FACTORS INFLUENCING ADOPTION OF RECOMMENDED CONSERVATION AGRICULTURAL PRACTICES OF MAIZE FARMERS IN BAUCHI AND GOMBE STATES, NIGERIA

BY

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DECLARATION

I hereby declare that this thesis titled **"Factors Influencing Adoption of Recommended Conservation Agricultural Practices of Maize Farmers in Bauchi and Gombe States, Nigeria"** has been written by me and it is a record of my research work. No part of thisthesis has been presented in previous application for another degree or diploma in this or any other institution. All borrowed informationhave been duly acknowledged in the text and a list of references provided.

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CERTIFICATION

This thesis titled **"Factors Influencing Adoption of Recommended Conservation Agricultural Practices of Maize Farmers in Bauchi and Gombe States, Nigeria"** by Pius Akinyele**ENIOLORUNDA**meets the regulations governing the award of the Degree of Doctor of Philosophy of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This project is dedicated to my parents, siblings and their spouses who laboured to give me the educational foundation upon which I have continued to build on.

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ABSTRACT

This study analyzed the factors influencing adoption of recommended conservation practices of maize farmers in Bauchi and GombeStates, Nigeria. The study was necessitated by the fact that the extent to which farmers understand the conservation practices extended among them over ten years ago so as to be able to practice them profitably and sustainably has not been holistically investigated and documented in the study area. In other words, the socio-economic characteristics of the farmers, factors influencing adoption of the practices,attitude of the farmers towards the innovation characteristics of the recommended practices,the knowledge level of the practices and the constraints to adoption of the practices have not been studied in the area. Multi stage sampling techniques was used to select the three hundred and nine (309) respondents that were used for the study in the twenty four (24) wards of the twelve (12) local government areas. Descriptive statistics such as frequency, distribution, percentage and mean were used to summarize the data while Torbit regression model and t- test were used for the inferential analysis. The socio-economic characteristics of the maize farmers as determined in the study revealed that the modal age bracket of the farmers where 41.4% of them belonged was 31-50 years while the mean age was 47.39 years. Male constituted 75.4% of the respondents and majority of them (69.6%) were married. The findings further revealed that yield of maize crop in Gombe and BauchiStates ranged between 2-4 metric tons. The findings indicated that five of the ten recommended conservation agricultural practices were adopted by the respondents. These include minimum or zero tillage, use of organic manure, controlled grazing, effective pest control and effective ridging method. The socio-economic factors that influenced adoption of the practices among the farmers include educational level, farm size, extension contact and income. Majority of the respondents indicated that adoption of the practices had positive impact on their maize output and yield.Constraints such as inadequate knowledge, inadequate capital, inadequate land and complexity of the practices were identified among the farmers. Knowledge of some of the conservation agricultural practices such as agro-forestry, controlled grazing, effective pest control and mulching was generally low among the farmers in the study area. In the same vein, there was significant relationship between adoption, yield of maize, income and level of living of the farmers. The study recommended that the capacity of extension agents be enhanced for better performance and that the maize association of Nigeria in the two states be mobilized into groups of cluster farmers which will be able to pool resources together for the acquisition and preparation of virgin land for farming. This will address the issue of continuous cultivation of same piece of land year after year.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Though the Nigerian economy predominantly depends upon petroleum oil, agriculture still remains an important sector of the country's economy. This is as a result of the numerous roles which the sector plays in contributing to the wellbeing of the citizenry. The sector is equally responsible for the provision of food for the citizens, generation of employment for about 60 – 70 percent of the country's population, production of raw materials for local industries, markets for industrial goods and a major foreign exchange earner through export of cash crops (Federal Ministry of Agriculture, 2012).

In order to affirm the potential of Agriculture, Ihekoronye (2007) reported that agriculture has the potential to do better than it is doing if the resources are used more effectively and efficiently. From this assertion, it can be deduced that if the productivity of farmer will improve, efforts would need to be made by concerned authorities and stakeholders in agriculture to find means through which farmers efficiency in the use of soil resources would be enhanced. If the soil and water resources at the farmer's disposal are used efficiently, productivity will increase and this will ultimately lead to improvement in the standard of living of the farmers. Therefore, no effort is supposed to be spared in an attempt at making the farmers more productive.

Achieving this feat of enhanced productivity may continue to be a mirage if the resources are not used in a sustainable way. Land and water are the most important resources required for agricultural productivity. Since all forms of life including plants, animals, macro and microorganisms depend on the land for sustenance, the soil must be

continuously kept fertile and productive.This is against the backdrop of the fact that soil is a non-renewable resource and its quantity or size can hardly be increased (FDA 2005).

The nutrient status of the soil in the north-east region of Nigeria has been found to be generally low despite the potentials that the zone has for production of rice, vegetables and maize crop (Chude*et al*., 2012). This low nutrient status was attributed to the land use practices of the farmers which were found to be inimical to plant growth and development.

For instance, the continuous use of agricultural lands without allowing for a year or two years fallow period is one of the major features of farming in the northern part of Nigeria despite the vast agricultural land that the region has. In some States such as Bauchi, Kano and Plateau, farmers have consistently cultivated the same piece of land for over twenty years and this basically is the reason why these areas use fertilizer more than other areas in the country as the soil has become very poor in fertility due to continuous removal of its nutrients (FDA 2009). Moreover, the Federal Department of Agriculture (2009), asserted that out of the 92.4 million hectares of land in Nigeria, only 33 million or 38 percent is under cultivation. This assertion lent credence to the fact that only this small portion is being used continuously leaving about 62 percent to be under permanent fallow.

Conservation agriculture which is aimed at enhancing food security and sustainable use of agriculture resources was initiated by the Federal Ministry of Agriculture and Rural Development in collaboration with development partners and other agencies involved in

agricultural development. This was targeted at farmers all over Nigeria and especially the Northern region that faces the challenges of desertification, drought and erratic rainfall. The conservation practices were also aimed at reducing the effect of heavy tractorisation of the cultivated lands that has led to formation of hard pan and destruction of soil structure. Though, agricultural mechanization has the potential of making farming operation less laborious and reducing the cost of production, the effect of this practice in the long-term especially on the soil that is cultivated continuously without a period of fallow is decrease in productivity.

This is because prolonged exposure of agricultural land to intensive cultivation by tractors has the tendency of causing structural degradation which can lead to formation of compaction and erosion. Federal Ministry of Agriculture (FMA) (2005) asserted that if conservation agricultural practices were adopted, farmers will do away with practices such as removal of crop residues, slash-and-burn, continuous ploughing and harrowing, overgrazing, excessive use of fertilizers and continuous cropping which have collectively led to the decline in the yield of crops in many parts of Nigeria.

Conservation agriculture comprises of agronomic and physical components that are aimed at conserving the soil and water resources in a given locality where the farmer carries out his farming activities so as to obtain maximum yield, income and continuously keep the environment safe for generations yet unborn.

The agronomic component of conservation agriculture which consists of a number of practices was the focus of this study.These practices include the following:

- Use of Vegetation cover

- Minimum or zero tillage
- Mulching
- Agro forestry
- Use of Organic Manure
- Crop rotation
- Controlled grazing
- Effective Pest control
- Shifting Cultivation
- Effective ridging method.

According to MTNRE (1994) application of the above agronomic practices will go a long way in improving farming techniques since they will collectively check deforestation, poor farming techniques, monoculture and nutrient loss which are detrimental to soil wellbeing.

In Nigeria, the Federal Government working through the Federal Ministry of Agriculture having discovered the great damage being done to agricultural lands occasioned by practices such as continuous ploughing, harrowing, overgrazing and burning of crop residues keyed into the campaign of World Overview of Conservation Approaches and Technology(WOCAT) and has been propagating conservation agricultural practices so as to achieve the following objectives.

i. The package provides the required remedy againstsoil loss and desertification in Nigeria as it advocates maintenance of permanent or semi permanent organic soil cover thereby reducing run off and other forms of erosion (Henspeter and Williams, 2007).

ii. Conservation agriculture at the farm level is associated with lower labour and farm power inputs thereby reducing the drudgery associated with farming.

iii. Soil compaction is reduced by a considerable amount as the use of heavy equipment like bulldozer and others are discouraged. Animal grazing is also controlled considerably and this ensures that the soil is well aerated.

iv. The practice is associated with reduced cost of production as money is saved on time, labour and machine.

v. Conservation agriculture ensures retention of soil moisture and increase in soil fertility as a result of decayed organic matter and microbial activities (Ogunmoye, 2008).

vi. The crop rotation aspect of the practice prevents buildup of pests and diseases as different crops are grown in sequence (Abdulsalam, 2008).

vii. The air pollution and power requirements on the farm and their effects on farm families is minimized as there is reduction in the use of machinery (Derpsch, 2005).

1.2 Problem Statement

The Central Bank of Nigeria (1999) reported that agricultural productivity has continued to dwindle in the country over the past three decades and that this is evidenced by the

rising food prices, importation of food items, inadequate supply of raw materials leading to the closure of some industries that are largely dependent on agriculture. The multiplier effect of all these is the explosion in the unemployment market as some able bodied men suddenly found themselves unemployed or underemployed. Some of these idle hands have since joined miscreants and are constituting social malaise in the country. Worried by this down turn in the productivity of farmers and the attendant consequences of food shortage on the general wellbeing of the citizenry, the Federal Ministry of Agriculture carried out a critical analysis of the situation and submitted that the dwindling agricultural productivity in the nation was largely attributable to general misuse of land by the farmers (FDA, 2005). The study revealed that the practices that were contributing to the low productivity include continuous cropping, over tractorization of the soil, blanket application of fertilizer, slash and burn method of land clearing, wrong cropping system, over grazing, wrong tillage and bad ridging system (FDA, 2005).The findings of the study led to the packaging of a number of conservation practices and its dissemination among farmers in the north-eastern region of Nigeria by the Federal Ministry of Agriculture.

The Federal Ministry of Agriculture having realized the damage that practices such as continuous cropping, over tractorization, bush burning, overgrazing and ridging along the slope could cause the nation in terms of food security and sustainable use of soil resources for the benefit of generations yet unborn came up with this package known as conservation agricultural practices and commenced its awareness campaign all over the country especially the northern region in the last ten years. This package is an approach at managing agro-systems for improved and sustained productivity which if clearly

understood and adopted could lead to increase in productivity, increase in profit, food security and preservation of soil resources for future generations.

Having carried out a lot of awareness campaign in different parts of Nigeria and especially in the Northern part over the past decade, the extent to which farmers understand these conservation practices so as to be able to practice them profitably and sustainably has continued to cause concern among the extension workers and policy makers in the planning and implementation of agricultural development initiatives. This concern is predicated upon the fact that various institutional survey by the concerned Ministries and Agencies as well as other individuals revealed varying level of adoption of conservation practices among the farmers in the Northern part of Nigeria. For instance, there was no consensus among the extension workers in the North-East region during a training programme organized by African Development Bank (ADB) at Kuru – Jos in 2008 (FDA, 2009) on the extent to which farmers in the region had integrated conservation practices into their farming operations. While few of the extension workers who participated in the training programme claimed that farmers in the zone had adopted most of the recommended conservation practices, many of them reported that only a few of the recommendations were adopted. In the same vein, though what is always noticeable by this researcher in the Northern region is that farmers still plant the same crop on the same land year after year, pack the crop residues and use them for cooking purposes, cultivate the same piece of land on yearly basis, allow animals to graze freely on their fields, expose their soils to heavy tractorisation, ridge along the slope in some places and they do not embark on any agro-forestry; many of the farmers do inform extension workers that they use organic manure and carry out minimum tillage which are components of conservation agriculture. This indicates that

eitherfarmers have not yet understood the whole concept of conservation practices or are not adopting the recommendations fully due to reasons that were investigated in this study as this piece meal adoption will not achieve the desired result.

Furthermore, in a study of the degree of use of sustainable environmental practices by farmers in Ondo State, Fakoya (2011) found that farmers' knowledge of conservation practices was low and this poor knowledge has continued to impact negatively on the adoption of the practices. Farmers are rational in their behaviours and will not adopt any practice if they do not fully understand how it works, the cost of implementation and other opportunity costs so as to appreciate the inherent advantages or benefits
Ezeiburo*et al*. (2008) using AbiaState as a case study also found that farmers did not have sufficient understanding of the cassava varieties introduced to them and that was why the adoption of the package was low. Realizing that a chain is as strong as its weakest link, determining the knowledge level of a target group about the practices that have been introduced to them is crucial as no farmer would want to embark on any practice that he is not sufficiently knowledgeable about.

Personal contacts by this researcher and his colleagues with farmers in the North-East and Central regions of the country over the years in the course of official duties to farms as extension workers in the Federal Ministry of Agriculture have always revealed that while farmers do claim that they are adopting the practices, the extent to which these practices are being adopted has not been ascertained. In essence, there has been no known documented report detailing level of adoption of the practices and constraints militating against the adoption so as to determine how the adoption of the conservation

practices can be scaled up among the farmers especially among the farmers in the north east region where a lot of extension services had been carried out on the package.

In view of the fact that adopting these practices and applying them sustainably is a means towards increasing food productivity, reducing hunger and mitigating poverty, this study was carried outinBauchi and Gombe States of Nigeria to find answers to the following questions particularly as it affect maize production:

i. What are the socio-economic characteristics of the maize farmers in the study area?

ii. What is the level of adoption of recommended conservation agricultural practices for maize production among farmers?

iii. What are the factors influencing adoption of recommended conservation agricultural practices for maize production in the study area?

iv. What is the knowledge level of farmers about recommended conservation agriculturalpractices?

v. What is the attitude of farmers towards the innovation characteristics of the recommended conservation agriculturalpractices for maize production?

vi. What are the constraints to adoption of recommended conservation agricultural practices for maize production in the study area?

1.3 Objectives of the Study

The general objective of the study was to analyze the factors influencing adoption of recommended conservation agricultural practices for maize production in the study area. The specific objectives of the study are to:

i. describe the socio-economic characteristics of the farmers in the study area;

ii. assess the level of adoption of recommended conservation agricultural practices for maize production in the study area;

iii. determine the factors that influence adoption of recommended conservation practices for maize production in the study area;

iv. determine the knowledge level of farmers about recommended conservation agriculturalpractices for maize production;

v. determine the attitude of farmers towards the innovation characteristics of recommended conservation agriculturalpractices; and

vi. describe the constraints to adoption of recommended conservation practices for maize production in the study area.

1.4 Hypotheses of the Study

The following hypotheses which were all stated in null form were tested in this study.

$H0_1$ There is no significant relationship between farmers' socio-economic variables and adoption of recommended conservation practices for maize production

$H0_2$ There is no significant relationship between the adoption of recommended conservation practices for maize production and yield of maize

$H0_3$ There is no significant relationship between the adoption of recommended conservation practices for maize production and income from maize production

$H0_4$ There is no significant relationship between adoption of recommended conservation agriculture practices for maize production and level of living of farmers.

1.5 Justification of the study

The need to enhance the productivity of food in Nigeria cannot be over-emphasized in view of the growing population of the country which has led to increase in the food demand of the country. Yanguba (2004) reported that a big gap still existed between national food supply and demand for food in the country.

Maize being one of the staple foods in Nigeria is said to be consumed by about 50 percent of Nigeria's population as it can be eaten in different forms. While the dried grain can be ground and made into flour for food, the fresh maize can be roasted or boiled to meet immediate food needs just as it is also a raw material for industries where products like beer and pastes are produced (IITA, 2009). Increasing the level of productivity of maize in the north-east region of Nigeria where the soil has become low in fertility status due to issues relating to poor application of conservation pratices could be a mirage as the soils have been found to be too low in fertility to the extent that this deficiency of vital nutrients has constituted a major constraint to maize production in the region. (Chude*et al.,* 2012).

The Federal Ministry of Agriculture in consciousness of these effects of continuous misuse of land and water resources which are some of the basic production factors of maize production embarked on the awareness campaign of a number of conservation practices which are aimed at ensuring that nutrient loss and desertification in the region are reduced to the barest minimum. These practices include use of vegetation cover, minimum or zero tillage, mulching, agro-forestry, use of organic manure, crop rotation, controlled grazing, effective pest control, bush fallowing and effective ridging method. The package is also aimed at retention of soil moisture and increase in soil fertility in order to enhance the productivity of the soils.

In Bauchi and Gombe States, the awareness campaign for farmers to adopt these conservation practices have been on for about a decade now as the sensitization campaign commenced in early 2005. The need to determine the level to which these

conservation agriculture practices have been adopted as well as the effects the adoption has had on the output and yield of maize among the farmers as well as the effect on their income and level of living necessitated the conduct of this study in the two states. The study has identified the factors associated with the adoption of the practices, the level of adoption of the practices, constraints militating against the adoption and also recommended how the adoption of the conservation practices can be enhanced among the farmers.

Findings of this study could also be useful for further research in adoption of technologies just as concerned Ministries, Departments and agencies of government that are involved in making policies could also find some of the findings and recommendations useful in their future policy making endeavours.

CHAPTER TWO

LITERATURE REVIEW

2.1 Empirical Findings on Socio-economic Characteristics of Farmers

Nigeria farmers vary greatly in their socio-economic variables. These variations in their demographic characteristics do play a great role in their disposition, willingness to acquire information and to seek knowledge and ultimately their adoption characteristics.

Most farmers in Nigeria can be described as resource-poor as they practice subsistence farming with little or nothing to sell to meet other needs at home. Imoh(2004) found that there was abject poverty among the majority of farmers in eastern Nigeria as they did not have the required amount of financial resources with which to embark on agriculture profitably.

2.1.1 Age

Yekini (2011) in his studies of the determinants of utilization of information communication technologies for agricultural delivery in Nigeria found a mean age of 43.2 years for farmers in Nigeria. This finding is closely related to that of Oyesola and Adegboye (2011) who found a mean age of 43.7 years for rural dwellers. However,Ibrahim*et al.* (2008) found that 69.7 percent of the rice farmers in Badeggi, Niger State were above 50 years of age. Idiong (2005) found that the older a farmer becomes, the more he or she is unable to combine the available technology with his farming practices.

2.1.2 Farm size

Farming in Nigeria is characterized by small holdings of less than one to two hectares. This is partly due to the fact that most farmers operate at subsistence level and are peasants. The major concern of most farmers is to feed their families and will only sell to meet some basic necessities at home. Tologbonse and Adekunle (2000) observed that majority of the rural farmers in Benue State had less than one hectare of farmland. Agbongiarhuoyi and Daniel (2009) discovered a mean farm size of 2.3 hectares among tea farmers in Nigeria. This small farm size which is usually attributed to their low economic power and land tenure system further limit their willingness to adopt new practices as most of the farmers do find it difficult to meet the financial challenges associated with new technology.

2.1.3 Marital status

Most farmers in Nigeria are married. This is mainly due to the fact that farming requires that labour be provided to attend to the various farm operations. Ayanda *et al.* (2000) in a study of rice farmers in Kwarastate observed that 85.3% of the farmers were married. Tologbonse and Adekunle(2000) also discovered that 98.5 percent of the farmers in Benue State were married. This lend credence to the fact that farmers prefer to be married and have large supply of labour than to remain single (Ndamitsa and Umar, 2008).

2.1.4 Farming experience

Adeogun and Oluyole (2004) reported that majority of the cocoa farmers in Oyo State had between 10 - 50 years of experience in farming. While this experience of farming over a long period of time sometimes act as impediment to change, it is advantageous in many aspects as younger farmers do benefit from the elderly farmers where there is a

challenge and extension officers are not readily available. A strong and negative relationship was discovered between farming experience and adoption of insecticide spray among citrus farmers in Pakistan (Yatsin,*et al.*,2003)

2.1.5 Formal education

The educational attainment of Nigeria farmers varies widely. While many do not have any form of education, some have elementary training while others have religious education of one form or the other. Olaleye (2000) submitted that education is an important characteristic especially in the adoption of innovation. In the past few years, highly educated Nigerians have taken up farming either as a secondary occupation or as full time business and are deploying their knowledge in the management of their farms. Oladeji (2011) opined that farmers do have one form of education or the other.

