ANALYSIS OF GENDER DIFFERENTIALS IN ADAPTATION TO CLIMATE VARIABILITY IN KADUNA STATE, NIGERIA

BY

ZONKWA KUBAI

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT,
FACULTY OF PHYSICAL SCIENCES,
AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

JANUARY, 2020

ANALYSIS OF GENDER DIFFERENTIALS IN ADAPTATION TO CLIMATE VARIABILITY IN KADUNA STATE, NIGERIA

BY

Zonkwa KUBAI
B Sc (Ed) (2006), M Sc, ABU (2012)
PhD/SCIEN/46393/12-13

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

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT,
FACULTY OF PHYSICAL SCIENCES,
AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

JANUARY, 2020

DECLARATION

I declare that the work in this thesis entitled **"ANALYSIS OF GENDER DIFFERENTIALS IN ADAPTATION TO CLIMATE VARIABILITY IN KADUNA STATE"** was carried by me in the Department of Geography and Environmental Management under the supervision of Professor E.O. Iguisi, Professor B. A. Sawa and Professor I.J. Musa. The information derived from literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at any University.

KUBAI ZONKWA Signature Date

CERTIFICATION

This thesis entitled **"ANALYSIS OF GENDER DIFFERENTIALS IN ADAPTATION TO CLIMATE VARIABILITY IN KADUNA STATE"** by Zonkwa KUBAI meets the regulations governing the award of the degree of Doctor of Philosophy in Geography of Ahmadu Bello University, Zaria and is approved for its contributions to knowledge and literacy presentation.

Prof. E.O. Iguisi Chairman, Supervisory Committee	Signature	Date
Prof .B. A. Sawa Member, Supervisory Committee	Signature	Date
Prof. I. J. Musa Member, Supervisory Committee	Signature	Date
Dr. A. K. Usman Head of Department	Signature	Date
Prof. Sadiq Zubair Abubakar Dean, School of Postgraduate Studies	Signature	Date

DEDICATION

This thesis is dedicated to the memory of my late father, Mr. Kubai Dodo, a man of exemplary character.

ACKNOWLEDGEMENTS

First and foremost, my profound gratitude goes to the almighty God for His mercies, guidance, provision, protection, grace, the gift of life and knowledge through this research work. To Him alone be all the glory.

In writing this thesis, I am greatly indebted to many people. However, numerous as they may be the following stand out in bold relief. These are my supervisors, Professors E.O. Iguisi, B.A. Sawa and I. J. Musa for not only painstakingly reading and constructively criticizing various drafts of the work but also for their patience. They are loving, friendly, gave fatherly advice and more importantly, for being propelling force that hastened its early completion. In fact, in the course of the study, they became more than supervisors but fatherly, friendly, role models and confidants. All these shall remain indelible in my memory.

My profound gratitude goes to the Head of Department, Dr. A.K. Usman who stood by me throughout this research work. May God bless and reward you greatly. I am grateful to the entire members of the academic and non-academic staff of the Department of Geography and Environmental Management, Ahmadu Bello University, Zaria for the challenges posed. These had facilitated the successful completion of the thesis. Mention must be made of the assistance of Prof. Binta Abdulkarim, Prof. J. O. Adefila, Dr. B. Akpu, Dr.Y. A. Arigbede, Dr. R.O. Yusuf, Dr. Muktar Ibrahim, Dr. Abdullahi Jibrin, Dr. M. Ibrahim. Dr. Usman Isyaku, Dr. S. Abbas, Dr. H. Mohammed, Mal. Abubakar, Mr Ezekiel Bamaiyi and all my other lecturers of the Department who were there for me throughout the research work.

I will not fail to appreciate every member of the Kubai and the Olademeji's families. To my beloved sweetheart and wonderful wife, Dr. Tosin Zonkwa and lovely children Victor and Daniel, I thank them for their prayers, moral and financial support, love, care and attention. My love for them cannot be quantified because they are rare gems. I will also want to thank my Honorable Senator, Sen. (Dr) Nenadi Esther Usman for her support and friendliness.

