FARMERS' PERCEPTION AND RESPONSE TO CLIMATE CHANGE IN KATAGUM LOCAL GOVERNMENT AREA OF BAUCHI STATE

BY:

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Declaration

I hereby declared that this thesis was written by me. Meanwhile, it is a record of my own work. It has not in any form been presented in any application for higher degree. All citations and sources are acknowledged.

Sign_____ Date_____

M.A. Isa

Dedication

Dedicated to my Late Farther, Alhaji Magaji Mohammad, my Mother, Ummina Habiba Magaji Mohammad, my Wife, Hajiya Hadiza Ibrahim Bature and children for their love, tolerance and prayers during the period of this study.

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All praise is to Almighty God (Allah) who granted me the opportunity and protection to write this work

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ABSTRACT

This study assesses farmers' awareness, perception, as well as the response strategies to climate change. It also examines the trends in annual totals and pattern of monthly distribution of rainfall and Temperature in Katagum L.G.A. Daily records of rainfall and Temperature over a period of 36 years were used. Proportionate random sampling technique was adopted for the study. Two sets of data were used for the study, the first data set which is the perception of farmers on climate change was done with the use of well- structured questionnaire, while the second data set on monthly rainfall and Temperature data for the period of 36 years used for the study was obtained from the archive of the Nigeria Meteorological Agency (NIMET), Abuja. A total of 306 respondents were selected for the questionnaire administration across the three districts. Data collected were analyzed using statistical package for social science (SPSS version 16.0) in form of line graphs, simple percentage, frequencies and cross tabulation. In addition, one – way analysis of variance (ANOVA) to detect significant variation at 0.05 level of significant between the four demographic characteristics (age, educational qualification, occupation and farming experience and perception of the respondents). The results of the study reveal that, the average age of the respondents is 40 years and which is fair enough to give an account of past and present climatic conditions of the area. The average of 73% of Farmers across the three districts has formal education. About 80% of the respondents are aware of climate changing issues in the area and the most popular source of information is electronic media and farming experience. About 80% of the respondents from Madara perceived increase in rainfall and 50% from Azare and Chinade districts. 60% revealed that the onset of rain is delayed whereas the average of 47.3% opined that the cessation of rain is delayed. The respondents cited lack of information on weather incidence as the major hindrance to adaptation, lack of water for irrigation farming, lack of improved seed and poor access to credit facilities are the major hindrances to adaptation measures in the area. The findings also reveals that, most farmers prepared Changes in crop types, Increase in the use of local manure, Increase in the use of fertilizers while other adapt Planting trees, changing from crop to livestock and Prayer. Based on the findings from this study, the researcher therefore recommends that Government, NGO's both at national and international level as well as other stakeholders in the community should join hand in enlightening the farmers about the future consequences of climate change, provide short-term growing seedlings and information on weather incidences, to mobilize farmers and other members of the community to planting trees.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Climate change has been described as one of the major challenges of 21st century to production, conservation, biodiversity and ensuring sustainable use of natural resources Suleiman *et al.* (2009). Two of the most pressing environmental issues facing our planet today are climate change and biodiversity loss. There is a growing scientific consensus that climate change could present a major threat to biodiversity at both spaces and ecosystem level. The millennium ecosystem assessment, as well as recent report from Intergovernmental Panel on Climate Change (IPCC) revealed that climate change is negatively impacting natural resources and, as one of the main drivers of biodiversity loss, human society is also vulnerable to climate change as a result of increased incidence of drought and threat to food security.

Climate change refers to a statistically significant variation in either mean state of the climate or in its variability; persisting for an extended period typically decades or longer. A change in climate may be due to natural process or external forces or persistent anthropogenic changes in the composition of the atmosphere or land use. The concept of global climate change addresses the issues of global warming, sea level rise, change in precipitation, and evaporation and stratospheric ozone depletion, Adebayo (2009).

Progress in understanding the biophysical impact of climate change on crops has been significant and has included an understanding of the importance of changes in both the mean and extremes of climate. Changes in the mean temperature can shorten the time to maturity of a crop, thus reducing yield. Experiment have also shown that even a few days of temperature above a threshold value, if coincident with anthesis, can significantly reduce yield, through affecting subsequent reproductive process, Andrew *et al* (2010).

Climate change and agriculture are interrelated processes, both of which take place on global scale. Global warming is projected to have significant impact on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interactions of these elements. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural product, Wikipedia (2011).

What has change in the last few hundred years is the additional release of carbon dioxide by human activities, fossil fuels burned to run cars and trucks, heat homes and businesses, and power factories are responsible for about 98% of the U.S emission s of carbon dioxide, 24% of methane, and 18% of nitrous oxide, IPCC (2007). Increase agriculture, deforestation, landfills, industrial production, and mining also contribute a significant share of emissions. In 1997, the United State emitted about one-fifth of the total global greenhouse gases, Buba (2009).

Indigenous farmers who are vital and active parts of many ecosystems may help to enhance the resilience of these ecosystems. Their livelihoods depend on natural resource that is directly affected by climate change, and they often inhabit economically and politically marginal areas in diverse, but fragile ecosystems. In addition, they interpret and react to climate change impacts in creative ways, drawing on traditional knowledge as new technologies to find solution, which may help society at large to cope with the impending changes, Jan and Anja (2007).

Peter and Stewart as cited in Yusuf (2008), define perception as "the social role of attitude to provide an input into planning process and to serve as a vehicle for public participation in decision making".

Accordingly, the perception farmers have about climate change may definitely play a significant role in eradicating its consequences or at worst minimizing it. When farmers are fully aware and have been sensitized about the encompassing effects of climate change, they will make input on what is seen in their local environment and as such it will assist government in making reliable planning and decision making.

Despite the fact that efforts have been made towards fighting climate change from scientific views, it seems likely that climate change will continuously be detrimental to socio-economic activities, particularly agricultural. Research, policies and strategies directed towards indigenous farmers' knowledge and perception are highly needed. It therefore, becomes important to assess indigenous farmers' perception and their response of climate change.

1.2 Statement of research problem

Anthony, (2005) projected that cereal production potentials in Sub-Saharan Africa will reduce to about 33% by 2060. Climate change could have a negative impact on pastoral livelihoods through a reduction in water availability and biomass. Up to 40% of Sub-Saharan

countries will lose a rather substantial share of their agricultural resources (implying a loss of 1990 prices of US and 10-60billion). Global warming and sea level rise could threaten fisheries and shrimp production in Africa, Anthony (2005).

It is also predicted that by 2020, between 75 and 250 million people are to be exposed to increased water stress due to climate change. By 2020, also yield from rain-fed agriculture in some countries could be reduced by up to 50% increasing food insecurity and hunger. By 2080, an increase of up to 5 to 8% of arid and semi-arid land in Africa is projected, IPCC (2007).

Therefore, being climate change takes longer period before it manifest; many local farmers are ignorant about the negative consequences and effects of climate change. Instead of attributing shortage of rainfall, late onset, early cessation, erosion, floods, excess of wind, increase temperatures etc. to climate change, many farmers perceive it from superstitious perspective. Thus, all the scientific known ways of tackling the menace will not work with the local farmers unless if they are sensitized.

Recognizing that climate change is one of the most important global environmental threats, causing serious implications on ecosystem, water supply, health, food supply etc. is a must if left indebted would cause deleterious consequences on the existence of man and things around him. The indigenous people who could assist in preventing deforestation and manage natural environment need sensitization to further understand the danger of the adverse impacts of climate change.

To reiterate how perception could affect the success or otherwise of anything, Schiff (1970) found in Yusuf (2008) described perception as "the impression one has of a social stimulus or set of stimuli. That impression is modified by the perceiver's past experience in general, with the same or similar stimulus of interest". This shows that as a particular way of understanding or thinking about something, perception plays very vital role in determining what to do or what not. Wrong perception of farmers concerning the effects of climate change is really worrisome since it will affect how they may respond to it.

The research on farmers' perception as regards to climate change was not investigated in the study area. Therefore, assessing their perception is significant. This will bring about a clear understanding of farmers' awareness to climate change. The dilemma related to climate change will only be resolved if farmers are sensitized and enlightened concerning their perception of climate change. This situation, if not fully investigated stands a chance of posing future threats, particularly to agriculture.

Therefore, their perception on climate change is very paramount and this is what the research is trying to assess in Katagum local government area of Bauchi State.

1.3 Aim and objectives of the study

This study aims at finding out farmers' perception and response to climate change in Katagum Local Government area of Bauchi State

The above aim will be achieved through the following objectives;

i. To analyze the trend of fluctuation in rainfall amount and Temperature for the period of 36 years.
ii. To assess the level of farmers' awareness of climate change in the study area.
iii. To assess farmers response strategies to climate change

1.4 Significance of the study

Over times, the root cause of climate change in the study area cannot be ascertained; there is a common denominator to this due to the increase in the environmental, economic and social impact such frequent occurrences of flood, over grazing, deforestation, drought condition among others. This research therefore focuses on local farmers particularly their perception towards climate change and indeed how they respond to it. If farmers' perception is established, it will surely guide government in planning and taking rational decision and to educate farmers on the types of agricultural practices to adapt and the best time to do so. Other significance of the research work are as follows; to delineate the climate factors of the study area and their relationship to the environment. It is also aimed at revealing the extent of threat we face in terms of global warming. This research is expected to shed more light in unfolding the historical evolution of climatic change of the study area. This study also generated and upgraded the existing database of the climatic condition of the study area made available by other researchers. The information produced serves as guide to other researchers in the future.

1.5 Scope and limitation of the study

This study covered all the three districts of Katagum Local Government Area of Bauchi State, namely; Azare, Chinade and Madara districts it focuses on farmers' perception and response to climate change. The study time frame is from 2011-2012.

Major analysis that was carried out includes:

a. Rainfall and Temperature data
b. Background data or social- demographic status (i.e. Gender, Age, Occupation, Education, farmer's years of experience etc.)
c. Farmers' response strategies to climate change
d. Farmers' perception of climate change (i.e. Views on local, regional and global climate)

The research of this kind requires enough time, finance and man power. However, due to time constraint research assistants are therefore employed in the process of administering the questionnaire during the field surveyed by the researcher.

1.6 Justification

Decrease in annual rainfall in Nigeria: Analysis of average annual rainfall in Nigeria (1960 – 2004) indicates that there has been a steady decline in rainfall and within the last four decades average annual rainfall decrease by 92mm or 7%, Adebayo (2010) Unpredictable change in the onset of rain in the period under discussion has led to situations where crops planted with the arrival of early rains get smothered in the soil by an unexpected dry spell that can follow early planting. Thus, rainfall variability may result in harvest failures especially, where rain fed agriculture is practiced.

Fluctuations in rainfall have been a major factor responsible for crop failures and low crop yields, especially in the savanna region. Accordingly, agricultural planning is expected to be done on the basis of the characteristics of the tropical rainfall such as total rainfall, length of rainy season, rainfall variability and rainfall probability, Adebayo (2010).

In the savannah, the start of the rains is often seldom abrupt, but it is usually preceded by a succession of isolated showers of uncertain intensity and intermittent dry periods of varying duration may last for two weeks. This may prevent germination or emergence of plants. Similarly, yield may decline or fail completely with late planting. All these are result of short fall in rainfall created in the growing season, Ati, *et al* (2002).

Climatic elements are the major factors influencing agricultural practice, especially the rainfall. It is therefore necessary to study and understand its characteristics since these characteristics affect, in one way or another, the agricultural development of the area.

However, going by the reviewed literature on related study in the study area, there are few or no in depth studies on climate change and farmers' perception and response to climate

change in the study area, despite the significant role agriculture plays in the development of rural economy and livelihood in most northern rural communities. This justified that there is need for a research work, such as this, to be carried out.

1.7.0 The study area

1.7.1 Location and extent

Katagum Local Government is situated on the northern part of Bauchi State Nigeria; it is located between latitudes 11^0 $42^/$ and 11^0 $40^/$ North and Longitude 10^0 $31^/$ and 10^0 $11^/$ East. (mapofworld.com. 2009). It shares common boundaries with Itas/Gadau Local Government in the northwest, Jama'are to the west, Damban to the east, Misau to the southeast, and Giade to the south and Shira to the southwest. Katagum Local Government has a landmass measuring about 1,120 square kilometers with population of about 326,775 thousand peoples, NPC (2006).

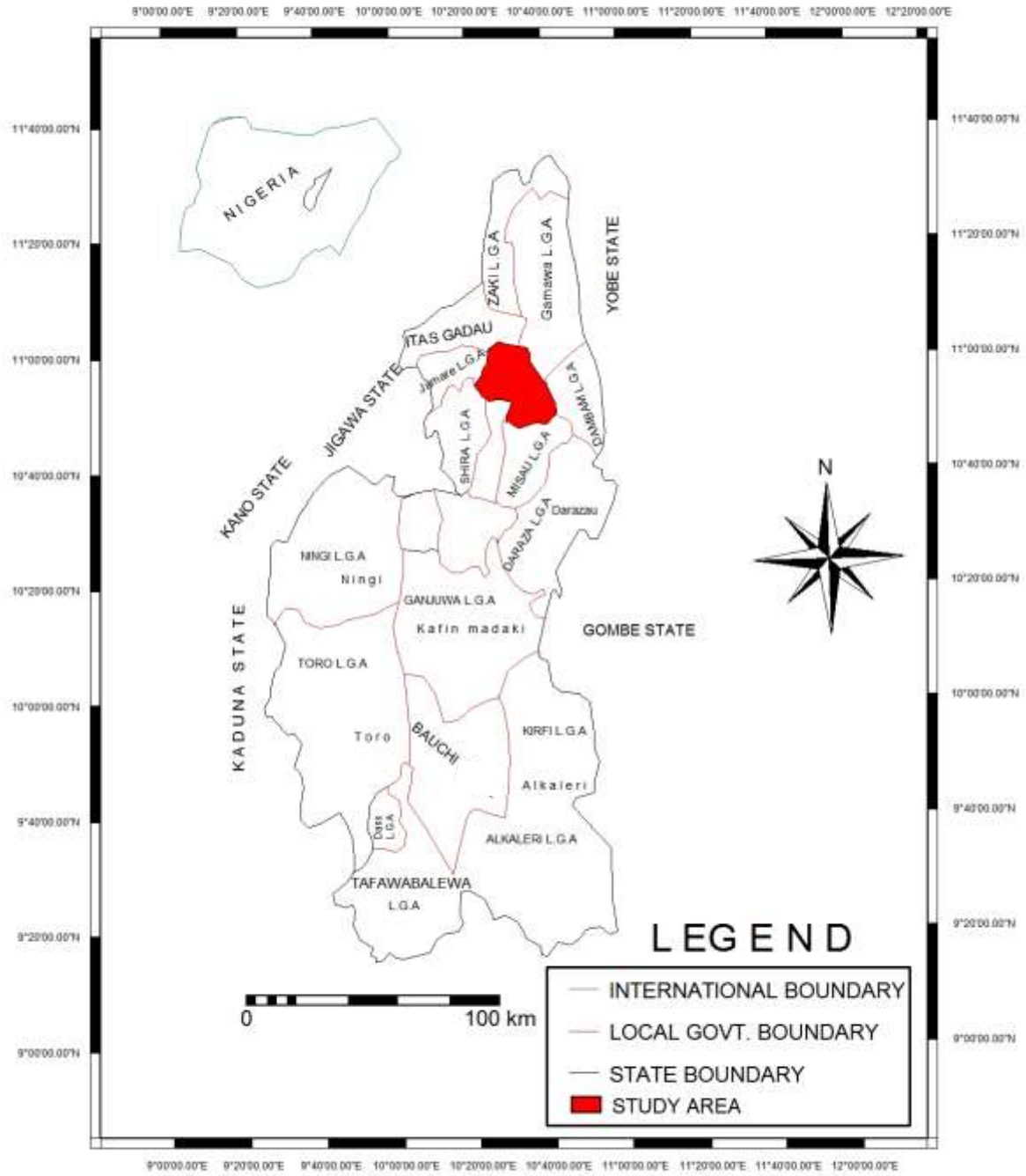


Figure 1.1: Bauchi State Showing Location of the study

Source: State Land and Survey (Bauchi)