2.1.6 Income

The income of most farmers in Nigeria is low, this is due to their poor resource base, low hectarage and inability to secure the required capital to expand their farming business. Badmus, *et al.* (2009) reported that agriculture as a sector is dominated by small holding farm families with most of them having low income and residing in rural areas. In their own studies of adoption of technology for cowpea farmers in Kaduna State, Omotugba, *et al.* (2008) discovered that farmers income in that area were between ₦16,000.00 – ₦20,000 per annum. This income is too paltry to meet the need of any household and it explains why there is great deal of poverty in most farming communities. When income is low, it impacts negatively on adoption of innovation.

2.2 Knowledge of Conservation Agricultural Practices among Farmers

For farmers to effectively integrate conservation agricultural practices into their farming operation, they must be knowledgeable about the practices so that they will be able to practices efficiently and productively.

Okunade(2006) referred to farmers as adult learners and extension workers as teachers. While extension workers are aiming at changing the behaviour of farmers towards a desired direction, the farmers will not change their practices or behaviours if they are not sufficiently knowledgeable about any new practice and are convinced of its relative advantage, profitability and compatibility with their existing practices. (Fakoya, 2011). Though local farmers have developed numerous farming systems through a process of trial and error, innovation and adaptation with each system fitting into their ecological, economic, socio-cultural and political environment, modern demands have necessitated that some of these practices be changed. This anticipated change cannot take place if farmers are not knowledgeable about the new practice (Dennis and Thomas, 2004). In their study of adoption of improved livestock technologies in Enugu State, Jegede*et al.* (2007) found that only 27.3% of the farmers were knowledgeable about the technologies and this accounted for the low adoption of the technologies. In the same vein,Adagba (2002) in his evaluation of the participation of farmers in Benue State agricultural development programmes ascribed the failure of some of the programmes to the poor knowledge that the farmer had about them as a result of inadequate mobilization. He therefore recommended that mobilization and education should be taken seriously as a deliberate policy so as to enhance participation and farmers adoption of programmes. Corroborating the above assertion, Agbontale*et al*., (2008) opined that for new technologies such as conservation agriculture and new skills to be adopted and for

changed attitude to be acquired by farmers, the knowledge of how to put them to use must be widely disseminated among the farmer. Anthony (2007) submitted that farmers select what they want to learn on the basis of their perceived needs and that extension education must be tailored towards the immediate needs of the farmers.

Maiangwa (2006) in his analysis of socio-economic factors associated with adoption of agro-forestry in the north-west zone of Nigeria discovered that level of farmers' knowledge of agro-forestry was associated with the adoption of the practice. Similarly, Abdulsalam (2008) found that the low uptake of integrated pest management practices among farmers in the north was as a result of low knowledge of the technology among the farmers.

This study determined the knowledge level of conservation agricultural practices among the maize farmers and also identified the gap that existed between what they knew and what they ought to have known.

2.3 Factors InfluencingAwareness and Adoption of Conservation Agricultural Practices

The level of adoption of an innovation is determined by a combination of factors. Many of these factors are socio-economic while others are institutional in nature. Socio-economic factors are the demographic variables of the farmers such as age, sex, education, size of his farm, his level of income etcetera.

The institutional factors are the circumstances that prevail around the farmers such as membership of organization, effectiveness of the extension agents involved in the extension farmer-input-linkage services. Okunade, (2006) found that the communication

ability of change agent influenced theknow-howand adoption of improved farmpractices among women farmers in Osun State, Western Nigeria. The level of support in form of subsidies and loans that the farmers enjoy also goes a long way in influencing the willingness of the farmers to seek information about any practice with the aim of adopting it.

Characteristics of the innovation are other factors that determine the adoption level of such innovation. These include observability, cost, relative advantage, compatibility, triability and complexity of the recommendations (Van Den Ban and Hawkins, 1988).

Technologies such as conservation agricultural practices cannot lead to increase in food productivity if the farmers are not knowledgeable in the various component areas of the package and are ready to adopt the practices. In his own submission, Yau (2005) reported that the poor trend of conservation agriculture practices as reflected in Northern Nigeria was a result of the perception that farmers had about the practices which again boiled down to the poor knowledge among the farmers of what the programme portends. Apart from being an acquired construct, knowledge also has other attributes as it can be measured, changed and transferred. Change in knowledge may occur if an individual is persuaded or influenced by others or if that person acquires new experiences about the issue in question. Knowledge goes a long way in influencing behavioural pattern of an individual. This is supported by Ezeiburo*et al.* (2008) in their studies among cassava farmers in AbiaState, Nigeria. They inferred that poor knowledge is a major contributor to low uptake of innovations among farmers. Jibowo (2004) identified four main methods through which knowledge can be acquired. These are authority, personal experience, reasoning and scientific methods.

Adeniji (1996) identified age, education, farm size and income as some of such variables that affect adoption. Also, in their study of farmers involvement in agricultural activities in Borno State, Gwary*et al.* (2008) found a significant relationship between the farmers' agricultural activities and their social-economic variable such as family size, annual income and number of years of involvement in farming.

The adoption of conservation practices being a package that seeks to replace the farmers' old practices will depend on the awareness and knowledge level of the farmer and his ability to try the practices on his own farm. Maiangwa (2006) in his study of socio-economic variables associated with adoption of agro-forestry in the north-west zone of Nigeria found that level of education, labour availability, farm size, land security, access to credit affect the rate of adoption of the innovation.

Furthermore, adoption of innovation can be likened to abandoning the known for the unknown and therefore involves some level of risk on the part of the farmers. The extent to which this risk will be taken will largely depend on the level of formal education of the farmer and his income as resource poor farmers will not invest their finance on practices that they are not thoroughly knowledgeable about.

The process of adoption of improved farm practices is a complex one which involves a sequence of thoughts and actions (Anthony, 2007). It is a mental process which will ultimately lead to making a choice by an individual as he goes through the journey from first hearing about a new idea to the complete and full incorporation of the idea into the total system of his behaviour. This is a journey under uncertainty which begins from the point at which the farmer becomes aware through the point of development of interest,

mental evaluation, trial before adoption. This exercise may terminate at any point on the continuum if the farmer becomes disillusioned due to lack of knowledge or not being very sure of what the outcome of his new venture will be. It is during this period that socio-economic factors of the farmer bring their pressure to bear on the farmer as he tries to make up his mind on whether or not to adopt a given innovation. Another factor that may determine the type and level of risk that a framer may be willing to take is age. Farmers that are still relatively young in age tend to take more risks than old farmers as they are still more agile and ambitious. Adeola,*et al.* (2008) found that as farmers increase in age, their enthusiasms to participate in new programmes dwindle. This inference was drawn from the negative correlation that they discovered between age and adoption in their studies among cassava farmers in Oyo State.

2.4 Attitude and Adoption of Technologies

Attitude refers to feelings, thoughts and pre-disposition those are more or less permanent that a person has about an idea, innovation, aspect of his environment etc. Van den Ban and Hawkins (1988) identified three basic components of attitude as knowledge, feelings and inclination to act. A person's attitude to a particular issue determines what he learns about it and the value he attaches to it. A person's attitude is usually influenced by the social environment in which he lives. It can also be influenced by the socio-economic variables of the individual such as age, level of education, income etc.

Extension activities are usually targeted at improving the knowledge, skill and attitude of the target group as attitude itself can be dependent on the knowledge of the individual. Being a major force behind any proposed direction of change, attitude can

slow down the rate of adoption, catalyses it or lead to non-adoption. This fact necessitates that the concept be investigated among respondents in this study.

2.5 Constraints to Adoption of Conservation Practices

Adoption of an extension programme by farmers could be influenced by other factors aside from the farmers' socio-economic variables and the characteristic of the innovation itself. Australian centre for International Agricultural Research (ACIAR)(ACIAR, 1986) in a study on tropical legumes improvement submitted that lack of incentive from the relevant authorities inform of credit subsidies as well as low prices of agricultural produce and poor market opportunities limit the interest of farmers in the cowpea programme. In the dissemination of conservation agriculture practices, the package does not offer inputs such as insecticide and simple tools that can arouse their interest for them to strongly desire further knowledge about the practice and embark on wide scale adoption of the various components.

Membership of groups and association is another factor that has a way of influencing the adoption level of farmers and their disposition towards a programme. This is due to the bandwagon effect that it has on members. Where farmers do not belong to any association, they become too individualistic as each person becomes confined in his cocoon and convincing them to follow a particular order may be difficult.

Realizing the impact of group dynamics, International Institute of Rural Reconstruction (IIRR)(IIRR, 1998) reported that a programmecode named "conservation supreme" in Kenya which was aimed at training farmers in various aspects of crop husbandry succeeded because the promoters of the extension programme encouraged the farmers to

form groups. This made them to be interested in continuing the programme and willing to seek further knowledge about it. This shows that for most extension programme to succeed, the opportunities offered by group dynamics should be harnessed.

Legislation for agricultural extension activities is another factor that enhances the interest of farmers to adopt an extension programme. Federal Ministry of Agriculture(FMA, 2012) reported that countries such as Japan, Thailand, Zimbabwe and Bangladesh have enabling legislation that strengthens their extension services and policies. Where this is available, the principles and philosophy of extension would apply and results will be better achieved among the given clientele. Nigeria is yet to legislate her agricultural extension policy, hence monitoring and evaluation is still weak.

2.6 Components of Conservation Agriculture

2.6.1 Use of vegetation cover

This is an act of allowing green manures and other fast growing plants usually legumes to grow on a piece of land so as to improve soil fertility and protect the soil from erosion. The advantage of this type of vegetation cover is that they reduce run off and the legumes also improve the nutrient status of the soil through their nitrogen – fixing ability which is carried out by the bacteria living in the nodules (lumps) on the roots of such plants. Furthermore, the green manure acts as cover crops by breaking the fall of rain drop thereby preventing compaction and helping water seep in rather than running off.

2.6.2 Minimum or zero tillage

Tilling has been an age long practice widely carried out by farmers before planting. This they do in order to permit good germination, control weeds and increase infiltration. However, studies have shown that a lot of damage is done to the soil structure especially when heavy equipment such as bulldozers and tractors are used (FMA, 2005). Conventional plough overtime also leads to formation of hard pan which prevents water percolation and increase in run off. These effects necessitates minimum tillage practice which entails minimum soil manipulation necessary for crop production or meeting tillage requirement under the existing soil and climate conditions. (IIRR, 1998). After planting, such plants grow rapidly and cover the soil surface quickly.

Minimum tillage ensures that the soil is worked upon but not inverted with heavy equipment in order to preserve the soil structure and save cost usually experienced in intensive land tilling. In some instances, special equipment like disk opener coulters are used to drop seed and fertilizer after which the soil is firmly closed to encourage contactbetween seed and soil. Control of weed is mainly achieved through herbicides while weeding with local instruments is also employed.

2.6.3 Mulching

Mulching isthe act of spreading materials such as leaves and grasses, cereal chaff, sawdust etc on the ground to protect the roots of plant from extreme temperature and moisture changes (Redmond, 2009). If at least 30% of soil surface is covered by plant residues after planting, water erosion will be greatly reduced and fertility will increase.

Awe (2008) opined that organic mulch is very useful in soil fertility management because of the different way it contributes to soil improvement. Not only does mulch

reduces the rate of evaporation of soil moisture, it also improves water infiltration by reducing run off. By reducing the amount of heat that enters the soil, the soil temperature is also reduced. All these contribute to enhancing the ability of the soil to support plant growth. An additional advantage of mulching is reduction of weed. According to LaI (1990) mulching ensures maximum retention of crop residues or other vegetation materials on the soil surface.

2.6.4 Agro-forestry

This practice is called taungya system and was first experimented in Nigeria in 1928 (Ige, 1999). Agro forestry is the practice of growing trees with agricultural crops and/or livestock on the same piece of land (Anderson *et al.,* 1991). Onota (2008) reported that in the savanna and semi and zones Nigeria, farmers grow crops and raise animals in park lands. In the southern part of the country, annual crops such as maize and beans can be planted with crops such as Avocado pears and mango trees. Plantain and banana also grow along with crops such as coffee while rubber and cashew can also be grown in mixtures with annual corps and perennial crops like sorghum, millet and yam. The advantages of this practice are that the tree provides stakes, improve soil fertility, provides additional income and mitigate the effects of weather on the annual crops. In the northern part of the country, agro-forestry is one of the means of combating desertification.In the view of Agbede*et al.,* (1987) application of fertilizer will significantly increase the yield of crops under this practice.

2.6.5 Use of organic manure

Application of organic manure to the soil is a means through which fertility can be maintained. Organic manure can either come in form of animal manure or from crops

that the farmers grow or those that grow on their own. When plants and animals decompose, the nutrients held in the tissues are released to the soil and become useful to the plants as manure.

International Institute of Rural Reconstruction (IIRR)(IIRR 1998) opined that optimum result can only be derived from manure if it is allowed to mature for several weeks or months before it is applied to the field. Though nitrogen is found in varying quantities in stems and roots, the highest concentration is in the leaves. Other sources of manure are kitchen waste, pruned parts of trees, weed residues and farm yard manure. Animals that are fed with high quality feed such as legumes, concentrates and improved pastures are also good sources of manure. The use of organic manure especially poultry droppings is very common in northern Nigeria as it is widely used in the production of different types of crops such as maize, millet, sorghum etc. Its use is further made attractive due to the high cost and procurement bottleneck of organic fertilizer.

2.6.6 Crop rotation

Crop rotation is the planting of different crops on the same piece of land in successive years in a scientific sequence. In the view of Camp*et al.* (1995), crops can be classified into heavy feeders and light feeders. Heavy feeders are crops which require many nutrients e.g. cassava and yam while millet and vegetables are examples of light feeders as they require less amount of nutrients. In practice, it is advisable to follow deep rooted crops such as cassava with shallow rooted crops such as maize.

Other principles of crop rotation include incorporation of legumes crops such as cowpea to boost soil fertility and alternating crop not affected by the same pests and diseases.

Hugues and Philippe (2003) asserted that the yield of a newly cleared field which only supplies nutrients from its own natural fertility resources is greater when different crops are grown in sequence.

2.6.7 Controlled grazing

Grasses are the primary source of food for domestic and wild grazing animals which feed on pastures and grasslands and which are fed hay and silage harvested from them.Pastoralists in Nigeria live nomadic life as they have to ensure that their animals have pasture to feed on and water to drink at all seasons. This necessitates their southward movement during the dry season of the year and annual return to the north during the rainy season to prevent their animals from attack of disease like trypanosomiasis which is usually prevalent during wet season.

During grazing, not only do animals destroy the vegetation indiscriminately especially when they are not properly controlled, they trample on the land thereby making the soil to be compacted and impermeable. There are usually a lot of conflicts between farmers and pastoralists which sometimes lead to loss of lives and property as stock routes are not provided.Controlled grazing involves drawing distinctions between the different kinds of grazing land and demarcating track or pathways (stock route) where livestock are expected to graze to minimize conflict and conserve the land for sustainable production (IIRR, 1998) recognized zero-grazing as a form of controlled grazing whereby animals are kept in a stall and folder is brought to them instead of allowing them to graze outside.

2.6.8 Effective pest control

Pests are organisms that cause damage to crops, livestock, humans or land. These may be insect pests, plant pathogen or weeds.The techniques of control include chemical, physical and the use of biological mechanisms. Post-harvest pests like the rodent and birds also need to be controlled so as to minimize or prevent post-harvest losses. Sustainable agriculture aims to reduce the incidence of pests and diseases to such a degree that the crops are not damaged and balance of nature is not upset. To control pest effectively, care must be taken not to use chemicals that can cause harm to the environment and the handler. Chemicals must be carefully selected to suit specific purposes.

Integrated Pest Management (IPM) being the coordinated use of pest and environmental information to design and implement pest control methods that are economically affordable, environmentally friendly and socially acceptable is one of the components being canvassed. (Abdulsalam, 2008)itinvolves using various combinations of chemical, biological and physical controls. Aliyu (2004) recommended spraying seven days before planting and use of Altrazine as means of controlling weeds under conservation agriculture. Pests can also be controlled by plowing them underground when they are attached to crop residues. In the view of Redmond (2009) simple paper or plastic barriers placed around fruit trees can prevent insects from attacking the trees.

While methods such as pulling and use of hoes are being practiced in most parts of Nigeria to control weeds, methods such as spreading of grasses, leaves and black plastic mulch as means of weed control are still new and are being encouraged as conservation techniques. Methods being canvassed under conservation agriculture are ploughing after

harvest, planting of resistant varieties, crop rotation, use of healthy seeds, planting at the right time. All these practices save the environment from pollution (FMA, 2005).

2.6.9 Bush fallowing

If a piece of land is continuously farmed year after year without allowing a period of rest, productivity may grow with increase in other inputs especially manure. However it will get to a point where marginal increase will begin to dwindle and productivity eventually declines.This necessitates that land be allowed a period of fallow. Bush fallowing entails farming a piece of land for a few years (2-4years) and leaving it for a while in preference for a new site while natural vegetation is allowed to grow on old site. The period of rest usually depends on population pressure on land and its availability. Hugues and Phillipe (2003) asserted that leaving land fallow is a cheap way of restoring the natural fertility of the soil. The fertility is restored since all kinds of vegetation are allowed to grow including herbaceous plants, shrubs and trees. Aromolaran*et al.* (2001) submitted that depending on reasons of population density and availability, average fallow period ranges between 1-5 years. This practice is integrated into conservation agriculture as it is a means through which agricultural land naturally regenerates itself.

2.6.10 Effective ridging method

Ridging means forming the soil into raised lines called ridges. The hollowed-out rows between the ridges are called furrows. Ridging methods vary from place to place but the method chosen is largely determined by the soil type, type of slope, cropping plan and type of implement used.

According to Hugues and Pillipe (2003) where the land is water logged (fadama type), the ridges are raised above the knee to a height of between 60cm and 70cm. Ridging is done to loosen the soil, promote air and water circulation, control weeds and bury manure.

Ridges can either be manually or mechanically done. To achieve its aims, tillage is supposed to be done when the soil is neither too dry nor too wet. If the soil is too dry, working on it will be difficult as the soil crust will be hard to break and ploughing will not be deep. On the other hand, soil saturated with water will make the job tedious and clods that will be formed will inhibit free flow of air into the soil thereby defeating the purpose of ridging.

To achieve maximum result on a sloppy land, it is advisable to raise the soil up instead of allowing it to fall down slope. This is to trap water and stop run-off and must be done across the slope and not along it.

2.7 Maize Production in North East Region

The North-East region is noted for the production of a great number of food crops such as sorghum, millet, maize, onion and wheat (Chude*et al.*, 2012).Maize is produced in large amount in local government areas such as Dass and Toro in Bauchi State as well as Gombe, Biliri and Dukku in Gombe State (FMA, 2005). It is a staple food crop which is also used for the production of animal feed. Production of the crop provides jobs for large proportion of the population of the region that are involved in the maize value chain.

However, most of the farmers who engaged in maize production as at the time the propagation of conservation agriculture practices commenced in the region still depended on their old methods of farming. Knowing that dissemination of conservation agriculture practices for maize production and its uptake has the potential of doubling the yield of maize as attested to by Alabi*et al*. (1997) the Ministry of Agriculture embarked on its propagation in the region. Though maize is not the dominant crop in the north-east region, adoption of recommended conservation practices could upscale the level of productivity as the potentials for its production abound in the region. This is due to the fact that the practices will ensure that soil moisture is retained over a long period of time, boost the nutrient status of the soil, guarantee maximum uptake of available nutrients by plants thereby increasing the productivity. Maize yield in other climes such as in United States of America (USA) could be as high as 24 tons per hectare but the average yield in most parts of Nigeria is still lower than 5 tons per hectare (Barry, 2006).

2.8 Maize Output and Conservation Practices

Conservation practices are meant to reduce the rate of water loss from the soil and preserve the available nutrients for plant growth and development (Ogunmoye, 2008). The yield of maize is highly dependent upon the amount of rainfall it receives during its growth cycle. As the crop goes through establishment, vegetative, flowering, yield formation and ripening stages, it requires a minimum of 500-700mm of rain over the growing season (Barry, 2006).

Though FMA (2005) reported that the yield of maize was between 2-3tons per hectare in most parts of northern Nigeria it added that proper conservation agriculture could

enhance this level of productivity as yield could be as high as 6tons per hectare where rainfall is between 700 – 900mm per annum. Conservation agriculture reduces stress that is associated with regions receiving low rainfall.