My profound gratitude also goes to my friends and course mates. These are Dr.Jonathan Inobeme, Dr.Nduka Ifeanyi, Dr. Abaje Bitrus, Dr. Michael Abashiya, Dr.Anslem Bako, Dr. Murtala Ma'aruf, Dr. Hassan G. Yakubu, Dr. Aruya Emmanuel, Dr. Y. B. Akut, Dr. Amina Maiwada, Mal. Inusa Musa, Mr. Sunday Ademola, Mr. Markus Bako, Mrs Mercy Aino, Mr. Ikpe Elisha, Mr. John Omale, Mr. Dabo Yusuf to mention but a few.

My gratitude also goes to Prof. David Sunday Abolude, Prof. Musa Lawal Sagada, Prof. Albert Oyati, Pharm. Friday Echu, Dr. Moses Adedokun, Dr. Samuel Yakubu, Dr. Ejeh Lawrence, Dr. (Mrs) A. Bello, Dr. (Mrs) R. Dyaji, Dr. Y.B Akut, Mr. Maliki Joseph, Dcn Emmanuel Jaja, Dcn Afred Sule, Mr. Ayodele Mike Oludare, Mr. Simon Loms, Mr. Wole Arigbede, Mal. Shamsudeen Bello, and others for their love, care and support.

TABLE OF CONTENTS

Title Page	i
Declaration	ii
Certification	iii
Dedication	iv
Acknowledgement	v
Table of contents	vi
List of Tables	vii
List of Figures	viii
List of Appendix	ix
Abstract	x

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study	1
1.2 Statement of the Research Problem	5
1.3 Aim and Objectives	8
1.4 Scope of the Study	9
1.5 Justification of the Study	9

CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 Conceptual Framework	11
2.1.1 Concept of Gender	11
2.1.2 Concept of Climate Change	13

2.1.3 Concept of Adaptation 14

2.1.4 Clarification of the Concept of Adaptation 15

2.1.4.1 Reactive Adaptation versus Anticipatory Adaptation 15

2.1.4.2 Spontaneous Adaptation versus Planned Adaptation 16

2.1.5Relationship between Gender, Climate Change and Adaptation 17

2.1.5.1Gendered dimensions of climate change 17

2.1.5.2 Gender and climate change impacts 20

2.1.5.3 Gender dimensions of climate change mitigation 26

2.1.6 Livelihood Adaptation 27

2.2 Literature Review 28

2.2.1 Nature of Climate Change 28

2.2.1.1 Natural Factors 28

2.2.1.2 Anthropogenic Factors 32

2.2.2 Climate Change Adaptation Strategies 37

2.2.2.1 Adaptive Capacity 38

2.2.2.2 Adaptation Strategies 40

2.2.2.3 Mitigation versus Adaptation 42

2.2.2.4 Climate Change Adaptation Frameworks 43

2.2.3 Gender Differentials and Adaptation Strategies 46

2.2.4 Causes of Gender Differentials to Climate Change 64

2.2.5 Challenges/Barriers to Climate Change Adaptation 67

2.2.5.1 Physical /Environmental Barrier 68

2.2.5.2 Technological Barrier 68

2.2.5.3 Financial Barriers 69

2.2.5.4 Social and Cultural Barriers 70

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 Study Area 72

3.1.1 Location and Size 72

3.1.2 Weather and Climate 72

3.1.3 Geology 77

3.1.4 Drainage System 79

3.1.5 Soils 79

3.1.6 Vegetation 80

3.1.7 Population 81

3.1.8 Socio-Economic Activities 82

3.1.8.1 Agriculture 82

3.1.8.2 Minerals Resources 83

3.2 Methodology 84

3.2.1 Reconnaissance Survey 84

3.2.2 Types of Data 84

3.2.3 Sources of Data 85

3.2.3.1 Primary Data 85

3.2.3.2 Secondary Data 87

3.2.4 Sampling Techniques of Local Government Areas 88

3.2.5 Sampling of Wards 92

3.2.6 Determining Sample Size 93

3.2.7 Sampling Techniques 95

3.2.8 Questionnaire Administration 95

3.2.9 Data Analysis Techniques 96

3.2.9.1 Nature of Climate Change 96

3.2.9.2 Climate Change Adaptation Strategies 96

3.2.9.3 Determination of Gender Differentiation in Adaptation Strategies 97

3.2.9.4 Causal Factors of Gender Differentials in Climate Change 97

3.2.9.5 Challenges of Climate Change 97

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Socio-Economic Characteristics of Respondents 98

