COMPARATIVE ECONOMIC ANALYSIS OF MAIZE PRODUCTION UNDER REDUCED AND CONVENTIONAL TILLAGE IN SOME SELECTED LOCAL GOVERNMENT AREAs OF KADUNA STATE

By

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A THESIS SUBMITTED TO THE SCHOOL OF POSGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMET OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

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OCTOBER, 2014

DECLARATION

I hereby declare that this thesis title **"Comparative Economic Analysis of Maize Production under Reduced and Conventional Tillage in some selected Local Government Areas of Kaduna State"** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have dully acknowledged in the text and a list of references provided.

_____ _____

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CERTIFICATION

This thesis titled **"Comparative Economic Analysis of Maize Production under Reduced and Conventional Tillage in some selected Local Government Areas of Kaduna State**", by Audu MARKUS meets the regulations governing the award of degree of Master of Science in Agricultural Economics of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my beloved wife Mrs. Favour Markus, my parent Mr. and Mrs. Audu Sauta whose boundless love and concern for my posterity have been revealed in their affection for me.

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ABSTRACT

This research is a comparative economic analysis of maize production under reduced and conventional tillage system in some selected local government areas of Kaduna state. A sample of 73 maize farmers were selected through simple random sampling technique as reduced tillage farmers and another set of 73 maize farmers were selected and grouped as conventional tillage maize farmers. Two sets of data were obtained from each of the two groups. The primary data were collected using structured questionnaire administered on the farmer based on information at 2012 cropping season. The tools of analysis used were descriptive statistics, net farm income, multiple regression model and single difference estimator (SDE). The mean adoption index of reduced tillage was 0.31, implying that only 31% of the land area cultivated for maize was devoted to reduced tillage maize production. The results revealed that the average yields of reduced and conventional tillage were found to be 2512kg/ha and 2478kg/ha respectively. The mean net farm income for reduced tillage maize farmers was N110,513.56/ha while the conventional tillage maize farmers was N87,165.10/ha. The return per naira invested in reduced tillage maize farmers was 1.76 and that of the conventional tillage maize farmers was 1.04. This suggested that maize production under reduced tillage system was much more profitable than conventional tillage system. The Ordinary Least Square Regression results revealed that the R^2 was 0.40 and 0.5 which implies that 40% and 50% of the variation in the adoption was explained by the independent variables included in the model. The positive regression coefficients indicates that these variables leads to the adoption of reduced tillage system, while the negative regression coefficients indicates that they reduce the adoption of reduced tillage practiced on maize production in the study areas. SDE results revealed that the reduced tillage system had a positive effects on income of maize farmers as it increased income by N106, 227.82. Recommendations made were that, the land use act of 1978 should be reviewed in order to allow farmers who are willing to practice reduce tillage maize production but may not have enough land to acquired sufficient land, government should encourage farmers by assisting them with credit and developing policies that would favour access to input and new farming technologies.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture had remained the mainstay of the Nigeria economy since independence. In spite of its relegation in term of export earning and terms of trade, it still employs at least 70% of the rural labour force and generates an average of 40% of the Gross Domestic Product (GDP) per annum (Isyaku, 2012). It is estimated that more than 70% of Nigeria population depends on agriculture for its livelihood; increasing human population has placed severe pressures on arable land resulting in the gradual extinction of the shifting cultivation systems and leading to more intensive use of the land for crop production. This has led to farmers growing maize on the same piece of land year in year out (Findlay, 2003).

Tillage is the process of creating a suitable environment such as seedbed/rootbed for seeds germination, seedling establishment and its satisfactory development up to harvest (Rufino, 2010). It involves physical or chemical process of creating a suitable environment for seeds germination and seedling establishment. Traditionally, small scale farmers in Africa are accustomed to practicing conventional tillage farming which involves land clearing, ploughing, discing, harrowing and ridging with the used of simple farm tools such as hoe or animal traction to form seedbed. While weeding and earthing up is carried out with the used of hoe or animal traction (Zakariya, 2011). It is generally believed that conventional tillage farming creates a favourable soil structure for seedbed preparation, controls proliferation of weeds and increases mineralization of the soil organic matter but inevitably promotes salinization, accelerates soil erosion and reduced soil organic matter and nutrient content (FAO, 2001). Continuous ploughing of

the arable farmland with both primary and secondary implement (e.g plough, mould board and harrow) or animal traction to achieve effective turning and burying of plant debris to form seedbed causes a degree of soil compaction, loosen of soil structure, soil erosion and low yield (Babaji, 2007). Daniel (2010) stated that, there is a dare need for appropriate tillage technology that will avoid the degree of soil compaction, soil degradation, replace nutrient depletion and maintain crop yield as well as ecosystem stability.

An alternative method to conventional tillage system is the introduction of reduced tillage system that encourages the use of herbicide (glyphosate or paraquat) to destroy weeds during land clearing, tilt the soil with hoe or cutlass before planting. Also weeding is done with the use of herbicide (Lamdanet) instead of the labouries traditional ploughing harrowing, ridging, weeding and earthing up (Findlay, 2003). It is a farming practice which involves fewer cultivations than used in conventional fallowing.

The principles of reduce tillage system is that all crop residues from previous cropping season are left on the farm, this in turn helps maintain organic matter on the soil surface and within soil profile, protect soil environment from heat, keep soil cool, reduced moisture losses and create a suitable environment for plant growth (Babaji, 2007) . This production system attempt to achieved at least 30% of soil surface is covered by plant residue or dead mulch in order to protect the soil physically from sun, rain and wind after planting (Findlay, 2003).

The main objectives of the reduced tillage system is to prevent further destruction of the soil, conserving soil and water for crop use, sustaining soil quality and productivity, inputs utilization, reducing labour cost, energy/fuel consumption ensuring higher stable crop yield at reduced production cost (Grigoras, 2011).

1.2 Problem Statement

Before 1960, agriculture has remained the chief support in Nigeria economy; though it suffered a serious setback following the discovering of Oil sector 1970. This together with the deterioration in the exchange rates has led to declining agricultural productivity (Isyaku, 2012). The production of maize in the study areas undergo major setback from the constant cultivation of arable farmland year in year out without proper soil management, this is due to rapid population growth. Expensive and inadequate labour resulting to young rural farmers migrating to the cities for better job (Oladele, 2003). Farmers have difficulty in securing labour and this has significantly affected maize production in the study areas. However, average yield of maize in the study areas decreased remarkably from 2.5t/ha in 2009 to 2.3t/ha in 2012(KADP, 2012).To address the problem of low productivity of maize in the study area, farmers to adopt improved technology that will reduced number of tillage and make labour intensive, easier and efficient at a fraction of normal cost. It is worth nothing the effort maize farmers made to adopt improved technology that has remarkable features of ensuring high productivity leading to an appreciable increase income of maize farmers and consequently reducing their poverty level. Above all, there is the need for alternative method for crop production as against the conventional systems that employ less use of implements and labour. This study attempts to provide answers to the following questions.

i. what is the level of adoption of reduced tillage in the study area?

ii. What are the inputs and outputs level in reduced and conventional tillage maize production in the study area?

iii. What are the costs and returns in reduced and conventional tillage maize production in the study area?

iv. what factors influence the adoption of reduced tillage system in the study area?

v. what is the effects of reduced tillage on the income of maize farmers?

vi. what are the constraints faced by reduced and conventional tillage maize farmers in the study area.

1.3 Objectives of the Study

The broad objective of the study was to carry out a comparative economic analysis of maize production under reduced and conventional tillage in some selected Local Government Areas of Kaduna State.

The specific objectives of the study were to:

i. determine the adoption level of reduced tillage in the study area,

ii. examine inputs and outputs level in maize production under reduced and conventional tillage,

iii. ascertain cost and returns of reduced and conventional tillage maize production,

iv. determine the factors that influence the adoption of reduced tillage practices specific on maize production in the study area.

v. determine the effect of reduced tillage practice on the income of maize farmers in the study area and,

vi. identify the constraints faced by reduced and conventional tillage maize farmers in the study area.

1.4 Justification of the Study

Presently there is dare needs for a technology that will conserve soil nutrient, make labour intensive, easier and efficient at a fraction of normal cost and prevent structural breakdown of soil aggregate. However, there have been little or no studies conducted on reduced tillage especially with respect to comparative economic analysis of maize production under reduced and conventional tillage in the study area. It is hoped that the reduced tillage technology will bring relief to farming households that make use of conventional tillage by improving their productivity, income and thereby reducing their poverty status. This study will help assess the effects of adopting reduced tillage technology by the farming households and economic efficiency of the farming households with the aim of suggesting ways of encouraging farmers to adopt the technology for the betterment of their livelihood. The outcome of this study will be useful to researchers; agricultural students who would find the information relevant for further research on other tillage system in a bid to developing appropriate tillage technologies that are better suited to meeting the needs of farmers as information will generate on the productivity of maize under reduced tillage technology. It is expected that, the information gathered from this research work will serve as a relevant resource material to policy makers which will enhance formulation of agricultural developmental policies aimed at improving agricultural productivity, income of farming households and reduce poverty level among farming households through promotion of improved farming technologies and development of agricultural sectors. The result of this research work will assist Kaduna State Agricultural Development Project (KADP) to create awareness on advantage of adopting reduced tillage technology.

1.5 Hypotheses

The hypotheses tested in the study were stated in the null form as follows:

i. There is no significant relationship between input and output under reduced and conventional tillage.

ii. There is no significant difference between profitability of reduced and conventional tillage system.

CHAPTER TWO

LITERATURE REVIEW

2.1 The Concept of Tillage

The development of plough and other Mechanical implements by man so many years ago was to prepare a good seedbed for seed germination, seedling establishment, crop growth and weeding. However, with the discovery of herbicides, weed control has changed from Mechanical methods to chemical control. Herbicides such as Roudup, Paraquat, Busta force and attrazine have been found to be very effective and have very favorable environmental characteristics in weed control (Ruma, 2006).

