.308)		(9.04)	
Farm size	β_2	-0.053	0.071	0.019	0.069

		(-0.75)		(0.275)	
Labour	β_3	-0.008	0.044	0.67***	0.260
		(-0.182)		(2.577)	
Pesticide	β_4	0.672***	0.154	0.002	0.002
		(4.364)		(1.000)	
Fertilizer	β_5	-0.089***	0.021	-0.039	0.038
		(-4.24)		(-1.026)	
Sigma square	δ^2	0.409***	0.133	0.525***	0.114
		(3.075)		(4.605)	
Gamma	γ	0.418***	0.144	0.796***	0.254
		(2.903)		(3.134)	
Log likelihood function		-77.231		-43.084	
LR test		24.987***		84.950***	
Mean		0.87		0.49	

Note: ***P<0.01 level of probability. Figure in parentheses is the t-value

4.2.1 Farm specific technical efficiency level

The estimation of technical efficiency for individual farmer in Table 4.7 revealed that more than 89% of beneficiaries of micro-credit had technical efficiency of over 80 % while the remaining 11% have their technical efficiency falling below or equal to 0.80. The result gives a mean technical efficiency of 0.93 which implies that the beneficiaries have potential to increase their output by 7%. On the other hand, 82% of the non-beneficiaries have their technical efficiency above 0.80 while 18% have their technical efficiency below or equal to 0.80. The result gives a mean technical efficiency of 0.89 implying the non-beneficiaries have potential to increase their technical efficiency level by 11%. The mean output oriented efficiency of 93% for beneficiaries and 89% for non-beneficiaries showed that the non- beneficiaries have more potential for technical efficiency increase while the beneficiaries are more technically efficient as the farmers operate on the same frontier. This finding agrees with the finding of Ezeh (2004) who reported that Fadama crop farmers in Abia State, Nigeria were more technically efficient than their non-Fadama crop counterpart. The differences in the level of technical

efficiency may be due to advisory services and some productive assets that the beneficiary had through their participation in Fadama II project. But is in variances with the findings of(Zeller et al., 2001) who stated that access to credit is not a guarantee for higher technical efficiency, except it goes with complementary factors as access to agricultural land, well-functioning markets for both input and output, and concluded that rather, access to credit will only enable (farming) households to adopt new technology, intensify agricultural production and invest in farm, all of which will eventually lead to increase income levels

Table 4.7: Farm specific technical efficiency level

Efficiency level	**Beneficiaries**		**Non-beneficiaries**	
	Frequency	Percentage	Frequency	Percentage
≤0.80	19	11	30	18
0.81-0.85	20	12	29	17
0.86-0.90	44	26	96	57
0.91-0.95	85	51	13	8
0.96-1.00	0	0	0	0
Total	168	100	168	100
Minimum	**0.68**		**0.36**	
Maximum	**1.00**		**0.97**	
Mean	**0.93**		**0.89**	

4.2.2 Maximum likelihood estimates of the inefficiency model

The variance parameters forsigma- square (δ^2) and gamma (γ) are estimated at 0.24 and 0.46 and were significant at 1%ineachcase for the beneficiaries. Within the non-

beneficiaries, the sigma- square (δ^2) and gamma (γ) are estimated at 0.18 which is significant at 1% and 0.03 which not significant.Thesigma-square atteststothe goodnessoffitandcorrectnessofthedistributional form assumedforthecomposite errortermwhilethegamma indicatesthesystematicinfluencesthatareunexplainedby theproduction functionandthedominantsourcesof randomerrors.Thisimpliesthatabout46% and 3%ofthe variation inoutputofthebeneficiaries and non- beneficiariesisduetothedifferences intheirtechnicalinefficiency.

For the associated inefficiency effects, it was found that the coefficients of all the variables (age, experience, education, household size and sex) were significant for beneficiaries of micro-credit, all the variables record negative signs except educational status. For non-beneficiaries of micro-credit, Moreover, only one variable (sex) was significant.

Within the beneficiaries of micro-credit, it was found that the coefficient of age was -0.031 which is significant at 10% level of probability. The negative coefficient of age implies that the older a farmer is, the lower will be the level of technical inefficiency or the higher will be his technical efficiency in maize production. This result is in contrast with Kolawole and Ojo (2007) who in their study of small scale farmers in Nigeria found age to be positively related to inefficiency.

It was found that the coefficient of farming experience was -0.031 which is significant at 5% level of probability. This implies that the more experienced a maize farmer is, the lower will be his level of technical inefficiency. This means being an experienced

farmer was not enough to significantly cause a farmer to attain higher levels of efficiency if he cannot rearrange his inputs to obtain higher output levels with a given technology. This finding is consistent with that of Onu *et al.,* (2000) whose result showed a negative relationship between farming experience and technical efficiency in cotton production in Nigeria.

The coefficient of education was found to be 0.114 which is significant at 10% level of probability. This implies that the more educated a maize farmer is, the higher will be his level of technical efficiency. That is to say education increases the farmer's technical efficiency and reduces his technical inefficiency. Education enhances farmer's ability to derive, decode and evaluate useful information as well as improving labour quality. This result concur with that of Onyenweaku *et al.*(2005) that showed a positive relationship between education and technical efficiency in yam production in Nasarawa state, Nigeria.

The coefficient of household was found to be -0.078 which is significant at 5% level of probability. This implies as household size increases, the technical inefficiency decreases thereby increasing technical efficiency of farmers. This finding disagrees with the findings of Mohammed Lawal *et al*., (2009) who reported that as household size increases the technical efficiency decreases. This could be due to the fact that large household size makes sufficient availability of labour for farm production. This is in harmony with findings of Bayacag (2001), who revealed that there is a positive and significant relationship between household size and farmers' efficiency in production.

The coefficient of sex was found to be -0.658 which is significant at 5% level of probability for beneficiaries. Gender is important in maize production because its production operations such as land clearing, cultivation and harvesting are labour intensive. Male farmers are likely to be more efficient in maize production than female farmers. This result agrees with that of Itam (2015), who reported a negative coefficient for sex. Men are more efficient than women in tilling while women are more efficient than men in weeding.

Table 4.8: Maximum likelihood estimates of the inefficiencymodel

Variable	Parameter	Beneficiaries		Non-beneficiaries	
		Coefficient	Standard-error	Coefficient	Standard-error
Inefficiency model:					
Constant	X_0	2.328	0.936	-0.425	0.669
		(2.486)		(-0.635)	
Age	X_1	-0.031*	0.016	-0.007	0.010
		(-1.94)		(-0.7)	
Experience	X_2	-0.031**	0.014	0.001	0.002
		(-2.214)		(0.5)	
Education	X_3	0.114*	0.058	0.087	0.095
		(1.97)		(0.92)	
Household size	X_4	-0.078**	0.035	0.015	0.013
		(-2.23)		(1.154)	
Sex	X_5	-0.658**	0.277	0.400*	0.223
		(-2.375)		(1.794)	

Note: *** P<0.01, **P<0.05 and * P<0.10 levels of probability. Figure in parentheses is the t-value

4.3 Profitability of Farm Enterprises (Crop Production Activities) of Beneficiaries and Non-beneficiaries of Micro-credit

4.3.1 Inputs and output levels in maize production.

The inputs utilized in maize production by beneficiaries and non-beneficiaries of micro-credit in the study area are land, seeds, labour, fertilizer and pesticide. Table 4.9 gives the levels of input used as well as the output in maize production.

Land

Land is one of the limiting resources for maize production in the study area. A total of 942.5 and 666.6 hectares of land were put into maize production by beneficiaries and non-beneficiaries of micro-credit giving an average of 6 and 4 hectares of land per farmer. Going by Ojuekaiye (2001), classification of farm size of 0.1 hectare to 5.9 hectares as small farms, it then implies that majority of the respondents were medium and small scale farmers. This will allow for meaningful investment and returns to scale on food security and productivity.

Seed

An average of 46kg and 41kg of local seed per hectare was utilized by beneficiaries and non-beneficiaries of micro-credit. The average quantity of seed used was above the recommended rate of 17 – 20kg per hectare Kaduna State Government (2014). Farmers over utilized seed because of poor germination rate of the local seed. They complain of high price of hybrid seed.

Labour

In the study area, labour is obtained from both the family and hired farmers. It was observed that farmers used a combination of family and hired labour for their farm operations. The total labour hour used was 34,293.5 and 48,483 man-hours with an average of 204 and 289 man-hours by beneficiaries and non-beneficiaries of micro-credit. Hired labour was mainly used for land preparation, weeding and harvesting to compliment the family labour.

Fertilizer

Although, fertilizers were used, the amount used was limited by the high price of the commodity. The total quantity used was 82905 and 75915 kg by beneficiaries and non-beneficiaries of micro-credit. The average quantity used per hectare was 493 kg (9.0 bags) and 452 kg (9.0bags) by both beneficiaries and non-beneficiaries. This is within the recommended quantity of 400kg–500kg (8–10 bags) per hectare depending on the level of Nitrogen content in the soil(Onyebinama, 2006). The effect of this finding is that output obtained would be high, because maize is a high fertilizer demanding crop.

Pesticides

Pesticides were used to control weeds to give the maize crop a luxurious growth. The total quantity of pesticide used was 1013 and 808litres by beneficiaries and non-beneficiaries of micro-credit with an average of 6 and 5 litres per hectare wage, respectively. The level of pesticide used was not unconnected with high price of the input in the market. Hence, weeding was mostly used in place of pesticides.