4.1.1 Sex 98

4.1.2 Age 100

4.1.3 Marital Status 101

4.1.4 Religion 101

4.1.5 Ethnicity 102

4.1.6 Educational status 103

4.1.7 Occupation 104

4.1.8 Income 105

4.1.9 Duration of Residency 106

4.2 Nature of Climate Change in Kaduna State 107

4.2.1 Temperature Characteristics in Kafanchan (Southern Zone) 107

4.2.2 Temperature Characteristics in Kaduna (Central Zone) 111

4.2.3 Temperature Characteristic in Zaria (Northern Zone) 114

4.2.4 Temperature Characteristic and Variation across the Zones 118

4.2.5 Rainfall Characteristics in Kafanchan (Northern Zone) 119

4.2.6 Rainfall Characteristics in Kaduna (Central Zone) 122

4.2.7 Rainfall Characteristics in Zaria (Northern Zone) 124

4.2.8 Rainfall Variation across the Zones 128

4.2.9 Level of Awareness of Climate Change 129

4.2.10 Source of Climate Change Awareness 131

4.2.11 Observable Change in the Climate Perceived by the People 133

4.2.12 Duration of Perceived Observable Change in the Climate 135

4.3 Climate Change Adaptation Strategies in the study area 136

4.4Gender Differentiation in Climate Change Adaptation Strategies 139

4.5 Causal Factors of Gender Differentials 141

4.6 Challenges of Climate Change Adaptation Strategies 143

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Findings 146

5.2 Conclusion 148

5.3 Recommendations 150

5.4 Suggestions for Further Research 152

5.5 Contribution to Knowledge 152

References 153

Appendices 173

LIST OF TABLES

TABLE	PAGE
3.1 Local Government Area in each Senatorial Zone and their Population	90
3.2 Selected Government Area in each Senatorial Zone and their Population	91
3.3Wards in the Selected Local Government Area	93
3.4 Selected Wards in the Selected Local Government Area	94
3.3 Distribution of Respondents by Wards	95
4.1 Age Distribution of the Respondents	101
4.2 Marital Status of the Respondents	102
4.3 Religion of the Respondents	102
4.4 Distribution of the Respondents by Ethnicity	103
4.5 Educational Level of the Respondents	104
4.6 Occupation of the Respondents	105
4.7 Monthly Income of the Respondents	106
4.8 Temperature Characteristics in Kafanchan Zone	108
4.9 Temperature Characteristic in Kaduna Zone	112
4.10 Temperature Characteristic in Zaria Zone	116
4.11 Variation in Temperature (^{o}C) Characteristic in the three Zone	120
4.12 Rainfall Characteristics in Kafanchan Zone	121
4.13 Rainfall Characteristics in Kaduna Zone	124
4.14 Rainfall Characteristics in Zaria Zone	126
4.15 Variation in Rainfall Pattern in the three Zones	129
4.16 Awareness of Climate Change	131
4.17 Source of the Respondents on Climate Change Awareness	134

4.18 Change in Climate Observed by the People 136

4.19 Duration of Observable Changes in the Climate 137

4.20 Climate Change Adaptation Strategies 139

4.21 Gender Variation on Climate Change Adaptation Strategies 141

4.22 Causal Factors of Gender Differentials in Climate Change Adaptation 144

4.23 Challenges affecting Climate change Adaptation strategies 146

LIST OF FIGURES

FIGURES	PAGE
2.1 Causal Factors of Climate Change	29
3.1 Kaduna State: The Study Area	73
3.2 The Selected Local Government Areas	92
4.1 Gender of the Respondents	100
4.2 Duration of Residency in the Study Area	102
4.3 Trend of Minimum Temperature in Kafanchan Zone	109
4.4 Trend of Maximum Temperature in Kafanchan Zone	110
4.5 Trend in Average Temperature in Kafanchan Zone	111
4.6 Trend of Minimum Temperature in Kaduna Zone	113
4.7 Trend of Maximum Temperature in Kaduna Zone	114
4.8 Trend in Average Temperature in Kaduna Zone	115
4.9 Trend of Minimum Temperature in Zaria Zone	117
4.10 Trend of Maximum Temperature in Zaria Zone	118
4.11 Trend of Average Temperature in Zaria Zone	119
4.12 Trend of Annual Rainfall in Kafanchan Zone	122
4.13 Trend of Annual Rainfall in Kaduna Zone	125
4.14 Trend of Annual Rainfall in Zaria Zone	127