Continued plowing of arable farmland to form seedbed had led to the destruction of soil causes soil erosion and reduced crop yield. In sub-saharan Africa there needs to be a fundamental change in crop production methods in order to conserve the soil and its environment (Findlay, 1999). He added that, this will enable a sustainable food production and increase income of farming families. Findlay (2003) revealed that historical crop production system has depended on the cultivation and inversion of the topsoil layer to prepare a seedbed for seeds germination, seedlings establishment and weeds control. In addition, the bare soil technology by manual and mechanical means has resulted in a gradual deterioration of the soil structure resulting in a pulverized soil which is prone to erosion, depleted soil nutrients level and low crop yield.

Adams (2002) stated that reduced tillage is accepted worldwide as a sustainable crop production system. In addition, United States of America used 38% of its cropped land for reduced tillage system. It also practiced in Latin and South America. Babaji (2007) noted that land in Nigeria is under continuous cultivation as a result of population

growth, and shifting cultivation is no longer tenable. He added that, reduced tillage system is a perfect replacement to shifting cultivation.

Cleaver, (1993) revealed that reduced tillage combined with organic manure and fertilizer use will sustain soil productivity and reduce the need to clear new land after the abandoned of the old. The adoption of reduced tillage in the study area will be an opportunity for farmers not only produce enough for consumption but also has surplus for income generation. In Nigeria today, efforts are being made by Sasakawa Global 2000 to push conservation tillage amongst maize and rice farmers. Findlay (2003), reduced tillage is widely practiced on a variety of crop species to include cowpea, Rice, Sorghum, Cassava, Millet and Maize.

2.2 Effects of Tillage on Soil Production

Davies (1983) state that, the optimal environment for seeds and seedlings establishment is often created by some form of mechanical interaction of the tillage implements (e.g. tractor or hoe) with the soil. The principle of bare soil technology by manual or mechanical means has resulted in a gradual deterioration of soil structure and depletion of soil nutrients, resulting in a pulverized soil which is prone to erosion and low yield (Findlay, 2003).

Benor (1994), Soil degradation affects soil quality that capable of crop grown by physical movement of soil particles from a given site by the water- soluble elements or wind. Findlay (1999) observed that, continuous plowing of farmland to create a suitable environment for plant grown has led to the destruction of soil structures resulting in soil loss and poor crop yield. Tolessa (2011), reported that, an annual soil losses from

effects of reduced and conventional tillage on arable land in Western Ethiopia is 4.9t/ha and 313t/ha respectively. Babaji (2007), reported that annual soil loses from water run-off under reduced tillage is 0.3t/ha and 30t/ha under conventional tillage in USA. He added that, annual percentage moisture retention on soil under reduced and conventional tillage is 13.3% and 9.7%. Most of the Semi-arid Tropics (SAT) Soils are structurally unstable when rain fall on the naked or bare soil, the force of the raindrops compact the surface of the soil which prevents moisture penetration and results in water run-off and subsequent soil erosion causing harmful effect on crop production (Findlay, 1999). Wall (2002), stated that the plough and harrow systems of soil cultivation are not suitable for the fragile Tropical soils and leading to soil erosion. Soil chemical properties of the surface layer are more favourable under the reduced tillage method with crop residue than under the conventional tillage methods (Parashivu, 2009). Furthermore these practices of soil inversion for seedbed preparation usually cause accelerated loses of nutrients, soil compaction and soil erosion resulting in decreased crop yields.

2.3 Reduced Tillage System.

Findlay (1999) revealed that the concept of reduced tillage is based on building up organic matter on the soil surface with the entire crop residues from the previous crops are left on the farm with the minimum soil disturbance. He added that hoe and cutlass are one of the implements used in preparing the seedbed for crop grown. According to Claassen (1996), stated that reduced tillage is tillage or planting system in which at least 30% of the soil surface is covered by plant residue after planting to reduce erosion by water or wind. This system of tillage provides the best opportunity for halting degradation and for restoring and improving soil productivity (Parashvu, 2009). Findlay, (1999) states that, when soil is covered by organic matter whether as a mulch

or as living plant such as grasses and has a good soil structure which allows for moisture penetration, water-run-off is minimal to soil erosion.

Dunham and Aremu (2000), states that, technique which causes a minimum soil disturbance can reduce the risk of soil erosion by binding soil particles. Babaji (2007) on his study states that principles of reduced tillage system have widespread, but the techniques necessary to put those principles into practice vary widely from place to place and under different conditions. In addition, farmer needs to understand the concept and principles of reduced tillage and why they adapt the system.

This practice has the potential of bringing about reduction in drudgery of muscles, input utilization, soil erosion while maximizing of infiltration from rainfall and minimizing evaporation and reduction of weed growth by the application of recommended herbicides (Ruma, 2006).

Findlay (2003) reported that, this system of reduced tillage creates an opportunity for farmers to improve soil and water conservation; sustainable agriculture practices, reduce labour requirement and increase output and financial gain. FAO (1999) states that, crop residues and crop rotation offer potential solution to mitigation effects on seasonal drought. This system of farming reduces production cost, decrease soil salinity and increase soil organic carbon and crop output. Oni (1999) defined reduced tillage as a system in which primary tillage is performed in combination with special planting procedures aimed at reducing or eliminating secondary tillage operation.

2.3.1 Conventional tillage system

The conventional tillage system involves the use of machines (tractor) or animal traction to cultivate an entire field to prepare seedbed for seeds and seedling establishment (Babaji 2007). This system of tillage includes plowing plus two or more secondary tillage which involves pre-plow operation to pulverize soil and form ridging or bedding. The main aim of conventional tillage system is to prepare seedbed through the application of appropriate tillage implements and equipment to create conducive environment for plant growth, rapid infiltration of soil water from rainfall and enhance soil air capacity exchange with atmosphere and reduce weeds growth (Oni, 1999). In some parts of West Africa, conventional tillage system is practiced mostly by manual labour, using simple tools such as the hoe and cutlass to facilitate seedbed preparation, planting and clearing of vegetation (Hamodoz, 1990). In addition, the system is a high energy demanding. In Nigeria, manual labouris becoming scarce and expensive which many farmers are tired of drudgery of muscle while animal tractions and tractors are not easily obtainable, even when obtained, the average cost is high (KADP 2010). To counterbalance these labour trends, emphasis must be placed on the introduction of reduced tillage system which is energy server and cost minimization.

2.4 Advantages of Reduced Tillage over Conventional Tillage.

Adoption of reduced tillage for erodible soil offers a practical means of preserving soil productivity and reducing soil contamination of surface water by eroded sediments, fertilizer nutrients and pesticide. The ever advances in technology had a greater and positive influence on the advancement in agriculture (Babaji, 2007). Daniel (2010) stated that adoption of reduced tillage system by farmers is greatest important in reducing fuel consumption, longer machinery life span, reduced horse power

requirement (energy cost), lower labour requirement, less input utilization and reduces cost of production. In contrasts to conventional tillage which involved the use of heavy tillage implements, increase fuel consumption, horse power requirement, high inputs utilization and increases cost of production. He added that, reduced tillage is a positive step towards increasing water use efficiency and protecting the crop against short- term droughts. It increases the infiltration capacity of soil, hence decreasing the amount of surface run-off and serving as a very effective erosion control measures. In contrast to conventional tillage its decreasing water use efficiency as soil undergo constant cultivation and expose the crop against long-term droughts and soil erosion. In addition, 13.3% of moisture content is conserved under reduced tillage while 7.9% under conventional system on maize production.

According to Luis (2004), the long- range benefits of reduced tillage over conventional tillage includes increase in soil organic matter due to high levels of plant residues left on soil surface and increased microbes and earthworm activities on the soil, which later improving soil structure and its capacity to hold soil moistures.

Zakaria, (2011) revealed that, in developed countries (especially U.S), farmers practiced reduced tillage system earns more from their production systems by reducing labour and energy costs through minimum till. In addition, in developing countries (West Africa), farmers adopting reduced till systems as a response to the limited fertility of shallow top soils, which are easily destroyed by conventional tillage operations. Zakari (2011) stated that areas with shallow topsoil, a rule of thumb are that land steeper than 4% slope should not be tilled to prepare seedbed. In such cases, minimum till farming is the only

alternative to terracing. In addition, farmers adopting reduced tillage technology can save up to 75% of energy used for conventional tillage.

According Mahmud (1992), the decomposition of crop residues left on soil surface from previous cropping under reduced tillage has a significant effect of replenishing soil nutrients, prevents water loss through evaporation and reduces soil temperature up to 31.6^{0c}. In contrast, there is high rate of water loss through evaporation and increase soil temperature up to 41.4^{0c} under the conventional tillage. In addition, nitrogen mineralization in the soil is more extensive (large amount) under reduced tillage than under conventional tillage. He added that, adoption of reduced tillage will reduces contamination of surface water by eroded sediments, fertilizer nutrients and pesticides.

Findlay (2003) reported that application of pre-emergence herbicides to kill un-germinated weed seeds (paraquat or glyphosate)before planting of maize seeds under reduced tillage, maize output can be 39 to 55 per cent higher than output of farmers under conventional tillage. Mahmud. (1992) reported that the response of starter NPK fertilizer on maize yield was better under reduced tillage than in conventional tillage systems. This system of farming offers an opportunity for farmers to minimize production cost per hectare which gave a high net profit.

Other economic studies have concluded that production cost per hectare for cotton under reduced tillage is lower and gives higher return than conventional tillage system (Benor, 1998). Water conservation as a component feature of good soil structure is also an important benefit highlighted by the reduced tillage. The crop residue remaining after

harvest increase water infiltration and prevent water loss through evaporation (Daniel, 2010).