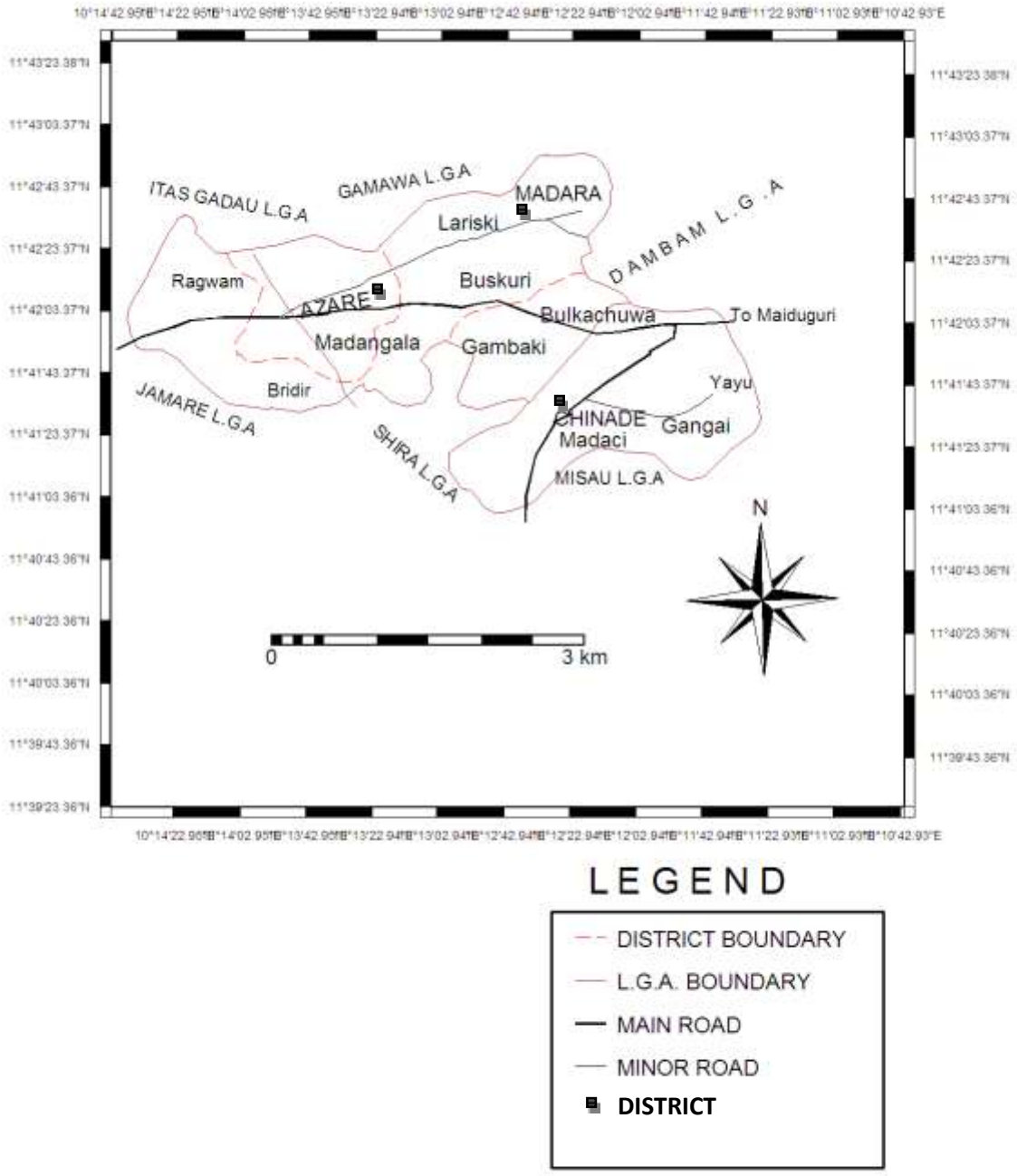


Figure 1.2: Katagum L.G.A Showing the Three District

Source: State Land and Survey (Bauchi)

1.7.2 Climate: Like in the other parts of Northern Nigeria, the climate of the study area is controlled by the Inter Tropical Convergence Zone (I.T.C.Z), which is marked by rainy and dry season. The major climatic elements that influence the climate of the area and affecting the farming system are temperature and precipitation (rainfall), the annual temperature range of 22-33 ^{0}C from April to May (Bashir et al 2001). Generally the mean annual rainfall of Katagum LGA ranges between 615.6 - 985.1 mm, with peak between July and August, as compared with about 4000mm in the south of Nigeria. Rainfall for effective farming (onset of rains) commences between April and May, with gradual increase of low amount. The cessation date of rains is usually in October. April is warmest, with an average temperature of 12.7^{o}C at night. The area has no distinct temperature season; the temperature is relatively constant during the year. Temperature drops sharply at night. November is averagely the month with the most sunshine.

1.7.3 Soils and vegetation

Katagum Local Government Area falls within the Sudan Savannah type of vegetation zone. The vegetation is greatly determined by the nature of soil. The soil in the area is high in arenosols (ar), soils with sandy and loamy sand texture and a high percolation rate. However, loamy soil type is found in Fadama areas of Buskuri, Yayu and Alamari of Chinade district as well as Kare and Zirame of Madara district. (Shehu, 2010). The land is not cultivated, most of the natural vegetation is still intact.vegetation cover of the area comprises with grasses and short trees. Common among which are Baobab (Adansonia *digitata*), Mahogany (*Khaya senegalensis L*), and Borassus palm (Barensus Ethiopium) etc. which have medicinal and of economic values. Guinea corn (*Sorghum bicolor*), Millet (*Penisetum SPP*), Beans (*Vigna unguiculata L*) and Groundnut (*Arachis hypogea L*) are the common crops being cultivated in the area.

1.7.4 Relief and drainage

Katagum Local Government is located on the border of two types of geologic units, Aeolian sands of the Chad formation occurring to the north and continental sand with grits to the south. The land surface is almost level having an average slope of only 0.5 percent. The plain (known as Potiskum plain) is at elevation of 330 to 395 meters above sea level. For example where the ground is hilly the soil is formed in ridges and furrows, these can be found in the north of Azare, Duhuwar Kura and Bagaje. However, ground water is the main source of potable water. This is due to its location in the sub Saharan region of the southern Sahel where rainfall is scanty, no substantial surface water body exists and evapotranspiration is high. Basement rocks contribute to underground water sources when they are weathered or

fractured, and overlying sandy Kerri Kerri Formation constitute a major regional aquifer but the sands are frequently dry.

1.7.5 Population and Land use

Katagum Local Government is the second largest LGA is a populated in the region of Bauchi State. The area is mildly densely populated with 223 people per km^2 and a total population of around 326,775 people as projected in 2011. The area is pluralistic in terms of ethnic composition with a rich and diverse historical cultural heritage all living together in harmony. The intermarriage and sharing of similar cultures and tradition prevailing amongst the people aptly depicts the mood for socio-economic development. The ethnic group include; Fulani, Hausas, Karai-Karai, Larawa and Badawa. The local lingua Franca is Hausa but Fulfulde is widely spoken. The people of the study area are friendly and hospitable to visitors; they are predominantly Muslim, mainly influenced by Islamic teachings. The religious beliefs of the people govern their culture and tradition, Bashir *et al,* (2001).

The major land uses in the study area include agricultural, residential, forest reserve, educational, governmental, commercial and recreational as well as primary transportation networks. The residential land use in the study area is made up of three Districts, namely; Azare, Chinade and Madara. These three districts comprise with one town and eleven villages, these are; Azare town, Bidir, Bulkachuwa, Buskuri, Chinade, Dagaro, Gambaki, Gangai, Madaci, Madangala, Madara and Ragwam village.

The economic resources of the people in the study area are mainly agricultural, livestock, trading and human resources. 80% to 90% of the population of the area is engaged in one form of agricultural activity or the other. The main agricultural products include cereals and legumes such as millet, sorghum, groundnut and beans. The major industry in the area is Ostrich Flour Mills at Azare that is engaged in the processing of wheat, sorghum and millet flour as well as grain-rice and bran. Other small scale industries include animal feed mills, bakeries, bottle and sachet water, local blacksmiths who engaged in the production of local farm implements and leather works, Bashir *et al* (2001).

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Scientists have confirmed that the earth has gone through many natural cycles of warming and cooling during droughts, flooding and extreme weather patterns, and earth's atmosphere and oceans are warming gradually as a result of human activity, IPCC (2001). The consequences of climate change are frightening and life threatening. All countries are affected in varying degrees. The most devastating adverse impacts of climate change in Nigeria and other subtropical countries includes frequent drought, increased environmental damages, increased infestation of crop by pest and diseases, depletion of households asset, increased rural urban migration, increased biodiversity loss, depletion of wildlife and other natural resources base, changes in the vegetation type, decline forest resources, decline in soil conditions (soil moisture and nutrients), increased health risks and spread of infectious diseases, changing livelihood systems, etc. Reilly (1999), Abaje and Giwa (2007).

Barben *et al* (2003), however, noted that in Nigeria, just as in many developing countries in the subtropical region the agricultural sector is more vulnerable to climate change; landless farmers, livestock keepers, people in poor health, those who are undernourished, people with low economic power, women and children including women headed households, those with low level of education, and those with low technological-know-how are more exposed to the risk of climate change.

Also Jan and Anja, (2007) noted that indigenous people who are vital and active parts of many ecosystems may help to enhance the resilience of these ecosystems, since their livelihoods depend on natural resources that are directly affected by climate change. In addition, they interpret and react to climate change impacts in creative ways, drawing to traditional knowledge as well as new technologies to find solutions, which may help society at large to cope with the impending changes. Climate change with expected Long Term Changes in rainfall pattern and shifting temperature zones are expected to have negative effect on agriculture Ejeh *et al* (2011). The Nigerian Agriculture which is a mainstay of the country's economy after oil and employing over 65% of the labour force is mainly rain-fed and heavily depend on rainfall. When the rainfall fells or become too varied the GDP falls, World Bank (2010). According to Nigerian Meteorological Agency (NIMET), Long term climate change in Nigeria is associated with changes in rainfall patterns and variability and temperature, which could increase the frequency of both dry spells and drought and floods.

These climatic hazard particularly prolong dry-spells and floods, are becoming major forces challenging the livelihoods of most farmers in dry land area of Nigeria. Although crop production and productivity seem to be increasing since 1980's Ejeh *et al* (2011), food insecurity at national level remains a great concern because of food production constraint in the dry land regions and vulnerability of its farmers to the shocks of crop failure. Therefore, the potential adverse effect of climate change on Nigerian economy to day is of great concern. Thus Katagum Local Government being a Sudan savanna where agriculture particularly rain-fed is highly practiced cannot be exempted from this phenomena.

2.2 Concept of Climate Change

The meaning of climate change is fairly straightforward- a- clear, sustained change (over several decades or longer) in the components of climate, such as temperature, precipitation, atmospheric pressure, or winds. Such changes must constitute a clear trend, and be clearly distinguished from the small random variation in these parameters that take place all the time. That is why climate change can only be determined after careful analysis of several decades of observations, IPCC (2007)

The climate of a place or region is changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or variability of the climate for that place or region. (Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use. Note that the definition of climate change used in the United Nations Framework Convention on Climate Change is more restricted, as it includes only those changes which are attributable directly or indirectly to human activity.) UN/ISDR (2004)

Climate change encompasses all forms of climatic inconstancy (that is, any differences between long-term statistics of the meteorological elements calculated for different periods but relating to the same area) regardless of their statistical nature or physical causes. The term "climate change" is often used in a more restricted sense, to denote a significant change (such as a change having important economic, environmental and social effects) in the mean values of meteorological elements (in particular temperature or amount of precipitation) in the course of a certain period of time, where the means are taken over period of the order of a decade or longer, National Snow and Ice Data Center, NSIDC (2011). The United Nation Framework convention on climate change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human

activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over a comparable time periods, IPCC (2001). Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural processes or external forcing or to persistent anthropogenic changes in the composition of the atmosphere or in land-use, IPCC TAR (2001 b)

Onuoha and Ezirim (2010) see climate change as any change in climate over time, as a result of either or both natural variability and anthropogenic factors. It can also be described as a long-term change in the statistical distribution of weather patterns over period of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events. Climate change may be limited to a specific region, or may occur across the whole earth. In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. It may be qualified as anthropogenic climate change, more generally known as global warming or anthropogenic global warming, Wikipedia (2011).

Climate change may also refers to shift in the mean state of the climate or in its variability, persisting for an extended period (decade or longer). Climate change may be due to natural changes or to persistent chemical changes in the composition of the atmosphere or land use. In the most general sense encompasses all forms of climate inconsistency (that is any differences between the ‘’long-term’’ statistics of the meteorological elements calculated for different periods but relating to the same area), regardless of their statistical nature or physical cause, Maunder (1994).

Climate change is therefore, not directly observable by individuals. It being a reference of average climate conditions over a long period of time rather than that observed on daily basis, it is perhaps really understood only through mathematical models and scientific measurement, Magaji (2011).

2.3 Causes of Climate Change

Climate change in any place is caused by the increase in the atmospheric concentration of Green House Gases (GHG) such as Carbon IV oxide (CO_2), Nitrous oxide (NO_2), Methane (CH_4), Hydroflurocarbon (HFC), Perflurocarbon (PFC), and Sulfur hexafluoride (SF_6). All these gases absorb terrestrial infrared radiations, Idowu (2010).

The infrared radiation from the high temperature sun has short wave length. This is absorbed by the earth and some are reflected by both the earth and the atmosphere. The proportion absorbed by the earth warms up the earth to the suitable temperature required for the earth. With increasing concentration of GHG in the atmosphere, infrared radiations reflected into the atmosphere are absorbed and re-emitted to the earth. This tends to increase the average temperature on the earth surface once the concentration increase without any control. The balance between incoming and outgoing radiation has always fluctuated from time immemorial in terms of the atmospheric constituents, their relative composition and concentration, solar variations etc and so has the corresponding changes in the climate, NSIDC (2011).

Eke (2011), noted that climate change is caused as a result of GHGs by burning of fossil fuel and deforestation that generate heat energy leading to the "warming" of the earth. It is also opined that it is the warming that leads "Acid rain" and the destruction of the Ozone layer and so many other hazards that depleting the layer could result in such as skin cancer and eye cataract defect.

However, Saka (2008), stated that the causes of climate change have now been documented and each day, the body of knowledge on the causes and consequences of climate change is being expanded. It is known that global warming which is the major cause of climate change is caused by the accumulation of greenhouse gases in the atmosphere.

There are several causes of global climate change: these are increased concentration of greenhouse gases, human driver, and land use changes, human activities increasing aerosols and methane in the atmosphere. Moreover, it has also been attributed to natural causes such as the earth's orbital cycle, solar radiation, Ayoade (2003). Eje *et at* (2011), concluded that destruction of the natural resources base leads to the unpredictable and erratic rainfall pattern, warmer temperature. They have also in the same study cited that the environment is getting warmer and drier leading to increased frequency of dry-spells and changes in timing of rains. Energy consumption contributes directly to climate change by adding carbon-base molecules to the atmosphere in excess of naturally occurring amounts. Carbon, molecules, primarily carbon dioxide from burning petroleum products, trap radiant heat and keep it from escaping from the earth's atmosphere. The resulting warming of the air has contributed to change in global climate, material consumption also contribute directly to climate change because it requires energy to mine, extract, harvest, process and transport raw materials, more energy to manufacture, transport and dispose of waste product.

Furthermore, Magaji (2011) in his findings attributed the causes of climate change to the occupation and activities on the environment such as fuel wood collection, industrial activities, use of automobile and power generating engines, urbanization among others are some of the causes of climate change.

Similarly, Ishaya and Abaje (2008) have shown that the environment has been changing over the years due to human activities such as farming, deforestation either by cutting down of trees for fuel, roofing, farmlands extension, furniture; overgrazing, bush burning, urbanization and industrialization. In analyzing the issues of climate change 85.5%of the respondents agreed that the environment and the climate in particular are changing due to diverse human activities.

Expert believed that climate change is caused by

i. Natural variability and
ii. Manmade or anthropogenic forces.

Long term climate change, is as a result of natural variability related to interactions among the atmosphere, ocean, land and heat radiation. Such interactions, lead to fluctuations in the amount of solar energy reaching the earth, changes in oceans currents and the formation or loss of ice sheets. Short term natural events responsible for climate change include volcanic eruption, which send some sun blocking particles into the stratosphere to cool the earth and the Pacific Ocean event, (ElNino) which transfer thermal energy from one part of the planet to other.

The anthropogenic forces, modifying the earth atmosphere energy balance leading to climate change and global warming are; land use changes, development of urban centers, draining of wet lands, increased concentrations of greenhouse gases especially carbon dioxide (CO_2) and methane (NH_4), Fraisse *et al* (2009).

It is believed that developed countries (through industrial activities) contributed more than 95% to greenhouse emission which is the chief cause of global warming. However, decisions taking about natural resources (the use of natural resources) in developing countries also contribute to climate change. We in Nigeria also contribute to climate change through the following ways or practices.

a. Use of fossil fuels(petroleum products)
b. Deforestation (through fuel wood harvesting, lumbering) which increase carbon dioxide in the atmosphere.
c. Land degradation due to soil erosion, over cultivation, overgrazing, bush burning etc.

d. Agricultural activities such as use of fertilizer and pesticides which release nitrous oxides into the atmosphere.
e. Rearing ruminant cattle which emit methane gas into the atmosphere, Adebayo (2010).

The major source of CO2 emissions is, as is well known, the combustion of fossil fuels, while deforestation also releases (and reduces the capture of) CO2, accounting for 15-20% of the climate change that has occurred to date. However, massive destruction of rain forests in tropical countries, which not only releases carbon that had been stored in living trees – it also reduces the uptake of carbon from the forest biota, both above ground and in the soils. While part of the reason for this destruction can be traced to population growth, with growing demand for land on which to grow food, a larger amount relates to development and trading patterns in which tropical forests are cut down to sell the wood abroad, or to grow crops such as soybeans or cattle (the latter most notably in the Amazon), to earn the foreign currency on which these countries are increasingly dependent, Goodwin (2008).