Maize yield (supply level)

The total yield of maize for the sampled farmers were 394,516.6 and 342,138 kg by beneficiaries and non-beneficiaries of micro-credit which is on the average, 2348 and 2037 kg per hectare. This is within the average yield of 2 tons/ha recorded in the state for the year 2012 (Kaduna State Government, 2014). This result is, however not surprising since these inputs (seed and fertilizer) were well-utilized with the realization

of 2.3 and 2.0 tons/ha, this is within the recommended yield of 2 tons/ha. There need to improve the use of other inputs.

Table 4.9: Levels of inputs used and yield obtained from maize production activities

Input	Beneficiaries				Non-beneficiaries				
	Max.	Min.	Average	Std.dev.	Max	Min	Average	Std.dev.	Z-value
Land	10	1.5	6	2.3	13	1.5	4	2.1	6.813***
Seed	85	10	46	17.1	100	10	41	22.3	1.983*
Labour	656	28	204	119.9	1454	23	289	239.3	1.127^{NS}
Fertilizer	3900	100	493	491.2	1150	100	452	277.9	1.653^{NS}
Pesticide	15	2	6	2.7	15	0	5	2.5	2.238**
Yield	11739.13	200	2348	1846.6	9666.67	307.69	2037	1453.4	1.72*

Note: ***P<0.01, **P< 0.05 and *P<0.10 levels of probability While NS=Not Significant

4.3.2 Costs and return analysis

The costs, returns and profitability analysis of maize production enterprise of beneficiaries and non- beneficiaries of micro-credit are presented on Table 4.10.

The following items were considered in estimating the costs and returns, Gross Revenue cost of seed, fertilizer, labour and pesticides.

Gross return

The gross return was computed by multiplying the total yields from the sampled farmers by the average price of maize at the time of data collection. The average price was varied considerably over the time. For instance, the prices dropped from ₦10, 000 per 100kg bag before harvest to ₦5, 500 at harvest time. The average price of ₦7750/bag (i.e. ₦ 77.5/kg) was computed and used to determine return. A gross

returns of 2348kg/ha and 2037kg/ha on the average which is ₦181, 994 and ₦ 157,832 was realized by the beneficiaries and non- beneficiaries of micro-credit, respectively.

Cost of production

In estimating the total cost of production, only the variable costs components were considered. This is because the fixed costs are negligible in small scale crop production. Farmer on the average did not use fixed assets. The variable inputs used were seeds, fertilizer, labour and pesticides.

Cost of seed

Maize seeds were obtained from different sources like the seed companies and open markets. The average market price of ₦200/unit (i.e. ₦80/Kg) for seed was used. On the average 46kg/ha and 41 kg/ha of seeds with a cost of ₦3669 and ₦ 3317 was invested in the maize production enterprise by the beneficiaries and non- beneficiaries of micro-credit, respectively.

Cost of fertilizer

The cost of fertilizer in the study area ranged from ₦ 3500 to ₦ 5500 per 50 kg bag. The average price was ₦ 4500/bag (i.e. ₦90/kg). On the average 493kg/ha and 452 kg/ha of fertilizers with a cost of ₦44, 413 and ₦ 40,669 was invested in the maize production enterprise by the beneficiaries and non- beneficiaries of micro-credit, respectively.

Labour costs

The labour cost includes the cost of land preparation, fertilizer application, planting and harvesting. The wage rate varied depending on the operation that was performed. The average wage rate was ₦120 per man-hour. On the average 204man-hour/ha and 289 man-hour/ha of labour with a cost of ₦24, 495 and ₦ 34,631 was invested in the maize production enterprise by the beneficiaries and non- beneficiaries of micro-credit, respectively.

Pesticide costs

The cost of pesticides in the study area ranged from ₦800 to ₦1000. The average market price of ₦900 was used. On the average 6 litres/ha and 5 litres /ha of pesticides with a cost of ₦5427 and ₦ 4329 was invested in the maize production enterprise by the beneficiaries and non- beneficiaries of micro-credit, respectively.

Total Variable Cost

The total variable costs of production consist of the costs of fertilizers, seeds, agrochemicals and labour. The high cost of production could be said to be responsible for the underutilization of the inputs by farmers.

Gross Margin.

The gross margin represents the difference between the total returns (Gross returns) and the total variable cost. The average rate of return i.e. the gross return divided by the total variable cost.

The revenue and total production costs incurred for maize production by beneficiaries and non-beneficiaries of micro-credit are presented on Table 4.10. The total amounts invested in maize production by both beneficiaries and non-beneficiaries were ₦78, 004/ha and ₦82, 945/ha respectively, while the total revenue realized was ₦181, 994/ha and ₦157, 832/ha respectively. The average rate of return was found to be ₦ 1.33 and ₦ 0.90. This implies that for every one naira invested in the maize production a profit of 33kobo was made by the beneficiaries while 90kobo was realized by the non-beneficiaries, which is 10kobo less than one naira for the non-beneficiaries to have a break even in maize production enterprise. The beneficiaries of micro-credit made additional profit of 33kobo compared to their non-beneficiaries counterparts who incurred 10kobo lost. This could be attributed to the beneficiaries' access to credit to purchase inputs such as fertilizers and pesticides for maize production. This is confirmed by earlier findings in Table 4.10 that the beneficiaries' utilization of inputs such as fertilizer and pesticides were significantly differences from that of the non-beneficiaries at 10% and 1% levels of probability, respectively.

Test of Hypothesis II

The hypothesis which stated that there is no significant difference in the farm enterprise input utilization, output and the profitability of beneficiaries and non-beneficiaries of micro-credit was subjected to Z-test. It was found that there is statistically significant difference between beneficiaries and non-beneficiaries of microcredit with respect to inputs such as land, seed and pesticide while labour and fertilizers were not statistically significant. Also from the result which indicated that the output and profitability of beneficiaries, is significantly difference from the output

and profitability of the non-beneficiaries at 1% level of probability (Table 4.10). Therefore, based on that result the null hypothesis that there is no significant difference between the input utilization, output and the profitability of beneficiaries and non-beneficiaries of micro-credit is rejected in favour of hypothesis that stated that there is significant difference between the input utilization, output and the profitability of beneficiaries and non-beneficiaries of micro-credit.

Table 4.10: Gross Margin per Hectare of Maize Production in the study area

Items	**Beneficiaries**			**Non-beneficiaries**		Z-value
	Unit Price (₦/kg)	Average quantity	Total Value (₦/Ha)	Average quantity	Total Value (₦/Ha)	
1. Gross returns						
(a) Average yield (kg/ha)	78	2348	181994	2037	157832	
2. Variable costs						
(a) Seed(kg)	80	46	3669	41	3317	
(b) Fertilizer(kg)	90	493	44413	452	40669	
(c) Labour(man/hour)	120	204	24495	289	34631	
d) Pesticide(L)	900	6	5427	5	4329	
2.Total Variable Cost			78,004		82,945	
Gross Margin			103,990		74,887	
Return per naira			1.33		0.90	
Profitability						4.697***

***P<0.10 level of probability.

4.4 Food Security Status of Beneficiaries and Non-beneficiaries of Micro-credit

4.4.1 Food security status between beneficiaries and non-beneficiariesof microcredit

This section is concerned with the description of food security status of beneficiaries and non-beneficiaries of micro-credit among maize farming households in Kaduna State based on their socio-economic characteristics. Food security status was determined after estimating the food security line (₦148) which represents the minimum cost of consuming 2700 kcal per person on a daily basis and therefore causing such person to be food secure. In other words, food secure maize farming households were those whose per capita food consumption expenditure or per capita cost of calorie was greater or equal to ₦148. Generally, it was observed that 104 (31%) and 232(69%) maize farming households were food secure and insecure respectively. This implies that about 69 percent of the sampled maize farming households fell short of the recommended daily calorie requirement of 2700 kcal (Olabisi and Olawamiwa, 2014).

According to Table 4.11, the frequency distribution of the food security status of maize farming households based on sex and across micro-credit group, it was found out that the number of food insecure maize farming households (232) in the pooled data were more than twice those that were food secure (103) which were in majority male-headed (86.41%) against only 14 percent that were female-headed. In other words, male-headed maize farming households were more food secure than female-headed maize farming households based on the pooled data and even across beneficiaries and non-beneficiaries of micro-credit. Specifically, 59 and 44 beneficiaries and non-beneficiaries of micro-credit were food secure respectively. In terms of sex, 50 and 39 male-headed beneficiaries and non-beneficiaries were food secure while only 9 and 5 female-headed beneficiaries and non-beneficiaries were food secure respectively. As expected, it can be

implied that maize farming households that benefited from micro-credit were more food secure than those that did not benefit. Moreover, male-headed and female-headed maize farming households that benefited from micro-credit were more food secure than their non-beneficiaries counterparts. It could be implied that male-headed maize farming households are more likely to become food secure than their female counterparts irrespective of micro-credit status but that the likelihood is higher among those that benefit than those that do not benefit. The finding is consistent with the study of Omonona and Agoi (2004), who observed that male-headed urban households in Nigeria are more food secure than their female counterparts. According to these authors, lower dependency ratio among urban households headed by males where the heads and their spouses are engaged in income generating activities could be one of the possible reasons.