2.5 Effects of Tillage on Maize output

In developing countries of Africa, maize is a major staple food crop for human consumption (Kudi, 2010). Dowswell *et al.*, (1996) revealed that the average maize output (*Zea mays L*) in developed countries (USA) is 6.2 t/ha and 2.5t/ha for developing countries (Nigeria). The gap average output level is a consequence of developed countries employs input- intensive and highly mechanized maize production systems, while developing countries employ lower-input maize production systems. In addition, environmental condition, Technological and political factors can bring about the gap. Babaji, (2007), revealed that an on- farm trial conducted in Ghana on maize, soybean, sorghum and groundnut under reduced and conventional tillage, the result show 3.64t/ha and 2.58t/ha for maize under reduced and conventional tillage, 2.36t/ha and 1.97t/ha for soybean, 3.30t/ha and 3.42t/ha for sorghum, 4.66t/ha and 4.61t/ha for groundnut and 3.50t/ha and 2.95t/ha for wheat respectively. He added that sorghum had low grain yield under reduced tillage than conventional tillage. In addition, lands that undergo frequent cultivation with heavy implements/ equipments to produced crop are reliably prone to erosion and low yield. Maize has been put in wider range of uses than any other cereals as stable food, industrial raw material, feed for livestock and poultry, fodder crop and its processed and consumed in a multitude of ways which vary from region to region or from one ethnic group to the other (Kudi, 2010).

2.6 The Need for Appropriate Technology for Farmers in Nigeria.

The selection of appropriate technologies to promote sustainable agriculture should be based on the ability of the technology to maintain farm production at higher output level, meet the needs and management capacities of the farmers, generate income within acceptable limits risk, improve utilization efficiency of scarce resources and incorporate indigenous knowledge (Jones 1997). Daniel (2010) on his study stated that, the appropriate technology for farmers should be the one that brings about less cost of production, energy saver and reduces drudgery of manpower. In addition it should be able to maintain soil fertility for plant growth, soil structure and reduces soil erosion. Daniel (2010) in his study reported that, the appropriate technology should be the one that is easy adapted by farmers. He added that, the appropriate technology should be able to provide feedback on the effectiveness of technology transfer and flow of information between researcher, extension agent, farmers and policy makers on the impact of technology generated. Jacnlin (1999) revealed that one of the greatest challenges to human life is the adoption of new idea. Blackburn (1984) supports the fact that "on- farm demonstration of new idea can enhance learning since several facilities are involved as learners watch, listen, hear, touch, smell and even practice. Participants in a learning process most have the opportunity to practice the skill learned and receive feedback on their performance soon after the demonstration, if it is to be effective.

2.7 Socio-Economic Factors Associated with the Adoption of Improved Agricultural Practices

Extension contact is the frequency of the visits of the extension agent to the farmer and vice versa. Odoemenem and Obinne (2010) found a positive contribution of extension contact to adoption of agricultural technologies. This is because constant meeting between the extension personnel and the farmers would enlighten the latter and create

awareness for the potential gains of improved agricultural innovation. Farmers' age is concerned with how old the farmers had been from birth to the time of investigation. Adeniji (2007) found that younger farmers adopted agricultural innovation more readily than the older ones. This is because young farmers tend to be more flexible in their decision, adopt new ideas more readily because of anticipated longer life-span within which the investment in new technology will pay off. Hence, the expectation is that many young farmers will be adopters while the older farmers will be non-adopters. Akanyan (1989) on his study found age and level of formal education to be positive and insignificantly related to farmers' awareness and adoption of farm innovation. He added that older farmers, perhaps because of several years investing in a particular practice may not want to jeopardize it by trying out a new farming technology.

Similarly, Yahaya (2007); Odeomenem and Obinne (2010) found low level of adoption among older farmers and that was because they got built-up ideas and practices, over time and found it difficult to change. But today, more and more of our aged farmers have come to accept the use of insecticide on cowpea production to obtain higher yield. What is important here is that old or young age alone does not determine acceptability of technology. An old farmer who has built up ideas and beliefs over the years and has not been exposed to extension agents will be less willing to acceptability of technology compared to an aged farmer who is literate and exposed to urban life or exposed to extension agents. However, Ekong (2005) stated that studies have shown that there is no association between age and adoption behavior of farmers. Agbamu (1993) revealed that age of a farmer does not contribute to adoption of new improved maize variety; improved practices of groundnut, and new varieties of cassava and maize respectively.

Yahaya (2007), observed that it is generally believed that males are often more energetic for energy demanding activities such agricultural activities while Oladele and Kareem (2003), opined that gender pose no barrier to active involvement in farming activities. Ojuekaiye (2001), in his classification of farm size opined that farmers who cultivate farmland between 1.0-5.9 hectares are small-scale farmers. Teressa (1994), reported that the size of the farmland cultivated is a function of land available to the farmer for use and also the potential of the land .Doss and Morris (2001), on their study focuses on farm size as the first and probably the most important determinant on adoption of farming technologies. They added that farm size can affect and in turn affected by the other factors influencing adoption. Atala (1986), also found that the most important variables which influenced adoption were extension contact, farm size and hired labour while those for gross farm output were farm size, hired labour and non-farm income. Clark and Akinbode (1986), defined household size as the number of people living and eating from the same pot. Nweke (1989), found that the average household size in Africa was between 8-9 people in a household. Okunade (2006), reported that the significance of household size in agricultural production hinges on the fact that the availability of labour provided for farming activities, the total land area cultivated, the amount of farm produce retained for domestic consumption and the marketable surplus are all determined by the size and composition of the household. Kassie (2009), reported that experience is gained with number of years spent in doing an activity. He maintained that as the years in doing agricultural activities increase among farmers, their years of experience also increase.

Agbamu (1993) on their study found that educational level significantly influenced the adoption of recommended practices. Level of education is the number of years an

individual farmer actually spent in formal school (Akpoko, 2001). For instance, if a farmer attended primary school and completed secondary school, the number of years taken for the two levels of schooling will be summed up. Waller *et al.,* (1998) on his study revealed that, the effects of education on adoption in most cases relate to years of formal schooling. Generally education is thought to create a favourable mental attitude for the acceptance of new farming practices especially reduced tillage and reduce the amount of complexity perceived in a technology thereby increasing a technology`s adoption. He added that ability to read and understand sophisticated information that may be contained in a technological package is an important aspect of adoption.

Berry (1993) found that when farmers spend more years in formal school, they become more proficient in reading and writing. Therefore, the adoption index is expected to be positively related to the level of formal education. Formal education enables the farmers to obtain useful information from bulletins, agricultural newsletters and other sources. Formal education usually aids farmers and leads them to accept new farm technologies more readily to enhance their income than those farmers without a formal education. Odoemenem and Obinna (2010) found that education had a very significant impact on the farmer's cash value. The low level of education of the farmers is inimical to the adoption of innovations. Agbamu (1993) revealed that level of education was positively related to adoption of recommended practices. They maintained that the more knowledgeable the individual, the more favourable attitude he/she had towards recommended technologies. Studies have shown that the more the farmers advance in their level of education, the more they tend to understand the importance, intricacies and need for adopting new improved farm practices such as recommended cotton production practices.

Akpoko (2001) also found that household size contributes positively to adoption of recommended practices. Household size is the total number of individual (wives, children or grand children and extended family members) that live with and feed from the household. The adoption index may be either household size depending on the magnitude, age structure and available farm labour among members. Adekoya *et al.,* (1995) revealed that farmers adopt agricultural innovations because they have more mouths to feed. And the family serves as labour source for agricultural production.

Atala (1980) and Ekong (2005) found size of farmland to be positively and significantly related to adoption of innovation. .Land ownership structure is an important factor that can affect the adoption of a new technology. The importance of land in agricultural and food production cannot be overemphasized. To this effect, farming cannot take place without land (Ekong, 2005). He also maintained that farmers can be indifferent in adopting new technologies if the land tenure system does not allow personal ownership of land to execute the technology. Tenure ship of land is also related to the size of land owned by a farmer. Studies have shown that in America, size of farm is always positively related to the adoption of new practices by the farmers. Ekong (2005) and Ajayi and Ogunlela (2006) reported that land acquisition in most cases is through inheritance, allocation and gifts, sales, pledges, lease, purchase and loans. He pointed out that the pressure on land as a result of increasing population which can lead to individual ownership of land and fragmentation of farmland. Sources of information on improved technology play a vital role in adoption of any recommended practice by the farmers.

Adeniji (2007) had identified the sources of information to farmers to include extension workers, fellow farmers, and neighbors and mediated information sources. The primary goals of these informants are to create awareness by diffusing among potential adopters useful and practical information on the innovation, and encourage its application. Caswell *et al.,* (2001) revealed that lack of adequate information about the technology may be obstacles to farmers' adoption of new technology. Exposure to information about new technologies as such significantly affects farmer choice about it. However in the case where experience within the general population about a specific technology is limited, more information induces negative attitudes towards it adoption.

Ekong (2005) also affirmed that such technical information are very useful during the trial stage of adoption process and are capable of leading to adoption of agricultural innovations.

Amount of credit available to the farmers will lead to adoption of modern technology. Agbamu (1993) reported that credit is a vital element to agricultural transformation. It contributes to the farmers' social welfare, enhances production, and helps in capital formation and sustainability of income. They also identified problems emanating from unavailability of credit to include, low productivities, inability to adopt recommended practices, poor marketing and distribution arrangement. The greater the participation of a farmer in social activities outside his household or locality and the more his interaction with other adopters, the earlier his adoption will tend to be. Interaction among human beings is the basis of social change (Ekong, 2005).