In their study of maize yield under drought and weed stresses, Azeez*et al.* (2007) reported that imposed water stress significantly affected maize growth especially 1-2 weeks after flowering. Drought stress lead to low productivity as drought induces a reduction in dry matter production, cob length and diameter. Since most of the conservation practices recommended are to conserve water, adoption of these practices will ensure that maize crop is not exposed to stress and optimum yield can be expected if other agronomic practices such as application of fertilizer, pest and disease control are done correctly.

Anne (2014) asserted that in this era of climate change, adoption of conservation agriculture practices by maize farmers will ensure that the impact of shrinking water supply, increased flooding, desertification and changing seasonal weather patterns will not impact negatively on the yield of maize crop.

CHAPTER THREE

THEORETICAL FRAMEWORK

A theory can be explained as a body of rules, ideas, principles and techniques that applies to a subject especially when seen as distinct from actual practice (Okodudu, 2007). Theories are set of interrelated constructs, definitions and propositions that present a systematic view of phenomena. In research, theories help the researcher to navigate his way by aiding in the identification of relevant variables and providing focus of analysis. Baker (1999) described a theory as a proposed explanation for a set of coordinated occurrences or relationships. Theories can be formulated and reformulated in an attempt to make sense out of a body of evidence.

This research wasguided by the following three theories which were considered relevant to the study.These are:

i. Adoption – diffusion theory

ii. Knowledge gap theory

iii. Human ecology theory

3.1 Adoption – diffusion Theory

This theory which was developed by E.M. Rogers explains how an idea, product or innovation gains momentum and diffuses through a specific population or social system, (Rogers, 1971). The end result of this diffusion is that people are expected to adopt a new behavior, idea or innovation so that they can continue to do things differently from the ways they used to do it.This theory explains that adoption does not happen simultaneously within a social system and that it is a process whereby some people are more apt to adopt the innovation than others.

This time lag is as a result of different socio-economic characteristics among the people in any given society (Rogers, 1995).Adoption refers to the acceptance and continuous use of an innovation while diffusion is the process by which such innovation is communicated through certain channels over time among members of the social system.

Five established adopter categories that have been identified according to Anthony (2007) in the adoption – diffusion study include innovators, early adopters, early majority, late majority and laggards.

While innovators are people who want to be the first to try innovations and are willing to take risks, early adopters represent the opinion leaders who understand the need to change and are always comfortable with new ideas. Members of the society that belong to early majority usually wait to see evidence that the innovation is beneficial before adopting it. However those that belong to late majority will only adopt an innovation after it might have been tried by the majority while laggards are conservative and will not want to change their traditional way of doing things.

Adoption – diffusion theory also deals with how each of the identified groups above can be managed or helped to accelerate adoption in any given social system. While innovators need just to be informed about an innovation or technology, early adopters will need to be given comprehensive education about how the innovation works. On the other hand, early majority will need to see evidence that the innovation works by listening to success stories and evidence of the innovation's effectiveness. Late majority would only be convinced when they have sufficient information about the number of people that have tried the innovation successfully and benefitted from it while laggards

will need statistics, fear appeals and pressure from other groups before they adopt innovations (www.bu.edu 2015).

The theory further identified five main factors that are innovation centered which also influence adoption of an innovation in any given social system. They include:

i. **Relative advantage**: The degree to which an innovation is seen as better than the idea or product it is meant to replace.

ii. **Compatibility**: How consistent the innovation is with the values, experiences and needs of the potential adopters.

iii. **Complexity:** How difficult the innovation is in terms of understanding and application.

iv. **Triability:** The extent to which the innovation can be tested or experimented with before its final adoption.

v. **Observability:** The extent to which the innovation provides tangible results.

The adoption – diffusion theory as explained above is relevant to this study since the study is aimed at understanding the farmers in the study area and the factors that influence their adoption of the conservation technologies that have been disseminated among them.

The different categories of adopters that the theory has identified, their characteristic and how best the members of the groups can be made to adopt innovations have been greatly exploited in the conduct of this study as it has been found that each group requires different styles of persuasion. The recommendations that were also made for policy makers and extension agencies who are involved in dissemination of conservation agricultural practices were also based on the needs of the specific groups identified in this theory.

3.2 Knowledge Gap Theory

This theory was proposed by the Trio of Tichenor, Donohue and Olien while working at the University of Minnesota, United of America in 1970. They propounded that when there is increasing information in the society, this information will not be evenly acquired by the members of that society (Kleinnijenhus, 1991).

The proponents of this theory identified socio-economic factors as the factors that largely determine the extent of knowledge acquisition and its application rate in any given social system thereby creating knowledge gap in the society. They submitted that members of the society that are of high socio-economic status will have greater access to information and use it better and faster than their counterparts who are of low socio-economic status. The three scholars identified five reasons why socio-economic factors determine the rate of knowledge acquisition among members of the same society. These are reproduced below.

i. Members of a society that have higher socio-economic status tend to have better communication skill and have the capacity to read, comprehend and remember information faster;

ii. Those with high socio-economic status have the ability to store information easily;

iii. The mass media is generally skewed towards members of the society that have higher socio-economic status;

iv. People of higher socio-economic status are considered more relevant in social context; and

v. Members of higher socio-economic status are more exposed, have less difficulty in accepting information and can retain information better.

From the proposition above, it can be deduced that there is a gap that usually exists among a given people in their level of knowledge, how it is acquired and how this knowledge is deployed in their day-to-day activities and interaction. The germane socio-economic factors that are usually responsible for this gap are level of education, income, farm size, access to information (media). This theory is related to this study in the sense that disparity existed among farmers in their socio-economic status and this has effect on their behavioural tendencies. According to Anthony (2007) extension education starts from where the people are.

For instance, while many of the farmers were old and less interested in seeking new information with the aim of changing their old practices, some that were still relatively young and are more adventurous were prepared to go extra length to source for information that may be advantageous to them in their farming operations.

In the like manner, education plays a great role in determining the extent of access to information and knowledge that an individual has. A farmer who is well read can access information through different sources such as personal contact with extension agents, radio and television, print media, telephone contacts and internet facilities. This goes a long way in widening his horizon and enriching his knowledge base.On the contrary, an illiterate farmer is limited to sources such as extension agents and radio which may not offer much of the information that such farmer needs due to the inherent disadvantages or limitations associated with such media. This automatically places a seal on the type and depth of information that this type of farmer will have. Income is another variable that limits access to information and knowledge. A farmer who is well off in the society can use his economic power to seek for information so as to enrich his knowledge.

This he can do by acquiring gadgets such as electronics and computers apart from regularly reading newspaper and participation in fora such as seminars and workshops where issues of concern to him are discussed. However, a poor farmer cannot afford such gadget and may not be in a position to sponsor himself to any forum outside his domain where knowledge may be shared (Ogunbameru *et al*., 2008).

To further aggravate the situation, the variation in socio-economic variables is often explored by government agencies, intervention agencies and multinational companies

such as United African Company (UAC), UnileverPLC, and Shell Petroleum Development Company (SPDC) in selecting the contact farmers or out growers within a particular target groups.When such farmers who are highly placed in the socio-economic continuum are so selected, not only do they benefit maximally from such programme, their knowledge base is also broadened and hence the gap that exists among them and other farmers is further widened. The extent to which this theory applies in this study was determined using a number of hypotheses.

3.3 Human Ecology Theory

This theory explains the relationship between man and his environment and it is of immense relevance when research like this that borders on how environmental resources are used by man for his existence is being conducted. The essence of conservation agriculture practices is to improve the ways in which man exploits the soil and water resources which are vital for agriculture so as to achieve higher productivity and ensure sustainability for generations yet unborn.

According to Hauser (1990) human ecology theory is primarily concerned with the social phenomena which are rooted in the dependence of man on limited supplies of necessary resources to satisfy his needs. The manner of usage of environmental resources can lead to the changes in the quality of the resources in man's environment. Where this usage affects environmental resources negatively, the productivity of such society reduces significantly.

In Nigeria, there is competition over the usage of land, vegetation and water resources. While crop and livestock farmers naturally plant on land and do not want the land to be

over grazed, livestock farmers who are basically into free range system and rearing want to use the land for grazing purpose. In the same manner, while crop farmers want to keep their farm land permanently covered, the vegetation is being continually exploited to feed animals. Water resources especially during dry season are scarce and so while crop farmers want to preserve the limited water to stay alive, pastoralists want their livestock to drink the water. These competitions usually lead to conflict and expose the people who depend on these resources to a lot of deprivations.

Succinctly put, the manner in which the resources available for man in his environment is used will greatly determine how much he can get out of those resources and for how long he will continue to derive his needs from the resources. This usage will depend on the level of knowledge that is available to man on how best to combat the influence of competitors and climatic factors so as to minimize environmental degradation and loss of the resources which are very crucial for his continuous existence. The environment is equally subjected to a great deal of exploitation by man in his quest to provide a comfortable habitation (homes) for himself and make life worthy of living. In trying to achieve this, not only are the trees felled for building and furniture making without replacement, oil and minerals are explored with reckless abandon. All these take their tolls on the available land area thereby reducing their suitability for agriculture purposes.

Since man cannot do without exploring these sources in his environment for day to day living it is expected of him to understand how these resources are supposed to be used so that not only will his needs be continuously met, the needs of future generations will also be met.

3.4 Concept of Awareness and Knowledge Level

Awareness as applied in agricultural extension services delivery refers to hearing about the existence of an innovation, technology or idea. At this level, the individual lacks details concerning the application of such ideas, how it works and how to use it. (Adekoya and Tologbonse, 2011).

Apart from knowing the name of the technology, the farmer does not know the cost implication of the technology, the inherent benefits, the opportunity costs of adopting or not adopting either in the short or long run. In his studies of adoption as an extension concept, Rogers (1995) identified awareness as the first stage or step that would be adopter goes through before developing an interest in a particular innovation. This is because adoption is not an instantaneous decision.

Knowledge on the other hand is the amount of know how that an individual possesses about an issue which may be an innovation, technology or concept. Van den Ban and Hawkins (1988) asserted that knowledge is a relative term in the sense that it differs between people either as a result of experience or other socio-economic, institutional or environmental factors. Following from this assertion, knowledge level of an individual about a particular idea, innovation or technology is the amount of know how that the individual possesses when it is valued in the light of the desired amount of insight he or she supposed to have. It is essential to study knowledge level in adoption as incorrect or deficient knowledge and skill required for carrying out specific activities can lead to non-adoption or low adoption of that innovation.

3.5 Concept of Attitude

Attitude refers to feelings, thoughts and pre-disposition that is more or less permanent that a person has about an idea, innovation, aspect of his environment etc. Van den Ban and Hawkins (1988) identified three basic components of attitude as knowledge, feelings and inclination to act. A person's attitude to a particular issue determines what he learns about it and the value he attaches to it. A person's attitude is usually influenced by the social environment in which he lives. It can also be influenced by the socio-economic variables of the individual such as age, level of education, income etc.

Extension activities are usually targeted at improving the knowledge, skill and attitude of the target group as attitude itself can be dependent on the knowledge of the individual. Being a major force behind any proposed direction of change, attitude can slow down the rate of adoption, catalyzes it or lead to non-adoption. This fact necessitated the investigation of the concept among respondents in this study.

3.6 Conceptual Model

This study is based on the factors influencing adoption of conservation agriculture practices for maize production and livelihood of farmers in the study area. A model can be defined as a figurative representation of a perceived object used to guide one in pursuant of knowledge (Rogers, 1995).Increases in maize production cannot be achieved if the farmers are not conversant with the core practices of conservation agriculture and adopt the practices sustainably. The presentation of the framework in a diagrammatic way shows the independent variables that could affect the adoption of conservation agriculture among maize farmers. The socio-economic variables identified in this study that could influence the adoption level of conservation agriculture are age,

sex, level of education, income, household size, access to media and knowledge level of farmers. All these socio-economic variables will impact on the farming operations of the farmer such as his farm size, cropping system and labour application.

For instance, an old farmer with long years of experience is more likely to have a deeper knowledge of traditional farming system than a young farmer and may not likely adopt new practices. Audi (2003) opined that knowledge can be gained either directly by abstracting the defining traits of a subject or phenomenon or by deducing new facts from those already known in accordance with the rules of logic. Knowledge transfer is the process by which attempts are made to pass knowledge from one person, institution, or nation to another.

Russell (1986) submitted that the process of knowledge formation is a result of observations of natural conditions over time and what an individual has imbibed through oral tradition. He added that it is dynamic and influencedby local creativity and experimentation as well as adaptation of ideas and technology from other systems.

However, for Knowledge to evolve, one must be informed as a person can only put to practice what he has been sufficiently informed, tutored about and participated in trying over time. Knowledge, like most constructs that are measured in social science, cannot be measured like tangible variables such as weight, height and length. Knowledge is therefore measured by ascertaining the knowledge level of an individual, which can be explained as the know how that the individual possess about certain thing when valued in the light of the desired amount of insight (Van Ban and Hawkins, 1988). Akinbile (2004) asserted that the possibility of measurement as well as its usability is based on

the existence of a multiplicity of individual differences in human status, behaviours, capacity and social elements. The extents to which farmers are able to solve their problems determine how knowledgeable they are about the issue. This can be measured by either putting some questions across to the farmer or asking him to carry out some specific demonstrations on his farm. The extent to which he responds correctly to the items determines his knowledge level.

In the view of Redmond (2009) knowledge is the amount of know how (know about) that an individual possess about an issue. It is the general awareness or possession of information, facts, ideas, truths or principles about a programme. Van den Ban (1988) averred that knowledge contains an element of the concept insight, i.e. quantum of insight about a particular subject that a person has. It can also be construed as the vision of an explanation for a particular issue. In this vein, there can be everyday knowledge about events, scientific knowledge, technical or social knowledge. Rogers and Shoemaker (1971) defined knowledge as the degree to which an individual possess correct information about an innovation, that is, information necessary to use an innovation correctly. Knowledge of conservation agriculture is still very low in Nigeria as reflected in the low uptake of the practices across many regions of the country. For instance, in the Western part of Nigeria and particularly in Ondo State, only 26.67 percent of farmers practice agro-forestry and less than 40 percent of them practice zero tillage. Fakoya (2011) in the report of that study attributed this low uptake to ineffective dissemination of environmental management information to farmers which led to their low level of knowledge.In the same manner, a farmer with high level of education has the potential of accessing extension messages more than his illiterate counterparts as he can take full advantage of print and electronic media as well as information and

communication technology (internet) in addition to the physical contact with extension agents. This will enable him to have a greater insight into any package that may be introduced to him by an extension officer and so adopt faster.

Following the same logic, a farmer with enhanced income could afford to have different sources of labour in addition to his family labour as he can engage labourers, hire tractors or even acquire machines and tractors for his own use. His knowledge of the effect of using tractors on the field will be greater than that of a farmer who has never used any machine on his farm and such privileged farmer may want to adopt zero or minimum tillage to see the difference in productivity level.

The combination of socio-economic and farming variables of the farmer will determine his attitude towards any agricultural practice that may be introduced to him. While a farmer who has little or no education may not be able to understand a complex extension package and therefore develop an unfavourable attitude towards it, an old farmer may consider it unattractive to begin to experiment any new practice at his advanced age hence his attitude towards the technology will be negative.

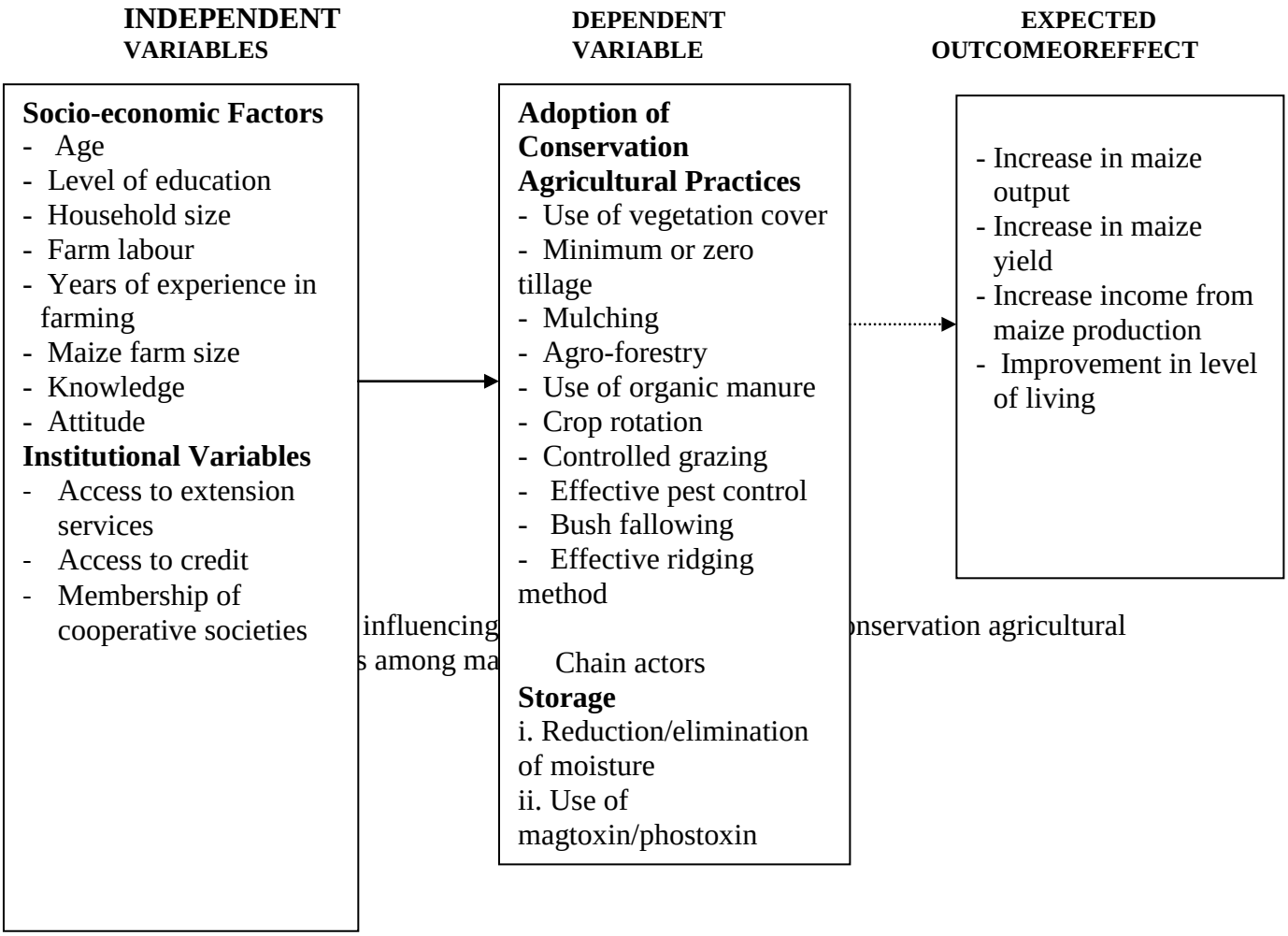
The relative advantage of a package may not also be known by a farmer if his access to media or extension service is not adequate. This limited access lead to incomplete information, poor attitude and low knowledge of such message. A farmer who has negative attitude towards any practice will not likely adopt such a practice.(Akinbile, 1998).

The institutional variables identified by the study that could influence the adoption level of recommended conservation agriculture practices among farmers include membership of cooperative organization and government support inform of credits, inputs and loans. If there is legislation for quality control and assurance of extension services and usage of agricultural land, a farmer may be persuaded to seek more information and seek knowledge about any extension package introduced to him with the aim of adopting it.

In the same vein, membership of cooperative organization will afford the members the opportunity to exchange idea, compare notes and widen their knowledge base while a farmer who does not belong to any forum of such nature will be limited in the type and depth of knowledge that he will possess. Availability of government support such as provision of improved seed, fertilizer and agro-chemicals have a way of motivating farmers to adopt an extension package. A farmer who does not enjoy any patronage from government or any agency may not show interest in any new technology that may be introduced to him and hence his adoption level will be low (IIRR, 1998).

The dependent variable of this study is the adoption of conservation agriculture as reflected in the number of practices adopted by the farmer from the content areas of the recommended practices. These content areas are use of vegetation cover, minimum or zero tillage, mulching, agro-forestry, use of organic manure, crop rotation, controlled grazing, effective ridging method, bush fallowing and effective pest control.