2.4 Effect of Climate Change on Agriculture

For the last 10,000 years we have been living in a remarkably stable climate that has allowed the whole of human development to take place. In all that time, through the mediaeval warming and the Little Ice Age, there was only a variation of 1^0C. Now we see the potential for sudden changes between 2^0C and 6^0C. We just don't know what the world is like at those temperatures. We are climbing rapidly out of mankind's safe zone into new territory, and we have no idea if we can live in it, Goodwin (2008)

The impact of climate changes since the 19^{th} century is particularly evident today in the observations of high average air and ocean temperatures, widespread melting of ice and snow around the world. Increase in global sea level, the frequency and intensity of heat waves, World Bank (2011). The further maintained that both floods and droughts are occurring more frequently and the interiors of continents have tended to dry out despite an overall increase in total precipitation. Globally, precipitation has increased as the water cycle of the planet has been sped up by warmer temperatures, even when the Sahel and Mediterranean regions have seen more frequent and intense drought. Heavy rainfall and floods have become more common, and there is evidence that the intensities of storms and tropical cyclones have also increase.

Climate change and agriculture are interrelated processes, both of which take place on global scale. Global warming is projected to have significant impact on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interactions of these elements. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural product, Wikipedia (2011).

Climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. For example, drought affected areas in sub-Saharan Africa could expand by 60-90 million hectares with dry land zones suffering losses of US $26 billion by 2060 (2003 price). Other developing regions – including Latin America and South Asia- will also experience losses in agricultural production, undermining efforts to cut rural poverty. The additional number affected by malnutrition could rise to 600 million by 2080, Oladipo (2011).

Odjugo (2011) observed that rivers and lakes are drying up and at the same time disappearing in Nigeria with Lake Chad a typical example. Settlements along the Lake Chad in the 1960s are now about 20km away from the Lake. Nothing drastic has been done to save the situation. For the past ten years, the countries sharing the Lake Chad water (Nigeria, Cameroon, Niger and Chad) have been planning to drain water from Congo basin to feed the Lake. Till this minute, no action has been seen.

In Nigeria, many rivers have been reported to have drying up or are becoming more seasonal, while Lake Chad has shrunk in area from 22,902 Km^2 in 1963 to a mere 1304 Km^2 in 2000. This shows that what is left of Lake Chad in the year 2000 is just 5.7 % of 1963, Odjugo (2007). Elisha (2012) also confirms the fact that Lake Chad has shrunk by 95 % since 1960s, Lake Chad and so many rivers in Nigeria, especially in the Northern part of the country, are in danger of disappearing. The water scarcity will create the tendency for concentration of users around the remaining limited resources of water. Under such circumstances, there is increased possibility of additional contamination of the limited resources of water and transmission of water borne diseases like cholera, typhoid fever, guinea worms infection and river blindness.

The 2012 rainy season in Nigeria has been worse than earlier years, and heavy rains at the end of August and the beginning of September led to serious floods in most parts of the country. This led to the Nigerian authorities contained the initial excess run-off through contingency measures, but during the last week of September water reservoirs have

overflown and authorities were obliged to open dams to relive pressure in both Nigeria and neighboring Cameroon and Niger, leading to destroyed river banks and infrastructure, loss of property and livestock and flash floods in many areas, the floods had affected 134,371 people, displaced 64,473, injured 202 and killed 148. The displaced population is residing with host families or in makeshift camps. The rainy season is not yet over, and the forced release of additional dams and reservoirs is expected to increase the extent and impact of these floods, International Federation of Red Cross and Red Crescent Societies IFRC (2012).

Available evidence also shows that climate change has impacted on agriculture and health in Nigeria, Adefolalu (2007). The decrease in rainfall, increasing temperature and evapotranspiration have resulted in either reduction of water levels or total dry up of some rivers and lakes in Northern Nigeria, while lake Chad in Nigeria is reported to be shrinking in size at an alarming rate since the 1970s,Odjugo (2007). In the coastal region of Nigeria, Sea level rise of 0.2m and incursion of salt water into the coastal plain for about 2016 – 3400 km^2 was reported, Nwafor (2006)

However, Nigeria's First National Communication under the United Nations framework convention on climate changes, NFNC (2003) survey group recently envisaged that a significant effect of climate change in Nigeria due to increased levels of carbon dioxide (CO_2) would be reflected in the production of both C3 crops (such as cassava, yam, cowpeas, wheat, soybeans, rice and potatoes), and C4 crops (such as millet, sorghum, sugar cane, and maize). In general, higher increases in productivity can be expected with C3 crops compared with C4 crops. Thus, the C4 crops, which are more common in Nigeria, would be generally adversely affected as many of them are already functioning below-optimal conditions with today's relative increase in CO_2 levels. C3 weeds will grow more rapidly and hence compete more severely with a number of C4 crops. Similarly, expected changes in crop development and phenology due to climate change extremities can cause shortening or lengthening of crop cycle that would lead to decreases or increases in productivity. Structural changes, especially in the carbohydrate status of plants can also occur. This may affect the nutritional value, taste and storage quality of the crops. Increases in CO_2 can also lower crop water requirements by reducing transpiration per unit leaf area.

It is also reported that "the government of Cross River has attributed the flood and mudslide that destroyed houses in Buanchor and Katabang Boki LGAs to illegal feeling of trees by the people. On the on-the-spot assessment of the extent of the damage at the tourist site, the disaster was largely human. The cause of this magnitude of disasters is 25% percent natural 75% human due to incessant tampering on the mountain reserve by the people. This

calamity would have been averted if there was conscious effort by the people not to tamper with the forest. Daily trust (26 July, 2012)

Recently in August, September and October, 2012, the adverse effect of climate change became clear to almost all the people in Nigeria. The common evidence that we noticed was the series of flooding that occurred in some part of Bauchi, Adamawa and Benue state in Nigeria. In Bauchi alone fifteen out of the 20 local government areas were affected by floods and over 1000 houses and 1,200 hectares of farmlands have been washed away and seven have been recorded. At the same period in Benue state, the flood disaster have rendered over 35,000 persons homeless and property worth about 18 billion were destroyed, 6,197 persons were displaced in Anambra State. Dailytrust (October 11, 2012). The same in Adamawa State about sixteen local government areas have been affected, the flood submerged almost all the farmlands of the affected areas, destroyed houses, bridges that linked to rural areas and several lives have been reported death.

When there is flooding like it is now, the entire farmland is submerged. So, whatever the crops, the animals there, are badly damaged and affected in the process. The impact of that is that there will be food shortage because some of these crops are not up to maturity stage before the flood came. He concluded that as soon as the flood recedes, cropping should begin immediately so that the crops will be ready for harvesting before the next rain season. He further stated that, the flood will have effect on the socio-economic environment because people will lose their employment, there will be hunger and many houses would collapse. Daily trust (October 11, 2012)

However, Berk (2005) noted that the environmental changes in the earth are as a result of climate change and global warming, stratospheric ozone depletion and greenhouse gases. The effect of these problems include the over warming of the earth, frequent floods as a result of excessive rainfall, depletion of the ozone layer, the effect of acid rain , among others. These effects of climate change are caused by human induced factors, including all man's efforts or releasing toxic gases to the atmosphere (bush burning, industrial discharge, domestic release, automobile, fuel burning and so on)

Similarly, in Katsina State, thirteen out of 34 LGAs were seriously affected by flood. According to the Rehabilitation and Emergency Relief Agency (RERA), no fewer than seven people died, while thousands of houses and 146 farmlands were destroyed in the recent flood in Katsina State. Daily Trust (September 7, 2012)

Global climate is already warming at a rate unprecedented in the past 1000 years, IPCC (2001a). This phenomenon is, therefore, inevitably altering the character of local and regional

weather around the world. Climate therefore, is currently a topical issue worldwide because of the climatic extremes experienced in various part of the world in recent years, these climatic extremes which have been mainly in form of floods, drought, heat and cold waves have had a devastating effect on man and his various activities, Ayoade (1995).

Cunningham and Saigo (1999) suggested that local changes could well have severe effects on human societies, agriculture and natural ecosystems. The African continent is particularly vulnerable to the impact of climate change; a vulnerability that is compounded by the continents massive infrastructure deficit, endemic poverty and disease burden. East Africa for example, is facing severe power shortages and declines in agricultural productivity due to droughts that expert are linking to climate change. In Tanzania drought has sharply reduced reservoirs that supply hydroelectric plants. The waters of Lake Victoria have reduced by at least 2 meters between 2000 and 2006, Barclay (2008).

Adebayo, (2010) stated that five aspects of the direct implication of climate change on agriculture may be noted. These include the implications resulting from (a) increased rainfall and rising air temperatures (b) increased rainfall intensities and variability in rainfall (c) changes in agro-climatic and agro-ecological zones (d) impacts on agricultural systems and (e) implications of the rise in sea level on agriculture. For example, increase in temperatures will have detrimental effects on agriculture because of an increase in the number of extremely hot days, a reduction in rainfall and soil moisture, and an acceleration of crop development that would lead to premature, ripening and lower yields in crops such as cereals. In particular, increased temperatures, which would increase evaporation, would reduce the effectiveness of any increase in precipitation and cause crop yields to be lowered.

Also, climate change in Nigeria is expected to be accompanied by greater variability in rainfall and temperatures, which would result in more frequent changes in agro-climatic characteristics and increased variability in yields of crops in the different ecological zones. Climate change would also have considerable impacts on agricultural system thus affecting crop calendar and length of growing periods.

Other possible direct effects of climate change include the effects of increased levels of CO_2 as predicted, which would of its own affect crop production of both C3 plants (such as wheat, soya beans, rice and potatoes), C4 plants (such as millet, sorghum, sugar cane, maize and weeds) in different ways, Adebayo (2010). Indirect effects of climate change on agriculture will include the effects on pests and diseases and the impacts of these on agricultural production.

According Bazza and Sombroek (1994), Change in the world's climate will bring major shifts in food production. In some places, temperatures will rise and rainfall will increase, in others rainfall will decrease. In addition, coastal flooding will reduce the amount of land available for agriculture. Ishaya and Abaje 2007 stated that the threat of climate change is more on health, food supply, biodiversity quality and fuel wood availability than on businesses, instigating of disaster.

Generally, the effects of climate change that we see happening now include, sea level rising, arctic sea ice is melting, glaciers and permafrost melting, sea surface temperature warming, the temperatures of large Lakes are warming, Heavier rainfall cause flooding in many regions, extremes drought is increasing, Hurricanes have change in frequency and strength, more frequent heat wave, warmer temperatures affect human health and sea water is becoming more acidic.

2.5 Concept of Perception

The term perception refer to the act of perceiving; cognizance by the senses or intellect; apprehension by the bodily organs, or by the mind, of what is presented to them; discernment; apprehension; cognition. It can be quality, state, or capability, of being affected by something external; sensation; sensibility. Accurate and Reliable Dictionary ARD (2010). Perception is also described as the process of becoming aware of the world around you through your senses (Positive Thinking Principle).

Perception is a long felt experience. It is related with the problem of different people selectively observing and interpreting different items in the same environment or section of reality. Their varying cultural backgrounds may thus lead to very different conclusions and assumptions about a landscape, Lodha (2007).

However, Cox (1972) defined perception as "piece of knowledge which is acquired by individual as a result of his visual, tactile, verbal and auditory contacts with the environment about him''. The term also refers to the way an individual regards something and the person's beliefs about what is like. Farmers' perception of climate change therefore, refers to the process or way farmers become aware of climate change and their views about it.

Existing research indicates perceptions and environmental views of climate change can be related to individuals' physical surroundings and experiences. People who inhabit places recognized as physically vulnerable to climate change impacts in certain overt ways, for example living in low-laying coastal areas, have been identified as having a heightened sense

of personal risk, Brody *et al* (2008). However, there is evidence that experience of an ecological disaster, such as floods, drought, oil spill, can impact environmental views of local community affected, Marshall *et* al (2008). Also there is evidence on weather living in a place physically vulnerable to climate change impacts, or with experiences that could be attributed to climate change, leads to changes in perceptions of climate change and support for related policies on mitigation or adaptation, Dessai *et al* (2010). Furthermore, dMan and Simpson-Housley, (1998) stated that in relation to flooding specifically, existing data link flood experiences to heightened awareness of flood risk. However, such experiences have not previously been found to relate to [perception of, or related action on climate change. For example, data collected in 2003 that examined experiences of flooding within UK communities indicated that climate change perceptions and self – reported actions on climate change between those who had and had not experienced flooding were very similar Whitmarsh (2008). According to Magaji, 2011, in his findings, reported that flood victims, interviewed as part of the aforementioned research tended to view flooding as a largely distinct issue from climate change and identified local observable causes for flooding, for example poor maintenance of water courses.

The local farmers who are vital and active parts of many ecosystems can help to enhance the resilience of the ecosystem: their livelihood depends on natural resources that are directly affected by climate change, and they often inhabit economically and politically marginal areas in diverse, but fragile ecosystems. These locals process ability to interpret and react to climate change impacts in varying creative ways, drawing on rich tradition knowledge as well as new technologies to proffer solutions, that may help society at large to cope with the impending changes, Jan and Anja (2007) and Eje *et al* (*2011*). According to Moris and Does (2001) and Eje *et* a*l*, (201l) the perspectives of the indigenous people, the way they think and behave in relation to climate change as well as their values and aspirations have vital role to play in addressing climate change. Despite this, indigenous and other traditional people such as local farmers are only rarely considered in both academic and public discourses on climate change, despite the fact that they are greatly impacted by impending changes in climate Berkes and Jolly (2001)

Thus it is believed that climate has changed in the past and is still changing with serious implications on ecosystem, water supply, health, food security e.t.c. For this reasons there is need to understand how farmers' perceive and their reaction to the changing climate in future.

2.6 Response Strategies to Climate Change

There are basically two types of response strategies to climate change. First, we have strategies aimed at controlling or preventing climate change. These are known as mitigation measures. Second, we have strategies which aimed at adapting to or accommodating the impacts of climate change. These are known as adaptation measures, Adebayo (2010).

Mitigation Strategies

Mitigation is an anthropogenic intervention to reduce the anthropogenic forcing in the climate system: includes strategies to reduce emission and enhancing greenhouse sinks, IPCC (2001)

Mitigation strategies are also known as Preventive Measures, these are measures taken to deal with causes of climate change. Some of the possible causes of climate change are natural factors that are outside the influence of man. Man can only deal with the man-made alteration of the chemistry of the atmosphere through the emission of greenhouse gases by various human activities.

Mitigation measures are therefore action taken by man to prevent or retard the increase of greenhouse gases concentration in the atmosphere. This may be achieved by limiting current and future emission from man-made sources of greenhouse gases and by enhancing the potential sinks of greenhouse gases.

Mitigation is also described as steps taken to reduce the amounts of greenhouse gases being produced by human societies over the long term. Most of the mitigation measures will be in the energy sector through use of cleaner technologies, forestry sector through reforestation and the agriculture sector through improved fertilizer application, crop and livestock management.

Climate change mitigation simply means acting to reduce the intensity of radioactive forcing in order to reduce the potential effects of global warming. Climate change mitigation involves reductions in the concentrations of greenhouse gases, either by reducing their sources or by increasing their sinks. The United Nation defined mitigation in the context of climate change, as a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation switching to renewable energy (solar energy or wind

power), improving the insolation of buildings, and expanding forests and other "sinks'' to remove greater amounts of carbon dioxide from the atmosphere, Eke (2011).

The major greenhouse gases produced by human activities are carbon dioxide (CO_2), methane, nitrous oxides and chlorofluorocarbon (CFC). Chlorofluorocarbon also contributes to the depletion of the ozone in the atmosphere. Over 80% of global warming is due to CO_2 and CFCs. CO_2 is produced mainly by activities involving the burning of fossil fuels like coal and lubricating oil. Hence, vehicular emissions and emissions from industrial establishments and thermal power stations are the major man-made sources of CO_2 found in the atmosphere, Adebayo (2010).

Controlling local emissions will do little to protect a particular community from the potentially adverse effects of climate change, since emissions of GHGs have global and no direct local effects. Local regions will be impacted on only through the impact of GHGs on global climate scale. It is therefore questionable whether local initiatives can make meaningful contributions to mitigating global climate change in the absence of policy changes at the state and national levels. When decision taken at such for a as the Kyoto Protocol on climate change are applied nationally and locally, great strides will be made to save the inhabitants of this planet from further disasters, Anselm and Stephen (2011)

National climate change response strategy for South Africa, NCCRSSA, (2004). Mitigating options that could be considered for the agricultural sector include; optimization of the herd sex, age and breed would allow the national herd to be reduced while maintaining the same level of production. Supplementing the feed with high protein forage would reduce the methane production from enteric fermentation and increase productivity, extending feed lot manure management to include anaerobic digestion and the collection and use of the methane gas produced, promoting the use of game in place of beef production, avoiding the burning of agricultural residues, including those from sugar cane plantations, even where such methods are accepted management practice, reduction of the frequency of fires by enhanced fire management practices. Promoting savannah thickening over substantial areas, effectively managing soil organic matter, adopting minimum tillage methods, and exploring synergies between adaptation and mitigation measures in the areas of agricultural product diversification and the application of more socially beneficial agro-technologies such as permaculture to provide sustainable livelihoods.