Agbamu (1993) revealed that social group meetings made significant contribution to adoption. People sometimes desire to change or feel a need for it. Where a farmer is favourably disposed towards change and innovation, adoption is more likely to occur. In some cases, according to Ekong (2005) people, who have lived for very long time under a particular condition and have perfectly adjusted to it, may find it very difficult to change. Therefore, such people are not prone to change for, as the saying goes, 'old habits die hard'. On the other hand, certain farmers have the urge or drive to aspire high and belong to higher social strata. Those farmers' intrinsic motivation could jolt them to attempt the adoption of several innovations in a bid to improve their agricultural production. On his study, he reported that the motivation to secure resources to attain high socio-economic goal to be an important psychological variable in adoption process. However farmers that are readily prone to change and have the urge to aspire high are more likely to adopt innovations than those who want to maintain the status quo.

Many researchers have confirmed the role of credit in adoption of recommended practices. Chikwedu *et al*., (1993) found that credit had a positive influence on adoption. This may be due to the fact that improved new technologies do come with some recommendations which require money for their implementations, with limited financial resources associated with Nigerian farmers, access to credit is likely to negatively influence farmer's adoption of improved technologies. Adekoya *et al.*, (1995); discovered that access to credit affects household welfare outcomes through at least two channels: first, it alleviates the capital constraints on agricultural households. He added that credit also reduces the opportunity cost of capital intensive assets relative to family labour, thus encouraging labour – saving technologies and raising labour

productivity, a crucial factor for agricultural development, especially in many African countries. Spencer (1997); confirmed that rural farmers are not able to adopt most modern production technologies because they are relatively poor. Therefore, for them to adopt most technologies, they must require subsidy and credit. Khanna (2001) on his study revealed that adoption of technology dependent on cost of a technology and on whether farmers possess the required resources. In addition, technologies that are capital- intensive are only affordable by wealthier farmers. Morehart (1999) stated that technology that cost little is adopted more quickly than those required large expenditures, hence both extent and rate of adoption may be dependent on the cost of technology. Akinola *et al.,* (2007) in their study on determinants of adoption and intensity of use of balanced nutrient management systems technologies in the Guinea Savanna of Nigeria reported that a number of factors such as access to credit, farmers` perception of the state of land degradation were found to be significant in determining farmers adoption decision on BNMS-manure while off farm income was found to be significant in determining farmers` decision on BNMS-rotation.

2.8 Production Cost

Reduced tillage system offer an opportunity for farmers to reduce production cost. Findlay (2003) stated that several ecological studies have conducted that production cost per hectare of maize is lower and return higher in reduced tillage system than in conventional tillage system. In his study in Ghana found that reduced tillage system saves fuel, labour and machine cost. Ribera et al (2004) reported that several economics studies have conducted that production cost per hectare for cotton is lower and higher returns than in conventional tillage systems. Findlay (1999) reported that in a rice demonstration in Senegal an outlay of N3,200 above the cost of conventional tillage

seedbed preparation and in crop weeding resulted in yield increase of 1.2tons/ha, giving a net profit of N88,960/ha.

2.9 Profitability Analysis (Net Farm Income)

The net farm income is the difference between the gross income (GI) and the total cost (TC) of production (Olukosi and Erhabar, 1988).The net farm income model is specified as:

NFI=GI–TC

Where: NFI = net farm income, GI = gross income, TC = total cost of production.

The gross income is the total return or total value product (TVP) which is the total output multiply by the price per unit of produce. i.e $Q*P_y$.

Where Q is the quantity of output and P_y is the price per unit of output.

However, the total cost of production (TC) comprises the total variable costs (TVC) and the total fixed costs (TFC) of the production. The total cost (TC) of production is given by:

TC= TVC + TFC

The total variable cost include all cost of variable inputs such as fertilizer, agro-chemical, seeds, labour while the total fixed cost include cost of renting land, stores, interest on capital and depreciation of farm tools such as cutlass and hoes. In the case of small scale farms with negligible fixed cost, the gross margin analysis (GMA) is a good approximate of the net farm income i.e GM= TR-TVC

Where

GM = Gross margin, TR = Total revenue and TVC = Total variable cost.

2.10 Concept of Adoption Process

The concepts of adoption and non-adoption are interesting by the social scientist. Adoption study has been conducted both in the developed and developing nations of the world. Davie (1998) defined adoption as the stage in which a technology is accepted and continued use by an individual or organization. The adoption decision process is a mental process through which an individual passes from knowledge of innovation to a decision to adopt or reject the innovation (Ruma, 2006). Also these scientists recognized that an individual`s decision about an innovation is not an immediate act, rather it is a process that occurs over time and consist of series of actions. The process of increasing sufficiency in agricultural production therefore depends on the extent to which farmers can incorporate their farming operations with improved technologies. He added that, the extent of adoption is measured as the proportion of area the farmer commits to a particular technology.

2.10.1 Stages of adoption

According to Rogers and Shoemaker (1971), adoption process can be classified into the following five stages namely: Awareness, Interest, Evaluation, Trial and Adoption.

Awareness: The farmer just knows about the technology but not the full details of it.

Interest: The farmer now seeks for more information on the technology and how it can work.

Evaluation: He compares the merit and demerits of the idea including the risk involved, comparing the effectiveness and the cost analysis.

Trial: After the evaluation, the farmer makes a trial on a small scale to see the results.

Adoption: The last stage is acceptance and continuation of the technology on a large scale production. Similarly, the IITA (1988), reveal that the attributes of a technology as

perceived by farmers determines the rate of its adoption. There are five attributes of a technology and these include: Relative Advantage, Compatibility, complexity, triability, and absorbability.

Relative Advantage: This is the degree to which a technology is perceived as better than the idea its supersede. The relative advantage is measured in economic terms but often social prestige factor, convenience and satisfaction are also of importance. The greater the perceived relative advantage of a technology the quicker the rate of its adoption.

Compatibility: This is the degree to which a technology is perceived as consistence with the existing values, past experiences and needs of the farmers. A technology that is compactable will be adopted more rapidly than the one that is incompatible.

Complexity: It is the degree to which a technology is perceived as difficult to understand and used. Some technologies are easily understood by farmers while others are more complexes, hence can only be adopted slowly.

Triability: It is the degree to which a technology will be experimented with limited bases. A new technology that can be tried in an installment plan will generally be adopted more quickly than a technology that is visible for trial.

Absorbability: This is the last attribute of a technology where the result of the technology is seen physically. A successful result of a technology on a demonstration plot will convince farmers to accept and adopt it (IITA 1988).

Madukwe (1991), opined that a group of farmers may be categorized according to their readiness to accept a new practice and put it into use as: Innovators, Early adopters, late adopters (Laggards) and Never Adopters.

Innovators: These are those who introduce new farming techniques into a farming community. They constitute a small proportion of the farming community. The source

of their information may be through contact extension agents, the mass media or from what they have seen in another farming community. **Early Adopters**: This group of farmers comes immediately after the innovators. Some of them are educated but may be conscious and would want to see the new technology tried under local condition. They usually express their interest and willingness but under conviction by result demonstrations.

Late Adopters (Laggards): This group of farmers is the third that can accept and try a technology. The percentage of late adopters is usually very high because of their conviction from result demonstrations. Although some take a much longer period to adopt.

Never Adopters: These are the last group of farmers that will neither accept nor adopt a new technology. They do not even consider what the extension agents try to put across them. This attitude may be due to factors such as illiteracy, poverty, conservative attitude, and lack of exposure, fear of tax payment as well as fear of risk of uncertainty (IITA 1988).

Rogers (1995), stated that technologies is a new Innovation being adopted to achieve a desire outcome. Two types of technology adoption studies are readily visible in the literature, namely, those that focus on the measurement of adoption rates, adoption intensity (Phillip, 2009). In addition the rate of adoption is usually measured by the length of time required for a certain percentage of members of a system to adopt an innovation. On the other hand adoption intensity is measured from the number of producers adopting an innovation. The current study focuses on the intensity of adoption. Adoption intensity A_i is measured as:

$$\text{Adoption intensity } (A_i) = \frac{\text{Area of crop under reduced tillage (ha)}}{\text{Total Area under the same crop (ha)}}$$

Phillip (2009), stated that measurement of adoption intensity have developed a profile that allows different levels of decision to be made by the farmer. The adoption profile may be applied to a single technology or to multiple technologies. A farmer may adopt more than one technology at a time, but may be at different stages of the adoption profile for different technologies.

2.11 Impact Evaluation.

The International Initiative of impact evaluation (IIIE, 2008), defined impact evaluation as "analysis that measures the net changes in outcomes for a particular group of people that can attributed to a specific technology using the best methodology available, feasible and appropriate to the evaluation question that is being investigated and to specific context. World Bank`s Development Impact Evaluation Initiative (2008), states that "impact evaluation compare the outcome of a treatment groups against a counterfactual (the value of the outcome of treatment group and control group). According to the United States Environmental Protection Agency (2008), Impact Evaluation is a form of evaluation that assess the net effect of a technology by comparing the Treatment group outcome with the counterfactual (comparing treatment group outcome with an estimate of what would have happened in the absence of a technology)

2.12 Single Difference Estimator.

White *et al*., (2010) explained that: "the difference in outcomes between the treatment group (the beneficiaries) and the comparison group is the most common approach to impact analysis. This is the "single difference". Where baseline data are available, then

the “double difference” (the difference in the change in the outcome) may be used. The model could be specified as:

$SDE = \bar{Y}_1^T - \bar{Y}_0^T$ .....(i)

Where:

$\bar{Y}_1^T$ = Average outcome (productivity) obtained by reduced tillage farmers.

$\bar{Y}_0^T$ =Average outcome (productivity) obtained by conventional tillage farmers.

$\bar{Y}_1^T - \bar{Y}_0^T$=Average output obtained by reduced tillage *minus* output obtained by conventional tillage farmers respectively.

An alternative approach is to use a regression in which project participation is an explanatory dummy variable. This approach is equivalent to (that is gives identical results to) single or double difference, depending on the specification of the regression. However, other variables may also be included, giving a better result, allowing for analysis of differential effects within sub-samples of the treatment group.