The expected outcomes of the study are increase in maize output, increase in maize yield, increase in income and improvement in the level of living of the farmers.


INDEPENDENT VARIABLES
DEPENDENT VARIABLE
EXPECTED OUTCOMEOREFFECT
Socio-economic Factors
- Age
- Level of education
- Household size
- Farm labour
- Years of experience in farming
- Maize farm size
- Knowledge
- Attitude
Institutional Variables
- Access to extension services
- Access to credit
- Membership of cooperative societies
Adoption of Conservation Agricultural Practices
- Use of vegetation cover
- Minimum or zero tillage
- Mulching
- Agro-forestry
- Use of organic manure
- Crop rotation
- Controlled grazing
- Effective pest control
- Bush fallowing
- Effective ridging method
Chain actors
Storage
i. Reduction/elimination of moisture
ii. Use of magtoxin/phostoxin
- Increase in maize output
- Increase in maize yield
- Increase income from maize production
- Improvement in level of living
influencing
among ma
onservation agricultural

CHAPTER FOUR
METHODOLOGY

4.1 Study Area

This study was conducted inBauchi and Gombe States of the North-east region of Nigeria. This area lies between latitude 7^0 and 14^0 North and longitude 8^0 and 14^0 east comprising of Borno, Yobe, Adamawa, Taraba, Bauchi and Gombe States (Chude, *et al.* 2012).The zone occupies an area of about 271,003km^2 and about 94.7% of this land mass can be described as arable.

This zone was specifically selected for this study because it is one of the zones where a number of staple crops are produced. Another main reason for the choice of this zone is the fact that a lot of extension works concerning conservation agriculture practice have been carried out by the Federal Ministry of Agriculture and Rural Development in collaboration with the various state agencies. Furthermore, the zone is home to a lot of herdsmen who allow their cattle, sheep and goat to graze freely with little or no restraint thereby putting the grassland at the risk of being overgrazed thereby causing intensive land degradation (Adaba, 2006).The major agricultural crops grown in the North – east zone are sorghum, millet, maize, groundnut, cowpea, soybeans, onion, acha and pepper. Others include tomato sugarcane, and sweet potato.

Bauchi State was created on 3rd February, 1976. The State is located between latitude 9.3^0 and 12.3^0 north of the equator and longitude 8.5^0 and 11^0 east of the Greenwich meridian. It is bordered by seven States. To the north, it shares boundary with Kano andJigawa States, Taraba and Plateau States to the south, Gombe and Yobe to the East and Kaduna to the west. The State occupies a total land area of 549,255.01 square kilometers representing about 5.3 percent land mass of Nigeria (Adaba, 2006). The State

has two vegetation zones: Namely, the Sudan Savannah and the Sahel Savannah. Rainfall in the State ranges between 1000mm and 1300mm per annum.

In the savannah, rainy season Starts in May and ends in October. Rainfall variability increases northwards with relative humidity that ranges from about 12 percent in February to about 68 percent in August. The State has a land mass of 49.4 Million hectares out of which 42.0 Million hectares is cultivable.

Predominant ethnic groups in the State are Hausa, Fulani, Kanuri, Gerawa, Sayawa, Jarawa, Bolawa, Kare – Kare and Warjawa.Suffice it to add that the State is pluralistic in nature as there are still other groups. There are twenty (20) local government areas in the state and these are Bauchi, Tafawa Balewa, Dass, Toro, Bogoro, Ningi, Warji, Ganjuwa, Kirfi, Alkaleri, Darazo, Misau, Giade, Shira, Jamaare, Katagum, Itas/Gadau, Zaki, Gamawa and Damban. These are indicated in figure 4.1

The second State that was used for this study is Gombe State which was created in October 1996 from part of the old Bauchi State. The State is located between latitude 9^0 30^1 and 12^0 30^1 N and longitude 8^0 45^1 and 11^0 45^1 E of the Greenwich meridian. (www.onlinenigeria.com). GombeStatehas a population of around 2.3million occupying a land area of 20, 265$km^{2.}$ Gombe is the administrative capital of the State.

The State shares boundaries with Yobe State to the North, Adamawa and Taraba States to the South, Borno State to the East and Bauchi State to the West. The tribal groups include Tangale, Terawa, Waja, Kumo, Fulani, Kanuri, Bolewa, Jukun, Perolshonge, Tula, Cham Hausa and Dadiya among many.Hausa is the Common language in the

State. The State is divided into eleven local government areas which are Gombe, Biliri, Akko, Balanga, Shongom, Funakaye, Dukku, Katungo, Nafaga and Kwami and Yamatu/Deba as indicated in figure 4.2.

The people are predominantly farmers but trading and handiworks are also engaged in by a number of the citizenry. Both food and cash crops are grown in the State. The crops include maize, Sorghum, rice, cowpeas, groundnut orange, lemon, mango etc. Vegetables such as tomatoes, pepper, onion and Okra are also grown in the State.

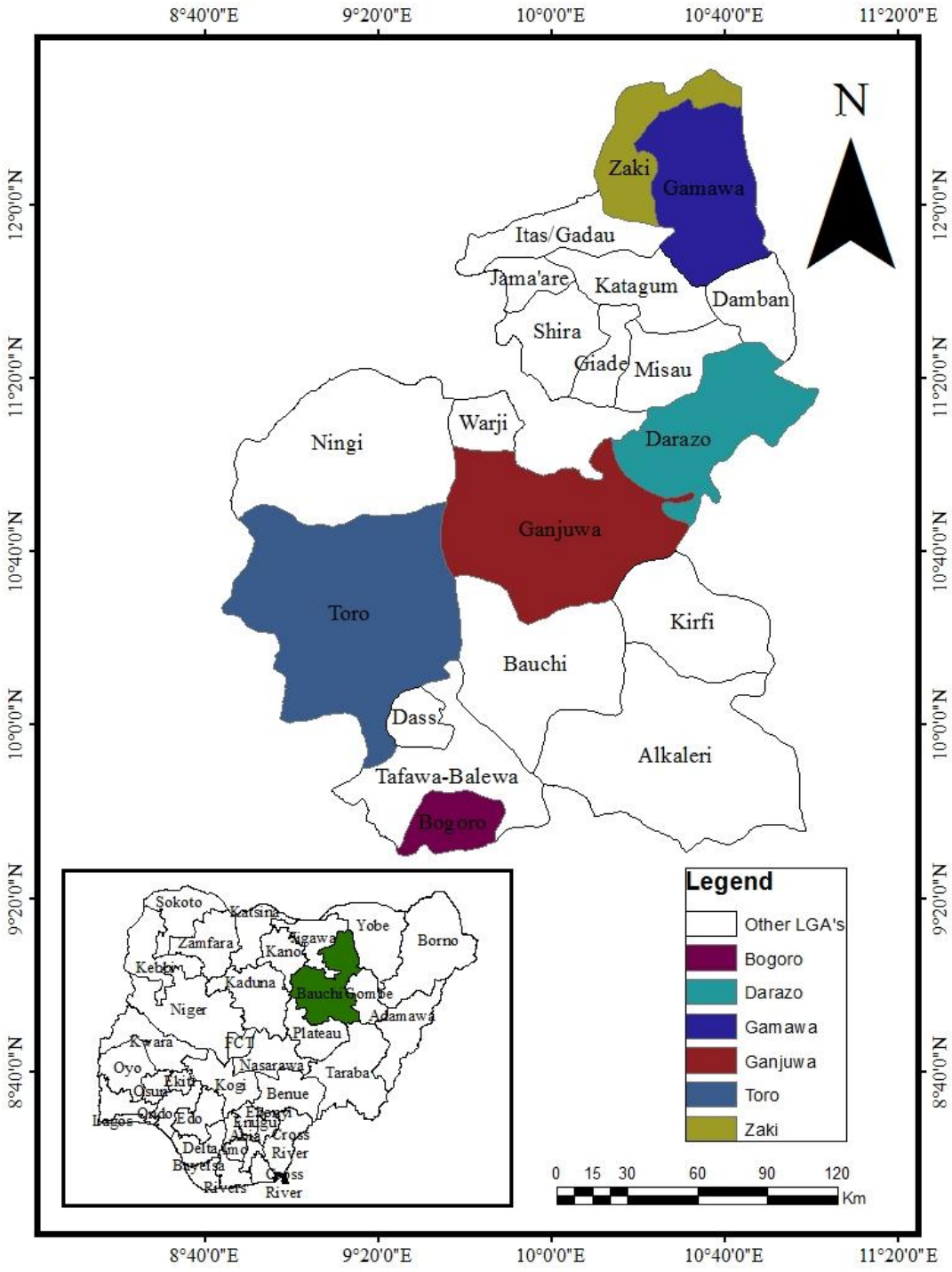


Figure 4.1: Map of Bauchi State Showing the Study Area

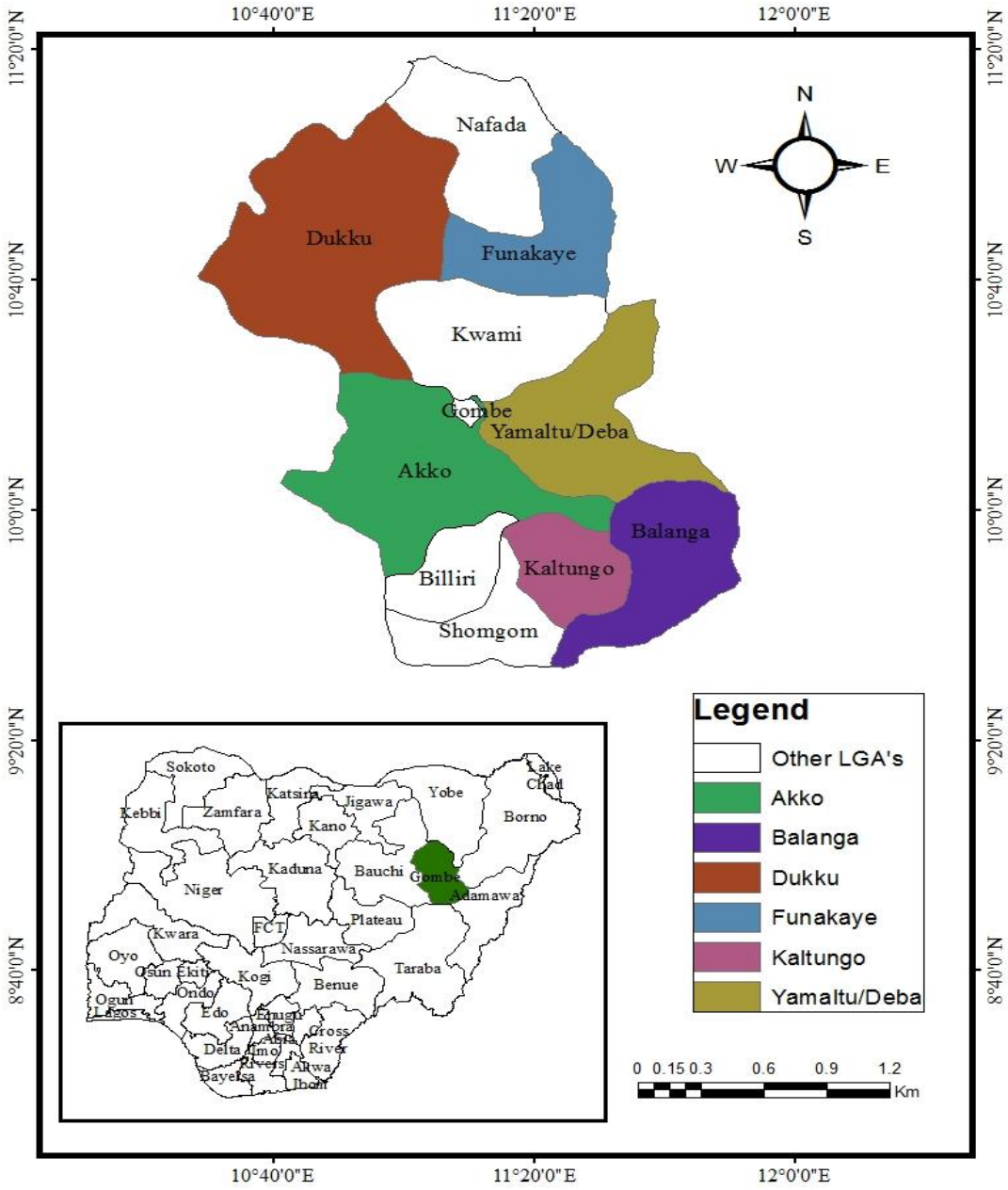


Figure 4.2: Map of Gombe State Showing the Study Area

4.2 SampleSize and SamplingTechnique

The general population for this research work comprised of the farm families of Bauchi and Gombe states of the north-east region of the country who were involved in maize production. Multi stage sampling technique was used to select the respondents for the study. In the first stage, Bauchi and Gombe States were purposively selected from the six states in North-East region because of the level of awareness campaign and extension activities carried out among the farmers about conservation agricultural practiceswhile Bauchi State is comprised of twenty (20) local government area, Gombe State has eleven (11) local government areas.

In the second stage, two (2) local government areas were also purposively selected from each of the three agricultural zones of the two states based on their maize production status making a total of six (6) local government areas from each of the two states. A total of twelve (12) local government areas were used for the study.

In Bauchi State, the six local government areas selected include Toro, Bogoro, Darazo, Ganjuwa, Zaki and Gamawa while Dukku, Funakaye, YamaltuDeba, Akko, Kaltungo and Balanga were selected from Gombe State.Darazo, Ganjuwa, Zaki and Gamawa local government areas of Bauchi State have eleven (11) wards each while Toro and Bogoro have twelve (12) and fifteen (15) wards respectively.Dukku, YamaltuDeba and Akko local government areas of Gombe State have eleven (11) wards each while Fanakaye, Kaltungo and Balanga have ten (10) wards each.

The third stage was the random selection of two (2) wards from each of the local government areas making a total of twenty four (24) wards where the respondents were selected. To achieve this, names of the wards in each of the local government areas were

written on cut pieces of paper and folded. The folded papers were mixed in a container after which the two wards were randomly picked from the container. This was done for the 12 local government areas.The fourth stage involved the simple random selection of the three hundred and nine (309) respondents across the 24 wards of the two states as indicated in Table 4.1. The enumerators that administered the questionnaire were trained to adopt similar technique in their selection of respondents of maize farmers in their wards of coverage.

Table 4.1 Sample Distribution of Respondents

State	AgriculturalZone	PurposefullySelected	Randomly	Number of Registered	Sampl

		LGAs	Selected Wards	Farmers/LGA	Size
		Toro	Tilden-Fulani Ribina	270	27
	Western	Bogoro	Bogoro Lusa	262	26
		Darazo	Darazo Wahu	200	20
Bauchi	Central	Ganjuwa	Yali Ganjuwa	300	30
		Zaki	Mainako Gumai	310	30
	Northern	Gamawa	Gologo Gamawa	270	29
		Dukku	Jamari Lafiya	250	25
	Northern	Funakaye	Tongo Bajoga	200	20
		YamaltuDeba	Deba Habe	270	27
Gombe	Central	Akko	Kumo Garko	300	30
		Kaltungo	Kaltungo Kamo	250	25
	Southern	Balanga	Tallase Kindiyo	200	20
Total		**12**	**24**	**3082**	**309**

4.3 Sources of Data

The primary data used for this study were collected with the use of structured questionnaire which were administered with the aid of trained enumerators. This questionnaire was subjected to critical face validity test with the help of my supervisors and other experts in the field of agricultural extension services in different universities and institutions.Secondary data such as rainfall pattern, level of maize production in the two states, number of local governments and wards in the states were obtained from the Agricultural Development Programmes headquarters and the Ministry of Agriculture offices of the two States.

Other secondary sources of information aside from the vast literatures reviewed include articles and publications from relevant ministries and agencies such as Federal Ministry of Agriculture, Federal Department of Agriculture, Journals and magazines as well as the internet.

4.4 Measurement of Variables

4.4.1 Independent variables

(i) Respondents socio-economic variables

Age: This was measured by asking respondent to indicate their actual age in years as at the time of field survey.

Sex: Respondents were asked to indicate their sex, i.e. male or female.

Level of education: The educational attainment was determined by asking the respondents to state the total number of years they spent in school.

Marital status: - This was categorized and measured as follows:

a. Married
b. Single
c. Widowed
d. Divorced

Income: Respondents were asked to indicate their estimated income from maize sales per annum in Naira value (₦).

Household size: Respondents were asked to state the number of persons they have as dependents within their household including their spouse(s).

Access to media: This was measured by asking the respondents to indicate which of the following mass medium they have access to. This is to determine the quantum of information available to them.

(a) No medium

(b) Radio only

(c) Radio and television

(d) Radio, television and newspaper

(e) Radio, television, newspaper and internet.

(ii) Farming information

Years of experience in farming: Respondentswere asked to state the number of years they have spent in farming.

Farm size: Respondents were asked to give the size of their maize farm (in hectares).

Cropping system: Respondents were asked to state the category they fall under the following option (a) Mono cropping (b) Mixed cropping (c) Intercropping.

Sources of labour: Respondents were asked to state which of the following constitutes the major source of labour on their farms. (a) Family labour (b) hired labour (c) government assisted.

Access to market: Respondents were asked to indicate the distance from his farm to the nearest market in kilometer.

Land ownership system: Respondents were asked to indicate where they fall as regards their farm land.

(a) Inherited the land

(b) Purchased the land

(c) The land is leased

(d) Given the land free of charge.

(iii) Measurement of farmer's attitude towards conservation agriculture and perceived effect

The attitude of the farmers towards conservation agriculture were measured through some attitudinal statements which were constructed using a 5 – point Likert type of scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). The attitudinal statements focused on two major variables. The first variable is the attitude toward the perceivedeffect of adoption of conservation agriculture on their maize yield output and income, while the second attitudinal statementswere on innovation characteristic of conservation agriculture such as relative advantage of the package, cost of application, compatibility with farmer's practice, trialability, observability and complexity of recommendations. Scores of respondents

were computed and a mean value was determined for each innovation characteristicto categorize respondents into those that had favourable and unfavourable attitude.

(iv) Knowledge of conservation agricultural practices

The knowledge level of conservation agriculture practices among farmers in the study area was measured by identifying the content areas of conservation agriculture as elucidated in the literature review and action programme of the Federal Ministry of Agriculture.

These content areas as follows:

- Use of vegetation cover,
- Minimum or zero tillage,
- Mulching,
- Agro-forestry,
- Use of organic manure,
- Crop rotation,
- Controlled grazing,
- Effective pest control,
- Bush fallowing,
- Effective ridging method.

This method of measuring knowledge level is in consonance with the following authors who applied similar methods to study knowledge among different group of people.

In their study of knowledge level of human immune deficiency syndrome among young people in Benin City, Nigeria, Unuigbe and Usafu (1999) identified some core content

areas of the syndrome from which they tested the know about or amount of insight that the respondents had. These include the causative agent of the disease, transmission and preventive methods. Fawole*et al.* (1999) also applied the same method in determining knowledge level of student in Ibadan North East Local Government Area about the disease.

Olowu (1991) in his studies of the effect of Television farm programme on farmer's knowledge of improved farm practices in Oyo State, Nigeria identified some areas in which he tested the farmers' knowledge and discovered a significant relationship between knowledge and education. The study also revealed a significant relationship between knowledge and television viewership.

Dennis and Thomas (2004) in their study of student's knowledge and perceptions towards agriculture before and after attending a Governors School for Agriculture in Virginia United States of America used true/false statements to measure knowledge. They achieved their objective by listing about twenty (20) statements to which the respondents were made to respond to. While correct responses signified that the respondent is knowledgeable in that field, wrong response signified no knowledge. The total scores in the twenty items were computed to know the aggregate score of each of the respondents.

Knowledge indices were constructed on each of the above content areas. These indices reflected what the farmers were expected to know as regards conservation agriculture and were in form of five (5) questions per content area. These questions were contained in the questionnaires that were administered among the farmers by carefully selected enumerators. Scores were assigned to both right and wrong responses. While correct

responses attracted 1 mark each, wrong responses attracted 0 mark each. While the maximum point obtainable was 5 marks per content area, the minimum was 0. Scores on this knowledge test indicated the extent to which each of the respondents understood the content areas of conservation agriculture.