Adaptation Strategies

To deal with the adverse and positive effects of climate change a number of adaptation strategies are required to be adopted in different conditions. The major scientific body associated with climate change, IPCC (TAR 2001a), defines climate change adaptation as: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. An alternative definition is offered in the inter-agency report, Poverty and Climate Change. Defined Climate change adaptation as the ability to respond and adjust to actual or potential impacts of changing climate conditions in ways that moderate harm or take advantage of any positive opportunities that the climate may afford. In language more familiar to those involved in risk management and development. Adaptation is about reducing the risks posed by climate change to people's lives and livelihoods, Mitchell *et al* (*2006*). Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Smith *et al (2000)* defined adaptation to climate change as adjustments in ecological, social and economic systems in response to the effects of changes in climate.

Adaptation is therefore refers to responses to both the adverse and positive effects of climate change. It can also be any adjustment made whether positive or, negative or anticipatory in response anticipated or actual consequences of climate change. To Goodwin, (2008) adaptation means coping with that climate change effects that we cannot, or will not, prevent. The greatest need is to help vulnerable communities and individuals (in both rich and poor countries) to increase their ability to cope with climate-related catastrophes such as Hurricane Katrina, Sandy Hurricane, floods and drought, pest and diseases etc.

The six types strategy for adapting to the effects of climate change has been identified, these include; prevention of loss, tolerating loss, spreading or sharing loss, changing use or activity, changing location and restoration, Adebayo (2010).

In other hand Saka (2008) notes that adaptation measures to climate change among communities can be considered with two broad activities in mind: (i) measures that reduce vulnerability and (ii) measures that increase resilience through the utilization of the available common assets.

At the national level, there is a need to implement policies and strategies that avert the undesirable effects and impact of climate change on different sectors of economic growth. At local farm level, these can be distinguished for the crop, vegetation and livestock sub sectors.

Changes in land- use and changes in crop and livestock management strategies will have to take place.

Examples include (a) changes in cultivated land areas, (b) changes in crop types (c)growing crop species or varieties with higher thermal requirements or those that are tolerant to drought and floods, (d) changes in crop locations, (e) intensive and extensive use of irrigation water and improved fertilizer use efficiency to counter the effects of drought, periodic water stress and low soil fertility conditions, (f) control of insect pests and diseases associated with floods and drought, (g) improved in soil management practices to reduce surface runoff and soil erosion, (h) establishment and creation of food grains reserves at farm and community levels safe- keeping and storage of harvested produced, and i) diversifying species and intercropping crops with trees to benefit from improved micro climate and tree products and services. These adaptation strategies need to be taken in tandem with government policies and strategies of poverty alleviation and food security, Ayeni, *et al* (2011) suggested adaptation options to includes; tree planting and terracing of slopes to improve slope stability, agro forestry, natural forest regeneration, diversification to new plants species and varieties that would have higher resistance to anticipated temperature increase and reduced in rainfall, reducing forest and woodland destruction rehabilitating overgrazed and irrigated agricultural lands. He further stated that adopting agricultural systems adequate to protect the soil from erosion, establishment of mechanical and engineering structures (e.g. check dams, storm diversion channels, bench terraces, contour bunds) as well as biological measures (e.g. cropping, mulching or contour cultivation (that could reduce soil erosion)

However, Ishaya and Abaje (2008) noted that adapting to climate change strategies include, planting different varieties of crops, cultivating different crops, shortening growing season, changing the extend of land put into crop production, changing to irrigation/fadama farming, the use of chemical fertilizer, improve in water maximization and mulching. More of the adaptation strategies are more on planting different varieties of crops, cultivating different crops and shortening of growing season among others.

Climate change is likely to have a significant impact on farming whether people accept that or not at present, so we should move forward on the issue. It is important to improve our understanding of the issue even if we are not completely sure of the agricultural implications or recommendations. Some actions that address climate change are simply good management practices such as: efficient N fertilizer and manure use, farm energy efficiency, cover cropping, and development of local markets. Innovative farming practices that may address climate change can also enhance profitability and/or air or soil quality (such

as use of bio-diesel and alternative fuels, on-farm energy generation, and reduced tillage systems). He further stated that agriculture has a role to play in the broader effort to reduce greenhouse gas concentrations by: Taking CO2 from the atmosphere and sequestering it in biomass and soils; Decreasing the rate of land clearing for agriculture and taking marginal lands out of production; Changing agricultural practices on productive, established agricultural lands; Increasing efficiency of farm inputs such as fuel, fertilizers, and pesticides; Increasing production of agricultural biofuels (renewable biological-based energy fuels) to replace fossil energy emissions; Improving N-use efficiency as the primary means of decreasing N2O emissions Decreasing methane emissions by capturing or preventing emissions from animal manure storage and by increasing livestock production efficiency, Vern (2008).

The single clearest conclusion emerging from the foregoing literatures is that Climate is currently a topical issue worldwide because of the climatic extremes experienced in various part of the world in recent years, Nigeria inclusive. Therefore climate change refers to a long term change in the statistical distribution of weather patterns over period of time that range from decade to millions of years. It may also mean average weather condition on the earth, including changes in precipitation, temperature and wind pattern, CIESIN (2005). It is also believed that climate change is cause by both natural variability and manmade or anthropogenic forces. It is also clear from the literature that Nigeria contributes to climate change through agricultural activities, rearing of cattle, deforestation, and use of fossil fuel. Two basic response strategies to climate change were also identified from the above literature; these are mitigation and adaptation strategies, the former aimed at controlling or preventing climate change whereas the latter aimed at adapting or accommodating the impacts of climate change.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter contains the description of the methodology used in the collection and analysis of data. The first part contains types, sources and methods of data collection as well as sampling technique while the latter deals with methods of data analysis.

3.2 Data and Data Sources

To achieve the objectives of this research, two types of data collection instruments were used i.e. the primary and the secondary data. The primary data was sourced through the structured questionnaire administered to farmers which was prepared by the researcher based on the set objectives. The questionnaire was structured with open and closed ended response questions, sourced information on farmers' background data, farm data, climate change perception and clime change adaptation in the study area (See appendix i for detail). In addition to questionnaire, discussion/personal interview was held with district heads and aged people who have farming experience and retired from farming due to old age.

The secondary data includes thirty six (36) years rainfall and temperature data of the study area obtained from the archive of Nigerian Meteorological Agency (NIMET) Abuja. Population size of the study area was obtained from the National Population Commission NPC (2006), Bauchi.

Also the researcher generated data from documentary sources. i.e. which involved the analysis of various documents or relevant literatures from research works on the related topics, journals, conferences, text books and conferences proceedings and workshops materials.

3.3 Sample and Sampling Procedures

In this study, the target population of 261,420 farmers representing 80% of the entire population of the study area (362775 numbers of people) was selected proportionately from the three districts. Accordingly, a sample size of 306 was drawn from the target population. To arrive at this figure (306) from the target population, Krejcie and Morgan (1970) table of sampling was adopted which hinted the adequacy of only 80% sample size. A summary of

sample size is presented on table 3.1. For the purpose of administering questionnaire, farmers above the age thirty three years were considered. A total sum of 306 questionnaires was administered to the respondents. Out of 306 copies of questionnaires administered to the respondents, Azare was given 199, Chinade 43 and Madara 64 copies. The primary data was obtained through questionnaire with the aid of trained research assistants. A number of 306 questionnaires were directly distributed to the respondents but 13 out of them could not be retrieved because they refused to return them for only God- knows reason.

By proportionate sampling, the researcher desired the use of sampling technique that guarantees wide representation of the entire population in each defined group. The researcher selected the sample at random in proportion to the size of population of each district using the

Formula;

P = TN/TP x SS where;

P = Proportion of sample obtained from the each district

TN = Total number of farmers in each district.

TP = Total population of the study

SS = Sample size

Below is a table showing the distribution of sample size proportionately drawn across the three districts.

Table: 3.1 List of Districts in Katagum L.G.A.

S/NO	DISTRICTS	POPULATION	SAMPLE
1	Azare	169923	199
2	Chinade	36599	43
3	Madara	54898	64
Total		261,420	306

3.4 Methods of Data Analysis

In this research work, the data analysis involves the use of descriptive statistics. The data collected by the researcher was analyzed using Statistical Package for Social Sciences (SPSS Version 16) with frequencies counts and percentages in order to show the responses of farmers to the questions administered to them inform of structured questionnaire. The monthly rainfall and temperature data collected by the researcher were used in calculating the monthly mean and annual rainfall as well as the maximum and minimum temperature for the study area obtained from Nigeria Meteorological Agency. In the same way, annual rainfall totals were calculated by summing up the daily rainfall data for the period under study within the study area (see appendix IV for details)

In addition to the trend of fluctuation in the precipitation (rainfall) and Temperature, the onset, cessation dates and the length of rainy days in the study area within a given period of 36 years were also analyzed and presented in form of frequencies and percentages and line graphs.

CHAPTER FOUR
RESULT AND DISCUSSION

4.1 Introduction

This chapter presents the results and analysis of rainfall data obtained from the archive of Nigerian Meteorological Agency, Abuja. Attempts were also made to discuss findings from the analysis carried out on the background data, farm data, climate change perception as well as climate change adaptation obtained from the administration of questionnaires. Data is mostly presented using percentages.

4.2 Background data

4.2.1 Socio-economic characteristics of respondents in the study area

Table 4.1 shows the basic socio-economic backgrounds of the sample respondents. The distribution of the respondents by sex revealed that in each of the three districts more than 90 percent of the respondents are male while only less than 10 percent reported as female. For example, in the Azare district the sample includes 91.4 percent of males and 8.6 percent of female. In Chinade the sample include 95.1 percent of males and 4.9 percent of female and in Madara the sample respondents include 93.8 percent of males and 6.2 percent of females. The reason for the low participation of female in farming system in the study area can be explained by the predominance of Islamic culture in which purdah is practiced. Even the 22 female out of 306 sample farmers used this study are mostly found in the Azare district due to urbanization and change in cultural practices especially with the proliferation of civil servants coming from different cultural background. The distribution of the respondents by age revealed that in the Azare district 53.5 percent of the respondents are in the age of 47years and above, in same district those between the ages of 40-46 are 29.9 percent, only 16.6 percent are within the range of 33-39 years. About 53.7 percent in the Chinade district are said to be within the age of 47years and above, while 43.9 percent are within the age limit of 40–46 years, only 2.4 percent of the respondents are in the age of 33–39years. Whereas in the Madara district about 46.2 percent of the sample farmers are between the age of 47years and above, 43.1 percent are within the age of 40-46years only 10.8 percent are in the of 33-39years. The distribution of respondents by age revealed that about 53.5 percent of the respondents in Azare, Chinade 53. Only 16.6 percent in Azare, Chinade 2.4 percent and Madara 10.8 percent formed small portion of the sample farmers are in the age bracket of 33-39. The distribution of the sample farmers by education reflects that majority of them have

had some formal education. Table 4.1 revealed that in Azare district alone about 51.9 percent of the respondents attended post-secondary education, 24.6 percent had Qur'anic education, 12.3 percent had secondary education and only 11.2 percent had primary education. In Chinade 36.6 percent of the respondents attended post-secondary education, 26.8 percent Qur'anic, 22.0 percent secondary and only 14.6 percent had primary form of education. In Madara 30.7 percent of the respondents attended Qur'anic, 26.2 percent had primary education, 24.6 percent secondary and only 18.5 percent formed post-secondary education.

The occupational distribution of the sample farmers varied across the three districts. Table 4.1 shows that in Azare 39.6 percent are fulltime- farmers, 35.8 percent farming and civil servant, 17.1 percent farming and trading and only 7.5 percent engaged in farming and other livelihood option. The same to Chinade fulltime-farming form the majority with 53.7 percent, farming and civil servant 24.4 percent and only 22.0 percent engaged in farming and trading. Whereas in Madara the occupational distribution differs significantly were in Azare and Chinade districts fulltime farming had less than 50% in Madara over 67.7 percent are fulltime farmers, 18.5 percent farming and civil servant, only 13.8 percent engaged in farming and trading. The Table also clearly reveals that about 54.0 percent of the respondents in Azare, Chinade 53.7 percent and Madara 49.2 percent have been in the farming activities for 31years and above. About 35.2 percent of the respondents in Azare, 36.6 percent Chinade and Madara 41.5 percent have been practicing farming activities for 20-30years. Only about 10.7 percent of the respondents in Azare, Chinade 9.7 percent and Madara 9.3 percent have been in farming for 10-20years. This is considered fairly long enough for them to observed changes in their farming activities and the environment in general.

Table 4.1 Percentage Distribution of Respondents by Selected Socio-Economic Characteristics in the area.

Socio-Economic Characteristics	**DISTRICTS**					
	Azare		**Chinade**		**Madara**	
`	No of resp.	%	No of resp.	%	No of resp.	%
Sex						
Male	171	91.4	39	95.1	61	93.8
Female	16	8.6	2	4.9	4	6.2
Age						
33 – 39	31	16.6	1	2.4	7	10.8
40 – 46	56	29.9	18	43.9	28	43.1
47 and above	100	53.5	22	53.7	30	46.2
Educational Level						
Primary	21	11.2	5	14.6	17	26.2
Secondary	23	12.3	9	22.0	16	24.6
Post-Secondary	97	51.9	16	36.6	12	18.5
Qur'anic	46	24.6	11	26.8	20	30.7
Occupation						
Fulltime - farming	74	39.6	22	53.7	44	67.7
Farming and trading	32	17.1	9	22.0	9	13.8
Farming and civil servant	67	35.8	10	24.4	12	18.5
Farming and others	14	7.5	-	-	-	-
Farming Experience						
10-20yrs	20	10.7	4	9.7	6	9.3
21-30yrs	66	35.2	15	36.6	27	41.5
31yrs and above	101	54.0	22	53.7	32	49.2

Source: Field Survey, 2012

4.3 Information on farm data

4.3.1 Distribution of Respondents Based on Means of Ownership, Farm Size, Income, Cropping System and Implement used.

Table 4.2 it can be seen that majority of the respondents forming more than 50% are in affirmation that the farmlands they cultivate belong to them. Most of them acquired the farmlands through inheritance as indicated by 56.1 percent of the respondents in Azare district. 58.5 percent Madara and 67.7 percent Chinade all acquired through inheritance. Less than 40% acquired their farmland through purchase as indicated in Table 4.2, the findings revealed that Chinade 39.0 percent, Azare 38.5 percent and Madara 30.8percent. Only 13 respondents representing 13.9 percent in all the three districts responded that the farmlands are leased out to them. The problem associated with this type of ownership of farmland System is that, it resulted to increase in over pressure and farmland fragmentation through an effort to provide increasing number of land owners leading to poor management of

agricultural practices. The Table also shows the percentage of farmer' responses with respect to their farmland size in the study area. The respondents having 1-1.9 hectare include sample of 40.6 percent for Azare, Madara 35.4percent and Chinade with 34.1 percent. Those respondents with farmland size between 2 - 2.9hectare include the sample of 35.4percent in Madara, Chinade 29.3 percent, and Azare with 20.9 percent. 21.9%, 17.1% and 15.4% with 3 hectare and above in Azare, Chinade, Madara respectively. 19.5 percent of the respondents in Chinade, Azare 16.6 percent and Madara 13.8 percent have farmland size of less than 1 hectare. From the responses it could be deduced that the sizes of the farmlands are small and this greatly affects the production. Since majority of the farmers acquired farmlands through inheritance and are of the sizes of less than 3 hectares, this impliedly means they produce in small quantity mostly for domestic consumption, more so as production here is proportional to the size of the land used, also the technology employed and the combined nature of their occupation. The local farmers in Chinade and Madara districts use local tools mostly simple hoe and Ox-drown, unimproved varieties of seed on small lands, hence the low production of farm produced. The distribution of respondents by source of capital revealed that majority of them earned their income through personal savings. About 64.7 percent of sample farmers in Azare, 62.2 percent in Madara and Chinade with 61.0 percent sourced their capital through personal savings. Respondents that cited bank loan as their sourced constituted less than 30 %, Azare with 20.8 percent, Chinade 29.3 percent and Madara 20.0 percent. This is indicating that those respondents solely depend on farming source their capital through personal saving and those farmers who combined farming and civil servants source their capital both from personal saving and loan from banks. Only 14.5% of the respondents in Azare, Chinade 9.8percent, and Madara 13.8 percent source from individual and relation.

The distribution of respondents by cropping system indicated that 81.1percent in Azare, 87.2 Chinade and Madara 92.3 percent of the sample farmers' practices mixed farming, only 18.2%, 22.8%, and 7.7% practices sole cropping in Azare, Chinade and Madara respectively. Results from Table 4.1 indicate that cultivation of farm land in the three districts is mostly done by combined tools i.e. simple hoe and cutlasses, Ox- drown plough and tractor. Simple hoe and cutlasses constituted the majority in Madara with about 49.2 percent, simple hoe and cutlasses formed the majority in Chinade whereas in Azare district tractor 21.3 percent, simple hoe & cutlasses and Ox- drown plough form 20.3 percent each.

Table 4.2 Percentage Distribution of Respondents with respect to Selected Farm data Characteristics in the Study Area.