Although these approaches are very common, they do not identify the channels through which the intervention is having its effect and so are inconsistent with a theory-based approach (White *et al.,* 2010). These effects are very likely through the determinants which have also been included on the right-hand side of the equation – when will the intervention have an effect other than affecting the determinants? If these determinants are included in the regression, then the actual impact of the project is under-estimated by the coefficient on the project dummy. But if they are not included then the project dummy may be an over-estimation. Hence, it is often better not to use a project dummy but to model the determinants and how the intervention has affected these determinants. This is called the ‘modeling of determinants’ approach.

2.13 Z-Test

Z-Test is often used to refer specifically to the one-sample location test comparing the mean of a set of measurements to a given constant (William 2008). He added that it is useful in experimental research design or in program evaluation. William, (2008) state that Z-Test is the most important analyses in program outcome evaluation involves comparing the treatment and control group on the outcome of variable. In addition, it used when to compare the average performance of two groups on a single measurement to see if there is difference. He said, if the observed data X_1, X_2----------X_n are uncorrelated have a common mean □, and common variance σ^2, then the sample average $\dot{X}$ has average mean □ and variance σ^2/n. If our null hypothesis is that the mean value of the population is given number □,$_o$ we can use $\dot{X}$-□,$_o$ as a test statistic, rejecting the null hypothesis if $\dot{X}$-□,$_o$ is large. To used Z-Test if the sample size is moderate or large. A typical rule of thumb range from 30 and above. The model could be specified as:

$$Z = \frac{X_1 - X_2}{\sqrt{\frac{{S_1}^2}{n_1} + \frac{{S_2}^2}{n_2}}}$$

Where:

Where Z = calculated Z value

x_1 =mean income obtained by the reduced tillage farmers

x_2 = mean income obtained by the conventional tillage farmers

s_1 =standard deviation of income obtained by the reduced tillage farmers

s_2=standard deviation of income obtained by the conventional tillage farmers

n_1=sample size of the reduced tillage farmers

n_2 = sample size of the conventional tillage farmers.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in Lere, Kauru and Zango Kataf L.G.A's of Kaduna State. Lere Local Government area is about 200km away from Kaduna city. It lies between Latitude $10^{o}52'$ and $12^{o}52'$North and Longitude 08^{o} and $10^{o}50'$ East. It occupies a total land Area of about 2,567 square Kilometers (KADP, 2009)**.** It has an estimated population of 331370 people in 2006 (National Population Commission, 2006) and a projected population of 400305people in 2012 at a growth rate of 3.2% per annum. Agriculture is considered as a major economic activity and approximately 75% of the populations are engaged in agricultural production as a means of livelihood and employment. It bordered by Ikara and Kauru L.G.A's to the North, Kaura to the South. It has two distinct seasons; rainy and dry seasons and has a mean average rainfall of about 1,482 mm with highest rainfall recorded in July. The minimum temperature is about 16^{0}c and maximum is about 33^{0}c (Kaduna state metrological station, 2012). The climate of the area favours the production of crops such as maize, groundnut, sugarcane and cowpea.

Kauru Local Government Area is about 195km away from Kaduna city. It lies between Latitude 9^{o} 68' and 10 $^{o}52'$North and Longitude 08^{o} and $9^{o}51'$ East. It occupies a total land area of about 2,739 square Kilometers (KADP, 2009)**.** It has an estimated population of 170,008 people in 2006 (National Population Commission, 2006) and a projected population of 205374 people in 2012 at a growth rate of 3.2% per annum. Agriculture is considered as a major economic activity and approximately 80% of the populations are engaged in agricultural production as a means of livelihood and

employment. It bordered by ZangoKataf and Lere L.G.A's to the South, Soba and Igabi L.G.A to the North while Kachia L.G.A to the West. It has two distinct seasons; rainy and dry seasons and has a mean average rainfall of about 1,524 mm with highest rainfall recorded in July. The minimum temperature is about 14^0c and maximum is about 35^0c (Kaduna state metrological station, 2012).The climate of the area favours the production of crops such as maize, groundnut, yam, sugarcane and cowpea.

Zango Kataf Local Government Area is about 220km away from Kaduna city. It lies between Latitude 09^0 30' and $10^0$08'North and Longitude $07^0$27 and 9^0 51'East. It occupies a total land area of about 2,542 square Kilometers (KADP, 2009)**.** It has an estimated population of 316370 people in 2006 (National Population Commission, 2006) and a projected population of 382184 people in 2012 at a growth rate of 3.2% per annum. Agriculture is considered as a major economic activity and approximately 80% of the populations are engaged in agricultural production as a means of livelihood and employment. It is bordered by Kauru and Lere L.G.A's to the North, Kaura and Jema`a LGA to the South, Kachia to the West. It has two distinct seasons; rainy and dry seasons and has a mean average rainfall of about 1,524 mm with highest rainfall recorded in July. The minimum temperature is about 14^0c and maximum is about 35^0c (Kaduna state metrological station, 2012).The climate of the area favours the production of crops such as maize, groundnut and yam. The study areas fall within the Northern Guinea Savannah ecology. The soil developed from undifferentiated basement complex rocks. The soil in the areas ranges from Sandy Loam to Clay Loam which allows continuous cropping of a wide variety of crops such as maize, rice, sorghum, cassava, cowpea, soybeans, yam and millet. The major tribes includes: Gure, Kurama, Kahugu, Kataf and

Bajju. Major activities include; Crop farming, Fishing, Livestock farming, Trading and Civil service.

3.2 Sampling Procedure and Sample size

Multistage sampling technique was employed in the selection of reduced tillage farmers for this study. The first stage is the purposive selection of Lere, Kauru and ZangoKataf Local Government Areas of Kaduna State. These selections are on the basis of being the prominent areas with high number of farmers practicing reduced tillage system on maize production in the state (Reconnaissance survey, 2012). In the second stage, three (3) villages were purposively selected from each Local Government Areas on the basis of their high number of farmers practicing reduced tillage system (Reconnaissance survey, 2012). These are: Gure, GaruKurama and Gurza (Lere L.G.A). Dandaura, Kauru, Kagandama (Kauru L.G.A). Gan Gora, Sagwaza and Bafai (ZangoKataf L.G.A). In the third stage, names of maize farmers practicing reduced tillage were obtained by extension agent working in the study area. Simple random sampling (Ballot box method) was employed in selecting 20% of 370 for the reduced tillage maize farmers in each village was taken given a sample size of 73 respondents. The method involved the use of flip papers on which names of each object in the population is written. These papers are folded and then put in a container. The papers are thoroughly mixed and one is picked. The name so picked is already in the sample and is written down on a piece of paper. The process is repeated till the number required for the sample is reached.

Names of conventional tillage farmers' for this study were obtained from Kaduna State Agricultural Production Survey (APS), 2012 cropping season questionnaire by Senior Evaluation Officer. 10% of 737 for the conventional tillage maize farmers in each village were taken as the sample size. The total respondents were 146 farmers. The sampling procedure and sample size are summarized in Table 3.1.

Table 3.1: Selected Villages and Sample size of Reduced and Conventional tillage Farmers.

		Reduced tillage		**Conventional tillage**	
L.G.A	**Villages**	**Population size**	**Sample size (20%)**	**Population size**	**Sample size (10%)**
Lere	Gure	40	8	90	9
	Garu	40	8	101	10
	Kurama				
	Gurza	32	6	70	7
Kauru	Dandaura	30	6	91	9
	Kauru	36	7	81	8
	Kagandama	31	6	80	8
Zango Kataf	Gandora	51	10	92	9
	Sagwaza	60	12	61	6
	Bafai	50	10	71	7
Total		370	73	137	73

3.3 Method of Data Collection

The data for this study were drawn from primary and secondary source. The primary data were collected using structured questionnaire administered to maize farmers who practiced reduced tillage system for the information in the 2012 cropping season. This was done through the use of extension agents. While secondary data was also obtained from Kaduna State Agricultural Production Survey (APS) questionnaires in the 2012 cropping season. This was done through the assistance of Senior Evaluation Officer, Kaduna State Agricultural Development Project (KADP), and these were used for farmers who practiced conventional tillage in the study area. The information were collected on the following:

i. Socioeconomic variable of farmers: Age of the farmer, membership of association, educational level.

ii. Capacity to effectively manage reduced tillage system: availability of animal manure, farm income, and method of acquiring land (inherited, lease, gift, rent or purchase) and credit facilities

iii. Adoption variables**:** The information was collected on number of farmers adopting reduced tillage system in the study area.

iv. Information on farm production variables includes: land area of maize cultivated under reduced tillage (ha), total farm output of maize (kg), labour use (man-hour) and cost (Naira), quantity of improved seeds planted (kg) and cost (Naira), quantity of fertilizer use (kg) and cost (Naira), quantity of agro-chemical used (ltrs) and cost (Naira)

3.4 Analytical Tools

The analytical tools used in achieving the objectives of the study include the following:

i. Descriptive statistics

ii. Net farm income

iii. Regression analysis

iv. Single difference estimator

v. Z-Test

3.4.1 Descriptive statistics

Descriptive statistics such as central tendency (mean, percentages and frequency and measures of dispersion such as variance and standard deviation) were used. This tools were used to achieved objectives (i), (ii) and (vi) of this study.

3.4.2 Net farm income

Net farm income is the difference between the gross farm income and the total cost. This tool was used to achieve objective (iii) of this study and expressed as.