4.4.2 Institutionalvariables

The institutional variables being the behavioral mediating variables that were measured in this study include:

(i) **Access to extension services:**Respondentswere asked to indicate whether or not they had access to extension services and the number of visits by extension agents to their farms in a farming season.

(ii) **Access to credit:** Respondents were asked to indicate whether or not they had access to credit facilities. Sources of these credits will also be investigated.

(iii) **Membership of cooperative Organization:** This was measured by asking the respondents to indicate where they fell under the following categories:

(a) Not a member of any,

(b) A member of one

(c) A member of two

(d) A member of many.

Non-membership was scored 0 point, while membership of one, two and many was scored 1, 2 and 3 points respectively.They were asked to indicate the type of benefits they enjoyed from cooperatives.

4.4.3 Dependent variable

Adoption level of conservation agricultural practices was the dependent variable of the study. This was measured by first asking the respondents to indicate the numbers of conservation practices they had ever practiced.Farmers were further asked to state thefrequency of use of the conservation practicesi.e. whether occasionally or always. This was to determine the sustainability of the adopted conservation practices among the respondents.While the maximum score obtainable from the number of recommended conservation agriculture practices adopted was 10, the minimum score obtainable was 0. All scores below 6 were interpreted to mean low adoption while scores between 6 and 10 were interpreted to mean high adoption.

4.4.4 Expected outcome or effect

The expected outcome or effect of the adoption of the recommended conservation agriculture practices for maize production were increase in maize output, increase in yield, increase in income of farmers from maize sales and increase in the level of living of maize farmers. To determine all these indices, each of the variableswas measured as indicated below after which the perception of the farmers were sought concerning the effect of adoption on the variables.

Crop output

This was measured by the number of 100 kilogrambags of maize the farmer got in 2014.

Crop yield

This was determined by converting the total output of maize that the farmer got in 2014 to kilogram and dividing this value by the total hectarage put to maize production to give ton per hectare.

Income

This was measured by asking the farmers to estimate their income from maize salesin 2014.

Level of living

This was measured by asking the respondents to respond to the following

i. Access to food all year round

ii. Type of house owned by the farmer

iii. Access to health facilities

iv. Access to farm labour

v. Ownership of farm equipment

vi. Ownership of household assets

Access to food

This was measured by asking the respondents to indicate whether or not they had access to food all year round. Positive response was scored 1 point while negative response was scored 0 point.

Type of house owned

Respondents were asked to indicate the type of house they lived in. Mud house with thatched roof was scored 1 point, mud house with zinc was scored 2 points and brick house with zinc was scored 3 points.

Access to health facilities

Respondents were asked to state whether they had the required money to take care of their medical challenge whenever they experienced such.Positive response wasscored point while negative response was scored 0 point.

Access to farm labour

Respondents were asked to state whether or not they could access the required labour for their farm work. Positive response attracted 1 point while negative response attracted 0 point.

Ownership of farm equipment

Respondents were asked to indicate whether or not they owned any equipment like hoes and cutlasses, oxen, water pump, knapsack sprayer, tractors, harvesters and processing machines. Ownership of any of these equipment attracted 1 point while non-ownership will attracted 0 point. The points obtained by each respondent was added to know the total score for the respondent.

Ownership of household assets

Respondents were asked to indicate whether or not they owned any household items like television, radio, cassette player, motor cycle, bicycle, motor vehicle, mobile phone, generators, fridge, DSTV decoder or any of the like, settee, gas cooker, electric cooker, stove etc. Ownership of any of these items attracted 1 point while non-ownership attracted0 point.

The total score of each respondent on the above 6 items was interpreted to mean the level of living of the respondent. To determine whether the farmers had experienced any increase in their maize output, maize yield, income and level of living, their perception was measured using a 5 – point Likert scale of strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and strongly Disagree (SD). Five attitudinal statements were provided for each of the four indicators (output, yield, income and level of living). The maximum score obtainable per respondent for each of the indicators was 25 points while the minimum was 5 points. A mean value was determined for each indicator.

4.5 Analysis of Data

The data collected from the field were analyzed using descriptive statistics such as frequency distribution percentage and mean. Torbit regression model and T-test were used for the inferential statistics.

To achieve objective 2, respondent's score on adoption scale were computed. Respondents who adopted each of the ten (10) recommended practices were determined and this gave insight into which of the practices were adopted as well as the number of the respondents that adopted each of the recommended conservation practices.The number of respondents who indicated always and those that indicated occasionally were computed and categorized to mean those who were adopting the practices on sustainable basis and those that were not.

To achieve objective 3, Tobit regression model was used as the study was focused on the number of conservation practices adopted by the farmers. The model follows the concept of maximum likelihood and quite appropriate for estimating regression coefficient. The empirical model is specified as follows:

$Y_i = 0$ if $Y^*_i < 0$

$Y_i = Y^*_i$ if $Y^*_i >= 0$

$Y^*_i = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+ e$……(1)

i = 1, 2… 11

Where

Y_i = recommended conservation practices

Y_i^*= Unobserved recommended practices ($[(Z\text{-}Ii)/Z]$)

Z = level of adoption

e_i= Truncated error term

β_0 = Intercept term

$\beta_1 \ldots \beta_{11}$ = Slope coefficients

x_{1i} = Age of household head (in years)

x_{2i} = Educational level(in years)

x_{3i} = Household size (number of persons)

x_{4i} =Labour (number of persons)

x_{5i} = Farm size (number of hectare)

x_{6i} = Yield (in tons)

x_{7i} = Extension contact (number of visits)

x_{8i} = Credit (Yes or No)

x_{9i} = Level of living (scores of respondents)

x_{10i} = Output of maize (in 100 kilogram bags)

x_{11i} = income (Naira)

To achieve objective 4,respondents score on the knowledge test for each of the ten content areas were computed and a mean value was determined separately for each content area. All marks above the mean value were interpreted to mean high knowledge of that particular content area while marks below the mean were interpreted to mean low knowledge for that particular respondent.

To achieve objective 5, respondents score on the 5 – point Likert scale on their attitude towards the innovation characteristic of recommended conservation practices for maize production were computed. Mean value was determined from the respondent's scores for each of the six characteristics and all scores below the mean value were interpreted to mean thatattitude towards that characteristics of conservation practices was not favourable for that particular respondent. Conversely, scores above the mean value were interpreted to mean that attitude of respondents towards that innovation characteristicof conservation practices wasfavourable for the respondent. To achieve objective 6, number of constraints identified by each respondent was determined.The level of severity of the constraints as indicated by the respondents was also determined from the responses.

4.6 Test of Hypotheses

To test hypothesis i, Tobit regression model was used as the hypothesis studied the influence of the socio-economic variables on the number of conservation practices adopted by the farmers. The model follows the concept of maximum likelihood and so quite appropriate for estimating regression coefficient. The formula of Tobit regression model is as given in section 4.5. To test hypotheses ii-iv, t-test statistic was used as it is

capable of determining the relationship between two variables of equal sample size. The formula is as given below:

$$t=\frac{\bar{x}_1-\bar{x}_2}{\sqrt{\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}}} \quad \text{..... (2)}$$

Where,

$\bar{x}_1$ =Mean value of adoption level of respondents

$\bar{x}_2$ =Mean value of independent variable (yield, income, level of living)

$S^2{}_1 and S^2{}_2$ = variance of adoption level and independent variable (yield, income, level of living).

$n_1 and\ n_2$ = corresponding sample size associated with adoption level and independent variable respectively.

CHAPTER FIVE
RESULTS AND DISCUSSION

5.1 Introduction

The findings of this study are discussed in this chapter. The different sections under which the findings are discussed are socio-economic variables of the maize farmers, level of adoption of the recommended conservation agricultural practices for maize production, factors influencing adoption of recommended conservation agricultural practices for maize production, effect of adoption of the recommended practices on the output, yield, income and level of living of the maize farmers. The constraints militating against the adoption of the practices, knowledge level of farmers about conservation agriculture practices, farmers' attitude towards the innovation characteristics of conservation agriculture practices and farming information of the farmers are also discussed as well as the findings from the tested hypotheses.

5.2 Socio-economic Characteristics of Respondents

The socio-economic characteristics of the farmers across the twelve (12) local government areas of Bauchi and Gombe States where this study was conducted are presented in the following Tables. The respective variables that are presented in the tables are age, gender, marital status, level of education, household size, other occupation, income, access to media, years of experience in farming and farm size.

5.2.1 Age of respondents

The distribution of the age of respondents cuts across four age groups as presented in 5.1 Table whichshows that the respondents were more distributed within 31 – 50 years age group as they constituted 41.1%. Those that were 30 years and below constituted 18.4% of the respondents while those that were between 51 – 60 years constituted 21%.A portion of 19.1% were aged between 61 years and 75. While the oldest among

the farmers was 75 years old, the youngest was 27 years and the mean age was 47.39 years. These findings are largely in agreement with the study of Abiodun*et al.* (2011) who found that 22.2% of the farmers who used recommended food grains storage technologies for sustainable food security programme in urban south west Nigeria were within the age bracket of 51 – 60 years. This is also in consonance with Alade*et al.* (2011) who found in their study of utilization of information and communication technology (ICT) among rural women in Oyo State, Nigeria that the respondents who aged between 30 and 39 constituted 40 percent of the respondents.A young and vibrant person is more likely to be receptive to new ideas and may be willing to take more risk than an elderly person.

The implications of this finding is that close to 60% of the respondents were 50 years and below and therefore still had the energy and the zeal to work hard on the farm and be receptive to new technologies thereby increasing their productivity.

Table 5.1: Distribution of the respondents based on age

Age (years)*	**Frequency**	**Percentage**
≤30	57	18.4
31 – 50	127	41.1
51 – 60	66	21.4
61 - 75	59	19.1
Total	**309**	**100**

*** Mean Age = 47. 39 years**

5.2.2 Sex of respondents

The results presented in Table 5.2 show that 75.4% of the respondents were male while only 24.6% were female. Men and women are assigned varying roles and responsibilities according to the societal, political, economic, cultural and religion norms (Ekong 2003). In the same manner, land ownership structure in Nigeria is tilted

in favour of men as men control the largest proportion of agricultural lands in most parts of Nigeria (Famoriyo 1985). This limited access to land among women puts a lot of constraints on women in their quest to adopt technologies that are connected with land usage (Adeyemo, 1991).

Table 5.2: Distribution of respondents based on sex

Gender	**Frequency**	**Percentage**
Male	233	75.4
Female	76	24.6
Total	**309**	**100**

5.2.3 Marital status of respondents

Figures presented in Table 5.3 as revealed from the findings of the study indicated that 68.6% of the respondents were married while the singles constituted 16.4%. The widowed and the divorced constituted 8% and 7% respectively. The high proportion of 68.6% indicates that the adults who are married were in the majority. Though Ndamitsa and Umar (2008) asserted that farmers preferred to be married and have large supply of labour, the unmarried too could have access to labour if they have the required resources or if they are involved in joint self-helplabour groups.

Table 5.3: Distribution of respondents based on marital status

Marital Status	**Frequency**	**Percentage**
Married	212	68.6
Single	50	16.4
Widowed	25	8.0
Divorced	22	7.0
Total	**309**	**100**

5.2.4 Level ofeducation of respondents

The findings as shown in Table 5.4 indicate that majority of the respondents in the study area (64.7%) had no formal education. While 16.2% of them had primary education,

12.3% had secondary education. Only 6.8% of them possessed tertiary education. These findings slightly differ from that of Issa*et al.* (2011) who found that 18.8% of the farmers who participated in extension programmes in the north western Nigeria had tertiary education but largely agrees with that of Oyesola and Adegboye(2011) who found that 15.5% of the farmers in Gombe State had secondary education.Olaleye (2000) found that education is an important variable that affects adoption among farmers. This assertion is also inclined to byHussain (2009) who submitted that the educational level attained by members of a community influences the growth and development of that society.

Table 5.4: Distribution of respondents based on educational level

Educational level	Frequency	Percentage
Non formal	200	64.7
Primary	50	16.2
Secondary	38	12.3
Tertiary	21	6.8
Total	**309**	**100**

5.2.5 Household size of respondents

Household size of respondents as measured in this study revealed the number of persons that are directly depending on the respondents in their house. These include the spouse, children and wards of the respondents. The findings as presented in Table 5.5 show that respondents that had between 1 – 5 persons in their household constituted 47.6% while the modal class is between 6 – 10 persons and constituted by 49.5% of the respondents. Those that had between 11 – 15 persons in their household were 2.9% of the population. This finding is in agreement with Adegboye*et al*. (2009) who found that 3.9% of the farmers in the northern part of Nigeria had more than 8 members in their household. This finding also agrees with Okosi (1990) who found that the average household size in Africa is between 8 and 9 persons. The implication of having large household size is that farm labour is assured for the farmer thereby reducing the amount of money he expends on his farming activities.

Table 5.5: Distribution of respondents based on the size of their household

Size of household	Frequency	Percentage
1 – 5	147	47.6
6 – 10	153	49.5
11 – 15	9	2.9
Total	**309**	**100**

5.2.6 Other occupation of the respondents

Other occupations that the respondents were engaged in were investigated. The findings shown in Table 5.6 revealed that 19.4% were involved in one form of trading or the other while 53.1% engaged in craftwork such as weaving, carpentry and moulding. Only 6.1% were engaged in civil service and 21.4% had no other occupation apart from farming. The implication of this is that the farmers had other sources of income with which they meet their financial obligations.

Table 5.6:Distribution of respondents based on involvement in other occupations

Other occupation	Frequency	Percentage
Trading	60	19.4
Craftwork	164	53.1
Civil service	19	6.1
None	66	21.4
Total	**309**	**100**

5.2.7 Income of respondents from maize

The income that the farmers generated from the sales of maize in 2014 was measured. This was done as income from a particular farming venture is one of the factors that could enhance or militate against the adoption of any technology that may be introduced to the farmer. The findings as shown in Table 5.7 revealed that while 44.3% of the respondents earned between ₦11,000.00 and ₦20,000.00 from maize sales, 42.1% got between ₦21,000.00 and ₦30,000.00. Only 13.6% of them got between ₦30,000.00 and ₦51,000.00 Further investigations revealed that the average selling price of 100kg of

bag in the study area as at the time of field study was ₦4,000.00. This finding slightly disagrees with Omotugba*et al*. (2008) who found that income of cowpea farmers in Kaduna State ranged between₦16,000.00 –₦20,000.00.

Table 5.7: Distribution of respondents based on their income from maize

Income	Frequency	Percentage	Mean
₦11, 000.00 – ₦20, 000.00	137	44.3	
₦21, 000.00 – ₦30, 000.00	130	42.1	
₦30, 000.00 – ₦51, 000.00	42	13.6	₦24,770
Total	**309**	**100**	

5.2.8 Respondents access to media

The results of respondents' access to different types of media is presented in Table 5.8 This is because for knowledge to evolve, an individual must be aware of the existence of a particular subject matter. Media exist in order to inform, educate and entertain. The more the individual has access to different media, the more the insight he has and the less difficult it would be for him to make a decision. The findings revealed that 12.9% of the respondents had no access to any form of medium, 77.7% had access to radio and 9.4% had access to radio and television. This finding agrees with Bolarinwa*etal*.(2011) who found that 75.2% of the farmers in Osun State receive information from radio. The implication of this is that most of the farmers in the study area had access to information.

Table 5.8: Distribution of respondents according to access to media

Media	Frequency	Percentage
No medium	40	12.9
Radio	240	77.7
Radio & Television	29	9.4
Total	**309**	**100**

5.2.9 Farming experience of respondents

The respondents had varying years of experience in farming. While 22.7% of them had 1-10 years of experience, 38.2% had between 11 and 20 years of experience. The results as presented in Table 5.9 also indicate that 34.3% had between 21 – 30 years and 4.8% had between 31 - 35 years of experience. This implies that majority of them had long years of farming experience which may constitute a barrier in the adoption of technologies as found out by Adeogun and Oluyole (2004). This finding is in conformity with that of Adebiyi and Okunlola who found that 33% of the farmers in Oyo State, Nigeria had between 11 and 30 years' experience in farming.

Though Bayacay (2001) asserted that farming experience have a positive and significant impact on technical efficiency, it also engenders conservative attitude among farmers and could lead to non-adoption or poor adoption of recommended technologies.

Table 5.9:Distribution of respondents based on years of experience in farming

Years of experience	Frequency	Percentage
1 – 10	70	22.7
11 – 20	118	38.2
21 – 30	106	34.3
31 - 35	15	4.8
Total	**309**	**100**

5.2.10 Farm size of respondents

The results presented in Table 5.10 indicate that 11.3% of the respondents had farm sizes of less than 1 hectare while 78% of them had 1 hectare. Only 10.7% of them had between 1.1 to 2 hectares.

Farm size of farmers largely determines his productivity and income. In Nigeria, farm size of farmers is generally small as found by and Adekoya and Tologbonse (2011) who discovered that majority of the farmers in Benue State had less than one hectare. The findings of this study as presented in Table 5.10 is not in consonance with their finding as it shows that 78% of the farmers had farm size of 1 hectare.

The implication of small farm size is that it may prevent a farmer from trying out new ideas on his farm as he may be thinking of the risks associated with the technology.

Table 5.10:Distribution of respondents based on their farm size

Farm size	Frequency	Percentage
< 1 hectare	35	11.3
1 hectare	241	78.0
1.1 – 2 hectares	33	10.7
Total	**309**	**100**

5.2.11 Respondents cropping system

The results in Table 5.11 show that only 34% of the farmers practiced sole cropping while 66% practice mixed cropping. The idea of mixing crops on the same piece of land is to maximize what the farmer can get from a particular farmland. The farmers mentioned that they always planted crops such as groundnut, sesame and cowpea on the same piece of land with crops such as maize or sorghum. This is also practiced to provide alternative means of compensating themselves in case of failure of any of the crops. This is in conflict with Hugues and Phillippe (2003) who canvassed sole cropping as the system that guarantees high return on investment.

Table 5.11: Distribution of respondents based on their cropping system

Cropping System	Frequency	Percentage
Sole cropping	105	34
Mixed cropping	204	66
Total	**309**	**100**

5.2.12 Respondents sources of extension information

Information is very vital to farmers. They need to be timely and correctly informed about new technologies, sources of inputs, price, processing opportunities, market availability etc. If a farmer is not informed, he will only be operating by trial and error.

The results presented in Table 5.12 indicate that farmers in the study area relied on two major sources for their extension information. These are cooperative groups and extension agencies such as the Ministry of agriculture at the state and local government areas and the Agricultural Development Programme. While 18.1% got their information through cooperative groups, 81.9% of them got their information from extension agencies. This finding is in agreement with Agbontale*etal.* (2008) who opined that for agricultural development to be accelerated and for production to increase extension services must be invigorated as farmers largely depend on it for their information needs.

Table 5.12: Distribution of respondents based on their sources of information

Information source	**Frequency**	**Percentage**
Cooperative group	56	18.1
Extension agency	253	81.9
Total	**309**	**100**

5.2.13 Method of land acquisition among respondents

The findings presented in Table 5.13 show that four main methods of land acquisition existed in the study area. These are all indicated in the Table. A greater proportion of the respondents (71.3%) inherited their land from their parents and guardians while 12.9% purchased their land. Those that got their land on lease and got it as gift constituted 8.7% and 7.1% respectively. This finding is in consonance with Udoh (2000) who found that land acquisition in Nigeria is mostly through inheritance and this accounts for the small size of farmland of farmers as inherited land is usually fragmented among children of the deceased parents or guardians.

Table 5.13: Distribution of respondents based on land acquisition method

Method	**Frequency**	**Percentage**
Inheritance	220	71.3
Lease	27	8.7
Purchase	40	12.9
Gift	22	7.1

Total	**309**	**100**

5.2.14 Maize output among respondents

The output of maize crop was investigated among the respondents. The finding as revealed in Table 5.14 shows that 43% of the farmers produced between 21 and 30 bags of 100kg of maize per annum while 37.9% produced between 31- 40 bags of 100kg. Only 19.1% of the respondents produced between 41 – 62 bags of 100 kilogram. This level of productivity is attributable to the small size of their farm and the quality of the agronomic practices of the farmers. The implication of these findings is that farmers would only have little to sell after they might have stored enough for food.