Table 4.11: Frequency distribution of food security status of maize farming households based on sex by micro-credit group

	Micro-credit group					
	Beneficiaries		**Non-beneficiaries**		**Pooled**	
Variables	**FS**	**FI**	**FS**	**FI**	**FS**	**FI**
Male	51	85	39	111	90	196
	(85)	(78.7)	(88.64)	(89.52)	(86.54)	(84.48)
Female	9	23	5	13	14	36
	(15)	(21.3)	(11.36)	(10.48)	(13.46)	(15.52)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Per capita daily calorie consumption. Food security line = ₦148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

Table 4.12 presents the frequency distribution of food security status of beneficiaries and non-beneficiaries of micro-credit among maize farming households across age group, it was observed in the pooled data that majority of food secure maize farming households (55.77%) and food insecure maize farming households (47.41%) were those with household heads aged between 34-43 years. It was also noted that the number of food secure and food insecure maize farming households decreased with age of household heads beyond certain age point between the age group 34-43 years. This would therefore imply that the relationship between food security status and age could be quadratic which is also consistent even after accounting for micro-credit status. Except for the age group 24-33 years, beneficiaries of micro-credit among maize farming households heads whose age are beyond 33 years were found to be more food secure than non-beneficiaries. In other words, above the age of 43 years, maize farming households that are headed by older persons are more likely to become food secure than their counterparts. The finding is consistent with the study of (Omonona *et al.* 2007) who found out that urban households in Nigeria whose heads are older tend to be more food insecure than their counterparts, although they argued that food insecurity tends to reduce beyond 70 years of age due to possible additional income from their adult children.

Table 4.12: Frequency distribution of food security status of maize farming households based on age of household head by micro-credit group

	Micro-credit group					
	Beneficiaries		**Non-beneficiaries**		**Pooled**	
Variables	**FS**	**FI**	**FS**	**FI**	**FS**	**FI**
24-33	5	11	7	32	12	43
	(8.33)	(10.19)	(15.91)	(25.81)	(11.54)	(18.53)
34-43	35	56	23	54	58	110
	(58.33)	(51.85)	(52.27)	(43.55)	(55.77)	(47.41)
44-53	14	33	12	34	26	67
	(23.33)	(30.56)	(27.27)	(27.42)	(25)	28.88

>53	6	8	2	4	8	(12)
	(10)	(7.41)	(4.55)	(3.23)	(7.69)	(5.17)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C. where X=Per capita daily food expenditure, C= Per capita daily calorie consumption. Food security line = ₦148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

In Table 4.13, 77 and 27 married-headed and unmarried-headed maize farming households were observed to be food secure in the pooled data respectively. In terms of micro-credit status, 44 and 16 married-headed and unmarried-head maize farming households that benefited from micro-credit were food secure while 33 and 11 married-headed and unmarried-head maize farming households that did not benefit from micro-credit were food secure. This implies that married-headed maize farming households were more food secure than their unmarried counterparts irrespective of their micro-credit status. In other words, married-headed maize farming households are more likely to become food secure than their unmarried counterparts. However, married-headed and unmarried-headed maize farming households that benefited from micro-credit were more secure than married-headed and unmarried-headed maize farming households that did not benefit from micro-credit; that is, married-headed and unmarried-headed maize farming households that benefit from micro-credit are more likely to become food secure than married-headed and unmarried-headed maize farming households that do not benefit from micro-credit.

Table 4.13: Frequency distribution of food security status of maize farming households based on marital status of household head by micro-credit group

	Micro-credit group					
	Beneficiaries		Non-beneficiaries		Pooled	
Variables	**FS**	**FI**	**FS**	**FI**	**FS**	**FI**
Married	44	91	33	100	77	191
	(73.33)	(84.26)	(75)	(80.65)	(74.04)	(82.33)
Unmarried	16	17	11	24	27	41
	(26.67)	(15.74)	(25)	(19.35)	(25.96)	(17.67)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Per capita daily calorie consumption. Food security line = ₦148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

Table 4.14 shows the frequency distribution of food security status among maize farming households in terms of household size across beneficiaries and non-beneficiaries. Based on the pooled data, it was observed that 101 (97.12%) and 3 (2.88%) maize farming households falling in the household size class 2-7 and 8-13 respectively were food secure while no maize farming household with more than or equal to 14 members were found to be food secure. This could imply that the probability to become food secure decreases with increase in household size in the pooled data and even after accounting for micro-credit status. In terms of micro-credit status, it was

observed that 57 and 44 beneficiary and non-beneficiary maize farming households with household size falling in the range 2-7 were food secure respectively. Also, while 3 beneficiary maize farming households with household size falling in the household size class 8-13 were found to be food secure, none of the beneficiary maize farming households with household size falling in the household size class 8-13 was found to be food secure. This could imply that, although the likelihood to become food secure decreases with increase in family size irrespectively of micro-credit status, maize faming household with family size ranging from 2-13 would be more likely to be food secure if they receive credit than if they do not.

Table 4.14: Frequency distribution of food security status of maize farming households based on household size by micro-credit group

	Micro-credit group					
	Beneficiaries		**Non-beneficiaries**		**Pooled**	
Variables	**FS**	**FI**	**FS**	**FI**	**FS**	**FI**
2-7	57	54	44	66	101	120
	(95)	(50)	(100)	(53.23)	(97.12)	(51.72)
8-13	3	41	0	45	3	86
	(5)	(37.96)	(0)	(36.29)	(2.88)	(37.07)
14-19	0	10	0	10	0	20
	(0)	(9.26)	(0)	(8.06)	(0)	(8.62)
>19	0	3	0	3	0	6
	(0)	(2.78)	(0)	(2.42)	(0)	(2.59)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Per capita daily calorie consumption. Food security line = ₦148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

Table 4.15 shows that 75 and 29 maize farming households headed by formally and no formally educated persons were observed to be food secure in the pooled data

respectively; 40 and 20 maize farming households headed by formally and no formally educated persons among the beneficiaries of micro-credit were observed to be food secure 35 and 9 maize farming households headed by formally and no formally educated persons among the non-beneficiaries were observed to be food secure. This implies that, irrespective of micro-credit status, maize farming households headed by formally educated persons are likely to become food securethan their counterparts. Surprisingly, maize farming households headed by formally educated persons were found to have cultivated virtually the same maize farm size with their counterparts irrespective of micro-credit status. Also, maize farming households headed by formally educated persons were found to have been less involved in secondary occupation than those with no formally educated maize farming household. However, the data showed that maize farming households headed by formally educated persons had higher social capital through association membership than those headed by no formally educated persons.

Table 4.15: Frequency distribution of food security status of maize farming households based on education status of household head by micro-credit group

	Micro-credit group					
	Beneficiaries		**Non-beneficiaries**		**Pooled**	
Variables	**FS**	**FI**	**FS**	**FI**	**FS**	**FI**
Formal	40	61	35	100	75	161
	(66.67)	(56.48)	(79.55)	(80.65)	(72.12)	(69.4)
No Formal	20	47	9	24	29	71
	(33.33)	(43.52)	(20.45)	(19.35)	(27.88)	(30.6)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Household per capita daily calorie consumption. Food security line = ₦148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

According to Table 4.16, it was observed that the majority (62.5%) of maize farming households with association membership of the heads were food secured based on the pooled data. In terms of micro-credit status, all the maize farming households with association membership of the heads that benefited from micro-credit were found to be more food secure than those without association membership of the heads that benefited from micro-credit. On the other hand, only 11.36 percent of maize farming households with association membership of the heads that did not benefit from micro-credit were found to be more food secure against 88.64 percent of those without association membership of the heads that did not benefit from micro-credit. The implication is that maize farming households with association membership of the heads that benefit from micro-credit are more likely to become food secure than those with association membership that do not benefit from micro-credit. However, maize farming households with no association membership of the heads that benefit from micro-credit are less likely to become food secure than maize farming households without association membership of the heads that do not benefit from micro-credit. It can also be said that association membership coupled with access to micro-credit increases the likelihood of becoming food secure while association membership without access to micro-credit tend to reduce the likelihood of becoming food secure.

Table 4.16: Frequency distribution of food security status of maize farming households based on association membership by micro-credit group

	Micro-credit group		
Variables	**Beneficiaries**	**Non-beneficiaries**	**Pooled**

	FS	FI	FS	FI	FS	FI
Yes	60	108	5	28	65	136
	(100)	(100)	(11.36)	(22.58)	(62.5)	(58.62)
No	0	0	39	96	39	96
	(0)	(0)	(88.64)	(77.42)	(37.5)	(41.38)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Household per capita daily calorie consumption. Food security line = N148/person/day. <=2 ha, 2.1-5 ha and >5 ha of land corresponds to small, medium and large scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

Table 4.17 presents the frequency distribution of food security status in terms of farm size across beneficiaries and non-beneficiaries. Based on the pooled data medium scale maize farms appears to be the optimal scale of production to lift up maize farming households out of food insecurity given that the majority of food secure maize farming households operated medium scale farms. But the fact, that the proportion of food secure maize farming households operating large scale maize farms could mean that, food security increases with increase with farm size operated. The proportion of maize farming households that operated either small or medium scale farm with access to micro-credit was greater than that maize farming households that operated either small or medium scale farm without access to micro-credit. In other words, access to credit could increase the probability of small and medium scale maize farming households to become food secure while reducing the likelihood of medium scale farming household of becoming food secure.