NFI= GI – TC

Where:

NFI = Net Farm Income (Naira/hectare)

GI = gross income (Naira/hectare)

TC = total cost (Naira/hectare)

3.4.3 Multiple regression model

Multiple regression model was used to achieve objective (iv) of this study. It determined the factors influencing adoption of reduced tillage farming by an underlying response variable that captures the true economic status of a farmer. The model specification as:

$$Y= a+bx_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+e$$

Where:

Y= adoption Index

X_1= Farmer age (years)

X_2= Level education (number of years of formal schooling)

X_3= Household size (number of members per household)

X_4= Farming experience (number of years in production)

X_5= Access to credit (actual amount received in naira)

X_6= Membership of association (years of membership in cooperative)

X_7= Extension contact (number of visits)

b_1-b_7 = regression coefficient

e = error term

a = constant

3.4.4 Single difference estimator (SDE)

Single difference estimator is the difference in the average outcome of the treatment group and the control group (Abouy, 2010).This tool was used to achieve part of objective (v) of the study. The Single difference estimator is expressed as:

$SDE = \bar{Y}_1^T - \bar{Y}_0^T$

Where:

$\bar{Y}_1^T$ = Average outcome (income) obtained by reduced tillage farmers.

$\bar{Y}_0^T$ =Average outcome (income) obtained by conventional tillage farmers.

$\bar{Y}_1^T - \bar{Y}_0^T$=Average output obtained by reduced tillage *minus* output obtained by conventional tillage of farmers respectively.

It is common to find difference estimator presented in a table.

Treatment (T)	$\bar{Y}_0^T$
Control (C)	$\bar{Y}_0^C$
T-C Difference	$\bar{Y}_0^T - \bar{Y}_0^C$

3.4.5 Z- Test

This tool was used on the basis of comparison between means of two groups' especially when the sample size is larger than 30. It was used to test the Hypothesis i and ii of the study. The test of hypothesis was conducted on the Net Farm Income obtained from reduced tillage and conventional tillage farmers.

Z- Test is expressed as follows:

$$Z = \frac{X_1 - X_2}{\sqrt{\frac{{S_1}^2 + {S_2}^2}{n_1 \quad n_2}}}$$

Where Z = calculated Z value

x_1 =mean income obtained by the reduced tillage farmers

x_2 = mean income obtained by the conventional tillage farmers

s_1 =standard deviation of income obtained by the reduced tillage farmers

s_2=standard deviation of income obtained by the conventional tillage farmers

n_1=sample size of the reduced tillage farmers

n_2 = sample size of the conventional tillage farmers.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Level of Adoption of Reduced Tillage by the Respondents

Table 4.1 show the adoption index of reduced tillage maize farmers. The mean adoption index was 0.31. This implies that 31% of the maize farmers land areas was devoted to practice reduced tillage system. Larger proportion (52.05%) of the reduced tillage maize farmers had their adoption index ranging between 0.21-0.4. This follows by 27.04% of the reduced tillage maize farmers with adoption index of 0.01-0.2. The small proportion of 2.7% of the reduced tillage maize farmers had their adoption index between 0.81-1.0. The implication of the result is that the objective of the reduced tillage system to facilitate rapid adoption of high – yielding improved farming technology is being achieved. Similar research conducted by Ezra (2012), in his study on adoption of short kaura in Biliri and Kaltigo Local Government Area of Gombe state, the result show that a larger proportion (61%) of the short kaura farmers had their adoption index between 0.1-0.5. The small proportion (3%) of the short kaura farmers had their adoption ranging between 0.9-1.0.

Table 4.1: Adoption index of reduce tillage maize farmers.

Adoption index (Ha)	Frequency	Percentage
0.01–0.2	20	27.40
0.21 –0.4	38	52.05
0.41 –0.6	13	17.81
0.61 –0.8	0	0
0.81 – 1.0	2	2.74
Total	73	100

Maximum = 1.0

Minimum = 0.06

Mean = 0.31

Standard error of Adoption index = 0.01

4.2 Inputs and Outputs Level under Reduced and Conventional Tillage

The result presented in Table 4.2 shows that the maize farmers who practiced reduced and conventional tillage had mean yield of 2512kg/ha and 2478kg/ha respectively. This result suggests that the yield of the maize under reduced tillage is higher than that of conventional tillage system. This result can be attributed to the influence of adoption of reduced tillage on farm production.

The results showed that farmers who practiced reduced tillage had mean labour of 31 man-days/ha while farmers who practiced conventional tillage system had mean labour of 60 man-days/ha. This result suggests that the labour/man-days under reduced tillage system is lower than that of the farmers practiced conventional tillage system.

The results also showed that farmers who practiced reduced and conventional tillage system had mean seeds utilization of 15kg/ha and 17kg/ha respectively. The variation in quantity of seeds used under reduced and conventional tillage system is that, farmers who practiced conventional tillage system do not used proper planting spacing (15cm) requested for maize production and also bring about variation in the cost of seed used.

The results further revealed that the maize farmers who adopted reduced tillage farmers had mean inorganic fertilizer of 250kg/ha while that of the farmers who practiced conventional tillage system on maize production had mean inorganic fertilizer of 301kg/ha. The variation in quantity of inorganic fertilizer used under reduced and conventional tillage practices was as a result of the planting spacing used in conventional tillage system that bring about increased in the number of plant populations.

KADP (2007), revealed that an On-Farm trial was conducted in Kaduna State, Nigeria on Sorghum under reduced and conventional tillage system show that both trials had an average yield of 1.5 metric tons and 1.3 metric tons respectively. This indicates that the yield of sorghum under reduced tillage system was higher than that under conventional system. The result of the On-Farm trial further revealed that the reduced tillage system had mean labour of 21 man-day/ha while that of the conventional tillage system had mean labour of 58 man-day/ha respectively. The result also show that the reduced tillage had mean inorganic fertilizer of 150kg/ha while that of the conventional tillage system had mean of 236kg/ha. This results was similar to that obtained by Bello (2002), in his study on economics of tomato production in Kudan Local Government Area of Kaduna state, that tomato under reduced irrigation had a mean of 9297kg/ha while under conventional tillage system, the mean yield was 4995kg/ha.

Table 4.2: Input and output levels under reduced and conventional tillage maize farmers

	Reduced tillage				Conventional tillage			
Variable	**Min**	**Max**	**Average**	**Std. Dev.**	**Min**	**Max**	**Average**	**Std. Dev**
Yield (kg/ha)	767	2700	2512	475.66	675	2500	2478	190.19
Labour (man-day/ha	15	35	31	6.79	42	82	60	7.98
Seed (kg/ha)	9	17	15	2.90	14	21	17	0.90
Inorganic fertilizer (kg/ha)	116	300	250	47	125	433	301	60.80
Organic fertilizer (kg/ha)	25	600	189	133	200	800	475	128
Agrochemical (litre/ha)	4	7	5	4	4	6	5	0.8

4.3 Cost and Return Analysis

Viability of an enterprise is indicated by the amount of profit realised per period of time. Profit is the difference between the monetary value of goods produced and the total cost of the resources used in the production. The amount of revenue realised and operating cost of the business venture determines how much gain or loss the enterprise can achieve within a certain period of time.

4.3.1 Fixed items

These are assets that are not easily sold in the regular course of a business operative for cash and are generally owned for its role in contributing to the business ability to generate profit. Example include land, machineries, farm equipments (sprayer, cutlass, hoe) etc. Generally, these are assets that cannot quickly turned into cash and are often only liquidated in a worst case scenario.

Table 4.3: The value of depreciated fixed items under reduced tillage and conventional tillage farmers.

	Reduced tillage		**conventional tillage**	
Fixed item	**cost ₦**	**depreciation**	**cost ₦**	**depreciation**
Hoe	310	108.75	500	172.58
Cutlass	196	28.54	260	71.70
Sprayer	3094	228.36	3695	184.02
Total fixed cost		**367.54**		**428.20**

Straight line depreciation method

4.3.2 Costs

The result presented in Table 4.4 revealed that an average Total cost (TC) of ₦62, 697.65/ha and ₦87,369.20/ha was incurred under reduced and conventional tillage maize production respectively. This indicated that the cost of production under reduced tillage is lower than that of the Conventional tillage system.

The results showed that larger proportion (56.8% and 52.63%) of the total cost of production was incurred for inorganic fertilizer, with a total cost of ₦35,440/ha and ₦44,113/ha under reduced and conventional tillage respectively. This implies that cost incurred for inorganic fertilizer is lower under reduced tillage than conventional tillage system. Therefore this will be attributing to the adoption of reduced tillage than conventional tillage.

A proportion of (24.86% and 34%) of the total cost of production was incurred for Labour, with a total cost of ₦15,500/ha and ₦30,000/ha under reduced and conventional tillage system. This shows indicated that total cost incurred for labour is lower in reduced tillage than conventional tillage. Therefore this will be attributing to the adoption of reduced tillage than conventional tillage.

A small proportion (3% and 2.7%) of the total cost of production was incurred for seeds, with a total cost of ₦1,880/ha and ₦2,274/ha under reduced and conventional tillage system respectively.

The result shows that cost of inorganic fertilizer and labour influencing the production cost of maize in the study areas.

The result also shows that fixed cost for both reduced and conventional tillage farmers accounted for only 0.98% and 0.76% of the total cost of production with the remaining 99.62% and 99.485 being the variable costs of production in each case. This results was similar to that obtained by Bello (2002), in his study on economics of tomato production in Kudan Local Government Area of Kaduna state, showed that an average total cost incurred under reduced tillage tomatoes production and conventional tillage system was ₦136,182/Ha and ₦237,737.17/Ha respectively. The results also showed that larger proportion (62% and 74%) of the total cost of tomatoes production was incurred for labour, with a total cost of ₦100,980/Ha and ₦146,986.25/Ha respectively.

4.3.3 Returns from Maize Production under Reduced and Conventional Tillage System

The results in Table 4.4 shows that the average maize yield under reduced and conventional tillage system were 2512/ha and 2478/ha respectively at the average unit price of ₦69/kg. From this, the total revenue realised by reduced tillage maize farmers and conventional tillage maize production were ₦173, 314.20/ha and ₦170, 974.41/ha respectively.