Table 5.14: Distribution of respondents based on their maize output

Output (No of 100kg bags)	Frequency	Percentage
21 - 30	133	43.0
31 – 40	117	37.9
41 – 62	59	19.1
Total	**309**	**100**

5.2.15 Maize yield among the respondents

The yield of maize was determined among the respondents. This was done by dividing their output by the number of hectares of land they put into maize production. The results shown in Table 5.15 show that 57.3% of the farmers produced between 2 and 2.9 tons per hectare while 42.7% of them produced between 3 and 4 tons per hectare. This result indicated that yield of maize is low in the study area as rainfall in the area ranges

between 1000mm and 1300mm per annum. Barry (2006) reported a yield of 6 metric tons per hectare where rainfall is below 1000mm per annum. The implication of this finding is that the land being cultivated had become less productive despite the fact that almost 10 bags of fertilizer was said to be required to produce this yield per hectare.

Table 5.15:Distribution of respondents based on their maize yield

Maize yield (tons/ha)	Frequency	Percentage
2 – 2.9	177	57.3
3 – 4	132	42.7
Total	**309**	**100**

5.2.16 Size of farmlabour among respondents

Results presented in Table 5.16 shows that 14.5% of the respondent had between1 – 2 persons working on their farm while 57.3% had between 3 – 4 persons on their farm. Only 28.2% indicated that they had 5 – 6 persons. This implies that the number of farm labour is low among the farmers. Though the farmers did not indicate cost of labour as a major constraint, low adoption of conservation technologies could be attributable to this low number of farm labour and is in consonance with the findings of Benjamin (2010) who found that technologies that require high labour use are usually resisted by farmers.

Table 5.16: Distribution of respondents based on the size of farm labour

Size (no of persons)	Frequency	Percentage
1 – 2	45	14.5
3 – 4	177	57.3
5 – 6	87	28.2
Total	**309**	**100**

5.2.17 Market availability among respondents

The findings as shown in Table 5.17 reveal that most of the farmers had access to markets where they sell their maize. The result in the Table shows that 85.4% of them had access to markets while only 14.6% said they had no access. Availability of markets is very essential for agricultural development to evolve. This is because farmers depend on the proceed from their farm to meet their financial obligations at the family level, attend to other social needs and to remain productive. Johnson (1982) opined that it is essential for markets to be developed so as to accelerate agricultural development.

Table 5.17: Distribution of respondents based on market availability

Response	Frequency	Percentage
Yes	264	85.4
No	45	14.6
Total	**309**	**100**

5.2.18 Input affordability among the respondents

The ability of the farmers to procure the inputs they required for their farming operations was investigated. This was premised on the fact money is required to buy seed, chemical, organic manure and equipment. When it is difficult for farmers to procure the required inputs to adopt an innovation, adoption will be low.

The results presented in Table 5.18 shows that only 35.3% of the respondents could afford the needed inputs while a greater proportion of 64.7% could not afford them. This explains why cost of input was indicated by most of the respondents in this study as a major constraint in the adoption of conservation agriculture practices.

Table 5.18: Distribution of respondents based on their ability to afford inputs

Response	Frequency	Percentage
Yes	109	35.3
No	200	64.7
Total	**309**	**100**

5.3 Institutional Variables among the Farmers in the Study Area

A number of institutional variables that could influence the adoption of conservation agriculture practices were investigated among the farmers. These include farmers' access to extension services, sources of extension information, access to credits, membership of cooperative organizations and derivable benefits from the cooperative organizations. This was done as farmers decision could be influenced by these factors. The results of the findings are as presented below.

5.3.1 Access to extension services

The results presented in Table 5.19 shows that 80.9% of the respondent had access to extension services while only 19.1% had no access. This indicates that majority of the respondent had access to extension services. This is in consonance with Olowu (1991) who found that majority of the farmers in Oyo State had access radio extension services. Adoption of innovations is influenced strongly by members of social groups. When some members of a group have adopted an innovation, others will often follow. This is the major principle in adoption – diffusion theory. Extension agents have a great role in influencing the diffusion process. Farmers like to find out which new farm practices they should adopt and which they should not. Van den Ban (1988) observed that extension agents are trained to deal with behavioural changes among farmers and are in position to analyze farmers situation and guide them in his decision making process. The results in Table 5.19 show that a good number of the farmers enjoyed the services of extension agents.

Table 5.19: Distribution of respondents based on their access to extension service

Response	Frequency	Percentage
Yes	250	80.9
No	59	19.1
Total	**309**	**100**

5.3.2 Sources of extension information among the respondents

The results presented in Table 5.20 shows that most of the respondents in the study area looked unto the agencies of government such as the Ministry of Agriculture, Agricultural Development Programme and the local government areas for their extension services. A greater proportion of 75.4% said they depended on the information from these sources though not all of them usually receive the information as expected. Only 24.6% of the farmers depended on private organizations such as cooperative organizations and commodity groups for their extension information. This finding lends credence to the opinion of Adekoya and Ajayi (2000) that interpersonal communication is very important in extension work.

The implication of this finding is that the farmers who relied on the information from his association will most likely carry out his farming operations the way other members of the group are doing it while those that depended on government agencies and did not receive the required information will either continue in their traditional method of farming or take their cue from their neighbours. With this tendency, adoption of conservation practices will be hampered as found out in the study.

Table 5.20: Distribution of respondents based on their sources of extension information

Sources	Frequency	Percentage
Government agencies	233	75.4
Private organization	76	24.6
Total	**309**	**100**

5.3.3 Respondents access to credit facilities

Access to credit facilities in form of loan, inputs and labour is very important if innovation that requires expenditure of fund is to be adopted especially among peasant farmers who operate on small farm sizes thereby earning low income. The findings of this study as shown in Table 5.21 indicate that 81.9% of the respondents had no access to credit while only 18.1% had access to credit facilities. The low adoption of conservation of conservation practices could be partly attributed to the non-accessibility to credit facilities and the findings is in agreement with Adebiyi and Okunlola (2009) who submitted that for adoption to take place among farmers, accessibility to credit facilities must be enhanced.

Table 5.21:Distribution of respondents based on their access to credit facilities

Response	Frequency	Percentage
Yes	56	8.1
No	253	81.9
Total	**309**	**100**

5.3.4 Membership of cooperative organizations among respondents

Membership of cooperative organizations was investigated among the respondents. This was premised on the fact that if farmers operate in groups, there is tendency for them to enjoy benefits such as credit facilities, extension messages, market information

etc. The results presented in Table 5.22 show that 53.7% of them belonged to cooperative group. All the respondents who responded in the affirmative also claimed that they belonged to only one group. The implication of this finding is that majority of them belonged to one association or the other and can be reached through this association either for extension information or any assistance that the government may be willing to offer the farmers. Adeola*et al.* (2002)found that if farmers operate in groups such as cooperatives, most of them will have access to credit and this can enhance their adoption of recommended practices.

Table 5.22:Distribution of respondents based on membership of cooperative groups

Response	**Frequency**	**Percentage**
Yes	166	53.7
No	143	46.3
Total	**309**	**100**

5.3.5 Derivable benefits from cooperative groups among respondents

The results presented in Table 5.23 show the benefits that could be derived by being a member of farmers' cooperative groups as indicated by the farmers. Majority of the respondents (53.4%) said they could obtain information about sale outlets for their farm product if they operate in groups.

A sizeable proportion of them (21.1%) also mentioned that they could obtain extension information (advisory services) from their cooperative groups while 5.5% indicated that they could access inputs for their farming operations. Opportunity for credit facilities was indicated by 18.1% as what they could benefit from cooperative groups. Only a very small fraction of the respondents (1.9%) indicated that there was nothing for them to benefit from any cooperative group. The implication of this finding is that though almost all the respondents believed that there were derivable benefits from cooperative groups, not all of them belonged due to one reason or the other. This low membership of

cooperative organizations despite knowing the accruable benefits as presented in table 32 is one of the reasons why adoption of conservation practices was low among the respondents. This finding lends credence to the finding of IIRR (1998) which stated that "Conservation Supreme" a code name for a programme aimed at training farmers in various aspects of crop husbandry succeeded because the promoters of the extension programme encouraged the farmers to form groups. Membership of these groups could have helped the farmers to overcome some of the challenges that militated against their adoption of the recommendations such as high cost of inputs which was cited as a severe constraint among the generality of the farmers.

Table 5.23:Distribution of respondents based on their response to derivable benefits from cooperative groups

Benefits	**Frequency**	**Percentage**
Not applicable	6	1.9
Credit	56	18.1
Input supplies	17	5.5
Advisory services	65	21.1
Sale outlet	165	53.4
Total	**309**	**100**

5.4 Level of Adoption of Recommended Conservation Agricultural Practices among Maize Farmers

Assessment of the level of adoption of recommended conservation agricultural practices among maize farmers was the second objective of the study. These practices consist of ten (10) major components as indicated in Table 5.24. These ten components were

presented to the respondents and they were asked to indicate which of the practices they had adopted. The results show that minimum or zero tillage was adopted by all the respondents as 100% of them responded positively to it. Adoption of minimum or zero tillage ensures that the structure of the soil is not disturbed. Most of the farmers confirmed that they used local hoes while few used oxen with light ridgers to turn the soil. Results in Table 5.24 also show that controlled grazing was adopted by 98.7% of the respondents while only 1.3% of them did not adopt the practice. Those that had livestock on their farm said they ensured that the animals were not allowed to graze their farm land at will and this usually prevented their crop from being destroyed by their animals.

None of the respondents adopted the use of vegetation cover as they attributed the reason to long dry spell they normally experienced between the time they harvest their maize crop and the next planting season. This same reason was also adduced for non-adoption of agro-forestry. According to the farmers, stalks of maize and other plant residues were usually left on the farm for a while after which some would be removed and used as fuel materials in the kitchen while the remaining would be packed and burnt in readiness for land preparation against the next planting season.

Results presented in Table 5.24 also show that use of organic manure was well adopted among the respondents. The practice is adopted by 90% of them. While those that had cattle used the dung, those that had access to poultry waste used it and some even claimed they usually make effort to source for the manure from poultry farmers. The farmers' knowledge about organic manure is centredaround animal waste only as most of them did not know that decayed plant materials are also good sources of organic manure. Only 10% of them did not adopt the practice as they depended on the use of

inorganic fertilizer only. The respondents that adopted the use of manure also claimed that they normally combined it with inorganic fertilizer to ensure high yield.

The findings in Table 5.24 indicate that 93.2% of the respondents adopted effective pest control methods as they claimed they used pesticides and herbicides as prescribed by extension agents. The practice was not adopted by 6.8% of the respondents.

Bush fallowing wasnot adopted bythe farmers and the non-adoption of the practice was attributed to limited size of their farmland. This implies that the same piece of land is put under cultivation on yearly basis by most of the farmers thereby limiting the capacity of the soil. This explains why high dosage of fertilizer is required in the north-east region as the soil has been over worked(Chude *et al., 2012*). This lends credence to the assertion by FDA (2009) that only 38% of the 92.4million hectares of land in Nigeria was under cultivation thereby leaving 62% under permanent fallow. The inability of most farmers to leave their ancestral home to distant places to acquire virgin land is partly responsible for the continuous cultivation of the same piece of land year after year.

The findings in Table 5.24 revealed that 95.5% of the respondents practiced effective ridging method while 4.5% did not adopt it. Most of respondents said the experiences they had over the years had given them insight into the ways their ridges should be done so as to prevent their crops from being washed away during heavy down pour. Some of them also said they farmed on flat land that is not sloppy thereby limiting the incidence of erosion.

This finding are in consonance with the submission of Fakoya (2011) who found that only few conservation agriculture practices were adoptedby farmers in Ondo State. The findings also agree with that of Ezeiburo*etal*. (2008) who submitted that adoption of conservation agriculture practices was low among farmers in AbiaState.

Table 5.24: Distribution of respondents based on their adoption level of conservation agriculture practices

Practices	**Adopted**		**Not Adopted**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Use of vegetation cover	-	-	309	100
Minimum or zero tillage	309	100	-	-
Mulching	-	-	309	100
Agro forestry	-	-	309	100
Use of organic manure	278	90	31	10
Crop rotation	-	-	309	100
Controlled grazing	305	98.7	4	1.3
Effective pest control	288	93.2	21	6.8
Bush fallowing	-	-	309	100
Effective ridging method	295	95.5	14	4.5

5.5 Application of the Adopted Conservation Agricultural Practices

Having indicated the number of conservation agricultural practices adopted, the respondents were asked how often they applied the adopted practices. This was to ascertain how sustainable the practices were in the study area. The results presented in Table 5.25 indicate that of all the respondents that adopted minimum or zero tillage, 100% of them always practice it. This shows that the practice has been sustainably adopted among the farmers. In the same vein, of all the 278 respondents that adopted the use of organic manure, all of them practiced it regularly and would not want to jettison it. Controlled grazing, though adopted was only being occasionally practiced as 74.8%

of the adopters practice it occasionally. This was attributed to the uncooperative attitude of the herdsmen who allowed their livestock to stray into their farms at will even when crops were yet to be harvested. They also claimed that as soon as harvesting was over, the herdsmen had unhindered access to their farmland and that they did not have power over them. The findings presented in the table also show that the practice of effective pest control was being regularly observed by only 17% of the adopters while 83% of them observe it occasionally. This indicates that the practice is not well taken among the adopters.

Effective ridging method as indicated by the findings in Table 5.25 is observed always by 66.81% of the adopters. Only 33.2% of the adopters practiced it occasionally. These findings revealed that for adoption of these practices to be sustained, a lot of awareness will be required among the farmers in the study area.

Table 5.25: Distribution of adopters of conservation agricultural practices based on application of the adopted practices

Practices	**Always**		**Occasionally**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Minimum or zero tillage	309	100	-	-
Use of organic manure	278	100	-	-
Controlled grazing	77	25.2	228	74.8
Effective pest control	49	17	239	83
Effective ridging method	197	66.8	98	33.2

5.6Factors Influencing the Adoption of Recommended Conservation Practices of Maize Production

This is the third objective of this study. Tobit regression model was used to estimate the parameters of factors influencing the adoption of recommended conservation practices for maize production in Bauchi and Gombe States. From the maximum likelihood

estimates of the Tobit regression, the results show that the modelfits the data reasonably. For example, the(maximum likelihood) estimates maximize the log likelihoodfunctions. This implies that among all the possible regressionlines, the coefficients of this regression line maximizesthe joint probability (likelihood) of observing the sample values of the adoption of recommended conservation practices for maize production This indicates thatvariation in adoption is explained by the (maximumlikelihood) estimates of the selected explanatory variables, suggesting that the model as specified explained significant on-zero variations in factors influencing adoption of recommended conservation practices for maize production among the respondents. Furthermore, the Pseudo R-square (coefficient ofdetermination) is 0.65, suggesting that the model has a good fit to the data. This indicates that 65% variation in adoption of recommended conservation practices for maize production is explained by variations in the specified explanatory variables, suggesting that the model has good explanatory power on the changes in adoption among the respondents with 95% level of confidence.

The coefficient of education had a direct relationship with adoption and statistically significant at 1% level, thus suggesting that the higher the educational level of the household, the more they adopt recommended conservation practices for maize production. This result implies that households with relatively better education are more likely to adopted recommended conservation practices for maize production than those without education. The result coincides with the theoretical evidences that educational improvement could lead to awareness of the possible advantages of modernizing agriculture and improve the quality of labor. It is similar with the findings of Ramakrishna and Assefa(2001).

The coefficient of farm size is positively significant and statistically significant at 5% level, meaning that farm size exhibits a positive relationship with adoption of recommended conservation practices of maize production. That is, households with larger farm sizes tendto adopt more practices than those with smaller sizes, and vice versa. As a household's farm size increases, adoption of recommended conservation practices increases. Reddy *et al.* (2004)observed that greater efficiencies in the use of resources are associated with the large farms than the small farms. They pointed out that the smallness of holdings deters the use of mechanization and does not allow the use of modern inputs due to lack of purchasing power in the hands of small farmers.

Maize yield obtained by the respondents is positive and statistically significant at 5% level which implies that the higher the yield the higher the adoption of recommended conservation practices of maize production by the farmers. This agrees with what Benjamin (2010) reported that farmers adopted agricultural innovation because of high yield advantage.

The coefficient of extension contact is positive and statistically significant at the 5% level with adoption recommended conservation practices. This implies that households with access to agricultural extension services tended to adopt more recommended conservation than those that did not have such access. This is because contact with extension services tends to enhance the chances of a household having access to better crop production techniques, improved inputs, as well as other production incentives that positively affect farm productivity and production. Asogwa (2012) observed that high level of technical inefficiency among small-holder farmers in the rural and peri-urban

areas of Nigeria were highly attributable to low availability of extension services and information about technical aspects of croptechnologies. This is also in support of Saddiq (2012) and Agbamu (2006) who independently reported significant relationship between extension contact and adoption of recommended cotton production practices by farmers in Zamfara state.

The access to credit facilitiesof the respondents had a positive and significant relationship with adoption at 1% level. This suggests that farmers who received credit adopted recommended conservation practices for maize production than those who did not receive credit. It is also implies that availability of credit contributed significantly to technology adoption because credit is necessary for the purchase and use of new technologies by low capital base farmers. This is expected because availability to credit enhances farmer's ability to purchase necessary inputs for recommended conservation practices for maize production such as improved seeds, fertilizers etc and pay for hired labour. This finding agree with Akpoko (2004) who reported that amount of credit received by farmers positively and significantly influenced the adoption of recommended soil management practices in Kaduna state.

The coefficient of level of living is positive and statistically significant at 1% level. Level of living of household is considered to be one of the strategies for enhancing households' resilience in the face of economic crisis and adverse circumstances. The coefficientof the variable exhibits a positive relationship with adoption, suggesting that the higher the level of living of a farmer,the higher the adoption of recommended conservation practices for maize production.

The coefficient of farm income is positive and statisticallysignificant at 5% level. Farm income generation is a measure of theextent of agricultural production commercialization and isexpected to affect adoption of recommended conservation practicespositively. The coefficient to the variable exhibits a positive relationship with adoption, suggesting that the higher the farm incomegeneration from agricultural production commercialization,the higher the adoption of recommended conservation practices for maize production.

Table 5.26: Factors influencing the adoption of recommended conservation practices of maize Production

Variable	**Coefficient**	**Standard error**	**T-value**
Constant	5.5321	0.353	15.677***
Age	0.002	0.003	0.475
Education	0.022	0.008	2.750***
Household size	-0.029	0.019	-1.484
Labour	-0.0014	0.006	-0.257
Farm size	0.323	0.138	2.341**
Yield	0.0469D-04	0.232D-04	2.020**
Extension contact	0.0558	0.024	2.309**
Credit	0.1864	0.116	1.699*
Level of living	0.0299	0.028	1.745*
Output	-0.530D-04	0.791D-04	-0.671
Income	0.721D-05	0.328D-05	2.198**
Sigma	0.6248	0.025	24.860***

Number of observations	309
Log likelihood function	-293.1285
Number of parameters	13
Info.Criterion:HQIC =	2.04421
Pseudo R-square	0.653
Threshold values for the model:	
Lower= .0000 Upper=+infinity	
LM test [df] for tobit=	.000[12]
Normality Test, LM =	257.801[2]
ANOVA based fit measure =	.069149
DECOMP based fit measure =	.069149

***p<0.001**p < 0.05 and *p < 0.10

5.7 Attitude of Farmers Towards the Effects of Adoption of Recommended Practices on the Output of Maize, Yield of maize, Income and their Level of Living

This study also determined the attitude of farmers toward effect of adoption of the recommended practices on the output of maize, yield of maize, income of respondents and level of living of the respondents respectively.

The findings in Table 5.27 show that 57.6% of the respondents indicated that adoption of the practices had effect on their maize output while 42.4% of them said the adoption had no effect on their maize output. Similarly, only 52.1% of the respondents agreed that they experienced any appreciable effect of adoption of the practices on their maize yield. The findings as indicated in the Table show that 47.9% of the farmers did not experience any effect. These submissions did not agree with Ogunmoye (2008) who asserted that conservation agricultural practices are primarily to improve crop yields. As regards effect on income, a higher percentage of 54.4% did not experience any effect of adoption of the practices on their income. Only 45.6% of the respondents claimed that the adoption of the practices had significantly impacted on their income.