Table 4.17: Frequency distribution of food security status of maize farming households based on land size by micro-credit group

Variables	Micro-credit group					
	Beneficiaries		Non-beneficiaries		Pooled	
	FS	FI	FS	FI	FS	FI

Small scale	29	57	32	100	61	157
	(48.34)	(52.78)	(72.73)	(80.65)	(58.66)	(67.68)
Medium scale	31	51	12	24	43	75
	(51.67)	(47.22)	(27.27)	(19.35)	(41.35)	(32.33)
Total	60	108	44	124	104	232
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Author's estimates from survey data (2015)
Note: Cost of calorie function is given by Ln X=4.23+0.00028*C where X=Per capita daily food expenditure, C= Household per capita daily calorie consumption. Food security line = N148/person/day. <=5 ha, and >5 ha of land corresponds to small and medium scale farm respectively. Values in parentheses are percentages. FS = Food secure, FI = Food Insecure

4.4.2 Relationship between maize farmers' socio-economic characteristics and their food security status

Table4.18presents the maximum likelihood estimates for determinants of food security in Kaduna States among both beneficiaries and non-beneficiaries. The analysis was done based on micro-credit status and pooled data where the dependent variable was food security status taking 1 if a household is food secure and 0 if food insecure while the independent variables included sex, age, marital status, education, association membership, micro-credit status of the household head, household size and land size. To ascertain the homogeneity of the coefficient estimates of the determinants of food security across beneficiaries and non-beneficiaries of micro-credit, a Wald test was used to test the significance of the coefficient estimate of micro-credit based on the pooled data. The results showed that the null hypothesis that the coefficient estimates of the determinants of food security across beneficiaries and non-beneficiaries of micro-credit cannot be rejected. In other words, the coefficient estimates of sex, age, marital status, education, association membership, micro-credit status of the household head, household size and land size are statistically equal across both the beneficiaries and the non-beneficiaries. Therefore, the interpretation and discussion of the findings were based on the pooled model.

According to the pooled model, 6 independent variables – sex, age, marital status, education, household size and land size – out of 8 were statistically significant in explaining any variation in the probability to become food secure. This implies that variables such as association membership and micro-credit status were not important determinant of food security status given the model under consideration. But globally, all the covariates were jointly significant in predicting the food security status of maize farming households. Specifically, the Likelihood Ratio (LR) chi-squared estimate of the pooled model was 74.78 and was statistically significant at 1 percent level of probability. The pseudo R-squared estimate was 0.25 which implies that the model explains about 25 percent of variation in food security status of maize farming households.

Out of the 6 significant determinants of food security among maize farming households, given the model, it was found out that the signs of the coefficient estimate of marital status, and household size were negative while those of sex, age,education and land size were positive. This implies that while marital status, and household size had an indirect relationship with food security status, sex, age,education and land size had a direct relationship with food security status among maize farming household in Kaduna State.This finding was contrary to findings by Robert, James and Thomas (2013) in Ghana, it is quite reasonable. In other words, an increase in age, land size as well as being male-headed household will increase the likelihood of a maize farming household to become food secure while any increase in household size as well as being married-headed household will reduce the probability of a maize farming household to become food secure.

In particular, given the model and under the assumption that all things are equal, the Average Marginal Effect (AME) of sex was 0.22 which implies that male-headed maize farming household is 22 percent point more likely than their female-headed counterparts to become food secure. The AME of age was 0.01 which implies that an increase in age beyond the mean age of about 42 by a year will increase the probability of becoming food secure.

In other words, beyond the age of 42 years, maize farming households that are headed by older persons are more likely to become food secure than those headed by younger persons. The finding is contrary to the a priori expectation, although consistent with the result of Oyebanjo, Ambali and Akerele (2013) who found out that age of household heads among farming households in Ijebu division of Ogun State was positively related to food security status. These authors argue that the positive relationship between age and food security status could be attributed to the fact that older people tend to have financial support from their older children who are working.

The AME of marital status was -0.17 which implies those maize farming households headed by married persons are 17 percent point less likely than their unmarried counterparts to become food secure. The AME of household size was -0.03 which implies that an increase in household size by one member will reduce the probability of a maize farming household to become food insecure beyond the average household size of 10. In other words, beyond the mean household size of 10, maize farming households with larger household are less likely than their counterparts to become food secure. The finding is consistent with other studies such as Omotesho *et al.* (2006),

The AME of land size was 0.02 which implies that any increase of 1 ha beyond the mean land size of about 2ha, the probability for a maize farming household to become food secure increases by 2 percent point.

Table 4.18: Maximum likelihood estimates of the logit model for the determinants of household food security among beneficiaries and non-beneficiaries of micro-credit

	Micro-credit group					
	Beneficiaries		**Non-beneficiaries**		**Pooled**	
Variable	**Coeff.**	**AME**	**Coeff.**	**AME**	**Coeff.**	**AME**
Constant	-3.7** (1.72)		-3.51** (1.7)		-4.69*** (1.28)	
Sex	1.35* (0.74)	0.19* (0.1)	NA	NA	1.79*** (0.69)	0.22*** (0.08)
Age	0.06** (0.03)	0.01** (0.004)	0.09** (0.03)	0.01*** (0.004)	0.07*** (0.02)	0.01*** (0.002)
Marital status	-1.6*** (0.51)	-0.22**** (0.06)	-1.04* (0.54)	-0.12** (0.06)	-1.35*** (0.36)	-0.17*** (0.04)
Household size	-0.22*** (0.07)	-0.03*** (0.01)	-0.27*** (0.08)	-0.03*** (0.007)	-0.24*** (0.05)	-0.03*** (0.01)

Education	0.98* (0.5)	0.08* (0.045)	0.39 (0.78)	0.05 (0.09)	0.74* (0.41)	0.09* (0.05)
Asso. Member.	NA	NA	0.04 (0.63)	0.005 (0.07)	0.25 (0.37)	0.03 (0.04)
Land	0.2* (1.99)	0.03** (0.01)	0.14 (0.12)	0.02 (0.01)	0.18** (0.07)	0.02** (0.01)
Micro-credit					0.22 (0.61)	
LR chi-squared	38.44***		32.65***		75.78***	
Wald test					0.12	
Pseudo R-squared	0.24		0.24		0.25	
Number of observations	168		168		336	

Source: Field survey (2015)

Note: *** P<0.01, **<0.05 and *<0.1 levels of probability. Standard errors are in parentheses. AME=Average Marginal Effect. NA=Not Available

4.5Impact of Microcredit Utilization on Farmers' Maize Output and Household Food Security.

The challenge in impact evaluation based on observational data lies on the estimation of the counterfactual of the treated group based on the observations on the untreated group. But these two groups are very unbalanced; that is, they are different socially, economically, psychologically, etc. However, in the literature researchers have often employed a number of statistical strategies to ensure the comparability of the two groups. In alignment with those authors, this study chooses the Propensity Score Matching (PSM) method to assess the impact of microcredit utilization on farmers' maize output and food security.

Prior to the evaluation of the impact of microcredit, the propensity score of microcredit utilization (probability to utilize microcredit) is estimated and assessed in terms of its success in balancing the distribution of covariates across the beneficiaries and non-beneficiaries of microcredit among maize farmers in the study area. Besides balancing the distribution of the covariates across users and non-users of microcredit, another difficulty in the implementation of PSM lies on the choice of the most appropriate algorithm. While some authors advocate the use of several algorithms to ensure robustness of the impact's findings, others believe that selecting the right algorithm to match the treated and untreated groups is critical. Thus, this section will first present the extent of bias between beneficiaries and non-beneficiaries, followed by the estimation of the propensity score, the choice of the most appropriate algorithms and finally the impact's results.

4.5.1 Extent of selection bias in the decision of microcredit utilization prior to matching

Table 4.19 presents the difference between the beneficiaries and the non-beneficiaries based on the mean values of their selected socio-economic characteristics and thereby the extent of bias that would be introduced if the naïve method of impact evaluation based the difference-in-means estimator was undertaken. Although the list of covariates retained appears too small, but it is still consistent with the ignorability assumption since a large list of covariates would violate it. Three algorithms were considered as the maintained hypothesis and then four statistics - the t-value, Standardized Percentage Bias (SPB), Rubin' B and the Rubin's R - were retained for the evaluation of the extent of bias between the treated and the control groups after matching based on the algorithms under study.

It is evident from the analysis that the beneficiaries and the non-beneficiaries differ in four socio-economic characteristics – age, sex, education and land - out of the six retained based on the t-values of the difference in means. The implication of this finding is that, the beneficiaries were significantly older, had more males, had more farming households headed by no formally educated people and had larger farms than the non-beneficiaries of microcredit. Based on the SPB, it can be said that the four covariates are sources of substantial bias between the two groups since the values are greater than 30% in absolute value. The Rubin's B is greater than 25% while the Rubin's R is greater than 2 thereby confirming the extent of bias between the beneficiaries and the non-beneficiaries. The implication of these findings as mentioned earlier is that the beneficiaries and non-beneficiaries are not directly comparable; that is, the non-beneficiaries cannot be used as the counterfactual of the beneficiaries.

Table 4.19: Comparison of beneficiaries and non-beneficiaries of microcredit among maize farmers in terms of socio-economic characteristics prior to matching

	Mean					
Variables	**Treated**	**Control**	**T-value**	**SPB**	**Rubin's B**	**Rubin's R**
Age	42.35	39.89	2.91***	31.70	174	6.24
Sex	0.80	0.89	-2.29**	-25.00		
Marital status	0.80	0.79	0.27	2.95		
Household size	6.54	6.56	-0.05	-0.52		
Education	0.37	0.14	5.06***	55.25		
Land	3.40	1.18	14.92***	162.75		

***P<0.01 and **P<0.05 levels of probability. Treated = Beneficiaries, Control= Non-beneficiaries. SPB = Standardized Percentage Bias

4.5.2 Propensity score of microcredit utilization

Table 4.20 presents the Maximum Likelihood (ML) estimates of the Propensity Score (PS) of microcredit utilization – the probability to use microcredit – among maize

farmers in the study area. The Likelihood Ration (LR) test estimate is 177. 48 and is statistically significant at 1% level of probability. The implication is that all the six independent variables jointly explain the decision of using microcredit. But individually, the age of household head, his or her level of education and the land cultivated by a household are important explanatory variables of microcredit utilization. The pseudo multiple coefficient of determination estimate is 0.49 which implies that 49% of variation in the decision to use microcredit is explain by the model.