LIST OF APPENDICES

APPENDIX		PAGE
A	Questionnaire	175
B	Focus Group Discussion Guide	179

ABSTRACT

This study analyzed gender differentials in adaptation to climate change in Kaduna State with a view to examining how different sex groups adapt or adjust to climate change. Data on the people's perception on climate change adaptation strategies, gender differentials in adaptation to climate change, causal factors of differentials in gender adaptation to climate change and challenges of climate change adaptation in the eleven selected Local Government Areas (LGAs) were collected by using household questionnaire survey, Focus Group Discussions (FGDs), Key Informal Survey (KIS) and field observations. Thirty five years (1981-2015) monthly temperature and rainfall data from three meteorological stations in the state were used for this study. Major information solicited from the respondents was the observed variation in temperature and rainfall and the occurrences of extreme events over the past thirty five years. Trend in temperature and rainfall variations were analyzed using time series analysis and standard deviation. Frequencies and percentages were used to present the results on gender differentials in adaptation strategies in the study area. Kruskal-wallis was used to test if male adapt differently to climate change than the female. Causal factors of gender differentials were also analyzed using kruskal-wallis and presented in a table while frequency tables and charts were used to summarize the various challenges of climate change. The result of the trend analysis of the observed temperature and rainfall in all the zones showed an increasing trend from the beginning of the data (1981) to the recent years. On the other hand, with regards to gender differentiation in climate change adaptation strategies 57% of the respondents revealed that men and women respond to climate change by coping differently. The Chi-square result 24.130, df =1, p=.001 showed that there is a significant relationship between gender and climate change coping strategies which implies that certain climate change coping strategies are gender sensitive. Gender differentiated impacts of climate variability were manifested in the unequal

distribution of roles and responsibilities of men and women. There is therefore no doubt that climate change is impacting differently on rural men and women. Causal factors of gender differentials in climate change adaptation strategies were identified as level of education, occupation, religion, culture, access to information, gender differences to property rights, health, poverty, and age, among others. Challenges of climate change adaptation strategies in relation to gender differentials include lack of capital and improved seeds/crop varieties (85%) which ranked 1st, followed by lack of awareness/ knowledge about adaptation measures (83%), poor government attention to climate change problems (81%), none availability of credit (79%), absence of government policy on climate change (78%), irregularities of extension services (77%) and access to fertile land (70%) whereas female house-hold headship (32%) has the least effect. The study revealed that although climate change creates hardships for both gender, it however affects men and women differently. These climate change gender differentials exist and persist in proportion to the severity of climate change disasters and depend on the relative socio-economic status of men and women. Women as a group are impacted more than men by climatic events. On the basis of the findings of this research, the study recommends the development of innovative ways to eliminate gender-stereotype about the roles of women and men, the need to empower men and women to successfully excel in agriculture, appropriate and labour saving technology and seeds that can withstand different climate conditions and financial capital, financing mechanisms supporting adaptation and adaptation initiatives at the global, national and local levels need to be gender-responsive among others.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Gender is an important consideration in development. Gender is a way of looking at how social norms and power structures impact on the lives and opportunities available to different groups of men and women. Globally, more women than men live in poverty. Women are also less likely than men to receive basic education and to be appointed to a political position nationally and internationally (Meena, 1992). Understanding that men and women, boys and girls experience poverty differently and face different barriers in accessing services, economic resources and political opportunities help to target interventions (UNDP, 2009).

The concept of gender has been generally described as socially constructed, culturally variable role that women and men play in their daily lives (Meena, 1992). It also refers to expectations which society have of women and men based on sexes (Iipinge and Williams, 2000). However, there is a distinction between concepts of gender and sex. Gender identities and roles are constructed in society but are not fixed, not universal and do change over time. Sex is biological and sex roles are fixed and universally similar (Meena, 1992, Iipinge and Williams, 2000).