The findings in Table 5.27 further show that only a paltry 18.8% of the respondents indicated that adoption of the practices had impact on their level of living. A greater percentage of 81.2% submitted that they had not experienced any appreciable effect of adoption of the practices on their level of living. These generally poor perceptions of respondents about the effects of adoption of conservation practices on output, yield, income and level of living of farmers must have contributed to the low adoption of the practices among farmers in the study area.

Table 5.27: Distribution of respondents based on their perception of effects of adoption of conservation practices on output of maize, yield of maize, income and level of living of respondents

Variables	Mean score	UnfavourablePerception		FavourablePerception	
		Frequency	Percentage	Frequency	Percentage
Maize output	2.7	131	42.4	178	57.6
Maize yield	2.6	148	47.9	161	52.1
Farmers' income from maize	4.6	168	54.4	141	45.6
Level of living of farmers	2.7	251	81.2	58	18.8

5.8 Knowledge of Recommended Conservation Agricultural Practices among Respondents

Determination of knowledge level of farmers about the different content areas of recommended conservation agricultural practices for maize production was the fourth objective of this study.Results in Table 5.28 show the results of the knowledge score of the respondents in the 10 component areas of conservation agriculture that were studied. These include use of vegetation cover, minimum or zero tillage, mulching, agro forestry, use of organic manure, crop rotation, controlled grazing, effective pest control, bush fallowing and effective ridging system. Five questions of 1 mark each were presented on each of the practices giving a maximum score obtainable of 5. The scores of the respondents were computed and a mean score was determined based on the range of the scores.

All scores below the mean were interpreted to mean low knowledge of that practice for the respondents while scores above the mean score were interpreted to mean high knowledge of the practice for the respondents. The mean scores are indicated in the Table.

The findings in Table 5.28 show that while 83% of the respondents had high knowledge about the use of vegetation cover, 16.8% had low knowledge of the practice. The non-adoption of the practice therefore could not be attributed to poor knowledge of that particular practice but may be due to other constraints faced by the farmers.

Knowledge of minimum or zero tillage was also high among the respondents as 89.6% of them had scores above the mean. Only 10.4% of the farmers had low knowledge of the practice. This high knowledge could possibly be the reason why the adoption of the practice was very high among the respondents. The table also indicates that 52.1% of the farmers had low knowledge of mulching while 47.9% of them had high knowledge of it. Similarly, the knowledge of agro-forestry was low among the respondents as only 37.9% of them had high knowledge while 62.1% had low knowledge. The implication of this finding is that the non-adoption of these two practices could be partly attributed to the poor knowledge that the farmers had about the two practices. This finding is in consonance with the finding of Maiangwa (2006) who discovered that level of farmers' knowledge of agro-forestry was associated with the adoption of the practice.

A high percentage of the farmers (60.2%) were knowledgeable about the use of organic manure while only 39.8% had low knowledge of the practice. The high knowledge could be attributed to the fact that application of organic manure especially poultry waste and cattle dung have been an old practice which has been practiced over a very long period. However, the farmers were largely deficient in the aspect of appreciating that decayed plants could also add to the nutrients status of their soils. This high knowledge of the use of organic manure explains why its adoption was high among the respondents. This is in consonance with the finding of Akpoko (2001) who reported that adoption of recommended practices is influenced by knowledge among other socio-economic factors.

Results in Table 5.28 also show that knowledge of crop rotation was high among the respondent as 63.8% of them had high knowledge of the practice while 36.2% of them had low knowledge of it. Though most of them were knowledgeable about the practice, limited access to land coupled with the practice of mixed cropping and inter-cropping prevented them from adopting the practice. Most of the respondents were not quite knowledgeable in the practice of controlled grazing as 60.2% of them had low knowledge of the practice while only 39.8% had high knowledge of it. The implication of these findings is that most of them allow animals to graze their farmland unchecked especially after harvesting their crops. This may not be as a result of negligence on the side of the farmers but a reflection of the general trend in the country where the herdsmen are always in competition and conflict with farmers over grazing land and water resources.

As further shown in Table 5.28, most of the farmers had low knowledge of effective pest control mechanism. Quite a very high percentage of them (70.6%) had low knowledge of the practice as against 29.4% who had high knowledge of it. This finding is in consonance with Abdulsalam (2008) who submitted that the practice of integrated pest management was low among farmers as it is a combination of several cultural and mechanical practices intended to make the environment less attractive to the pests. This explains why the occasional adopters of the practice far outweighed the regular adopters as explained previously. Most of the farmers (77.7%) as revealed by the findings in Table 5.28 had high knowledge of bush fallowing,while only 22.3% of the respondents had low knowledge of it. However, this did not translate into high adoption of the practice as the farmers were constrained by inadequate land.

The implication of this is that though most farmers in the study area were conscious that bush fallowing could improve yield, the choice of continuous cropping was as a result of the limitation posed by their location and inability to explore areas beyond their vicinity for virgin land.

Knowledge of effective ridging system was high among 45.3% of the farmers but low among 54.7% of them. This explains while occasional adopters of the practice constituted a sizeable proportion as shown earlier. This finding agree with Fakoya (2011) who found that low uptake of agro-forestry practices among farmers in Western Nigeria was as a result of their low knowledge of the practice.

Table 5.28:Distribution of respondents based on their knowledge level of recommended conservation agriculture practices

Conservation practices	Mean score	Low Knowledge		High knowledge	
		Frequency	Percentage	Frequency	Percentage
Use of vegetation cover	3	52	16.8	257	83.2
Minimum or zero tillage	2.5	32	10.4	277	89.6
Mulching	2.5	161	52.1	148	47.9
Agro-forestry	2	192	62.1	117	37.9
Use of organic manure	3	123	39.8	186	60.2
Crop rotation	2	112	36.2	197	63.8
Controlled grazing	3	186	60.2	123	39.8
Effective pest control	2.5	218	70.6	91	29.4
Bush fallowing	2	69	22.3	240	77.7
Effective ridging system	3.5	169	54.7	140	45.3

5.9 Attitude of Respondents towards the Innovation Characteristics of Recommended Conservation Agricultural Practices

The fifth objective of this study was to determine the farmers' attitude towards the innovation characteristics of recommended conservation agricultural practices. The results are as presented in table 5.29

5.9.1 Respondents' attitude towards relative advantages index

Result presented in Table 5.29 shows that 48.5% of the respondents indicate unfavourable attitude towards the relative advantages of the practice while 51.5% expressed favourable attitude. This finding indicates that almost half of the respondents did not consent to the fact that conservation agriculture practices had any advantage as canvassed by the change agents. This non-favourable attitude largely explains the low uptake of the conservation of agricultural practices among the respondents and is also a reflection of the low knowledge they had about conservation agriculture.

5.9.2 Respondents'attitude towards cost of application index

The result also show that 40.8% of the respondents expressed unfavourable attitude towards the cost of application of recommended practices while 59.2% where favourably disposed in their attitude towards the index. This finding could have arisen from the fact that farmers need money to procure inputs such as organic manure, pesticide, herbicide and also for land preparation as required for adoption to take place. To most of them, this extra cost could impact negatively on their savings and affect their ability to meet other financial obligations at the family level. The implication of these findings is that those respondents with unfavourable attitude will not readily adopt most of the conservation practices that will involve expenditure of money.

5.9.3 Respondents' attitudetowards compatibility index

The results in Table 5.29 further reveal that 59.5% of the respondents expressed unfavourable attitude towards the compatibility index of the practices while only 40.5% expressed favourable attitude to it. This result could be attributed to the fact that having practiced agriculture in the same way over a long period of time, planting the same crop

on the same piece of land year after year, the farmers had become conservative and did not think changing the way they had been used to was compatible with their practice. For instance, most of the farmers submitted that they had cultivated the same piece of land for over 10 years and did not see any need for allowing the soil to be under fallow since it could still support plant growth and ensure high yield if enough fertilizer is applied to the soil. The implication of these findings is that with this mindset of most of the farmers and the fact the farm land around the villages and farm stead is limited in size, farmers will continue to stick to most of their habitual practices until the soil becomes unproductive.

5.9.4 Respondents'attitude towards complexity index

Attitude of 42.1% of the respondents towards the complexity index of the recommended conservation practices was not favourable while that of 57.9% of them was favourable. This finding is in consonance with the results of the knowledge test as the cumulative results of the knowledge test indicated 56.6% of them had poor knowledge of the 10 component areas of the conservation agriculture practices. With this high proportion not being knowledgeable enough about the practice, the tendency is for most of them to conclude that the package is complex and therefore difficult to understand. The implication of these findings is that since most of them did not possess the needed knowledge and therefore developed unfavourable attitude towards the complexity index, adoption will automatically be low among such respondents.

5.9.5 Respondents'attitude towards trialability index

Results in Table 5.29 further reveal that 70.9% of the respondents had unfavourable attitude towards the trialability index while only 29.1% had favourable attitude.

Trialability, according to Van der Ban and Hawkins (1988) entails testing an innovative on a small piece of land to ascertain how workable it is. With this high percentage of the respondents not willing to try most of the recommended practices, it would be difficult for them to see the inherent advantages of the practices over their normal practices. The implication of these findings is that since majority of them had unfavourable attitude towards trying out the practices, adoption of the recommendations would be low. This partly explains the low level of adoption as shown in section 5.3. This finding is in consonance with Adegboye*etal.* (2009) who found that there was correlation between attitude and adoption of any extension programmes.

5. 9.6 Respondents'attitude towardsobservability index

The attitude of the respondents as shown in Table 5.29 indicate that 30.4% of them had unfavourable attitude towards the observability index of the recommended practices while 69.6% expressed favourable attitude. The ability of the farmers to see the demonstrations as shown by extension agents in the early stage of the awareness campaign accounted for this response. However, this did not translate to adoption as most of them did not adopt many of the recommend practices. The implication of these findings is that though farmers may see trials being carried out around them, they may not adopt if they are not convinced about the other technological issues of the innovation.

Table 5.29: Distribution of respondents based on their attitude towards the innovation characteristics of conservation agricultural practices

Index	**Mean score**	**Unfavourable Attitude**		**Favourable Attitude**	
		Frequency	**Percentage**	**Frequency**	**Percentage**
Relative advantage	3.1	150	48.5	159	51.5
Cost of application	3.2	126	40.8	18.3	59.2
Compatibility	3.1	184	59.5	125	40.5

Complexity	2.7	130	42.1	179	57.9
Trialability	3.2	219	70.9	90	29.1
Observabilty	3.0	94	30.4	215	69.6

5.10 Constraints Faced by Maize farmers in the Adoption of Conservation Agricultural Practices

A number of factors that could constitute constraints to farmers in their efforts at adopting the recommended conservation practices were identified as the sixth objective of the study and farmers were asked to indicate the severity of those constraints if applicable to them. The results as presented in Table 5.30a and 5.30b show that the constraints that were prevalent among the farmers include inadequate knowledge, inadequate capital, high cost of inputs, inadequate farm equipment, low price of maize, lack of adequate farmland and complexity of the practices. These factors were indicated by all the respondents as barriers towards the adoption of the conservation practices. Possession of requisite knowledge is of immense importance in any adoption process. This explains why a lot of awareness campaign is required when introducing a technology among any group of clientele. The rate at which adults learn also varies greatly and learning may take long time depending on the complexity of the technology being introduced. Farmers, according to Dennis and Thomas (2004) need to be knowledgeable about any new practice before such practice can be adopted. The poor knowledge of the farmers in the study area definitely contributed to the low adoption of the practices and this explains why they considered the practices complex. There was no distinction among the respondents in their knowledge of conservation practices hence the socio-economic factors identified in knowledge gap theory as capable of causing gap did not apply among the respondents. Inadequate capital that was identified as another constraint caused the inability of farmers to procure the needed inputs, seed and farm equipment. According to the farmers, to adopt some of the recommendations, money would be required to procure chemicals and manure, for hiring of tractors and

source for another piece of land. This is in consonance with the submission of Ogungbile and Olukosi (1991) who found that abject poverty among farmers could lead to non-adoption of techniques.

Inadequate farm equipment and high cost of inputs as expressed by the farmers is attributable to the low economic base of the farmers. Most of the farmers claimed they could barely save to procure the needed inputs from the sales of harvested crops as they had to expend money in training their children and meeting other financial needs at the family level.

The proceeds from the sale of maize as at the time of survey which stood at ₦4000.00 per 100 kilogram bag was said to be low. According to them, they usually expended a lot of money in buying fertilizer and other chemicals. This limits their ability to try any innovation that could add to their financial burden.Findings in Table 5.30b reveal that factors such as cost of labour, incompatibility with existing practices, poor storage facilities and nature of land ownership did not constitute barrier in their adoption decision.

Table 5.30a: Distribution of respondents based on the constraints faced and the severity of the constraints

Constraint	Applicable		Not applicable		Severe		Very severe	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Inadequate knowledge	309	100	-	-	309	100	-	-
Inadequate capital	309	100	-	-	-	-	309	100
High cost of inputs	309	100	-	-	309	100	-	-
Inadequate farm equipment	309	100	-	-	309	100	-	-
Low price of maize	309	100	-	-	309	100	-	-

Table 5:30b:Distribution of respondents based on the constraints faced and the severity of the constraints continued

Constraints	Applicable		Not applicable		Severe		Very severe	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Cost of labour	309	100	-	-	309	100	-	-
Incompatibility with existing practice	-	-	309	100	-	-	-	-
Poor storage	-	-	309	100	-	-	-	-
Lack of adequate farm land	309	100	-	-	-	100	309	100
Complexity of the practices	309	100	-	-	-	-	309	100
Nature of land ownership	-	-	309	100	-	-	-	-

5.11 Result of the Tested Hypotheses

A number of hypotheses were tested in this study and the results are discussed below. These hypotheses as stated by Osuala (1987) are tentative generalization whose tenability was tested on the basis of the compatibility of their implications with empirical evidence from the study. These hypotheses are expressed in form of a relation between independent and dependent variables. According to Adedoyin (2004) dependent variables are those factors that change as a result of change in other variables with which they are related.

In this study, adoption of recommended conservation agricultural practices measured by the numbers practices adopted by the respondent is the dependent variable while other factors which are the independent variables include socio-economic and institutional variables of the respondents.

5.11.1 Test of hypothesis I

The hypothesis tested for significant relationship between famers' socio-economic variables and adoption of recommended conservation agricultural practices for maize production. The instrument employed for this test was Tobit regression model because it is appropriate for estimating maximum likelihood and indicating the independent variables contributing to variation in a given dependent variable.

The results presented in Table 5.31 show that adoption of recommended conservation practices is influenced by the educational level of the farmer as the coefficient of 0.022 had a direct relationship with adoption and is statistically significant. This finding agrees with Adeniji (1996) who found that education was among the variables that affected adoption in his study. It is also in consonance with Olaleye (2000) who discovered that education is an important factor that affects adoption of recommended technologies.

Farm size is found to be significant at 5% level and coefficient of 0.323 indicating that the larger the size of the farmer's farm, the higher the number of practices adopted by him. This finding lends credence to the submission of Agbongiarhuoyi and Daniel (2009) who found that small farm size limits the ability of farmers to adopt new

technologies. The extension contact which is significant at 5% with coefficient of 0.0558 as presented in Table 5.30 indicates that the higher the number of extension contacts, the higher the number of technologies adopted by the farmers. This finding agrees with that of Odoemene and Obinna (2010) who found that increased number of extension contacts was positively and significantly associated with over all adoption of improved agricultural technologies among farmers. Other variables that have positive coefficient and are significant at 5% level include access to credit and level of living. This corroborates Akpoko (2004) findings that access to credit had positive influence on adoption of soil management practices in Kaduna state. Factors such as age, household size and labour size were not found to affect adoption of conservation agriculture practices.

Table 5.31: Relationship between farmers socio-economic variables and adoption of recommended conservation agricultural practices

Variable	**Coefficient**	**Standard error**	**T-value**
Constant	5.5321	0.353	15.677***
Age	0.002	0.003	0.475
Education	0.022	0.008	2.750***
Household size	-0.029	0.019	-1.484
Labour	-0.0014	0.006	-0.257
Farm size	0.323	0.138	2.341**
Yield	0.0469D-04	0.232D-04	2.020**
Extension contact	0.0558	0.024	2.309**
Credit	0.1864	0.116	1.699*
Level of living	0.0299	0.028	1.745*
Output	-0.530D-04	0.791D-04	-0.671

Income	0.721D-05	0.328D-05	2.198**
Sigma	0.6248	0.025	24.860***
Number of observations	309		
Log likelihood function	-293.1285		
Number of parameters	13		
Info.Criterion:HQIC =	2.04421		
Pseudo R-square	0.653		
Threshold values for the model:			
Lower= .0000 Upper=+infinity			
LM test [df] for tobit=	.000[12]		
Normality Test, LM =	257.801[2]		
ANOVA based fit measure =	.069149		
DECOMP based fit measure =	.069149		

***p<0.001**p < 0.05 and *p < 0.10

5.11.2 Test of hypothesis II

The null hypothesis (H_o) which stated that there is no significant difference between adoption of recommended conservation practice of maize production and yield of maize production in the study area was tested using the result of a t-test presented in Table 5.32. From the result in the Table 5.32, an average level of adoption was 4.78 and average yield was 3895.85kg. The calculated t-value was 20.44 and exceeds the critical value (t-critical two tail) of 1.97, therefore, the null hypothesis (H_o)is rejected at 5% level of significance. The result of the analysis indicates that there is significant influence of adoption of recommended conservative practices on yield of maize in the study area.

Table 5.32: Relationship between adoption of recommended conservation practices and yield of maize

	Adoption	**Yield**
Mean	4.776	3895.85
Variance	0.420	1119.29
Observations	309	309
Pearson Correlation	-0.114	
Hypothesized Mean Difference	0	
Df	308	
t Stat	-20.46	
P(T<=t) one-tail	1.33E-59	
t Critical one-tail	1.64	
P(T<=t) two-tail	2.66E-59	

t Critical two-tail	1.97*

*P<0.05

5.11.3Test of hypothesis III

The null hypothesis (H_o) which stated that there is no significant relationship between adoption of recommended conservation practices of maize production and income of farmers realized from maize production in the study area was tested using the result of a t-test presented in Table 5.33. From the result in the Table 5.33, an average level of adoption was 4.78 and average income was ₦24770. The calculated t-value was 35.1 and exceeds the critical value (t-critical two tail) of 1.97, therefore, the null hypothesis (H_o)is rejected at 5% level of significance. The result of the analysis indicates that there is significant influence of adoption of recommended conservative practices on income of maize farmers in the study area.

Table 5.33: Relationship between adoption of recommended conservation practices and income from maize production

	Adoption	**Income**
Mean	4.776	24770.22
Variance	0.4207	15347.5
Observations	309	309
Pearson Correlation	-0.039	
Hypothesized Mean Difference	0	
Df	308	
t Stat	-35.140	
P(T<=t) one-tail	4.36E-110	
t Critical one-tail	1.6498	
P(T<=t) two-tail	8.73E-110	
t Critical two-tail	1.97*	

*P<0.05

5.11.4 Test of hypothesis IV

The null hypothesis (H_o) which stated that there is no significant relationship between adoption of recommended conservation practice of maize production and level of living

of maize farmers in the study area was tested using the result of a t-test presented in Table 5.34. From the result in the Table 5.34, an average level of adoption was 4.78 and average score on level of living was 7.78. The calculated t-value was 30.8 and exceeds the critical value (t-critical two tail) of 1.97, therefore, the null hypothesis (H_o)is rejected at 5% level of significance. The result of the analysis indicates that there is significant influence of adoption of recommended conservation practices on the level of living of maize farmers in the study area.

Table 5.34: Relationship between adoption of recommended conservation practices and level of living of the farmers

	Adoption	**level of living**
Mean	4.776	7.779
Variance	0.420	2.587
Observations	309	309
Pearson Correlation	0.036	
Hypothesized Mean Difference	0	
Df	308	
t Stat	-30.83	
P(T<=t) one-tail	1.86E-96	
t Critical one-tail	1.649	
P(T<=t) two-tail	3.7E-96	
t Critical two-tail	1.97*	

*P<0.05

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The general objective of this study was to analyze the factors influencing adoption of recommended conservation agricultural practices for maize production in Bauchi and Gombe States, Nigeria. The specific objectives were to describe the socio-economic characteristics of the farmers in the study area, assess the level of adoption of recommended conservation agriculture practices for maize production in the study area, describe the factors that influence adoption of recommended conservation practices for maize production in the study area, determine the knowledge level of farmers about conservation agriculturalpractices for maize production and determine their attitude towards theinnovation characteristic of recommended conservation practices for maize production. Other specific objective was to describe the constraints to adoption of recommended conservation practices for maize production in the study area.