The relationship between age and the decision to use microcredit is positive and statistically significant at 5% level of probability; that is, older headed maize farming households are more likely than their younger counterparts to use microcredit. Age hasbeenconsidereda major determinantfor income diversificationand attaining householdfoodsecurity (Oluwatayo,2012).Bashir *et al.* (2013) asserted that householdheadswithintheireconomicallyactiveageshouldbemorefoodsecure.

The relationship between the decision to use microcredit and the level of education is positive and statistically significant at 1% level of probability; that is, households headed by people with higher level of formal education are more likely to use microcredit than those with less formal education. Educationisconsideredakeydeterminantofparticipationinremunerativefarmsectorandachieving householdfoodsecurity (DejanvryandSadoluet,2001;AsogwaandUmeh,2012).Thisisasexpected,sincethelevelofeducationshouldpositively affect theincome earning capacityand levelof efficiencyin managingthe household food resources.Thisimpliesthat,householdheadswithrelatively bettereducationaremore likelytobefoodsecurethanthoseheadedbyuneducatedpeople(AsogwaandUmeh,

2012;OniandFashogbon,2013**;** AdepojuandAdejere,2013). Educational improvement could lead to awareness of the possible advantages of modernizing agricultureandimprovequality oflabourwhichinturnimproveshouseholdfoodsecurity (Haile*et al*., 2005; Omonona and Agoi, 2007;Adebayo, 2012).

The relation between the decision to use microcredit and land cultivated is negative and statistically significant at 1% level of probability; that is, maize farming households cultivating larger parcels of lands are more likely to use microcredit than those operating smaller parcels of lands. Farmsizesignificantlydeterminesthefoodsecurity statusofhouseholds(Aidoo*etal*.,2013;Asogwa andUmeh,2012).Vander Veen(2010) assertsthat,foodproductioncanbe increased extensivelythroughexpansionofareasundercultivation.Reddy*etal*.(2004)observed that,greaterefficienciesinuseofresourcesareassociatedwithlargefarmsthansmall ones.Inreality,small-scaleproducersare notalways efficient(Gebrehiwot,2009).Aidoo*etal*.(2013) opined that household food securityincreases with increasein areaunder cultivation.

Table 4.20: Maximum likelihood estimates of the propensity score for microcredit utilization

Variable	**Coefficients**	**Standard error**	**T-value**
Constant	-3.28***	0.65	-5.05
Age	0.02**	0.01	2
Sex	-0.12	0.26	-0.46
Marital status	0.25	0.22	1.14
Household size	-0.01	0.02	-0.5
Education	0.78***	0.23	3.39
Land	1.1***	0.12	9.17
LR	229.43***		
Pseudo R Squared	0.49		
Number of observations	336		

Note: *** P<0.01 and **<0.05 levels of probability.

4.5.3 Choice of the propensity score matching algorithm

Three common PSM algorithms from the literature were considered in this study: the Nearest Neighbor Matching (NNM), the Radius Matching (RM) and the Kernel Matching (KM). According to the three algorithms, the difference in means of the socio-economic characteristics between the beneficiaries and non-beneficiaries is completely eliminated based on the t-value. In terms of the SPB, the NNM has reduced the number of substantial bias from four to two while the RM and the KM have reduced the substantial bias from four to three. Only the Rubin's B estimate for the NNM is less than 25% which implies that only the NNM is effective in balancing the covariates across beneficiaries and non-beneficiaries based on the Rubin's B criterion. But in terms the Rubin's R, it can be said that all the three algorithms were effective in balancing the covariates across the treated and control groups. Overall, it can be concluded that the NNM is the best algorithm for the estimation of the impact of microcredit utilization on output and food security.

Table 4.21: Comparison between NNM, RM and KM algorithms

Algorithms	T-value	SPB	Rubin' B	Rubin's R
NNM	6	4	19.7	0.69
RM	6	3	25.8	1
KM	6	3	26.3	1.15

Note: NNM=Nearest Neighbor Matching, RM=Radius Matching and KM=Kernel Matching

4.5.4 Impact of microcredit utilization on maize output

Table 4.22 shows that microcredit utilization has a positive and statistically significant impact on maize output among maize farming households in the study area.

Specifically, the NNM shows that an additional maize output of 2,920.47kg was achieved, on average, by a maize farming household who used microcredit during the production period under study. Moreover, a positive and statistically significant impact of microcredit utilization on maize output is found for male headed maize farming households (3,381.82kg) and no statistically significant impact is found for female headed maize farming households. The impact for maize farming households cultivating less than or equal to 2ha (2,774.81kg) was positive and statistically significant while the impact for those operating more than 2ha was not statistically significant. It can be noted that the impact based on the RM and KM was equally positive and statistically significant therefore showing the robustness of the findings. However, the RM and KM overestimate the impact of microcredit utilization on output.

Table 4.22: Average treatment effect on the treated (ATT) of microcredit utilization on maize output among maize farmers

Parameters	**NNM**	**RM**	**KM**
Pooled	2,920.47***	3,528.14***	3,751.25***
	(1,273)	(1,009.41)	(1,013.84)
Impact by Sex			
Male	3,381.82***	4,304.42***	4,551.76***
	(1,461.68)	(1,148.91)	(1,155.71)
Female	1,031.25	1,340	2,257.25
	(1,693.02)	(1,915.72)	(2,050.36)
Impact by land size cultivated			
<=2ha	2,774.81**	3,245.92***	3,120.22***
	(1,228.37)	(959.5)	(938.44)
>2ha	85.26	1426.32	1711.13
	(2,845.4)	(2,885.76)	(2,883.81)

Note: ***P<0.01 and **P<0.05 levels of probability. NNM=Nearest Neighbor Matching, RM=Radius Matching and KM=Kernel Matching. Standard errors in

parentheses

Test of Hypothesis iii

The hypothesis which stated that microcredit utilization has no impact on output of the beneficiaries in the study area was conducted using T-test (Table 4.23).Maize farmers with microcredit utilization after nearest neigbour matching was 10,436.47 kg while that of farmers without microcredit utilization was 7,516 kg (Table 4.23). Consequently, the impact of microcredit utilization on maize output (ATT) was 2,920 and was statistically significant at 5 percent level of probability. This implies that the null hypothesis that microcredit utilizationhas no impact on maize output of the beneficiaries in the study area was rejected at 5 percent level of probability. In other words, there is a significant impact of microcredit utilization on maize output of the beneficiaries in the study area.

Table 4.23: T-test of the impact of micro-credit utilization on output of beneficiaries

Variable	Treated	Controls	ATT	S.E.	T-stat
Maize output (kg)	10,436.47	7,516	2,920.47	1,273	2.29**

Source: Author's estimates
Note: **<0.05. ATT=Average Treatment Effect on the Treated (Impact)

4.5.5 Impact of microcredit utilization on food security

Table 4.24 shows that the impact of microcredit utilization on food security by per capita farm income is positive and statistically significant. Specifically, using microcredit raised per capita income, on average, by ₦254, 080.94 annually. The per capita income for males increased significantly, on average, by ₦294, 218.18 annually, but the impact for the females was not statistically significant. The impact for maize

farmers cultivating less than or equal to 2ha was positive and statistically significant. In effect, an average maize farmer operating less than or equal to 2ha had an additional ₦241, 408.89 annually for using microcredit. As pointed out earlier, the RM and the KM overestimated the impact of microcredit utilization on food security, although they all show that the impact is positive and significant.

Table 4.24: Average treatment effect on the treated of microcredit utilization on food security among maize farmers

Groups	**NNM**	**RM**	**KM**
Pooled	254,080.94***	306,948.01***	326,359.18***
	(110750.978)	(87818.4608)	(88204.3723)
Impact by Sex			
Male	294,218.18***	374,484.14***	396,003.30***
	(127,166.03)	(99,954.81)	(100,546.91)
Female	89,718.75	116,580	196,381.04
	(147,292.63)	(166,667.77)	(178,381.68)
Impact by land size			
<=2ha	241,408.89***	282,395.33***	271,458.89***
	(106,868.00)	(83,476.87)	(81,644.30)
>2ha	7,417.89	124,089.47	148,868.63
	(247,549.41)	(251,060.84)	(250,891.60)

Note: ***P<0.01 and **P<0.05 level of probability. NNM=Nearest Neighbor Matching, RM=Radius Matching and KM=Kernel Matching. Standard errors in parentheses

Test of Hypothesis iv

The hypothesis which stated that microcredit utilizationhas no impact on food security of the beneficiaries in the study area by total quantity of kilo calorie consumed by a household was conducted using T-test (Table 4.25). The food security level of a household with microcredit utilization after using nearest neigbour matching was 12,855kcalper day while that of household without microcredit utilization was 10,028kcal per day (Table 4.25). Consequently, the impact of microcredit utilization on food security (ATT) was 2,827 per household on average and was statistically significant at 5 percent level of probability. This implies that the null hypothesis that microcredit utilization has no impact on food security of the beneficiaries in the study area was rejected at 5 percent level of probability. In other words, there is a significant impact of microcredit utilization on food securityof the beneficiaries in the study area.