Variables `	**DISTRICTS**					
	Azare		**Chinade**		**Madara**	
	No of resp.	%	No of resp.	%	No of resp.	%
Mean of possession the Farm land						
Purchase	72	38.5	16	39.0	20	30.8
Inheritance	105	56.1	24	58.5	44	67.7
Lease	10	5.3	1	2.4	1	1.5
Farm size						
0 - 0.9 hectare	31	16.6	8	19.5	9	13.8
1-1.9 hectare	76	40.6	14	34.1	23	35.4
2 - 2.9 hectare	39	20.9	12	29.3	23	35.4
3 hectare and above	41	21.9	7	17.1	10	15.4
I**ncome**						
Personal saving	121	64.7	25	61.0	43	62.2
Bank Loan	39	20.8	12	29.3	13	20.0
Individual and relations	27	14.4	4	9.8	9	13.8
Cropping System						
Mixed cropping	153	81.8	36	87.2	60	92.3
Sole cropping	34	18.2	5	22.8	5	7.7
Implements used						
Hoe and cutlass	38	20.3	15	36.6	6	9.2
Ox-drawn plough	38	20.3	5	12.2	7	10.8
Tractor	41	21.9	7	17.1	13	20.0
Both a and b	37	19.8	12	29.3	32	49.2
Both a and c	33	17.6	2	4.9	7	10.8

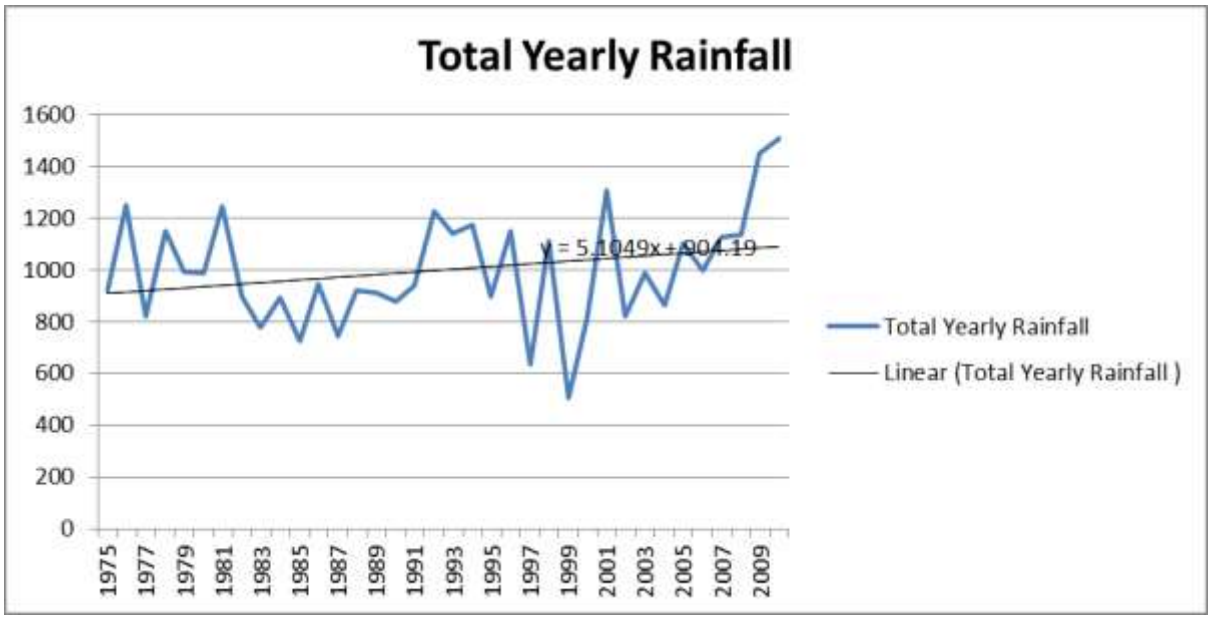
Source: Researcher's Survey, 2012

4.4. Analysis of rainfall data

4.4.1 Trend in Mean Annual Rainfall in Azare Katagum L.G.A. Bauchi Northen Zone for 36 Years (1975-2010)

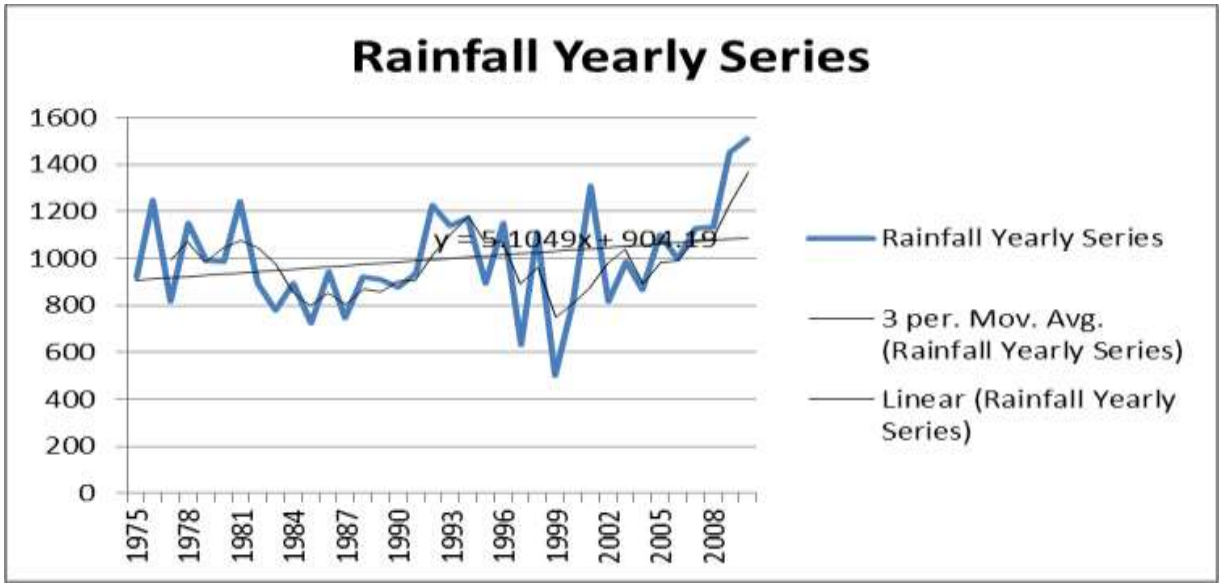
Fig. 4.1 shows the fluctuation and trend in the annual rainfall distribution by year. It shows the total annual rainfall in Azare Katagum LGA, Bauchi Northern Zone. The distribution of rainfall varies annually through the period of 36 years. The graph shows a clear variation in the occurrence of the amount of rainfall in each year. Three year running average value indicates a sudden increase in the first decade as we can see in fig.4.1 below. 1981(1250.7mm) attained the highest peak, and sharply declined in the second decade i.e. 1999 with rainfall value of 932.7mm. The years that have higher rainfall value occurred in

2010 (1504.1mm) and 2009 (1448.3mm) all in the third decade. This shows that the decadal mean of the annual rainfall in Katagum from 1975-2010 shows a rise in the first decade with a rapid fall in the second decade and reaching the peak in the last decade. The trend is considered to be in accordance with farmers' perception as regards to the increase in rainfall in the study area. It can be rightly be observed that a greater number of respondents representing 55% both at Azare and Chinade districts and about 80% from Madara district are of the view that, rainfall is increasing, considerably. It can therefore be concluded that rainfall trend increases in Katagum LGA from 1975 – 2010.



YEARS

Fig 4.1 Trend in Total annual rainfall (mm) values in Azare for 36years (1975-2010)



Years

Fig. 4.2 Three year annual rainfall (mm) running average in Katagum LGA for 36 years (1975-2010)

4.4.2 Statistics of annual Rainfall in Azare Katagum L.G.A 1975-2010

From the table 4.3 of statistics of annual rainfall in Katagum LGA from 1975 – 2010, it could be observed that the mean annual rainfall is 998.6278. This is obtained from the monthly averages of rainfall for a period of between March to October being the only periods when precipitation (rainfall) values are recorded. In the same way, monthly deviations of rainfall figures obtained were summed up, with which the researcher arrived at the standard deviation of 459.491590 for the months stated above. It is in a similar way that the coefficient of variation, skewness and kurtosis (88.647, 10.70, and 24.8370 respectively) were determined. (See figure 4.3 for details) of statistics of the annual rainfall which was ascertained in Azare for the period under study.

Table 4.3 Statistics of Monthly Rainfall Value in Azare, Katagum 1975-2010

	March	April	May	June	July	August	Septembe r	October
Mean	2.5889	30.1250	84.45833	161.055 6	234.383 3	281.452 8	166,7361	36.33889
S/Dev	7.43047	32.51847	38.70836	73.3292 3	88.8491 9	92.0733 6	86.94968	39.63283
CV	55.212	1.057	1.498	5.377	7.894	8.478	7.560	1.571
Skew	3.453	1.547	.418	.486	.805	.359	.970	2.662
Kurt	11.659	2.447	.008	.241	1.011	1.856	3.200	4.415

Source: Based on data from Nigerian Meteorology Agency (NIMET), Abuja.

4.4.3 Trend in Average Annual Minimum and Maximum Temperature in Azare, Katagum L.G.A., Bauchi Northern Zone from 1975-2010

Figure 4.4 have shown the highest and lowest minimum annual mean temperature, the lowest minimum annual temperature of 18.30^{O}C was recorded in 1975 and 1977 while the highest minimum annual mean temperature of 20.80^{0}C in 2009 and 21^{O}C were observed in 2005 and 2010. However figure 4.5 shows the highest and the lowest mean annual maximum temperature of 33.90^{O}C and 30.90^{O}C. Generally, both the minimum and maximum temperature were slow in the first decade but the pattern have change earlier in the second decade later dropped around the middle of the same decade, it rises again and these increase continue throughout the third decade. The last decade recorded the highest minimum

temperature value right from 2005 to 2010 as earlier mentioned with a slight declined in maximum temperature in 2008 and with rapidly increased in 2009 and 2010. The linear trend shows an increase in both the minimum and maximum temperature in the study area. This support the findings of farmers responses in the increase in temperature in the study area were about 174 (93%) out of 187 (100%) in Azare, 36 (87.8%) out of 41(100%) in Chinade and 56 (86.2%) out of 65 (100%) in the Madara district said that there is increased in the temperature in the study area. It can be ultimately deduced that the temperature is rising in Katagum LGA from 1975 to 2010.

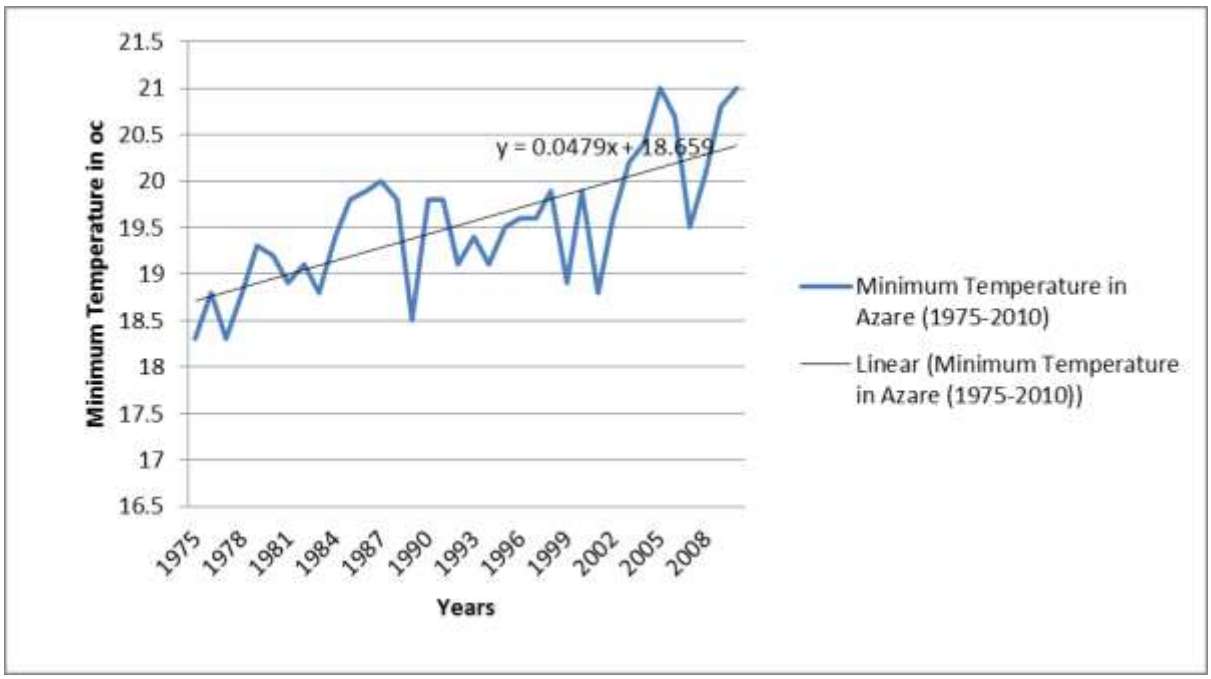


Figure 4.3 Trend in Annual Minimum Temperature in Azare, Katagum L.G.A (1975 – 2010)

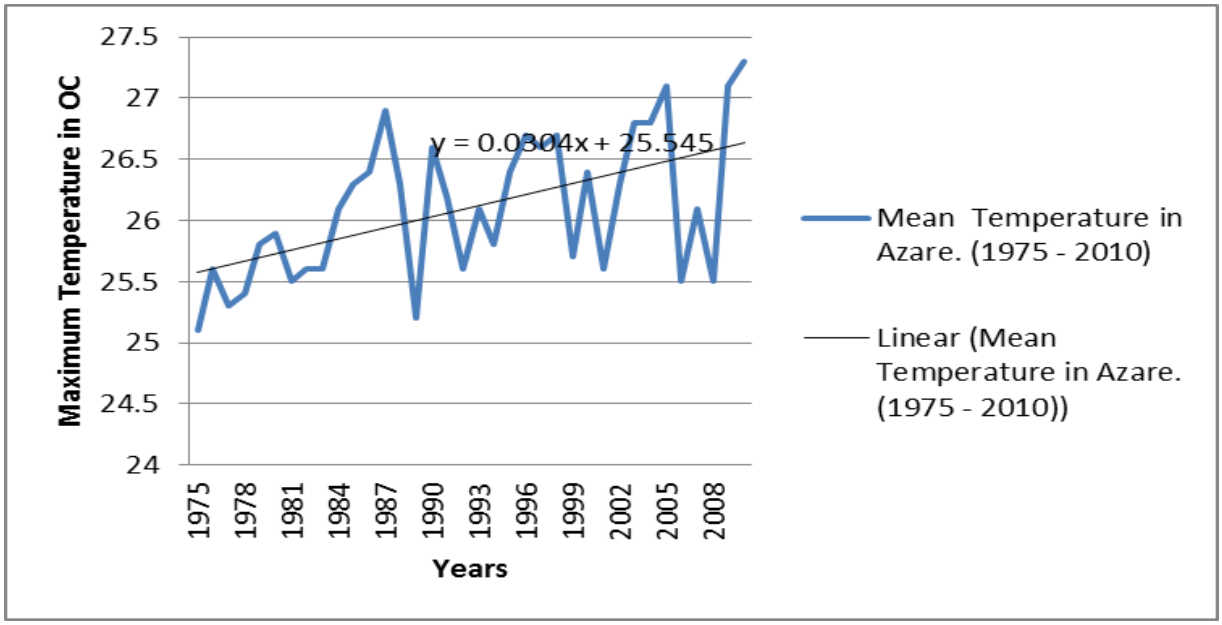


Figure 4.4 Trend in Annual Maximum Temperature in Azare, Katagum L.G.A (1975 – 2010)

4.4.4 Trend in Onset, Cessation and Length of Rainy Season

Onset refers to the time a place receives an accumulated amount of rainfall sufficient for growing of crops. It is not the first day the rain falls. Cessation means the termination of the effective rainy season, it does not imply the day rain falls, but when rainfall can no longer be assured. Length of Rainy season (LRS) is the difference between the cessation date and onset date.

Figure 4.6 Shows the trend of onset dates of rain in the study area. The trend of onset dates in the study area rotated around first to third week of April but majory of the onset are in May with the exception of the 1997 where the onset of rains arrived very lately in July. Table 4.4, shows that about 19% of the rain begings from 1st to 3rd weeks of April. 64% of the onset received in May. 14% of the rains started in June with only 3% of the onset received in July. On the other hand, the Cessation dates in the study is deelayed as shown in figure 4.5. The trend of cessation dates indicates that most of the rain terminated in late September and some times even in October with the exception of the year 1991 where the rain terminated in August. Table 4.5 shows that about 6% of Cessation dates terminated in August, 19% in October and 75% in September.

Table 4.4 Frequency of Onset Dates for Azare (1975 – 2010)

DATE	OBSERVED	PERCENTAGE (%)

	OCCURRENCE	
APRIL 1st – 22nd	7	19
MAY 1st – 31st	23	64
JUNE 1st – 30th	5	14
JULY 1st – 31st	1	3
TOTAL	36	100

Source: Field survey, 2012.