The Net Farm Income (NFI) for reduced tillage maize farmers and conventional tillage maize farmers were ₦110, 513.56/ha and ₦87, 165.10/ha. The Return to Naira Invested for reduced tillage maize and conventional tillage maize farmers were ₦1.76/ha and ₦0.96/ha. This result showed that reduced tillage system generated high profits than conventional tillage maize farmers. The results obtained by Bello (2002), in his study on economics of tomato production in Kudan Local Government Area of Kaduna state, that an average tomatoes yield produced under reduced and conventional tillage were

9297kg/ha and 4995kg/ha respectively. The Net Farm Income (NFI) under reduced and conventional tomato production were N132, 916.83/ha and ₦65, 536.99/ha respectively. The Return to Naira Investment by irrigate reduced tillage tomatoes farmers and conventional tillage rain fed tomatoes farmers were ₦1.1/ha and ₦0.8/ha respectively. This indicated that extra unit of variable inputs under irrigate reduced tillage and traditional rain fed bring about ₦1.10/ha and ₦0.8/ha respectively.

Table 4.4: Costs and returns analysis of reduced tillage and conventional tillage Maize Production

	Reduced tillage		Conventional tillage	
Inputs variable	**Amount(₦)**	**% of cost**	**Amount(₦)**	**% of cost**
A. Variable cost				
Cost of seeds	1,880.00	3.00	2, 274.00	2.60
Cost of labour	15, 500.00	24.86	30, 000.00	34.00
Cost of inorganic fertilizer	35, 440.00	56.86	44, 113.00	50.70
Cost of organic fertilizer	3, 702.00	5.90	3, 879.00	4.50
Cost of agrochemicals	5, 810.00	9.00	6, 675.00	7.68
Total variable costs(TVC)	62, 332.00	99.62	86, 941.00	99.48
B. Fixed cost				
Depreciation on:				
Hoes	108.75	0.29	172.58	0.40
Cutlasses	28.54	0.07	71.70	0.16
Sprayer	228.36	0.62	184.02	0.20
Total fixed costs(TFC)	365.65	0.98	428.20	0.76
Total cost(TC)= TVC + TFC	62, 697.65	100.00	87, 369.20	100.00
C. Revenue				
Maize yield (kg/ha)	2512		2478	
Unit price (₦/Kg)	69.00		69.00	
Total revenue(TR)	173, 314.20		170, 974.41	
D. Net farm income				
NFI= TR – TC	110, 616.55		83, 605.21	
Returns to naira invested(NFI/TC)	1.76		0.96	

The Net farm income is calculated on the basis of multiplying the average price of ₦69/kg by average maize yield (kg/ha) realized by reduced and conventional tillage farmers minus the total cost of the production.

4.4 Factors Influencing the Adoption of Reduced Tillage System

The results presented in Table 4.5 shows the regression coefficient with respect to each independent variable as well as their corresponding T-values. The overall coefficient of determination for the equation was found to be R^2 = 40% and 50% under reduced and conventional tillage respectively. This implies that 40% and 50% of the variation in the dependent variables under reduced and conventional tillage system is explained by the independent variables included in model. The remaining proportion can be therefore being attributed to the random error and other uncertainties.

The F-value presented in the results, is a measure of joint significant of all the explanatory variables in the model. The F-value is 6.284 and 7.314 for reduced and conventional tillage system. This indicates that, taken together the included explanatory variables significantly explain variation in the adoption reduced tillage system.

The results revealed that the regression coefficient with respect to years of farming experience has negative coefficient of -0.003 and -0.007 and significant at 1% level of probability. This indicates that an increase in years of farming experience by -0.003 and -0.007 will bring about decrease in adoption of reduced tillage system. The older the farmer years of farming the difficult to accept or apply the new technology introduced.

Farming association also indicate positive regression coefficient of 0.053 and 0.059 and significant at 1% level of probability. This implies that increase in farming association by 0.053 and 0.059 will lead to increase in adoption of reduced tillage system. The more

a farmers join farming association the greater the opportunity of the farmer to acquire more knowledge of farming technologies.

The result showed that age have positive regression coefficient of 0.373 and -0.412 and significant at 10% level of probability. This implies that an increase in age of the farmer will lead to decrease in the adoption of new farming technology. Aged farmers found it difficult to abandon their old modern farming system to adopt new improved farming technology. Household size has negative coefficient of -0.042 and -0.054 and significant at 10% level of probability, meaning that decrease in household size of the farmers will lead to increase in adoption of reduced tillage system by -0.042 and 0-054. Small household size has opportunity to available land to practice any type of new farming technology. Amount of credit has negative coefficient of -8.017 and -7.014 and significant at 10% level of probability. This indicates that farmers with low credit facility tend to have less efficient in the adoption of new farming technology. The result obtained by Ezra (2012) noted that age and educational level have positive regression coefficient of 0.210 and 0.423 and significant at 5% level probability.

Table 4.5: Factors influencing the adoption of reduced tillage

Variable	Reduced Tillage			Conventional Tillage		
	Coefficients	**Std. Error**	**T-value**	**Coefficients**	**Std. Error**	**T-value**
(Constant)	0.219	0.081	2.707	0.259	0.091	2.746
Yrs of farm exp. (X_1)	-0.003	0.003	-1.714***	-0.007	0.005	-1.734***
Member of farming assoc. (X_2)	0.053	0.035	1.655***	0.059	0.037	1.875***
Age (X_3)	0.373	0.063	5.896*	0.412	0.067	5.906*
Household size (X_4)	-0.042	0.015	-2.702*	-0.054	0.018	-2.816*
Yrs in schooling (X_5)	0.001	0.014	0.051	0.002	0.016	0.141
Amount of credit (X_6)	-8.017E-07	0.000	-2.260*	-7.019E-05	0.000	-2.201*
Extension contact (X_7)	0.004	0.034	0.3997	0.014	0.048	0.403
	R^2 = 40%			R^2 = 50%		
	R^2 adjusted 33%			R^2 adjusted 42%		
	F-value = 6.284*			F-value = 7.314*		

Dependent variable = Adoption index
*** significant at 10%
* significant at1%

4.5: Effects of Reduced Tillage on Income

The result in Table 4.6 showed that the average farm income by reduced and conventional tillage farmers was ₦263, 054.12 and ₦156, 826.30 respectively. The mean value of reduced and conventional tillage farmers showed a statistically significant difference of ₦106, 227.82. This result suggest that the income of the maize farmers who adopted reduced tillage system was higher than that of the farmers who practiced conventional tillage system and this can be attributed to the influence of reduced tillage on their farm production. The result obtained by Ezra (2012) noted that the average farm income realized by farmers produced short kaura under reduced tillage and conventional was ₦98,250 and ₦87,900 respectively. The average value of reduced tillage realized was ₦10,350.

Table 4.6: Effect of Reduced tillage system on income.

	Amount(₦)
Average farm income from reduced tillage ($\bar{Y}_1^T$)	263, 054.12
Average farm income from conventional tillage ($\bar{Y}_0^T$)	156, 826.30
Single difference ($\bar{Y}_1^T - \bar{Y}_0^T$)	106, 227.82

4.6 Challenges Faced by Maize Farmers

High cost of fertilizer: 20.55% of reduced tillage farmers reported high cost of fertilizer as a serious constraint. While conventional tillage 15,07% of farmers identified fertilizer as a constraints faced by farmers in the study area. When the price of fertilizers is high, farmers cannot afford to buy them even if they are available and accessible.

High cost of labour: 17.81% and 27.40% of reduced and conventional tillage maize farmers identified unavailability of labour as a constraint. Labour costs include the cost of clearing, ploughing, ridging, weeding, earthing-up, harvesting and packaging. Labour is very expensive when it is scare and this could be the reason of influencing cost of production.

Insufficient Credit: This has to do with the inability of the farmer to get access to money from credit source or financial institution to enable him/her purchase farmer inputs that will bring about high productivity. The study revealed that 13.70% and 17.81% of both reduced and conventional tillage maize farmers complained of no credit as constraint.

Insufficient extension service: The study showed that 10.96% of the reduced tillage farmers identified inadequate extension service as a constraint. This constraint affects the information the farmers received on new farming practices and as a result play a major role in the adoption of new practices by the farmer. The effectiveness of extension service can determine the productivity of the farmer. While conventional tillage maize farmers did responded to inadequate extension service.

Inadequate Land: Scarcity of land as a problem was identified by 9.59% and 5.48% of the reduced and conventional tillage maize farmer. Unavailable of arable farmland affects the expansion of maize production in the study area. The high cost of land within the range of ₦600, 000 – ₦700, 000 per hectare in the study area limited purchase.

Poor market: Access to good market and market information on price and demand for the commodity is important to producers as it helps farmers to know the quantity to which the crop is needed. The study revealed that 8.22% and 10.96% of the reduced and conventional tillage maize farmers reported this as a constraint faced in maize production in the study area.

Inadequate capital: 8.22% and 9.59 of the reduced and conventional tillage maize farmers highlighted that insufficient capital as a constraint to maize farmers in the study area. This hinders the adoption of agricultural technology.

Inadequate Improved seeds: Regards to improved seeds, 5.48% of reduced tillage farmers considered unavailability of improved seeds as a constraint, 1.37% of conventional tillage farmers reported that inadequate improved seeds as a constraint to farmers in the study area.

Poor storage facility: About 2.74% and 8.22% of both reduced and conventional tillage maize farmers identified storage facility as a problem in maize production. Most farmers store their grain in rumbu or bags and keep in stores which may not have enough apace and may be destroyed by weevils or rodent.

Lack of modern processing facilities: Farmers gave emphasis on value addition. About 2.74% and 4.11% of the reduced and conventional tillage farmers disclosed that it was not their wish selling produce in its raw form. They wished they owned or had access to modern huller and milling machines for processing thereby adding value to the produce before disposal.

Table 4.7: Challenges faced by maize farmers.