According to the World Bank (2008), gender is defined as socially constructed norms and ideologies which determine the behaviour and actions of men and women. Understanding these gender relations and the power dynamics behind them is a prerequisite for understanding individuals' access to and distribution of resources.

Adaptations to climate change are actions taken to help communities and ecosystems moderate, cope with, or take advantage of actual or expected changes in climatic conditions (Omolala). Adaptation could be proactive these are referred to as planned. This requires assessing the vulnerability of natural, man-made systems as well as costs benefits of actions versus inactions, and planning alternatives accordingly. Adaptation could also be reactionary which means actions are taken to reduce the impact of climate or take advantage of the opportunities presented (Omolola, 2009; Suleiman, 2014).

Adaptation depends greatly on the adaptive capacity of an affected system, region or community to cope with the impacts and risks of climate change. Adaptive capacity varies from one country to another country, from one state to another state, from one community to another community, from household to household, among social groups, individuals and over time (Abaje, Sawa, Iguisi, and Ibrahim 2016). The adaptive capacity of communities is determined by their socioeconomic characteristics. Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, including variability and extremes. In this way, enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development (Abaje, Sawa, Iguisi, and Ibrahim 2016).

Climate change is one of the greatest socioeconomic and biophysical challenges confronting the world in the 21st century. It is brought about by the complex malfunctioning of the climate system (atmosphere, oceans, cryosphere, surface lithosphere, and biosphere) (Le Treut, Somerville, Cubasch, Ding, Mauritzen, Mokssit and Prather 2007; Abaje, Sawa and Ati, 2014). Several observations of the behavior of the climate system by various scientists over the past decades to the present have highlighted the rate at which the system is currently changing.

Climate change is caused by two basic factors which include natural processes (biogeographical) and human activities (anthropogenic). The natural processes are the astronomical and the extraterrestrial factors. The astronomical factors include the changes in the eccentricity of the earth's orbit, changes in the obliquity of the plane of ecliptic and changes in orbital procession while the extra-terrestrial factors are solar radiation quantity and quality (Ayoade, 2004; Anyadike, 2009 Akpodiogaga and Odjugo, 2010). Scientific evidences for the past decades, indicate that anthropogenic factors like urbanization, deforestation, population explosion, industrial development, and the release of Green House Gases are some of the contributing factors of climate change (Buba, 2004; Odjugo, 2007; 2010; IPCC, 2007; Scott,2010; DeWeedt, 2007; Jamila, Shaibu-Imodagbe, Fatima, Sa'idu and Idris, 2009).

A change in climate implies a change in the general circulation of the atmosphere on which climate ultimately depends (Ayoade, 2003). Climate change may be limited to a specific region, or may occur across the whole earth (Ayoade, 2003). Scholze, Knorr, Arnel and Prentice, (2006); Mendelsohn, Dinar and Williams, (2006) opined that climate change is an environmental, social and economic challenge on a global scale. This is exacerbated by excessive emission and concentration of greenhouse gases such as Carbon (II) oxide (CO_2), Methane (CH_4), Nitrogen (II) oxide ($NO_{2)}$, Chlorofluorocarbon (CFC_2) and other haloes (Odjugo, 2001) in addition to other human induced actions like; the widespread use of land, broad scale deforestation, the major technological and socio-economic shifts with reduced reliance on organic fuel, and the accelerated uptake of fossil fuels. Man has really posed a threat to his life by his various activities such as industrialization, urbanization, deforestation, mining oil exploration, bush burning and other activities that contribute to the emission of greenhouse gasses to his atmosphere.

The world's poor are disproportionately affected by climate change and natural disasters. Climate change affects women and men differently. Women's domestic roles often make them disproportionate users of natural resources such as water, firewood and forest products. As these resources become scarcer, women experience an increased work burden and may fall further into poverty as a result (Neumayer and Plumper, 2007). Increasing population growth puts further pressure on resources. Natural disasters also have gender implications, killing more women than men. The more pronounced the trend the stronger the disaster (Neumayer and Plumper, 2007).