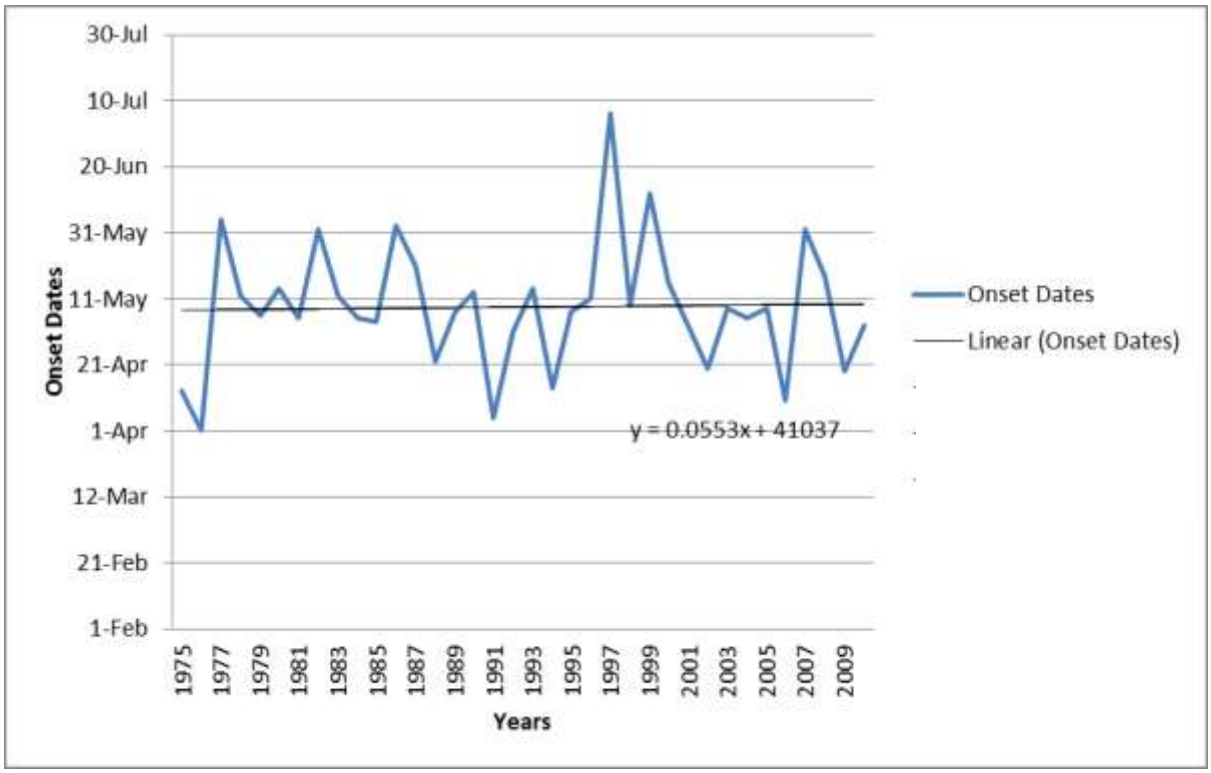


Figure 4.5 Trend in Onset Dates in Azare, Katagum L.G.A (1975 – 2010)

Table 4.5 Frequency of Cessation Dates for Azare (1975 – 2010)

DATE		OBSERVED OCCURRENCE	PERCENTAGE (%)
AUGUST	1st – 31st	2	6
SEPTEMBER	1st – 30th	27	75
OCTOBER	1st – 31st	7	19
TOTAL		36	100

Source: Field survey, 2012.

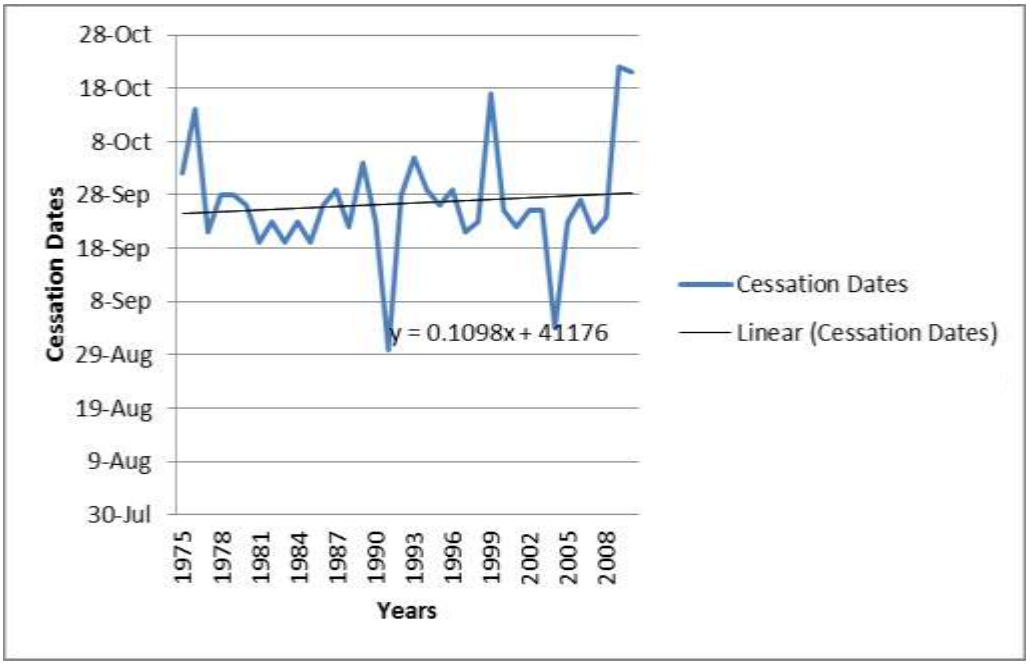


Figure 4.6 Trend in Cessation Dates in Azare, Katagum L.G.A (1975 – 2010)

4.4.5 Length of Rainy season

Figure 4.7 shows the trend of the length of rain days in Azare. The longest rainy days recorded was in 1976 with 197days, 2009, 187, 171 in 2006 and 2010. The lowest rainy days recorded was in 1997 with 78 days followed by 1987, 101days, 1977 110days, 2007, 113days and 117 in 1986. This is as a result of late onset and early cessation in the study area during those periods.

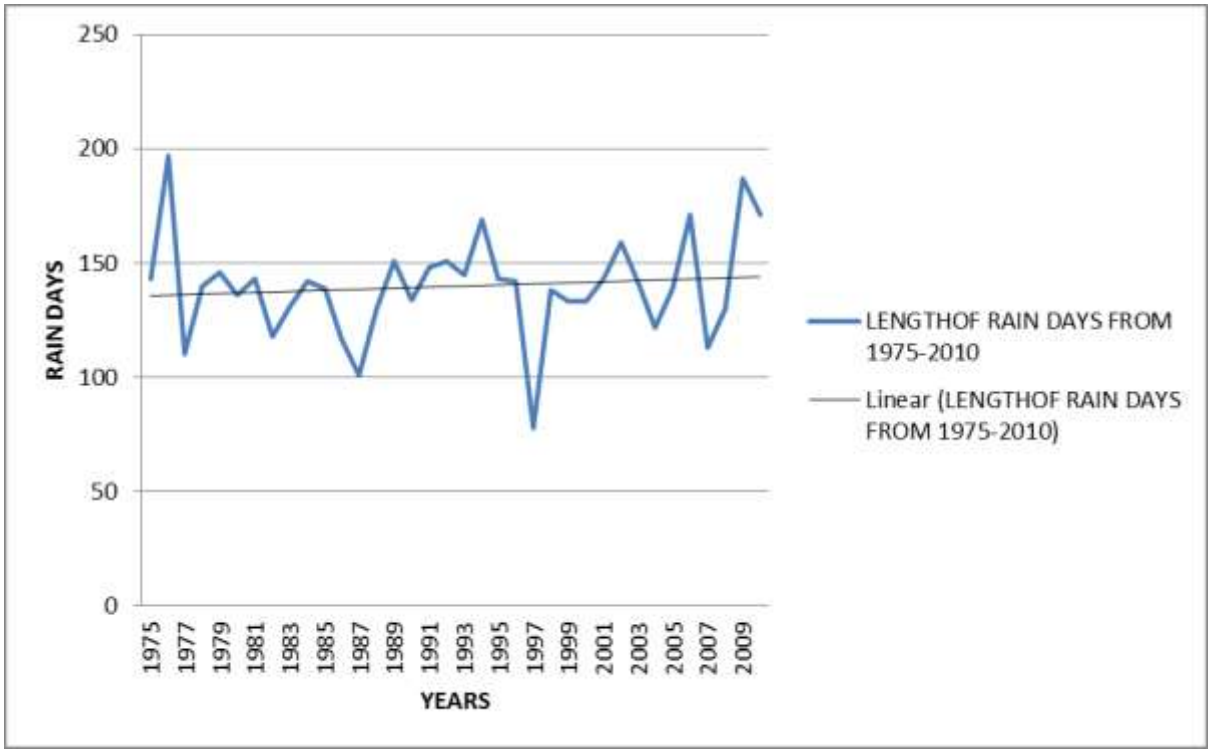


Figure 4.7 Trend in Length of Rain Days in Azare, Katagum L.G.A (1975 – 2010)

4.5 Farmers perception of climate change

This section discusses the local farmers' perception to climate change in the study area with regard to rainfall and temperature variability, onset and cessation dates of rains, adaptation measures as well as the difficulties to adaptation.

Table 4.6. The result indicates that 93.0 percent of farmers in Azare, 87.8 percent in Chinade and about 86.2 from Madara district are in the view that there is temperature increase and only 7.0percent, 12.2 percent and 13.8 percent from Azare, Chinade, and Madara that said there is no increase in temperature. This means that above 80% of the sampled farmers in the study area consider temperature increase as an indicator of climate change. About 53.4 percent and 55.4 and some 17.1 percent of farmers surveyed at Azare, Madara and Chinade perceived an increase in temperature for about two decades, whereas about 56.1 percent, 30.0percent, and 24.4 percent of farmers in Chinade, Azare and Madara districts perceived an increase for the last decade. Only 16 percent from Azare, 26 percent from Chinade and 20 percent of farmers surveyed are in the view that there is increase in temperature for over 21 years.

In terms of rainfall, 80 percent of the sample farmers from Madara reported increase, 57.8 percent from Azare and Chinade 56.1 were also reported an increase in rainfall in the study area. About 41.7 percent reported a decrease in rainfall in Azare, Chinade 36.6 percent and 20 percent also reported decrease in rainfall from Madara district. Only 7.3 percent and 0.5 percent of the respondents from Chinade and Azare said that there is no increase. The variation in farmer's opinions is not unconnected with their level of education and modernization. Local farmers in the study area observed and comment on rainfall based only on onset and cessation of rainfall. They have no meteorological station upon which would have been more accurate. For this reasons, the opinions of farmers vary as they buttress their opinions. This research result support the conclusion of Ejeh, *et al* (2011) that farmers in the study Area observed that their environment is getting warmer and drier leading to increased frequency of dry spells and changes in the timing of the rains. Observed trends of temperature and precipitation support this perception. Heavy storms, floods after rains, changing precipitation patterns are among major climate related hazards. Hence this result indicate that majority of farmers perceived that there is increased in rainfall in the area rather than decrease. A very large percentage of respondents in all the three districts agreed that the onset/beginning of planting date is delayed with about 114 (61.0%) out of 187 (100%) respondents in Azare, 27 (65.9%) out of 41 (100%) in Chinade and 36 (55.4) out of 65 (100%). Those reported early onset are less than 20% out of 100% of the sample farmers

from each district. About 35.4 percent of the respondents from Madara said that there is no change as regard to onset of rain. 19.7 percent and 19.5 percent from Azare and Chinade are also in the view that the onset of rain is not changing. While farmers in the study area perceived that the cessation period is also delayed Madara 56.9 percent, Chinade 43.9 percent and Azare 38.5 percent. 37.4 percent, 29.3 percent and 23.1 percent from Azare, Chinade and Madara indicates early cessation of rains in the area. Those reported that there is no change in cessation include 24.1 percent, 26.8 percent and 20.0 percent respectively.

In conformity to the trend of onset and cessation dates of rain in the study area, perception of farmers revealed that the onset, nowadays, arrived lately and that of cessation terminated early. Table 4.6 indicates the above statement in such a way that over 60% of respondents from Azare and Chinade opined delayed onset. Over 50% of respondents from Madara district came with the same view. However, with regard to cessation, it was observed that cessation is delayed as according to 39% of the respondents from Azare, and 44% from Chinade as well as 57% from Madara. Conclusively, onset of rain in Katagum LGA is generally delayed, whereas cessation is to be considered moderately delayed.

Table 4.6: Respondents Perception of Climate Change

Variables `	DISTRICTS					
	Azare		Chinade		Madara	
	No of resp.	%	No of resp.	%	No of resp.	%
Temperature						
Increasing	174	93.0	36	87.8	56	86.2
No increasing	13	7.0	5	12.2	9	13.8
Time of Rising Temperature						
1 – 10years	56	30.0	23	56.1	16	24.6
11 – 20yrs	100	53.4	7	17.1	36	55.4
21years & above	31	16.6	11	26.8	13	20.0
Rainfall						
Increasing	108	57.8	23	56.1	52	80.0
Decreasing	78	41.7	15	36.6	13	20.0
No increase	1	.5	3	7.3	_	_
Onset						
Early	36	19.3	6	14.6	6	9.2
Delayed	114	61.0	27	65.9	36	55.4
No change	37	19.7	8	19.5	23	35.4
Cessation						
Early	70	37.4	12	29.3	15	23.1
Delayed	72	38.5	18	43.9	37	56.9
No change	45	24.1	11	26.8	13	20.0

Source: Field Survey, 2012

4.6 Assessment of Demographic Characteristics on the Perception of Farmers

The result on the analysis of variance on table 4.7 indicated that there is no significant variation on the respondents' perception to climate change at 0.05 level of significance in respect of their age (0.55) and educational qualification (.309) respectively. Whereas significant variation can be observed in respect of occupation (0.003) and farming experience (.011)

This generally implies that the perception of farmers to climate change in Katagum LGA is considered to be the same irrespective of age and educational qualification

differences. On the other hand, it can be concluded that their perception to climate change differs in terms of occupation and their experience in farming, specifically farming and civil service as well as farmers with less than 20 years of experience.

Table 4.7 Assessment of Demographic Characteristics of the Perception of Respondents

Characteristics	Perception	Sum of Squares	Df	Mean Squares	F	Sig.	Remark
Age	Between Groups	12.328	2	6.164	2.933	0.55	Not Sig.
	Within Groups	609.365	290	2.101			
Educational Qualification	Between Groups	7.670	3	2.557	1.203	.309	Not Sig.
	Within Groups	614.023	289	2.125			
Occupation	Between Groups	28.943	3	9.648	4.704	0.003	Sig.
	Within Groups	592.750	289	2.057			
Farming Experience	Between Groups	19.063	2	9.532	4.587	.011	Sig.
	Within Groups	602.629	290	2.078			

Key: Significant = There is Significant Variation

Not Significant = There is no Significant Variation

$\alpha = 0.05$ level of Significance

4.5.1 Knowledge of indicators of Climate Change and Effects on Agricultural Activities

About 68.2 percent of farmers surveyed perceived that deforestation is the main cause of climate change in Chinade district. Another 22.0 percent attributed it to agricultural activities. Only 9.8 percent are in the view that the change in climate are as a result of long term natural global change. In Azare and Madara districts the percentage are 58.3 and 55.4 respectively. While 22.4 percent and 21.5 percent said that the changes in climate is as result of long term global change. Only 19.3 percent in Azare and 23.1 percent from Madara indicates that agricultural activities as the cause of climate change in the area. This support the findings by Odjugo *et al* (2011) titled "Evaluation of the State of Climate Change adaptation Strategies in Nigeria" reported that the causes of climate change have been scientifically studied and showed that deforestation, water pollution, industrialization, transportation among the highest contributors, Nmet Zaria, (2011). About 67.7 percent of the respondents in the Madara district agreed that the flood incidences have increase, also in the increase of flood incidences 55.1 percent are reported from Azare and 29.3 in the Chinade district, 70.7 percent in the Chinade district perceived that there is no incidences of flood,

about 44.9 and 32.3 percent in Azare and Madara districts perceived that there is no incidences of flood. However, over 80 percent in the Azare, 78.0 percent Chinade and Madara 72.3 percent of the respondents perceived that the number of dry days is increasing, only 27.7 percent in the Madara, 22.0 percent Chinade and Azare 17.1 percent reported contrary in the area. The result on the incidences of flood and dry days support the conclusion of Ejeh, *et al* (2011) that farmers in Sumaila LGA. of Kano State observed that their environment is getting warmer and drier leading to increased frequency of dry spell and changes in the timing of rains. Heavy storms floods after rains, changing precipitation patterns are among the major climate related hazards.