A sample size of three hundred and nine (309) was used for the study. These respondents were selected through a multistage sampling techniques. Statistical Programme for Social Sciences (SPSS) was used to analyze the data. Descriptive statistics such as frequency distribution, percentage and mean were used to summarize the data while Torbit Model regression analysis and T-test were used for the inferential analysis.

The descriptive analysis showed that the modal age of group of the famers was 31 – 50 years while 19.1% of them were above 60 years. Most of the farmers were male as female constituted only 24.6% of the respondents. About 69% of them were married and most of them had no formal education as only about 12.3% of them had secondary

education while 6.8% had tertiary education. Income from maize was generally low among the farmers as about 42% of them earned between N21,000 – N30,000 from the sales of their maize. Most of the farmers (77.7%) had radio as their main medium of information. They had varying number of years of farming experience but about 5% of them had above 30 years of experience in farming.

The study revealed that five of the ten recommended practices were adopted by the farmers. These were minimum or zero tillage, use of organic manure, controlled grazing, effective pest control and effective ridging method. Out of the five practices adopted by the farmers, minimum or zero tillage was regularly applied by all the respondents while only 17% of them applied effective pest control on regular basis.

The socio-economic variables that had influence on adoption of conservation agricultural practices among the farmers include educational level, farm size, extension contact and income. Only about 58% of the respondents indicated that adoption of the practices had effect on their maize output while only about 46% claimed that the adoption of the recommended practices had significantly impacted on their income.

A number of constraints were identified by the respondents as factors militating against the adoption of the practices. These include inadequate knowledge, inadequate capital, high cost of inputs, inadequate farm equipment. Other constraints were lack of adequate farmland and complexity of the practices.

Results of the knowledge test that was carried out in the study indicated that most of the farmers had poor knowledge of mulching, agro-forestry, controlled grazing and effective pest control while most of them had high knowledge of minimum or zero

tillage, use of organic manure and use of vegetation cover. However, the high knowledge of the use of vegetation cover and crop rotation that 83% and 63% of the farmers had respectively did not translate into adoption of the practices among the farmers.

The attitude of the respondents towards the innovation characteristics of conservation agricultural practices such as relative advantage and observability was favourable among 51% and 69% percent of the farmers respectively while 70% of them had unfavourable attitude towards the trial-ability index. Results of the tested hypotheses indicated that there was significant relationship between farmers' socio-economic variables such as educational level, farm size, extension contact, access to credit and level of living and adoption of recommended conservation agricultural practices. Similarly, there was significant relationship between adoption of the practices and the maize output, maize yield, income and level of living of the farmers in the study area.

6.2 Conclusion

Based on the findings of the study, most of the farmers in the study area were below 50 years and therefore still had the energy to work on the farms and significantly contribute to food production. The respondents were mainly male which implies that men still dominate farming in the area of study and were mostly married. Level of education was low among the respondents as majority of them did not have formal education. They generally had large households and were engaged in other vocations such as trading and craftwork. Radio is the most common medium of communication among the respondents through which they got information. Most of the respondents had long years of farming experience but their farm size was generally low.

Out of the ten recommended conservation practices, only five of them were adopted by the farmers. Some of the adopted practices were not regularly practiced by the farmers.The adoption of the recommended conservation practices was influenced by farm size, extension contact, income and educational level of the farmers. The knowledge level of the farmers about some of the recommended conservation agricultural practices such as agro-forestry, controlled grazing, effective pest control was generally low among the farmers in the study area.

Based on the findings of the study, the farmers were generally constrained by inadequate knowledge about some of the practices, inadequate capital, high cost of inputs, inadequate farm equipment and low price of maize. Other constraints identified were lack of adequate farmland and complexity of the practices.

6.3 Recommendations

Based on the findings of this study, the following recommendations are made:

i. It is recommended that the Ministries of Agriculture and Environment of the two States and the Agricultural Development Programme units which are concerned with agriculture be empowered to scale up their level of extension services delivery to the farmers through on-farm trials of the recommended conservation practices. This will address the constraint of low knowledge of these practices among the farmers and significantly improve their attitude towards the technological indices as well as their attitude towards the effects of adoption of the practices. Enhancing the knowledge of the conservation practices among farmers has become more imperative now than ever before in view of the

devastating effects of climate change being experienced in the country which has led to reduction of the rainy season as witnessed in the country in 2015.

ii. There is need to enhance the ability of the extension agents that are involved in the awareness campaign of conservation agricultural practices. The Federal Ministry of Agriculture being the major facilitator of the extension package of conservation agriculture practices can further build the capacity of these service providers by organizing refresher courses, workshops and short duration trainings for them. This will enable them to bridge the knowledge gap of the farmers.

iii. The association of maize farmers in the two States working in conjunction with the government of Bauchi and Gombe States can mobilize farmers into cluster groups where they will be able to pool resource together to open up new farm land in virgin areas around the states since one of the main reasons why farmers did not adopt bush fallowing and crop rotation was lack of enough farmland in the locality of the farmers. These will reduce pressure on lands that are cultivated year after year and allow the lands to naturally regain the lost nutrients.

iv. Members of the maize association of Nigeria in the two States can further encourage their members to join cooperative groups so as to boost their access to loans from Bank of Agriculture and other financial institutions for their agricultural enterprises.This will address the constraint of fund militating against the adoption of the practices among farmers as revealed by the findings and also

address the issue of lack of access to credit as claimed by 81.9% of the farmers. This will address the constraint of fund militating against the adoption of the conservation practices among the farmers.

v. There is a need for the ongoing Agricultural Transformation Agenda (ATA) of the Federal Ministry of Agriculture and Rural Development to be sustained and invigorated so as to ensure that farmers continue to enjoy the subsidy on fertilizer, seed and other inputs that are being delivered to them at their wards. This will address the constraint of high cost of input and will further encourage the farmers to adopt the practices and other technologies that may be introduced to them thereby boosting agricultural productivity.

6.4 Contributions to Knowledge

The findings from this study were examined in relation to the theoretical and conceptual framework that guided the study and the following contributions to knowledge were deduced.

i. Five (5) of the ten (10) recommended conservation agriculture practices were adopted by the maize farmers in Bauchi and Gombe States.

ii. The adoption of the recommended practices was influenced by some socioeconomic variable of the farmers such as educational level of the farmers (0.022), extension contact (0.0558) and farm size (0.323).

iii. Adoption of the conservation practices had positive and significant effect on the maize output of 57.6% of the farmers as well as on the income of 45.6% of the farmers.

iv. The level of knowledge of recommended conservation agriculture practices possessed by farmers in the study area varies from one component area to the other. For instance, while 29.4% of them possessed high knowledge level of effective pest control, 37.9% possessed high knowledge level of agro-forestry.

v. The yield of maize crop in Bauchi and Gombe States ranged between 2 and 4 metric tons per hectare.

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APPENDIX I: FARMERS QUESTIONNAIRE

Section A: Socio-economic Characteristics

1. Age of the respondent: ……. (years)
2. Gender: Male ( ) Female ( )
3. Marital Status: Married ( ) Single ( ) Widowed ( ) Divorced ( )
4. Educational qualification: (please indicate no of years spent at each level)
   (i) Non formal education
   (ii) Primary education ---------- (years)
   (iii) Secondary education -------- (years)
   (iv) Tertiary education ---------- (years)
5. Local Government Area:
6. State: Bauchi ( ) Gombe ( )
7. Household size: (Number of dependents) …… persons
8. Religion: Islam ( ) Christianity ( ) Others ( )
9. Secondary occupation: Trading ( ) Craftwork ( ) Civil Service ( ) Others ( ) …….. specify
10. Income from maize production in 2014: ₦…….
11. Access to media: (i) No medium ( ) (ii) Radio ( ) (iii) Radio & T.V ( )

    (iv) Radio, T.V. and Newspaper ( ) (v) Radio, T.V. Newspaper & Internet ( )
12. Do you have enough food to feed your household all year round? Yes ( ) No ( )
13. Do you experience food shortage at any period of the year? Yes ( ) No ( )
14. Please indicate the type of house you live in
    (i) Mud house with hatched roof ( )
    (ii) Mud house with zinc
    (iii) Brick house with zinc
15. Do you and your household have access to medical care when required? Yes ( ) No ( )
16. Can you access the labour that you require on your farm? Yes ( ) No ( )
17. Can you afford the cost of the required labour? Yes ( ) No ( )
18. Please indicate if you own any of the following farm equipment.

Equipment	Yes	No
Hoes and Cutlasses		
Oxen		
Water pump		
Knapsack sprayer		
Maize shellers		
Planters		
Power tillers		
Tractors		
Bulldozer		
Other (specify)		

19. Which of the following household assets do you own?

Asset	Yes	No
Radio		

Cassette player		
Television		
Decoder of any type		
Bicycle		
Motor Cycle		
Motor Vehicle		
Mobile Phone		
Generator		
Refrigerator		
Stove		
Electric Cooker		
Gas Cooker		

SECTION B
Farming Information

20. Years of experience in farming……. (years)
21. Zize of maize farm…… (hectares)
22. Cropping system: Sole cropping ( ) Mixed cropping ( ) Agro-forestry ( ) Inter-cropping ( ) Others (specify)……..
23. Farming system: Continuous cultivation ( ) Crop rotation ( ) Shifting cultivation ( )
24. Source(s) of Farming Information: Friends and Relatives ( ) Cooperative Groups ( ) Religious Organizations ( ) Extension Agencies ( )
25. How did you acquire your farm land? Inherited ( ) Lease ( ) Purchase ( ) Gift ( )
26. Maize output in 2014:……bags of……kg.
27. Maize yield in 2014:……..tonnes/hectare
28. Sources of labour: Family ( ) Hired ( ) Government Assisted ( )
29. Can you afford all farm inputs needed? Yes ( ) No ( )
30. Are there ready markets for maize? Yes ( ) No ( )
31. Access to markets: (Distance to the nearest market):……..km

SECTION C

32. **Attitude of Farmers Towards Recommended Conservation Practices.**
(Please respond to the following technological issues of conservation agriculture practices).

S/N	(i) Relative Advantage Index	SA	A	U	D	SD
1.	The package can improve the fertility of the soil					
2.	The package can increase the level of productivity					
3.	The package will worsen the soil condition					
4.	The package can reduce erosion menace					
5.	The package can increase the drudgery on the farm					
6.	The package can reduce erosion and soil compaction					
	(ii) Cost of Application Index					
1.	Adopting the practices will cost me lot of money					
2.	Adopting the practices will not increase my cost of production					

3.	The cost of applying the practices is beyond my reach					
4.	I can easily afford the cost					
5.	The returns on my investment cannot compensate for the expenditure					
6.	I can make profit if I apply the package					
	(iii) Compatibility Index					
1.	The package cannot fit into my present practice					
2.	The package can be incorporated into my present practice					
3.	The package will improve my farming system					
4.	The package will obstruct my present system of farming					
5.	The practices will not enable me to plant maize					
6.	Adoption of the practices will not change the crop that I plant.					
	(iv) Complexity Index					
1.	The package is too difficult to understand					
2.	The package is very simple					
3.	It requires the services of extension agents to adopt the practice on my farm					
4.	I can easily apply the practices without any assistance					
5.	None of the recommendations is difficult to apply on my farm					
6.	All the recommendations are difficult to apply on my farm					
	(v) Trialability Index					
1.	The package cannot be tried on small scale					
2.	The package can be tried on a small scale					
3.	It involves too much risk					
4.	No risk is associated with the package					
5.	I do not have the required land to try the package					
6.	I have enough land to try the package					
	(vi) Observability Index					
1.	The effect of the package is not easily noticeable on growth of maize					
2.	The effect of the package can be easily noticed in maize growth					
3.	The effect on soil fertility is not seen					
4.	The effect is easily seen on the soil					
5.	There is no noticeable effect on the yield of maize					
6.	There is noticeable effect on the yield of maize					

33. **SECTION D**

Knowledge of Recommended Conservation Practices among Farmers.

(Please respond to the following questions and statements as understood by you)

Use of vegetation cover

(i) Do you consider it necessary to plant soybeans, groundnuts or any green manure on your farm during or after harvesting maize (a) Yes (b) No

(ii) What do you do with the maize stump on your farm before planting your crops?

(a) Slash and incorporate into the soil.

(b) Slash and burn.

(c) I use it for cooking

(iii) Can the green plants on your fields add to the fertility of your soil?

(a) True (b) False

(iv) Can the plants you left to grow on your farm reduce erosion on your farm?

(a) Yes (b) False

(v) The plants on the field can help soil to retain moisture? (a) True (b) False

Minimum or zero tillage

(i) Prolonged seasons of ploughing can damage any soil. (a) True (b) False

(ii) Continuous ploughing using tractors can prevent water percolation.
(a) True (b) False

(iii) Oxen-pulled sub-soiler and simple tools are the most suitable for ploughing hard pans soil. (a) True (b) False

(iv) Minimum tillage ensures higher yields. (a) True (b) False

(v) Early and regular weeding are necessary features of minimum tillage. (a) True (b) False

Mulching

(i) Soils must be covered with dry vegetative materials before and after planting.

(a) True (b) False

(ii) What can mulch do to your soil?

(a) It helps the soil to retain moisture

(b) It dries off the soil moisture

(iii) Mulch can be used to control erosion. (a) True (b) False

(iv) What does mulch do to weeds?

(a) It suppresses weeds,

(b) It encourages weed growth.

(v) Mulching can aid maize growth. (a) True (b) False

Agro-forestry

(i) Is it beneficial to leave trees on your farm land? (a) Yes (b) No

(ii) Can trees help in breaking winds on the farm? (a) Yes (b) No

(iii) In what ways can trees affect the fertility of your soil?

(a) It can add to the fertility

(b) Trees reduce soil fertility

(iv) Trees can be used to combat desertification. (a) Yes (b) No

(v) Trees can prevent the soil from overheating. (a) Yes (b) No

Use of organic manure

(i) What are the sources of organic manure?

(a) Animal wastes only.

(b) Decayed plants and animal manure

(ii) How do you keep manure before application period?

(a) In a covered pit or drum.

(b) On bare ground.

(iii) Which of these sources of animal manure is of better quality?

(a) Pigs and Poultry

(b) Goats and Cattle

(iv) Organic manure can be mixed with artificial fertilizer before application

(a) True (b) False

(v) Organic manure can be used to fertilize which of these crops?

(a) Any type of crop

(b) Staple crops only

Crop rotation

(i) Planting maize on the same piece of land repeatedly for 5 or more seasons does not affect productivity. (a) False (b) True

(ii) Maize and sorghum can be grown in sequence on a given piece of land. (a) False (b) True

(iii) Growing cereals and legumes in sequence can add to the fertility of the soil. (a) True (b) False

(iv) Crop rotation achieves maximum results when it lasts for how many season? (a) 4 - 5 seasons (b) 1 – 2 seasons

(v) Crop rotation reduces pests and diseases build up on the field. (a) False (b) True

Controlled grazing

(i) Allowing animals to graze freely on farmland is not good for the soil. (a) True (b) False

(ii) Continuous grazing destroys the structures of the soil. (a) True (b) False

(iii) Grazing routes are supposed to be created for livestock farmers. (a) True (b) False

(iv) Animal grazing should only be controlled when crops are on the field. (a) True (b) False

(v) Continuous grazing makes the soil impermeable for water. (a) True (b) False

Effective pests and diseases control

(i) Do you think that the seeds you plant can introduce pests and disease to your farm? (a) Yes (b) No.

(ii) Ploughing the residues of maize under the soil can reduce pests and disease. (a) True (b) False.

(iii) Planting crops in sequence can reduce the incidence of pests and diseases. (a) True (b) False.

(iv) Mixed cropping reduces the prevalence of pests and diseases. (a) True (b) False

(v) It is necessary to seek professional advice before using chemicals to control pests and diseases. (a) True (b) False

Bush fallowing

(i) Leaving a farmland uncultivated for one or two years can increase the fertility of such soils. (a) True (b) False

(ii) Bush fallowing increases the capacity of soils to produce higher yields (a) True (b) False.

(iii) Bush fallowing reduces buildup of pests and diseases. (a) True (b) False.

(iv) The longer the fallow period, the more fertile the soil becomes. (a) True (b) False

(v) Duration of fallow period is a function of which of the following factors

(a) Soil fertility and availability of farm land.

(b) Farmers preference

Effective ridging method

(i) All kinds of land can be cultivated in the same way. (a)True (b) False

(ii) Ridges can be done regardless of whether the soil is dry or saturated with water. (a) True (b) False.

(iii) Ridging methods affect water runoff (a) True (b) False

(iv) Bad ridging may trigger erosion (a) True (b) False

(v) Ridging enhances soil aeration (a) True (b) False.

SECTION E

Institutional Variables

34. Do you have access to extension services? Yes ( ) No ( )
35. Which of the following is your source of extension services?
    (i) Government agencies
    (ii) Private organizations
    (iii) Universities and Research Organization
    (iv) Others (specify) ----------
36. What type of extension services do you access? Individual ( ) Group ( ) Mass Media ( )
37. No of extension contacts per year: ---------- (times)
38. Level of satisfaction with extension service: Satisfactory ( ) Unsatisfactory ( )
39. If not satisfied, give reasons ----------
40. Do you require credit for your farming operations? Yes ( ) No ( )
41. Do you have access to credit facilities? Yes ( ) No ( )
42. Have you ever taken credit? Yes ( ) No ( )
43. What is the source of credit taken? Friends and Relatives ( ), Local Money Lenders ( ) Cooperatives ( ) Bank ( )
44. Membership of Cooperative Group: Yes ( ) No ( )
45. Number of Cooperatives joined: One ( ) Two ( ) Many ( )
46. Indicate the benefits derived from cooperatives (i) Provision of credit ( ) (ii) Provision of inputs ( ) (iii) Advisory services ( ) (iv) Provision of sales outlet ( ) (v) Others…… specify

Dependent Variable

47. (Please indicate the practices that you have adopted so far and the frequency of usage)

S/No	Conservation Practices Adopted	Yes	No	Always	Occasionally
	Use of vegetation cover				
	Minimum or zero tillage				

	Mulching				
	Agro-forestry				
	Use of organic manure				
	Crop rotation				
	Controlled grazing				
	Effective pest control				
	Bush fallowing				
	Effective ridging system				

48. Assess the severity of these constraints in adopting conservation practices if applicable to you

Constraints	**Not applicable**	**Very severe**	**Severe**	**Not severe**
Inadequate knowledge				
Inadequate capital				
High cost of inputs				
Inadequate farm equipment				
Low price of maize				
Cost of labour				
Incompatibility with existing practices				
Poor storage facilities				
Lack of adequate farmland				
Complexity of the practices				
Nature of land ownership				

49. **Expected Outcome** (Perception of adopters of maize production conservation practices about the effect of adoption of the practices on the output, yield, income from maize and level of living).

For Adopters of Conservation Practices only

S/No	(i) Maize Output	SA	A	U	D	SD
1.	Adoption of the practices has increased my output					
2.	Adoption of the practices has reduced my output					
3.	Adoption of the practices has not affected my output					
4.	Adoption of the practices might increase my future output					
5.	Adoption of the practices might decrease my future output					
	(ii) Maize Yield					
1.	Adoption of the practices has increased my yield					
2.	Adoption of the practices has reduced my yield					
3.	Adoption of the practices has not affected my yield					
4.	Adoption of the practices might increase my future yield					
5.	Adoption of the practices might decrease my future yield					
	(iii) Income from maize					
1.	Adoption of the practices has increased my income from maize					
2.	Adoption of the practices has reduced my income from maize					
3.	Adoption of the practices has no effect on my income from maize					
4.	Adoption of the practices might increase my future income from maize					
5.	Adoption of the practices might decrease my future income from maize					
	(iv) Level of living					
1.	Adoption of the practices has increased my level of living					
2.	Adoption of the practices has reduced my level of living					
3.	Adoption of the practices has no effect on my level of living					
4.	Adoption of the practices might increase my level of living in the future					
5.	Adoption of the practices might reduce my level of living in the future.					