Women and men are not helpless victims of climate change but use various methods and strategies to adapt to climate change. It is increasingly recognized that empowering women, children and other marginalized groups by giving them soft loans is beneficial not only as a policy in itself, but also as a means of strengthening the effectiveness of climate change measures. Often, strategies that are adopted are related to the social norms concerning what is acceptable for men and women (Carvajal, Quintero and Garc'ia, 2008).

Climate change impacts are not gender-neutral. For instance, the greater proportion of women victims in floods and other climate change related natural disasters, clearly reflects the unequal risk and exposure across genders (Aguilar, 2008). Women are more vulnerable both to the short term recurring climatic events and long term climate induced changes because of gender differences in socially constructed roles and responsibilities that affect mobility, social networks and access to information and local institutions, as well as access to, control and ownership of assets (Adger, 2006).

Climate may likely continue to charge at all scales and level. Traditional coping and adaptation mechanisms may therefore not be sufficient to deal with impacts of climate change on gender.

Humanity will have no choice but to try to cope with it and in the long-term adapt to it. Thus, a good understanding of the gender differentials in adaptation strategies is imperative to facilitate appropriate strategies to ameliorate the scourge of climate change at all levels. This form the basis for this research with emphasis on some selected wards in Kaduna State.

1.2 Statement of the Research Problem

Climate change increasingly affects the livelihoods of people. Poor people experience especially negative impacts given their lack of capacity to prepare for and cope with its effects. Among poor people, women and men may experience these impacts differently. According to the studies of Banda and Mehlwana, (2005); Watson (2006); Brody, Demetriades, and Esplen, (2008) who focused on the economic differentials between men and women with regards to wealth possession, that gender relations are socially constructed power relations between men and women in a given society. They determine the different benefits that men and women can derive from natural resources. Their studies also revealed that women's and men's differential access to social and economic resources is one of the key aspects of gender inequality. Women occupy subordinate social positioning because their roles are less visible and often, especially in rural areas, do not earn wages. However, they are expected to assume primary responsibility for their families' subsistence, agricultural production and sustainable livelihood.

In addition, there exists differences in the way and manner males and females or men and women adapt and carry out their various responsibilities at individual level, family level and community level and undertaking their means of livelihoods influenced by climate change phenomenon (Aguilar, 2007). Studies have been extensively conducted substantiating the fact that climate change exists. Also, there are several studies on the effects of climate change. However, there

are little or no studies delving into a peculiar aspect of the influence climate change has on gender. How Climate Change affects gender, if it affects men and women the same way or differently, how men and women adapt to these impacts in order to survive. Probably, there exists a fundamental difference between men and women in relation to their livelihoods and roles in families as a consequence of changing climatic conditions.

Most of the researches dealing with aspect of climate change are based on theories and principles of Climatology without recourse to gender issues as related to climate change. For example, Anderson (2002), Adger (2006), Aguilar (2008),Dankelman (2008), Ishaya and Abaje (2008), Kubai (2012), Yavinsky (2012), Bruce, El-Ganzori, El-Shinnawi, Joel, McAcarl, Muhammed, Mossad and Smith (2013), Abaje, *et al* (2014), Udeh (2014), Uganda Climate Change Unit (2015) and the United Nation Framework Convention on Climate Change (2015) have focused on regional and national assessment of climate change effects. Furthermore, most researches on local people and communities perceptions of climate change have shown that different areas and environments are affected by climate change differently; as a result, people will equally be faced with different challenges of climate change depending on where they live. However, the aforementioned studies excluded the gender dimensions to climate change to show how the different genders are affected by climate change.

Watson (2006) conducted a study on women's role in natural resource and environmental management similar to Dankelman's (2008) position, Anderson (2002) argues that women play a major role in natural resource and environmental management yet their contribution is ignored. The researcher further opines that it is clear that ways in which individuals, groups of people and

communities interact with their natural environment are different. It is also clear that climate change does not affect women and men in the same ways.

Buba (2004) assessed the effects of climate change and water problems in Chad Republic. The result agreed with the climatic data for the study period. Consequently, there is correlation between climate change and water problems in the study area, but gender adaptation to climate change was not put into consideration in this study.