Table 4.7 also shows the percentage distribution of the respondent with regards to the effects of climate change on agriculture and crop production were over 80 percent of the sample farmers in each of the three districts agreed that climate change have effect agriculture while only less than 14.0 percent said it has no effect. This result implies that climate change effect agriculture in the study area. However, large proportion over 90 percent in the Azare district and 80 percent of the respondents in Chinade and Madara districts indicates that there is reduction in crop production and less than 20 percent of the respondents across the three districts are in the view that there is no reduction. This implies that good percentage of farmers are of the view that climate negatively effects agriculture and thus, causing reduction in crop production.

Table 4.8: Respondents Perception of Causes of Climate Change and Effect on Agricultural Activities

Variables	**DISTRICTS**					
`	**Azare**		**Chinade**		**Madara**	
	No. of resp.	%	No. of resp.	%	No. of resp.	%
Causes of Climate Change						
Long term natural global change	42	22.4	4	9.8	14	21.5
Deforestation	109	58.3	28	68.2	36	55.4
Agricultural activities	36	19.3	9	22.0	15	23.1
Incidences of floods						
Yes	103	55.1	12	29.3	44	67.7
No	84	44.9	29	70.7	21	32.3
Number of dry days						
Yes	155	82.9	32	78.0	47	72.3
No	32	17.1	9	22.0	18	27.7
Effect on agricultural activities						
Yes	161	86.1	36	87.8	56	86.2
No	26	13.9	9	12.2	9	13.8
Decreased in Crops production						
Yes	172	92.0	33	80.5	58	89.2
No	15	8.0	8	19.5	7	10.8

Source: Field Survey, 2012

4.5.2 Sources of information on climate change in the study area

When the sample farmers were asked to state their source of information or knowledge of climate change issues they acknowledge their sourced through radio, print media, farming experience. Only small portion of the respondents were able to acquire the information through school and also had from people around (7.5 percent and 3.7 percent) in the Azare

district, Chinade (7.3 percent), Madara (6.2 percent and 7.7 percent) respectively. About 36.4 percent, 29.3 and some 21.5 percent across the three districts got their knowledge through radio, 27.8 percent in the Azare district, Chinade 24.4percent, Madara 15.4 percent source their information through print media, greater percentage of 49.2 percent in the Madara, 31.7 percent in Chinade and some 24.6 percent in the Azare district got their knowledge through farming experience. This result revealed that the widest and famous means of public enlighten is through electronic and print media as well as public campaign through agricultural extension services.

4.9 Awareness of climate change in the area

Source knowledge	**DISTRICTS**					
	Azare		**Chinade**		**Madara**	
	No. of resp.	%	No. of resp.	%	No. of resp.	%
Radio	68	36.4	12	29.3	14	21.5
Newspaper	52	27.8	10	24.4	10	15.4
Farming experience	46	24.6	13	31.7	32	49.2
In School	7	3.7	3	7.3	4	6.2
from people	14	7.5	3	7.3	5	7.7

Source: Field Survey, 2012

4.5.3 Farmers' Adaptation to climate change across the three districts of the study area.

Adaptation has been described as an understanding of how individuals, groups and natural systems can prepare for and respond to changes in climate or their environment Mitchell and Tanner (2006). The common responses did respondents adapt in the study area include embarking on shifting cultivation, changes in crop type, increase in the use of local manure, increase in the use of fertilizer, planting trees, change from crops to livestock and prayer. Table 4.9 indicates that about 36.6 percent in the Chinade district, 33.2 percent Azare and Madara 18.5 percent of the respondents said that they change crop types as adaptation measures. About 17 to 19 percent of the respondents across three districts adapt change of cultivated land area. 14.4 percent in Azare, 15.4 in Madara, Chinade with only 7.3 percent of the respondents adapt increase in the use of local manure; another 24.6 percent in the Madara district, Azare17.1percent, Chinade 9.8 percent said there is need for the increase in fertilizer.

In other vein, 12.2 percent in the Chinade district, 9.2 in Madara, Azare 5.3 percent of the responses adapt planting trees as climate change adaptation, another 12.3 percent in the district of Madara, Azare 9.8 percent, Chinade 7.0 percent stated that they change from crops

to livestock most of them female, and only 5.9 percent in the Azare, Chinade 4.9 percent, Madara 1.5 percent of the responses cited prayers as climate change adaptation measures in the study area. This implies that change in crops types, change in cultivated land area, increase in the use of fertilizer and planting trees stands as the most common adaptation measures adapted by the respondents across the three districts comprising the study area. This result support the findings of Ishaya and Abaje (2008) that the Indigenous adapting to climate change strategies in Jema'a LGA of Kaduna State. Nigeria include, planting different varieties of crops, cultivating different crops, shortening growing season, changing the extend of land put into crop production, changing to irrigation/fadama farming, the use of chemical fertilizer, improve in water maximization and mulching. More of the adaptation strategies are more on planting different varieties of crops, cultivating different crops and shortening of growing season. Factors hindering the use of quality seed are found to be the non-availability of the desired variety seeds and higher price of quality seeds. It is also in line with the findings of Gbetibouo (2008) that the farmers' common responses to adaptations in Limpopo Basin, South Africa included planting different crops, changing crop varieties, changing planting dates, increasing irrigation, diversifying crops, changing the amount of land grazed or under cultivation, or supplementing livestock feed.

4.10 Percentage Distribution of Respondents with respect to Selected Adaptation Measures in the Study Area.

CLIMATE CHANGE	**DISTRICTS**					
ADAPTATION	**Azare**		**Chinade**		**Madara**	
	No. of resp.	%	No. of resp.	%	No. of resp.	%
Change in cultivated land area	32	17.1	8	19.5	12	18.5
Changes in crop types	62	33.2	15	36.6	12	18.5
Increase in the use local manure	27	14.4	3	7.3	10	15.4
Increase in the use of fertilizer	32	17.1	4	9.8	16	24.6
Planting trees	10	5.3	5	12.2	6	9.2
Changing from crop to livestock	13	7.0	4	9.8	8	12.3
Prayer	11	5.9	2	4.9	1	1.5

Source: Field Survey, 2012

4.5.4 Perceived difficulties to adaptation of modern techniques of combating climate change

Table 4.10 shows that 31.7 percent in the Chinade district, Azare 27.0 percent, Madara 21.5 cited lack of information on weather incidences as the major hindrances to adaptation in the study area. While about 20.9 percent, 12.2 percent, and 13.8 percent of the respondents in the Azare, Chinade, and Madara districts acknowledged difficulties to adaptation to lack of water for irrigation farming. About 29.2 percent in the Madara district, Chinade 24.4 percent and Azare district with only 11.8 percent of the sample farmers attributed that lack of improved seed are the major problem to adaptation in the area. However, about 21.5 percent from same Madara, 19.8 percent Azare and 17.1 percent of the respondents in the Chinade district perceived that lack of information and knowledge on appropriate adaptation measures as difficulties to adaptation. While 13.5 percent in the Azare district, Chinade 12.2 percent and Madara 10.8 percent said that lack of access to credit was their major problem to adaptation, only 7.0 percent in the Azare, 3.1percent in Madara and Chinade 2.4 percent of the sample farmers said there is no problem to adaptation in the study area. This result is in contrary to the research findings of Gbetibouo (2008) that the farmers in Limpopo Basin, South Africa include; poverty and lack of savings, insecure property right, and the lack of market were cited as the major significance barrier to adaptation. But consistence with the findings of Ishaya and Abaje (2008) The perceived hindrances to adoption of modern technique as adaptation strategies of climate change include lack of improved seeds, lack of assess to water for irrigation farming, lack of current knowledge on adaptation methods, lack of information on weather incidence and lack of money to acquired modern techniques all influences the drive towards adapting to climate change.

4.11 Distribution of Respondents in Respect of Selected Difficulties to Adaptation in the Study Area.

Difficulties to adaptation	**DISTRICTS**					
	Azare		**Chinade**		**Madara**	
	No. of resp.	%	No. of resp.	%	No. of resp.	%
Lack of information on weather incidence	51	27.0	13	31.7	14	21.5
Lack of water for irrigation farming	39	20.9	5	12.2	9	13.8
Lack of improved seed	22	11.8	10	24.4	19	29.2
Lack of information and knowledge on appropriate adaptation measures	37	19.8	7	17.1	14	21.5
Lack of access to credit	25	13.5	5	12.2	7	10.8
There is no problem to adaptation	13	7.0	1	2.4	2	3.1

Source: Field Survey, 2012

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study aims at analyzing farmers' perception and response with regard to recent climatic change in Katagum Local Government Area, Bauchi State.

Climate change is one of the most important global environmental threats, causing disasters such as low agricultural output, delayed in onset and early cessation, increase in temperature and frequent drought, flooding and other environmental damages resulting from greenhouse gases injected to the earth atmosphere etc. This has serious implications on food supply, ecosystem, water supply and health among others. Therefore, the effects cannot be over-emphasized. Being farmers are always at the receiving ends of these damages; particularly in the arid zones, there is need to mobilize farmers to further understand the danger of the adverse impact of climate change in the study area. Therefore, data was sourced from both primary and secondary source, which include, structured questionnaire, record of rainfall and temperature data, population size of the study area and review of literature, respectively. The data was further subjected to descriptive statistics, trend analysis and the analysis of variance (ANOVA).

Accordingly, the background data has revealed that about 90-95% of the respondents were male while the female were less than 10 % mostly aged 40-47 years and above and have practiced farming for more than 31 years. Majority of the respondents are literate and took to farming as their primary activity. The study on perception also revealed that 86-97% and 56-80% of the respondents felt the impact of climate change and they believed that temperature and rainfall are increasing and have noticed increased in temperature for the last two decades across the three districts of the study area. Approximately 60 % noticed delayed in onset and 44 % believed that cessation of rainfall is delayed in the study area. About 60 % at the average attributed that deforestation stands as the major caused of climate change in the area. 55-67% in Azare and Madara districts reported increased in flood, number of dry days are also increasing causing effects on agriculture consequently resulted in the decreased in crop production in the study area. The result of one – way analysis of variance (ANOVA) indicated that there is no significant variations in the respondents' perception to climate change irrespective of age and educational qualification, whereas there is significant variation in respondents' occupational characteristic and farming experience. Major source of information on climate change in the study area are electronic media and farming experience.

The common adaptation measures identified to all the three districts are changes in crops type, Increase in the use of fertilizer, increase in the use of local manure, change from crops to livestock among others. While planting of trees and prayer remained the least measures in the study area. It was also revealed that lack of information on weather incidence, water for irrigation, information on appropriate adaptation measures and lack of improved seed are the perceived difficulties to adaptation in the area.

After examining the trend in rainfall pattern for the study area, the following deduction were observed. The months of May, June, July, August, and September experience more rainfall than other months of the year. It was also observed that there are variations in the amount of total annual rainfall pattern throughout the period. There are some years with relatively heavy rainfall such as in 2009 and 2010, others with relatively low rainfall amount recorded such as in 1997 and 1999. The findings also revealed that there is increase in both minimum and maximum temperature, late onset and early cessation dates as well as increase in rain fall especially in the 2009 and 2010.

In order to overcome the impact of climate change in the study area, the findings suggested that the farmers should be enlighten on the current climatic changes the world is facing, provision of weather observation and recording station, personnel training, provision of short – term growing seed, development of water conservation strategies, banning or reducing the use of fuel wood by making Kerosene and cooking gas available and at affordable prices.

5.2 Conclusion

Scientifically, effort has been made to address the menace of climate change but its effects are still a matter of concern. This has been due to the serious hardship the change brings to human survival in terms of floods, drought, increased in temperature, low agricultural productivity and relative destruction of ecosystem, fluctuation in the trend of rainfall, deforestation, and rural–urban migration and alike. However, being farmers are now aware about the devastating effects of the climate change, the menace could be minimized. Planting of different crops at different time by many farmers is really a welcome development on this perspective. The findings of this study revealed that the major reasons for climate change include; deforestation, agricultural activities and long term global natural change. However, the threat of climate change is more on agriculture, biodiversity lost and health, floods, rainfall and temperature variability. The measures taken by the farmers to curtail climate change in the study area include, planting of trees, changing cropping plan,

change in crop type, increase in the use of chemical fertilizer, change in cultivated land area, shortening growing season, improved soil management. The findings also revealed that the farmers in the study area are faced with some difficulties to adaptation. The perceived difficulties to adaptation are lack of information on weather incidence, lack of information and knowledge on appropriate adaptation measures, lack of water for irrigation farming and lack of improved seed. All these affect the progress towards adapting to climate change. Farmers in the study area have very weak strategies towards tackling climate difficulties. The findings revealed some of the ways to be taken to ease the problems farmers are facing with regard to the effect of climate change in the study area. These include cutting down further emission of GHGs, setting of public enlightenment campaign against deforestation, establishment of weather observation and recording stations, monitoring and training programs, development of water conservation strategies among others.

Generally, the rainfall trend indicated that there is increase in Katagum LGA, caused by climatic change. On the other hand, temperature is again traced to the changing of climate. Finally, onset of rain in Katagum LGA is relatively delayed while cessation is also moderately delayed. This observation is seen as an indication for future early cessation.

From this study, it is obvious that knowledge of climatic condition can allow the farmers in Katagum L.G.A to develop a seasonal management strategy for agricultural practices in the locality under study. The study revealed that intervention of government and other non- governmental bodies will help the farmers foresee the dangers of tempering with the natural environment and atmospheric Ozone layer of which the consequence will brings more harm than good.

5.3 Recommendations

Base on the findings of this study, here are some proposed recommendations that will, in many ways ease the problems that farmers are facing with regard to the climate change so that measures will be taken to tackle the situation before it further escalates: These include among others;

1. The best that can be done at a local government level in particular and the world in general with regard to climate change are to cut down on emission of GHG because it appears that the rate of rebuilding the gaps in the Ozone layer seems to be slow. This is because human beings need the environment much more than it needs the humans.
2. Public enlightenment. This means that farmers should be fully enlightened on the current climatic changes the World is facing, particularly the global warming. This

could be done through sensitization campaign such as group discussion with farmers at local level and radio and newspapers at wider level.

3. Weather observation stations should be established and Personnel should be trained on the observation and recording of data annually so that they will pass the information to the farmers in their respective local vernacular.
4. Government at all level should join hands with NGO's and other international communities to mobilize the people on the importance of tree planting and utilization.
5. Government should also set an example of deforestation campaign by either reducing or banning the use of fuel wood usage in all government establishment and private industries consuming fuel wood. Such establishment include; boarding schools, bakeries, Prisons formations, etc. This could be curtailed by making availability of kerosene and cooking gas at a subsidized price.
6. Water conservation strategies are needed to be developed and motivated. This will provide water for both livestock and domestic usage; it will also be useful in productive purpose such as irrigation farming, thereby contributing to poverty reduction and increase foodstuff for both man and animals around him.
7. Short-term growing seed should be provided and introduce to minimize the effect of the late onset of rains in the area.
8. There is need for restructuring and empowering of government agencies and enabling communities to monitor the onset of disasters such as floods, drought and rapid temperatures increased.

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Appendix I QUESTIONNAIRE

DEPARTMENT OF GEOGRAPHY,
SCHOOL OF ENVIRONMENTAL SCIENCES
MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY,
P.M.B 2076 YOLA, ADAMAWA STATE.

Dear Sir / Madam,

I am a postgraduate student (M.Sc. Climatology) of the above institution undertaking a study on the topic titled "**Farmers' Perception and Response to Climate Change**'', in Katagum Local Government Area of Bauchi State. I will be grateful if you could furnish me with relevant information needed on this questionnaire. All information provided will be confidential and used for academic purpose only.

Please answer the following questions by ticking the appropriate box or filling the gap provided.

SECTION A: BACKGROUND DATA

1. Name of village/town……..
2. Sex (a) Male (b) Female
3. Please circle your age bracket
(a) 33 – 39 (b) 40 – 46 () 47 and above
4. Educational Background
(a) Primary (b) Secondary (c) Post-Secondary (d) Qur'anic (e) None
5. Occupation
(a)Fulltime- farming (b) Farming & trading (c) Farming & civil servant (d) Farming & others specify……
6. How long have you been in farming practice?
(a) 10-20yrs (b) 21-30yrs (c) 31yrs and above

SECTION B: FARM DATA

7. How did you acquire your farmland? (a) Purchase (b) Inheritance (c) Lease
(d) OthersSpecify…….....
8. What is the size of your farm?
(a) Less than 1 hec. (b) Above 1 hec but less than 2 hec
(c) Above 2 hec but less than 3 hec. (d) More than 3 hec and above

9. What is the main source of your capital? (a) Personal saving (b) Loan from bank (c) Individual and relations (d) Others (Specify…….....

10. What type of cropping system does you practices? (a) Mixed cropping (b) Sole cropping (c) Others(Specify)…….....

11. What implement do you use? (a) Simple hoe and cutlass (b) Ox- drawn plough (c) Tractor (d) Both a and b (e) Both a and c

SECTION C: CLIMATE CHANGE PERCEPTION.

12. Have you noticed any change of climate in this village area? (a) Changing (b) No change

13. Have you noticed an increase in the temperature? (a) Increasing (b) Decreasing

14. For how long /years did you start noticing this rising in temperature? (a) 1 – 10 yrs. (b) 11 – 20yrs (c) 21yrs and above

15. Do you notice a decreased in rainfall in this area as compared to previous years? (a) Increasing (b) Decreasing/ No Increase

16. What is the situation of onset of rain/beginning of growing season now? (a)Early (b) Delayed (c) No change (d) others (Specify)…….....