Table 4.25: T-test of the impact of micro-credit utilizationon food security level of beneficiaries

Variable	Treated	Controls	ATT	S.E.	T-stat
Food security (Kcal/hhs/day)	12,855	10,028	2,827	984	2.87***

Source: Author's estimates

Note: ***<0.01. ATT=Average Treatment Effect on the Treated (Impact)

4.6 Constraints Faced by Beneficiaries and Non-beneficiaries of Micro-credit

The constraints faced by beneficiaries and non-beneficiaries of micro-credit are presented in Table 4.26. It was found that pooling respondents together approximately 20% ranked low output price as foremost constraints faced. Approximately 16% of pooled respondents ranked pests, disease and weed infestation and lack of human labour

as second constraints. Approximately 11% ranked high price of good seed as fourth constraints, 10% of respondents ranked inadequate extension service and lack of capital as fifth constraints. Also, approximately 8%, 7% and only 3% of respondents ranked insufficient marketing system, high price of fertilizer and poor storage facilities as seventh, eighth and ninth constraints, respectively.

Within beneficiaries of micro-credit, 19% of beneficiaries of micro-credit ranked low output price as foremost constraints faced. Approximately 17% ranked pests, disease and weed infestation as second constraints. Approximately 16% ranked lack of human labour as third constraints. 15% ranked inadequate extension service as fourth constraints while high price of good seed and fertilizer were ranked as fifth and sixth constraints respectively. Also, approximately 6%, 4% and 2% of beneficiaries of micro-credit ranked insufficient marketing system, poor storage facilities and lack of capital as seventh, eighth and ninth constraints respectively.

Within non-beneficiaries of micro-credit, 21% of non-beneficiaries of micro-credit ranked low output price as foremost constraints faced. Approximately 18% ranked lack of capital as second constraints, with the gradual increase of the degree of market orientation of farm households, capital becomes of prime importance (Doppler, 2001). Lack of capital resources is a major constraint for farming activities in the study area. The available formal sources for obtaining agricultural credit are beyond their reach. This is because of the collateral and other institutional conditions needed to obtain such loans which most of the farmers cannot afford (Obamiro, 2004). Approximately 16% ranked lack of human capital as third constraints, 13% ranked pests, disease and weed infestation as fourth constraints. Approximately 11%, 9% and 6% ranked insufficient

marketing system, high price of good seed and fertilizer as fifth, sixth and seventh constraints respectively.

The result of the analysis revealed that constraints such low output price, pests, disease and weed infestation, lack of human labour and high price of good seed affected respondents across the two groups (beneficiaries and non-beneficiaries of micro-credit).

Also non-beneficiaries of micro-credit mentioned low output, lack of capital and insufficient marketing system as constraints they faced more than the beneficiaries of micro-credit.

Table 4.26: Constraints faced by beneficiaries and non-beneficiaries of micro-credit

Constraints	**Beneficiaries**	**Rank**	**Non-beneficiaries**	**Rank**	**Pooled**	**Rank**
Low output price	168 (19.00)	1st	165 (21.00)	1st	333 (20.00)	1st
Pests, disease and weed infestation	158 (17.00)	2nd	108 (13.00)	4th	266 (16.00)	2nd
Lack of human labour	147 (16.00)	3rd	128 (16.00)	3rd	275 (16.00)	2nd
Inadequate extension service	133 (15.00)	4th	30 (4.00)	8th	163 (10.00)	5th
High price of good seed	113 (13.00)	5th	70 (9.00)	6th	183 (11.00)	4th
High price of	71	6th	50	7th	121	8th

fertilizers	(8.00)		(6.00)		(7.00)	
Insufficient marketing system	50 (6.00)	7th	92 (11.00)	5th	142 (8.00)	7th
Poor storage facilities	38 (4.00)	8th	15 (2.00)	9th	56 (3.00)	9th
Lack of capital	22 (2.00)	9th	143 (18.00)	2nd	165 (10.00)	5th
Total	***900 (100.00)**		***801 (100.00)**		***1704 (100.00)**	

*Multiple Response Allowed, Figure in parentheses is percentage

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings

This study broadly investigated Micro-credit Utilization and its Impact on Farmers Maize Output and Household Food Security with the specific objectives to describe and compare the socio-economic characteristics of beneficiaries and non-beneficiaries of microcredit in the study area; investigate and compare productivity efficiency of the farm enterprises of beneficiaries and non-beneficiaries of micro-credits in the study area; ; investigate and compare profitability of the farm enterprises of beneficiaries and non-beneficiaries of micro-credits in the study area; determine and compare the food

security status of beneficiaries and non-beneficiaries of microcredit in the study area; examine the impact of microcredit utilization on Farmers Maize output and household food security; identify and discuss the constraints faced by beneficiaries and non-beneficiaries of microcredit in the study area.

A multi-stage sampling technique was adopted to collect exclusively primary data from Zango-Kataf, Chikun, Lere and Giwa Local Government Areas of the State. First stage involved stratification of the state into four (4) Agricultural operational zones. Second stage was the purposive selection of one local government area within each of the 4 operational zones. Third stage involved the random selection of one microfinance bank (MFB) from each of the LGAs selected for the study.The statistical tools used to conduct the analysis were descriptive statistics, stochastic production frontier**,** budgetary analysis, household food security analysis(cost-of-calorie index), multiple regression and propensity score matching. Z – test and t - test were also carried out to test the significance of the formulated hypotheses of the study.

The results of the descriptive analysis revealed that majority 79% by pooling the respondents together were within the age brackets 29-48 years with an average age of 41 years. It implies that the respondents were within their economically active age, while majorities (85%) of maize farmers were males. The results also showed that the majorities were married with large household size and some form of formal educational qualification. However, they were quite experience in maize farming. From result of z - test, it was found that there is statistically significant difference between beneficiaries and non-beneficiaries of microcredit with respect to socio-economic variables such as age, sex, educational level and farming experience at 1% and 5% levels of probability while marital status and household size are not statistically significant.

The average technical efficiencies for beneficiaries of micro-credit maize farmers and non-beneficiaries maize farmers were about 87% and 49%. This implies that on the average the beneficiaries farmers were able obtain almost full potential production output from a given mix of inputs while the non-beneficiaries were able to obtain below half of its production potential. This shows that the beneficiaries of micro-credit farmers were more technically efficient than the non-beneficiaries farmers.It further indicates that there is higher level of technical inefficiency among non-beneficiaries of micro-credit than beneficiaries of micro-credit. It was found that both beneficiaries and non-beneficiaries of micro-credit had minimum technical efficiency of 0.68 and 0.36, maximum being 1.00 and 0.97, while mean technical efficiency are 0.93 and 0.89, respectively. This implies that the output of non-beneficiaries of micro-credit dropped by 3% from the maximum feasible level of 1.00 due to technical inefficiency.

It was found that both beneficiaries and non-beneficiaries of micro-credit made use of seed above the recommended rate of 17 – 20kg per hectare. Also, average quantity of fertilizer used per hectare is within the recommended quantity of 400 kg – 500kg (8 – 10 bags) per hectare depending on the level of Nitrogen content in the soil (Onyebinama, 2006). On the average, 2348 and 2037 kg of Maize per hectare was realized. This is within the average yield of 2 tons/ha. The amounts invested in maize production by both beneficiaries and non-beneficiaries were ₦78, 004/ha and ₦82, 945/ha respectively, while the total revenue realized was ₦181, 994/ha and ₦157, 832/ha respectively. The average rate of return was found to be ₦ 1.33 and ₦ 0.90.

Food security status was determine after estimating the food security line (₦148) which represents the minimum cost of consuming 2700 kcal per person on a daily basis and

therefore causing such person to be food secure. In other words, food secure maize farming households were those whose per capita food consumption expenditure or per capita cost of calorie was greater or equal to ₦148. Generally, it was observed that 104 and 232 maize farming households were food secure and insecure respectively. This implies that about 69 percent of the sampled maize farming households fell short of the recommended daily calorie requirement of 2700 kcal.

Five (6) independent variables – sex, age, marital status, household size, education and land size – out of 8 were statistically significant in explaining any variation in the probability to become food secure. While variables such as, association membership and micro-credit status were not important determinant of food security status given the model under consideration. But globally, all the covariates were jointly significant in predicting the food security status of maize farming households. Specifically, the Likelihood Ratio (LR) chi-squared estimate of the pooled model was 74.78 and was statistically significant at 1 percent level of probability. The pseudo R-squared estimate was 0.25 which implies that the model explains about 25 percent of variation in food security status of maize farming households.

It was discovered that the beneficiaries and the non-beneficiaries differ in four socio-economic characteristics age, sex, education and land out of the six retained based on the t-values of the difference in means. The result of the Maximum Likelihood (ML) estimates of the Propensity Score (PS) of microcredit utilization revealed that socio-economic variables such as age, education and land contributed collectively 49% of total variation in the decision to use microcredit.

It was also observed that microcredit utilization has a positive and statistically significant impact on maize output and food security status among maize farming

households in the study area. Specifically, the NNM shows that an additional maize output and per capita income of 2,920.47kg (29%) and N254, 080.94(29%) on average was achieved, by a maize farming household who used microcredit during the production period under study. Finally, it was found that both beneficiaries and non-beneficiaries of micro-credit ranked low output price as foremost constraints faced.