Constraints	**Reduced tillage farmers**			**Conventional tillage farmers**		
	Freq	**%**	**Rank**	**Freq**	**%**	**Rank**
High cost of fertilizer	15	20.55	1st	11	15.07	3rd
High cost of labour	13	17.81	2nd	20	27.40	1st
Insufficient credit	10	13.70	3rd	13	17.81	2nd
Insufficient extension staff	8	10.96	4th	-	-	-
Inadequate land	7	9.59	5th	4	5.48	7th
Poor market price of maize	6	8.22	6th	8	10.96	4th
Inadequate capital	6	8.22	6th	7	9.59	5th
Inadequate improved seeds	4	5.48	7th	1	1.37	9th
Poor storage facility	2	2.74	8th	6	8.22	6th
Lack of modern processing facilities	2	2.74	8th	3	4.11	8th
Total	**73**	**100**		**73**	**100**	

CHAPTER FIVE

SUMMARY, CONCLUTION AND RECOMMENDATIONS

5.1 Summary of Findings

The specific objectives of this study were to determine the level of adoption of reduced tillage, examine inputs and outputs levels of both reduced and conventional tillage maize farmers, ascertain costs and returns under reduced and conventional tillage farmers, determine the factors influencing the adoption of reduced tillage, determine effects of reduced tillage on income of maize farmers and indentify constraint faced by maize farmers in the study area. The data for this study were drawn from primary and secondary sources. The analytical tools used in achieving the objectives of the study include, descriptive statistic, Net farm income, Regression, Single difference estimator and Z-Test.

The result revealed that, the mean adoption index of reduced tillage was 0.31ha and a large proportion (52.05%) of the reduced tillage maize farmers had adoption index of 0.21/ha and 0.4/ha. The average yield obtained under reduced and conventional tillage were 2512kg/ha and 2478kg/ha respectively.

The results of inputs and outputs analysis revealed that mean labour under reduced and conventional tillage were 31 man-days/ha and 60 man-days/ha respectively.

The results also showed that the average total cost (TC) incurred under reduced tillage maize production and conventional tillage maize production was ₦62, 697.65 and ₦87,369.20 respectively. The result also showed that the Net Farm Income (NFI) under reduced and conventional tillage maize production were N110,616.55/ha and

N83,605.21/ha respectively. The Return to Naira Invested under reduced and conventional tillage maize production was N1.76 and N0.96 respectively.

Major constraints identified by the farmers were high cost of labour, high cost of fertilizer, inadequate credit, inadequate extension agent and inadequate land.

5.2 Conclusion

In conclusion, this study revealed that reduced tillage maize production was more profitable than the conventional tillage maize production. The profitability of the reduced tillage has positive impact for investment opportunities for individual and thus, household income. Reduced tillage system has the potential for the farmers to sustainably increase their maize output and income. Maize output and income can be increased by increasing the adoption of reduced tillage technology already available.

5.3 Recommendations

Based on the findings of this study, the following recommendations have been put forward:

i. Cost of labour and fertilizer were limiting factors in the production of maize and therefore, there is a need for Government to provide financial assistance in the form of agricultural loan and at low interest rate to help the farmers expand their production.
ii. Production of maize under reduced tillage is more profitable than conventional tillage farming. It is recommended that farmers should be encouraged to adopt the reduced tillage technology for profit maximization.
iii. Maize farmers should form strong maize producer association that would represent their interest and should participate actively in the association so as to

pool their resource together in order to improve their financial base to enable them meeting their production needs.

iv. Sensitization workshop and On-farm demonstration on reduced tillage should be organized to educate maize farmers on the need to adopt reduced tillage farming technology in the study area.

If these recommendations mention were fully implemented they will go a long way in improving the productivity and profitability of maize farmers in the study area.

5.4 Contribution to knowledge

i. Reduced tillage farming is more profitable than conventional tillage.

ii. Farmers in the study area are small-scale farmers.

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APPENDIX 1: QUESTIONNAIRE

DEPRTMENT OF AGRICULTURAL ECONOMICS,
FACULTY OF AGRICULTURAL ECONOMICS AND RUAL SOCIOLOGY,
AHMADU BELLO UNIVERSITY, ZARIA

Dear Respondent,

The data requested are on 2012 cropping season only. All information given will be treated with utmost confidentiality and will strictly be used for academic purposes.

You are therefore requested to answer the following questions. Kindly tick (√) or fill(s) in the blank space(s) as appropriate.

Thanks for your cooperation.

Questionnaire No:…… L.G.A……. District……

Village……...

A. Socio-Economic characteristics of the respondent

1. Name of farmer……
2. Age of Farmer……(years)
3. Main occupation……
4. Other occupation(s)……
5. Gender: (a) Male ( ) (b) Female ( )
6. Marital Status: a. single ( ) b Married ( ) c Divorce ( ) d Widow ( ) Widower ( )
7. Household size (number)…….
8. Highest educational level
   a. No formal education ( ) b. Primary education ( ) c. secondary education ( )
   d. Tertiary education ( )
9. Number of years spent in schooling
   (a) 0-6 years ( ) (b). 6-12 years ( ) (c). 12-17 years and (d). 17 and above ( )
10. Do you have access to credit last season? Yes ( ) No ( )
11. If yes, from which source? A. commercial bank ( ) b. co-operative bank ( ) c. friends ( ) d. relative ( ) e. others (specify) ……

12. If yes, how much did you borrow? N ……

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

14. If yes, how regular were these visits?

    i. weekly ( ) ii. Monthly ( ) iii. Quarterly ( ) iv. Annually ( )

15. If yes, how many times were these visits in a week, month, quarterly or yearly?

i. ……times week ii. …….times a month iii. …….times a quarterly iv. …….times annually

B. Farm Data

Cropping Pattern:

16. Years of farming experience? .....years

17. For how long have you been practicing reduced tillage on maize production? ……Years

18. Do you normal plant maize as a sole crop? Explain:

……
……
……

20. If no, what are the reasons? Explain:

……
……
……

21. Do you grow maize in mixture with other crop(s)? Yes ( ) No ( )

22. If yes, what other crop(s) do you grow in mixture with maize? Name the crops:

……

C. Resource Use

23. What is the number of farms (plots or fields) under maize production in 2012…….(No)

24. What are their total sizes? …….(ha)

25. What is the number of farms (plots or fields) put into reduced tillage maize production in 2012……..(No)

26. What are their total sizes? ..... (ha)

27. What advantages you obtained from practicing reduced tillage system on maize production?

.....
.....

28. How did you acquire farmlands for maize production?

a. Inheritance ( ) b. purchase ( ) c. gift ( ) d. hired ( ) f. borrowed ( ) g. others (specify)

……

29. If land was hired, how much did you pay per annum? N ……

30. Do you belong to any farmers association? a. Yes ( ) b. No ( )

31. If yes, what benefit did you derive from your membership of the association?

……

……

D. Labour Use (Tick)

32. a. Hired labour ( ) b. Family labour ( ) c. both ( )

I. Labour inputs records (in man- days for maize field under reduced tillage)

i. Hired labour

S/N	Operation	No. of people used	No. of man-days	Unit cost in Naira/day	Total cost in Naira
1	Land clearing				
2	Ridging				
3	Planting				
4	Manure application				
5	Herbicides application				
6	Weeding				
7	1st Fertilizer application				
8	2nd Fertilizer application				
9	Harvesting				
10	Threshing and bagging				
11	Transportation				
12	Storage				

13	Earthing up				
14	Others (specify)				

ii. Family labour

S/N	Operation	No. of people used	No. of man-days	Unit cost in Naira/day	Total cost in Naira
1	Land clearing				
2	Ridging				
3	Planting				
4	Manure application				
5	Herbicides application				
6	Weeding				
7	1st Fertilizer application				
8	2nd Fertilizer application				
9	Harvesting				
10	Threshing and bagging				
11	Transportation				
12	Storage				
13	Earthing up				
14	Others (specify)				

What is the cost adult labour per day? N ……..

iii. Fixed cost

Fixed items	**Number**	**Cost/unit**	**Total**
Hoes			
Cutlass			
Sprayers			
Store			
Total			

32. Information on inputs use.

Inputs information	Unit (kg/bags)	Quantity	Unit cost N	Total cost N
Seeds i. improved seed ii. Local seed				
Fertilizer N.P.K CAN SSP Urea				
Herbicides Round Up Paraquat Attrazine Lamdanet Buster force				

Insecticide				
Bags or sacks				
Manure				
Others (specify)				

If improved or local seed is used enter if possible the name of the variety……...

34. Sources of input use in 2012?

a. KADP ( ) b. Seed company ( ) c. Open market ( ) d. Own stock ( ) e. Government ( ) f. IAR ( ) g. Others (specify)

……
……

35. **Production Output (maize under reduced tillage) and Income level.**

Field/Plot No.	Unit type (kg/bag)	Total Output harvested	Quantity for house used	Quantity marketed or sold	Unit price N	Total revenue N
Total						

36. Do you grow maize solely for commercial purpose? Yes ( ) No ( )

37. Do you sell part or all your maize output? (Tick)

i. Part at harvest ( ) ii. Part during off season ( ) ii. All output at harvest time ( )

iv. All output during off season ( )

38. Which is the more important market outlet for your maize production? (Tick)

i. Farm gate market ( )

ii. Local market ( )

iii. Urban market ( )

39. What is the selling price of maize per bag?
N…….(Naira)

40. How much is your total farm income from sales of output in 2012?
……..(Naira)

41. How much is your total non-farm income in
2012?**.....**…….(Naira)

42. Indicate the size of the bag used…….(kg)

E. Production constraints:

43. What problems do you normally encounter with regards to your maize production under reduced tillage system?

i. ……

ii ……..

iii. ……..
iv……

v. …….
Vi…….

44. What can you suggest for improvement with regards to problems to problems highlighted in 43 above?

i……

ii……

iii……