17. What is the situation of cessation/end of growing season? (a) Early (b) Delayed (c) No change (d) Others (Specify)……..

18. Which of the following options do you think is the main cause of climate change in your area? (a) Natural variability (b) Deforestation (c) Agricultural activities (d) Industrial activities (e) others (Specify)…….....

19. Have you noticed any increasing incidences of floods during the rainy season in your area? (a) Yes (b) No

20. Is the number of dry days during the rainy season increasing? (a)Yes (b) No

21. Is it true that the climate change has effect on agricultural activities? (a) Yes (b) No

22. Is it true that climate change brought about decreased in Crops and animal production in this area? (a) Yes (b) No

23. Through which of the following means do you come to be aware of climate change? (a) Radio (b) Newspaper (c) Farming experience (d) In School (e) from people

SECTION D: CLIMATE CHANGE ADAPTATION

24. What are your responses to the adverse effects of climate change in your area?

(a) Embarking on Shifting cultivation (b) Changes in crop types

(c) Increase in the use local manure (d) Increase in the use of fertilizer

(e) Planting trees (f) Improved soil management and (g) Prayer

25. What are the perceived difficulties to adaptation of modern techniques of combating climate change? (a) Lack of information on weather incidence (b) lack of water for irrigation farming (c) lack of improved seed (d) lack of information and knowledge on appropriate adaptation measures (e) there is no problem to adaptation

26. What do you suggest to the best of your knowledge will be put in place to fight against the problems of climate

change.....

.....

Thanks for your contribution

Yours faithfully,

Magaji, Isa Azare

Appendix II

Table for determining sample size from a given population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	159	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	36	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	114	5000	357
100	80	500	117	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	130	650	242	9000	368
140	103	700	248	10,000	370
150	108	750	254	15,000	375
160	113	800	260	20,000	377
170	118	850	265	30,000	379
180	123	900	269	40,000	380
190	127	950	274	50,000	381
200	132	1000	278	75,000	382
210	136	1100	285	1000000	384

Note. N – Is population size.
S is sample size
Source adopted from krejcie R.V and Morgan, (1970): educational psychological measurement. Pp 30,607-610.

Appendix III
Total Annual Rainfall for Katagum LGA from 1975 – 2010 (Bauchi Northern Zone)

YEAR	RAINFALL (mm)
1975	196.7
1976	1635.1
1977	1045.2
1978	1177.1
1979	1017.02
1980	982.2
1981	1250.7
1982	1150.7
1983	741.9
1984	865.8
1985	711.6
1986	993.1
1987	744.5
1988	889.3
1989	900.2
1990	847
1991	932.7
1992	1191.5
1993	1143.3
1994	1168.3
1995	897
1996	1151.3
1997	632.6
1998	1094.4
1999	501.6
2000	870.7
2001	1403.4
2002	819.1
2003	963
2004	838
2005	1074.5
2006	995.5
2007	1115.8
2008	1130.7
2009	1448.3
2010	1504.1

Appendix IV Descriptive statistics

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	0	0	0	14.5	83.9	107	354.5	306.3	0	55.4	0	0	921.6
1976	0	48.3	0	73.3	106	125.1	230.7	363.4	211.5	90.7	0	0	1249
1977	0	0	0	0	31	149	174.5	332.7	115.1	16.4	0	0	818.7
1978	0	0	0	21.3	74.3	241.1	298.1	340.2	133.2	42.8	0	0	1151
1979	0	0	0	37.2	75.1	101.2	312.1	271.4	153.3	41	0	0	991.3
1980	0	0	0	0.5	111.6	121.3	314.1	317.9	82.5	40.3	0	0	988.2
1981	0	0	0	34.4	109	252.8	389.8	268.9	172.5	18.4	0	0	1245.8
1982	0	0	0	43.8	43.8	160.7	242.5	233.9	140.7	31.6	0	0	897
1983	0	0	13	0	95	123.5	227.1	184.2	136.2	0	0	0	779
1984	0	0	6.8	19.3	148.7	77.8	239	227.8	164	10.3	0	0	893.7
1985	0	0	33.2	0.4	121.9	108.4	152.2	173.5	135.6	0.4	0	0	725.6
1986	0	0	5.6	8	40	133.5	339.9	169.9	228.9	20.3	0	0	946.1
1987	0	0	0	0	74.7	200.9	151.3	240.2	31.9	45.6	0	0	744.6
1988	0	0.5	1.8	66.6	90.9	143.3	173.3	276.1	159	9.2	0	0	920.7
1989	0	0	0	28.6	98	77.6	185.5	344.2	118.2	57.3	0	0	909.4
1990	0	0	0	6.4	108.2	100.5	303.9	243.1	87.8	29.7	0	0	879.6
1991	0	0	28.5	135.7	99.3	103.3	283.1	230.8	42	13	2.7	0	938.4
1992	0	0	2.4	49.4	50.2	177.5	328	357.6	233.5	28.1	1.4	0	1228.1
1993	0	0	0	15.3	80.9	243	227.7	340.7	173.7	60.6	0	0	1141.9
1994	0	0	0	108.8	56.5	56.4	227.1	387.3	294	44.2	0	0	1174.3
1995	0	0	0	27.2	104.8	197	123.1	212.8	212.8	19.4	0	0	897.1
1996	0	0	0	18.1	95	151.2	237.2	341.4	261.8	44.6	0	0	1149.3
1997	0	0	0	0	0	2.5	237.8	213.6	178.7	0	0	0	632.6
1998	0	0	0	11.6	134.6	139.8	303.1	329.9	183.6	7.8	0	0	1110.4
1999	0	0	0	0	0	127.2	0	2.2	261.2	113.1	0	0	503.7
2000	0	0	0	10.3	80.5	222.7	0	308.4	168	20.9	0	0	810.8
2001	0	0	0	37.1	155.7	234.4	324.8	360.9	193.3	1.2	0	0	1307.4
2002	0	0	0	76.9	35.9	102.9	158.4	235.9	192.9	16.2	0	0	819.1
2003	0	0	0	31	73	295	126.4	268.2	172.1	23.5	0	0	989.2
2004	0	0	1.9	33.8	87.8	277.7	267.4	138.3	54.9	4.1	0	0	865.9
2005	0	0	0	24.8	100.8	241.6	206.5	340	184.7	6.1	0	0	1104.5
2006	0	0.7	0	0	149.5	192.3	241.8	229.5	146.5	36	0	0	996.3
2007	0	0	0	27.6	17.3	122.3	276.2	520.9	162.3	0	0	0	1126.6
2008	0	0	0	0	86.6	351.6	209.5	388.8	57.1	39.7	0	0	1133.3
2009	0	0	0	82.6	106.2	184.8	220.8	394.6	288.9	173.4	0	0	1451.3
2010	0	0	0	40	113.8	151.1	350.4	236.8	470.1	146.9	0	0	1509.1

Appendix V

AVERAGE MINIMUM ANNUAL TEMPERATURE FOR KATAGUM L.G.A BAUCHI STATE 1975 - 2010

YEAR	MAXIMUM TEMP.
1975	18.3
1976	18.8
1977	18.3
1978	18.8
1979	19.3
1980	19.2
1981	18.9
1982	19.1
1983	18.8
1984	19.4
1985	19.8
1986	19.9
1987	20.0
1988	19.8
1989	18.5
1990	19.8
1991	19.8
1992	19.1
1993	19.4
1994	19.1
1995	19.5
1996	19.6
1997	19.6
1998	19.9
1999	18.9
2000	19.9
2001	18.8
2002	19.6
2003	20.2
2004	20.4
2005	21.0
2006	20.7
2007	19.5
2008	20.1
2009	20.8
2010	21.0

Appendix VI

MEAN MAXIMUM TEMPERATURE IN AZARE KATAGUM L.G.A BAUCHI STATE 1975 - 2010

YEAR	MAXIMUM TEMP.
1975	32.0
1976	32.4
1977	32.3
1978	32.1
1979	32.4
1980	32.6
1981	32.2
1982	32.2
1983	32.4
1984	32.8
1985	32.8
1986	33.0
1987	33.9
1988	32.9
1989	32.0
1990	33.5
1991	32.7
1992	32.2
1993	32.9
1994	32.6
1995	33.4
1996	33.9
1997	33.7
1998	33.6
1999	32.5
2000	32.9
2001	32.5
2002	33.0
2003	33.4
2004	33.2
2005	33.2
2006	33.3
2007	32.8
2008	30.9
2009	33.5
2010	33.7

Appendix VII

ONSET DATE FOR AZARE, KATAGUM L.G.A BAUCHI STATE 1975-2010

YEAR	MONTH	T/PRE	T/MONTH	DS/M	CONST.	ONSET DATE
1975	May	14.5	83.9	31	51	13th May
1976	April	48.3	73.3	30	51	1st April
1977	June	31	149	30	51	4th June
1978	May	21.3	74.3	31	51	12th May
1979	May	37.2	75.1	31	51	6th May
1980	May	0.5	111.6	31	51	14th May
1981	May	34.4	109	31	51	5th May
1982	June	43.8	160.7	30	51	1st June
1983	May	13	95	31	51	12th May
1984	May	26.1	148.7	31	51	5th May
1985	May	33.6	121.9	31	51	4th May
1986	June	40	133.5	30	51	2nd June
1987	May	0	74.7	31	51	21st May
1988	April	2.3	66.6	30	51	22nd April
1989	May	28.6	98	31	51	7th May
1990	May	6.4	108.2	31	51	13th May
1991	April	28.5	135.7	30	51	5th April
1992	May	49.4	50.2	31	51	1st May
1993	May	15.3	80.9	31	51	14th May
1994	April	0	108.8	30	51	14th April
1995	May	27.2	104.8	31	51	7th May
1996	May	18.1	95	31	51	11th May
1997	July	2.5	237.8	31	51	6th July
1998	May	11.6	134.6	31	51	9th May
1999	June	0	127.2	30	51	12th June
2000	May	10.3	80.5	31	51	16th May
2001	May	37.1	155.7	31	51	3rd May
2002	April	0	76.9	30	51	20th April
2003	May	31	73	31	51	8th May
2004	May	35.7	87.8	31	51	5th May
2005	May	24.8	100.8	31	51	8th May
2006	April	0.7	149.5	30	51	10th April
2007	June	44.9	122.3	30	51	1stjune
2008	May	0	86.6	31	51	18th May
2009	April	0	82.6	30	51	19th April
2010	May	40	113.8	31	51	3rd May

Appendix VIII

CESSATION DATES IN AZARE KATAGUM L.G.A BAUCHI SATE 1975-2010

YEAR	MONTH	T/NEXT	T/MONTH	DS/MONTH	CONSTANT	CESSATION
1975	October	0	55.4	31	51	2nd October
1976	October	0	90.7	31	51	14th October
1977	September	16.4	115.1	30	51	21st September
1978	September	42.8	133.2	30	51	28th September
1979	September	41	153.3	30	51	28th September
1980	September	40.3	82.5	30	51	26th September
1981	September	18.4	172.5	30	51	19th September
1982	September	31.6	140.7	30	51	23rd September
1983	September	0	136.2	30	51	19th September
1984	September	10.3	164	30	51	23rd September
1985	September	0.4	135.6	30	51	19th September
1986	September	20.3	228.9	30	51	26th September
1987	August	31.9	240.2	31	51	29th August
1988	September	9.2	159	30	51	22nd September
1989	October	0	57.3	31	51	4th October
1990	September	29.7	87.8	30	51	23rd September
1991	August	42	230.8	31	51	30th August
1992	September	32.2	233.5	30	51	28th September
1993	October	0	60.6	31	51	5th October
1994	September	44.2	294	30	51	29th September
1995	September	19.4	212.8	30	51	26th September
1996	September	44.6	261.8	30	51	29th September
1997	September	0	178.7	30	51	21st September
1998	September	7.8	183	.1	51	23rd September
1999	October	0	113.1	31	51	17th October
2000	September	20.9	168	30	51	25th September
2001	September	1.2	193.9	30	51	22nd September
2002	September	16.2	192.9	30	51	25th September
2003	September	23.5	172.1	30	51	25th September
2004	September	4.1	54.9	30	51	3rd September
2005	September	6.1	184.7	30	51	23rd September
2006	September	36	146.5	30	51	27th September
2007	September	0	162.3	30	51	21st September
2008	September	39.7	57	30	51	24th September
2009	October	0	173.4	31	51	22nd October
2010	October	0	146.9	31	51	21st October

Appendix IX

LENGTH OF RAINY SEASONS IN AZARE KATAGUM L.G.A BAUCHI STATE 1975-2010

YEAR	ONSET	CESSATION	LRS(DAYS
1975	13th May	2nd October	143
1976	1st April	14th October	197
1977	4th June	21st September	110
1978	12th May	28th September	140
1979	6th May	28th September	146
1980	14th May	26th September	136
1981	5th May	2nd September4	143
1982	1st June	26th September	118
1983	12th May	19th September	131
1984	5th May	23rd September	142
1985	4th May	19th September	139
1986	2nd June	26th September	117
1987	21st May	29th August	101
1988	22nd April	22nd September	130
1989	7th May	4th October	151
1990	13th May	23rd October	134
1991	5th April	30th April	148
1992	1st May	28th September	151
1993	14th May	5th October	145
1994	14th April	29th September	169
1995	7th May	26th September	143
1996	11th May	29th September	142
1997	6th July	21st September	78
1998	9th May	23rd September	138
1999	12th June	17th October	133
2000	16th May	25th September	133
2001	3rd May	28th September	143
2002	20th April	25th September	159
2003	8th May	25th September	141
2004	5th May	3rd September	122
2005	8th May	23rd September	139
2006	10th April	27thseptember	171
2007	1st June	21st September	113
2008	18th May	24th September	130
2009	19th April	22nd October	187
2010	3rd May	21th October	171

Appendix X

Multiple Comparisons (Age of the respondents)

(1)AGE	(J) AGE	Mean Difference (I-J)	Std. error	Sig	95% Confidence Interval Lower Bound	Upper Bound
<=39	40 – 46	-.48356*	.23572	.041	-.9475	-.0196
	>=47	-.57110*	.24311	.019	-1.0496	-.0926
40 – 46	<=39	.48356	.23572	.041	.0196	.9475
	>=47	-.08754	.18808	.642	-.4577	.2826
>=47	<=39	.57110	.24311	.019	-.0926	1.0496
	40 – 46	.08754	.18808	.0642	-.2826	.4577

*The mean difference is significant at the .05 level

Multiple Comparisons (Educational qualification of the respondents)

(I)EDUCATION	(J) EDUCATION	Mean Difference (I-J)	Std. error	sig	95% Confidence Interval Lower Bound	Bound Upper Bound
Primary	Secondary	-.36170	.31573	.253	-.9831	.2597
	Post-secondary	.05263	.26543	.843	-.4698	.5751
	Qur'anic	-.21622	.28843	.454	-.7839	.3515
Secondary	Primary	.36170	.31573	.253	-.2597	.9831
	Post-secondary	.41433	.24735	.095	-.0725	.9012
	Qur'anic	.14549	.27188	.593	-.3896	.6806
Post-secondary	Primary	-.05263	.26543	.843	-.5751	.4698
	Secondary	-.41433	.24735	.095	-.9012	.0725
	Qur'anic	-.26885	.21139	.204	-.6849	.1472
Qur'anic	Primary	.21622	.28843	.454	-.3515	.7839
	Secondary	-.14549	27188	.593	-.6806	.3896
	Post-secondary	.26885	.21139	.204	-.1472	.6849

*The mean difference is significant at the .05 level

Multiple Comparisons (Occupational characteristic)

(I) OCCUPATION	(J) OCCUPATION	Mean Difference (I-J)	Std. error	Sig.
Fulltime Farming	Farming and Trading	-.11111	.23561	.638
	Farming and Civil Servant	.53905*	.19452	.006
	Farming and Others	-.44444	.33941	.191
Farming and Trading	Fulltime Farming	.11111	.23561	.638
	Farming and Civil Servant	.65017*	.24143	.007
	Farming and Others	-.33333	.36831	.366
Farming and Civil Servant	Farming and Trading	-.53905*	.19452	.006
	Farming and Trading	-.65017*	.24143	.007
	Farming and Others	-.98350*	.34348	.004
Farming and Others	Fulltime Farming	.44444	.33941	.191
	Farming and Trading	.33333	.36831	.366
	Farming and Civil Servant	.98359*	.34348	.004

*The mean difference is significant at the .05 level

Multiple Comparisons (Farming Experience of the respondents)

(1)STAY	(J) STAY	Mean Difference (I-J)	Std. error	Sig	95% Confidence Interval Lower Bound	Upper Bound
<20	21 – 30	-.87593*	.29750	.003	-1.4615	-.2904
	31+	-.56559	.28753	.050	-1.1315	.0003
21 – 30	<20	.87593*	.29750	.003	.2904	1.4615
	31+	.31033	.18069	.087	-.0453	.6660
31+	<20	.56559	.28753	.050	-.0003	1.1315
	21 – 30	-.31033	.18069	.087	-.6660	.0453

*The mean difference is significant at the .05 level