5.2 Conclusion

On the basis of the findings of this study, it was concluded that thebeneficiariesweremoretechnically efficientthan thenon-beneficiaries, howeverbothrespondentsdidnotattaintheirmaximumtechnical efficiency assuchthereisroomforimprovement intheirleveloftechnicalefficiency in maizeproduction. It was found that the respondents made use of recommended quantity of fertilizer with the realization of the average yield of 2 tons/ha. It was also observed that maize production in the study areas has a higher profitability among the beneficiaries of micro-credit than the non-beneficiaries. Averagely, the beneficiaries and non-beneficiaries of maize farming household would need about₦148/dayas per capita food consumption expenditure or per capita cost of calorie to become food secure maize farming households. The study also revealed thatthere is a significant impact of microcredit accessibility on maize output and household food security of the beneficiaries in the study area.It was found that both beneficiaries and non-beneficiaries of micro-credit ranked low output price as foremost constraints faced.

5.3 Recommendations

From the findings of the study, the following recommendations are put forward:

i. The average land, seed, labour, fertilizer and pesticide usage of beneficiaries of microcredit were higher than that of non-beneficiaries of

microcredit.Policy that will address both incessant inputs price increase and timely availability of these inputs should be formulated, while recapitalization policy of the federal government extended to micro-finance banks..

ii. Since the result of technical efficiency analysis revealed that age increase technical efficiency. It is therefore, recommended that government policy should be focused on attracting the youth who are more agile and aggressive to go into maize production. The youth who constitute the majority of the respondents covered in this study have the potential and much-needed effort to help raise the current level of efficiency. More programmes and resources should therefore be channeled through the youth who are engaged in agriculture or are willing to go into agriculture.

iii. It was found that the non-beneficiaries were food insecure than beneficiaries. To reduce food insecurity of the respondents' government must make sure that appropriate measures should be implemented to boost farmer's productivity. Measures such as: intensification of using new input technology in farming, at an affordable price to the farmers should be implemented.

iv. It was observed that micro-credit had a positive impact on maize output and household food security status of beneficiaries in the study area hence; there is need for the provision of infrastructure such as electricity, roads, markets, portable water, health and communication to compliment credit use which would improve the welfare of the farmers.

v. Most of the respondents complained of low output price as the foremost constraints faced. Therefore, there is a need to improve the pricing system of maize. Farmers should form a production clusters to improve their market intelligence. This could be achieved through the formation of producer groups or cooperatives. In each group there should be an advisory committee trained in various aspects of marketing which will be able to have access to up-dated pricing information and make it available to farmers on time.

vii. Provision of input such as weedicides, fertilizer, improves seeds and others will motivate farming households and also increase their productivity, especially those in the study areas would be a step in the right direction. This will increase the volume of food production. This could be done through selling of input at subsidized rate to farmers on credit by MOFA and allow farmers pay in kind with their farm produce. This will serve as source of market to farmers and also contribute to the performance of the government's buffer stock program.

viii. Food insecurity coping strategies adopted by the farming households have short term effect. Therefore, there is the need to increase the volume of food production as well as improve on access to income generating activities that are more sustainable.

ix. The research was conducted for four local government areas of the state; hence the results may not be representative of the food security status of

farming households across the state. Therefore, extending this study to cover other parts of the state is a useful avenue for future research.

5.4 Contribution to Knowledge

i. The study found that, maize production in the study areas is profitable by returning ₦ 1.33 and ₦ 0.90 among beneficiaries and non-beneficiaries of micro-credit in the study areas.

ii. The study established that beneficiaries of microcredit were fairly technical efficient (93%) than non-beneficiaries (89%).

iii. It was found that the maize farming household who used microcredit made an additional output and per capita income of 2,920.47kg and N254, 080.94 which constituted about 29% each of the total output and per capita annual farm income on the average during the production period under study.

iv. Food security line was determined as (₦148) which represents the minimum cost of consuming 2700 kcal/person/day causing such person to be food secure in the study area.

v. The logit regression analysis revealed that socio-economic characteristics– sex, age, marital status, household size and land size are the significant factors influencing the food security status of maize farming households in the study area.

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Appendix1:

Questionnaire

MICRO-CREDIT UTILIZATION AND ITS IMPACT ON FAMERS MAIZE OUTPUT AND HOUSEHOLD FOOD SECURITY IN KADUNA STATE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY,FACULTY OF AGRICULTUREAHMADU BELLO UNIVERSITYZARIA, KADUNA STATE.

QUESTIONNAIRE FOR BENEFICIARIES OF MICRO-CREDIT

Dear Respondent,

This questionnaire will be used by a student of the Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria. Please, fill as appropriate. All information will be treated with confidentiality and strictly for the purpose of research. Thanks for your co-operation.

(A) SOCIAL –ECONOMICS CHARATERISTICS

1. Name of farmer……

2. Sex: Male ( ) Female ( )

3. Age (years) of household head ……..

4. How many of your household members fall in the following age group

Age group (in years)	Number of males	Number of female
0-1		
2-3		
4-6		
7-9		
10-12		
13-15		
16-19		
20 and above		

5. Marital status: Married ( ) Single ( ) Divorced ( ) Widowed ( )

6. What is your Household Size? .....

6a. Number of boys in the household.....

6b. Number of girls in the household.....

7. Level of Education:

(a) No Formal Education ( ) (b) Adult Education (c) Primary school Education ( )
(d) Secondary School Education ( ) (e) Arabic Education ( ) (d) Tertiary Education ()

8. Family Size (All the number of the people depending on you for living)……..…….

9. What is your (household head) Primary Occupation? .....

10. What is your Secondary occupation?

(a) Farming (b) Trading (c) Government Salaried Job

(d) Crafts and Artisans (e) Others Specify……..

11. How long have you been in Maize farming? ..... Years

12. Do you belong to any co-operative/Association? Yes ( ) No ( )

13. If yes, (Years of participation) ----------

14. What benefit did you derive as a member?

(a) Provision of certified Seed (b) Fertilizer (c) Credits (d) Sale of Farm Produce

15. What is your major source of capital for Maize farming?

a. commercial bank. ( ) b. Micro-finance Banks ( ) c. Friends and family ( )

d. Money Lenders (Borrow) ( )

16. If you borrow, what were the sources of the credit?

a. commercial bank( ) b. Nigeria Agricultural Cooperative And Rural Development banks( )

c. Cooperative Society ( ) d. Money Lenders ( ) e. Friends and Family ( )
g. Micro-finance Banks ( )

17. How much did you borrow to finance last production? (Fill the Table below)

SOURCE OF LOAN	AMOUNT(₦)	INTERST RATE (%)
Commercial Bank		
Nigeria agricultural Cooperative And Rural Development Bank		
Cooperative Societies		
Money Lenders		
Friends And Family		
Others (Specify)		

18. What did you use the Credit obtained for?
(a) Maize production (b) Groundnut production (c) Cowpea production (d) Guinea Corn production

19. What is the Total Output of Maize realized in 2010.....Kg?

20. What is the Total Output of Maize realized in 2014.....kg?

21. What is your annual Income from the Sale of Maize in 2010.....? Naira

22. What is your annual Income from the Sale of Maize in 2014.....? Naira

23. Have you been visited by an extension agent? Yes ( ) No ( )
24. If Yes, How many times in last one year?

25. What activities did the agent teach you? .....

26. Of what benefit were the techniques learnt to the success of your farm?

(B).INFORMATION ON INPUTS

1. Farm size (Ha)

(i).How many Maize farm / plot do you have? ..... Indicate and the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

(ii). How did you acquire your land? *(Tick below)*

Plot	Mode of Acquisition				
	(a) Inheritance	(b) Lease	(c) Borrowed	(d) Gift	(e) Purchased
1					
2					
3					

(iii) What does it cost to rent one Hectare of land per season in your village? ....……..... Naira

(2) Labour input

(a) Land preparation

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(b) Planting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(c) Fertilizer Application

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(d)First Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(e) Second Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(f)Harvesting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(3) What quantity of Seed did you use per hectare?

Plot No	Quantity of Seed in (Kg)	Cost (₦)
1		
2		
3		

(4) Did you apply any Pesticide to your Farm? (a) Yes ( ) (b) No ( )

(5) If yes, how many Litres/ha?

Plot No	Quantity Pesticide in Litres/ha	Cost (₦)
1		
2		
3		

(6) Fertilizer Use

Total Quantity of Fertilizer Acquired (kg)	Quantity Applied for Maize Production (kg)	Type of Fertilizer Used	Source of Fertilizer Used	Price (₦)/Kg

(7) Maize Output

Total Quantity of Maize Harvested (kg)	Quantity Consumed (kg)	Quantity Sold (kg)	Price (₦)/Kg

(8) CONSTRAINTS OF MAIZE PRODUCTION

S/N.	CONSTRAINTS
1	
2	
3	
4	
5	
6	

(9) Suggest possible solutions to the constraints in Maize production.

1……

2……

3……

C. Household food security

(i). kindly provide information on the following crops (only on those you have purchased or produced).

ITEMS	Item purchased last season for household consumption		Amount produced last cropping season (quantity/units)	Amount consumed last cropping season (quantity/units)	Value of prepared foods purchased outside household last week (naira)
	Quantity and units	Price paid/units			

MAIZE					
Grain					
Flour					
SORGHUM					
Grain					
Flour					
MILLET					
Grain					
Flour					
RICE					
Imported					
Local					
CASSAVA					
Tubers					
Gari					
Cassava chips					
YAM					
Tubers					
Flour					
GROUNDNUT					
Shelled					
Unshelled					
SOYBEAN					
Grain					
Flour					
COWPEA					
OKRA					
TOMATO					
ONION					
PEPPER					
CARROT					
G/LEAVES					
MANGO					
OTHERS SPECIFY					

D. Household expenditure

1. Indicate the amount purchased of the following items for household consumption.

Items	Items purchased last week / month/last year for household consumption (indicate whether for a week, month or year)	
Salt, potash/maggi	purchased value (₦) in 2010	purchased value (₦) in 2014
Palm oil		
Fish (fresh, dried or smoked)		
Meat (beef, mutton etc.)		
Sugar		
Bread		
Shoes		
Clothing		

Purchase of motor vehicles		
Purchase of motor cycles		
Purchase of bicycles		
Repairs of vehicles/ bicycles		
Petrol for vehicles		
Kerosene		
Detergent		
Electricity bill		
Remittance/gift/donations		

E. How many times does your household eat the following food items in the past months? (Respond only on those eaten)

Item	No. Daily	Or no. Weekly	Or no. Monthly	Or not eaten
Millet				
Sorghum				
Maize				
Rice				
Groundnut				
Bread				
Egg				
Meat				
Fish				
Groundnut oil				
Butter				
Tea/beverages				
Fruits				
Vegetables				

Beans				
Others specify				

QUESTIONNAIRE FOR NON-BENEFICIARIES OF MICRO-CREDIT

A. SOCIAL –ECONOMICS CHARATERISTICS

1. Name of farmer……

2. Sex: Male ( ) Female ( )

2. Age (years) of household head ……

4. How many of your household members fall in the following age group

Age group (in years)	Number of males	Number of female
0-1		
2-3		
4-6		
7-9		
10-12		
13-15		
16-19		
20 and above		

5. Marital status: Married ( ) Single ( ) Divorced ( )Widowed()

6. What is your Household Size? .....

6a. Number of boys in the household.....

6b. Number of girls in the household.....

7. Level of Education:

(a) No Formal Education ( ) (b) Adult Education (c) Primary school Education ( )

b. Secondary School Education ( ) (e) Arabic Education ( ) (d) Tertiary Education ( )

8. Family Size (All the number of the people depending on you for living)…….

9. What is your (household head) Primary Occupation? .....

10. What is your Secondary occupation?

(a) Farming (b) Trading (c) Government Salaried Job

(d) Crafts and Artisans (e) Others Specify…….

11. How long have you been in Maize farming.....? Years

12. Do you belong to any co-operative/Association? Yes ( ) No ( )

13. If yes, (Years of participation) ----------

14. What benefit did you derive as a member?

15. What is your major source of capital for Maize farming?

a. commercial bank. ( ) b. Micro-finance Banks ( ) c. Friends and family ( )

d. Money Lenders (Borrow) ( ) (e) Self Financing ( )

16. What is the Total Output of Maize realized in 2010.....Kg?

17. What is the Total Output of Maize realized in 2014.....Kg?

18. What is your annual Income from the Sale of Maize in 2010.....? Naira

19. What is your annual Income from the Sale of Maize in 2014.....? Naira

20. Have you been visited by an extension agent? Yes ( ) No ( )

21. If Yes, How many times in last one year?

22. What activities did the agent teach you? .....

23. Of what benefit were the techniques learnt to you to the success of your farm

.....

24. Have you ever sought for credit from any micro-credit institution? Yes ( ) No ( )

25. If your answer to question 21 is no, state reason (s) for not seeking for such credit facility:

a)……

b)……

c)……

d)……

26. If your answer to question 21 is yes, was your application approved? Yes ( ) No ( )

27. If your answer to question 23 is no, what were the reasons for non-approval of your facility request?

a)……

b)……

c)……

d)……

B.INFORMATION ON INPUTS

(1) Farm size (Ha)

(i) How many Maize farm / plot do you have? ..... Indicate the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

(ii). How did you acquire your land? *(Tick below)*

Plot	**Mode of Acquisition**

	(a) Inheritance	(b) Lease	(c) Borrowed	(d) Gift	(e) Purchased
1					
2					
3					

(iii). what does it cost to rent one Hectare of land per season in your village? ....…….... Naira

(2)Labour input

(a) Land preparation

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(b)Planting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(c)Fertilizer Application

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(d)First Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						

3						

(e) Second Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(f)Harvesting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(2) What quantity of Seed did you use per hectare?

Plot No	Quantity of Seed in (Kg)	Cost (₦)
1		
2		
3		

(4) Did you apply any Pesticide to your Farm? (a) Yes ( ) (b) No ( )

(5) If yes, how many Litres/ha?

Plot No	Quantity Pesticide in Litres/ha	Cost(₦)
1		
2		

(6) Fertilizer Use

Total Quantity of Fertilizer Acquired (kg)	Quantity Applied for Maize Production (kg)	Type of Fertilizer Used	Source of Fertilizer Used	Price (₦)/Kg

(7) Maize Output

Total Quantity of Maize Harvested (kg)	Quantity Consumed (kg)	Quantity Sold (kg)	Price (₦)/Kg

(8) CONSTRAINTS OF MAIZE PRODUCTION

S/n	CONSTRAINTS
1	
2	
3	
4	
5	
6	
7	

(9) Suggest possible solution to the constraints in Maize production.

1……

2……

3……

B. Household food security

(i). kindly provide information on the following crops (only on those you have purchased or produced).

ITEMS	Item purchased last season for household consumption		Amount produced last cropping season (quantity/units)	Amount consumed last cropping season (quantity/units)	Value of prepared foods purchased outside household last week (naira)
	Quantity and units	Price paid/units			

MAIZE					
Grain					
Flour					
SORGHUM					
Grain					
Flour					
MILLET					
Grain					
Flour					
RICE					
Imported					
Local					
CASSAVA					
Tubers					
Gari					
Cassava chips					
YAM					
Tubers					
Flour					
GROUNDNUT					
Shelled					
Unshelled					
SOYBEAN					
Grain					
Flour					
COWPEA					
OKRA					
TOMATO					
ONION					
PEPPER					
CARROT					
G/LEAVES					
MANGO					
OTHERS SPECIFY					

C. Household expenditure

1. Indicate the amount purchased of the following items for household consumption.

Items	Items purchased last week or month or last year for household consumption (please indicate whether for a week, month or year)	
Salt, potash/maggi	purchased value (₦) in 2010	purchased value (₦) in 2014
Palm oil		
Fish (fresh, dried or smoked)		
Meat (beef, mutton etc.)		
Sugar		

Bread		
Shoes		
Clothing		
Purchase of motor vehicles		
Purchase of motor cycles		
Purchase of bicycles		
Repairs of vehicles/ bicycles		
Petrol for vehicles		
Kerosene		
Detergent		
Electricity bill		
Remittance/gift/donations		

E. How many times does your household eat the following food items in the past months? (Respond only on those eaten)

Item	No. Daily	Or no. Weekly	Or no. Monthly	Or not eaten
Millet				
Sorghum				
Maize				
Rice				
Groundnut				
Meat				
Fish				
Groundnut oil				
Tea/beverages				
Fruits				
Vegetables				
Beans				

Thanks for your Attention

Appendix 2:

Calorie content of some commonly eaten foods in Nigeria

Food items	**Kcal/kg**	**Food items**	**Kcal/kg**
Staple foods		Mango	590
Cassava Tube	1500	Pawpaw	300
Cassava flour	3800	Pineapple	320
Cassava chips	3000	Apple	570
Garri	3840	Coconut	580
Yam Tuber	1100	Guava	730
Yam flour	3810	Sugar cane	360
Yam chips	3000	***Meat and animal products***	
Sweet potato Tuber	1100	Cow meat	2370
Sweet potato chips	900	Goat meat	2370
Irish potato	1200	Sheep meat	2370

Cocoyam Tuber	3830	Pork	2370
Maize green	3100	Bush meat	2370
Maize grain	4120	Chicken	2380
Maize flour	4120	Turkey	2380
Sorghum grain	3500	Fish	2230
Sorghum flour	3500	Snail	2245
millet grain	3500	Shrimps	2230
Millet flour	3500	Crayfish	2200
Rice	1230	Crabs	2200
Wheat grain	3400	Eggs	1400
Wheat flour	3300	***Dairy products***	
Cowpea (beans)	5920	Milk	4900
Groundnut	5950	Cheese	4000
Soybeans	4050	Yoghurt	4100
Soybeans flour	2600	Ice cream	4100
Melon (shelled)	5670	Beverages	
Plantain	770	Cocoa	1200
Banana	960	Tea (leaves)	1200
Vegetables		Tea (liquid)	1200
Okra	4550	Coffee (powder)	1340
Tomato	880	Coffee (liquid)	1340
Pepper	3930	***Drinks***	
Onion	440	Soft drinks	620
Carrot	400	Orange juice	400
Egg plant	440	Apple juice	550
Cucumber	270	Pineapple juice	560
Bitter leaf	220	Wine	330

Source: Oguntona and Akinyele, (1995

Appendix 3:

Adult equivalent scale for adjusting household size

Years of age	**Male**	**Female**
0-1	0.27	0.27
2-3	0.45	0.45
4-6	0.61	0.61
7-9	0.73	0.73
10-12	0.86	0.78
13-15	0.96	0.83
16-19	1.02	0.77
20 and above	1	0.73

Source: FOS, (2004)