Abaje (2016) carried out a study entitled "assessment of rural communities' perceptions, vulnerability and adaptation strategies to climate change in Kaduna State This study via the administration of questionnaire to farmers in the study area focused on farmers' perception and the ways and manners in which they adapt to the problems posed by climate change especially to farming and agricultural activities in general. The result indicates that the inhabitants are to a large extent, aware of changes in local climate as well as global climate change. The study focused on farmers alone without any attempt to examine the distinct impact on gender.

Climate change has impacted on innumerable people exposing them to increasing hazards and making them more vulnerable; and this can become more marked, and for some communities catastrophic in coming years. Gender is a major factor that determines the response to climate change impacts. Presently, there is limited in-depth understanding the impact of climate change on gender and their adaptation to climate change in Kaduna State. Therefore, this present research analyzed gender differentials in adaptation to climate change in Kaduna State.

Based on the aforementioned, crucial information pertaining adaptive capacity of male and female to the changing climate in Kaduna State is still missing. It is this missing link that this study seeks to address in order to develop a comprehensive adaptation strategic framework for the State as it relates to gender adaptive capacity. This is because successful implementation of adaptation strategies has a strong bearing on the changes in behavior of the people whose individual choices may have huge collective impacts al global scale.

Based on the foregoing statement of problem, the following questions were raised in order to guide the study:

i. What is the nature of climate change in the study area?
ii. What are the climate change adaptation strategies in the study area?
iii. Are there gender differences in adaptation to climate change in the study area?
iv. What are the causal factors of these differentials in the study area?
v. What are the challenges of climate change adaptation in the study area

1.3 Aim and Objectives of the Study

The aim of this study is to analyze gender differences in adaptation to climate change in Kaduna State. The specific objectives of the study are to:

i. examine the nature of climate change in Kaduna State;
ii. assess climate change adaptation strategies in the study area;
iii. determine gender differences to climate change adaptation strategies in the study area
iv. determine causal factors of differentials in Kaduna State; and
v. examine challenges of climate change adaptation in the study area.

1.4 Scope of the Study

The scope of the study in term of content is to examine gender differentials in adaptation to climate change in Kaduna State. It also assessed the differential impacts on men and women as well as the causes (reasons) for the differences identified and the copping strategies since they cannot be considered as two homogenous groups. The spatial scope covers three senatorial zones of the state. The senatorial zones are: Northern Senatorial Zone (Kubau, Lere, Sabon gari, Zaria), Central Senatorial Zone (Chikun, Igabi, Kaduna South) and Southern Senatorial Zone (Jamaa, Kagarko, Kajuru, Zangon Kataf). The target populations are the males and females household population affected by climate change. The temporal scope examined climate data of Rainfall and Temperature in the three senatorial zones of Kaduna State for the period of 35 years from 1981 to 2015.

1.5 Justification of the Study

Climate change has become the primary environmental threat of the 21stcentury with its effects on gender are differently. Science suggests that its effects are at a scale that adds urgency not only to the efforts to prevent additional change, but equally important, to adapt to the impacts already occurring (Oladipo, 2010). While poor people, especially in Africa, are contributing less to the climate change with their 'simple' living, they are most vulnerable especially to problems of increasing heat, water scarcity, and food security among others (DFID, 2004, Arya, 2010).

This study is expected to constitute an invaluable source of data for future references in terms of gender differentials to climate change issues. It is also to be used as a tool for developing strategies for mitigating the menace of climate change in the study area. The study is expected to show the link between climate change, mitigation and adaptation strategies to gender equality and women's empowerment strategies, and presents experiences and initiatives that would

pioneer integrative actions. The study will offer a gender approach which would attempt to take this fact into account while striving to provide an understanding of how gender identities and relations in specific contexts are related to climate change. The study will reveal the importance of analyzing these factors to enable the formulation of social transformation proposals that would help to build more equitable societies. The study is significant as its gender approach would promote understanding of how the identities of women and men determine different vulnerabilities and capacities to deal with climate change; such an approach could also help to attenuate the causes of climate change.

The knowledge obtained will help the communities in Kaduna State to have a better understanding of the way they would respond to climate change and enhance their

Integrating the gender approach would also be helpful in designing and implementing policies, programmes and projects that lead to greater equity and equality. In particular, it would contribute to building more capacity of adaptation and mitigation to climate change. It will assist in creating awareness among the people. Thus, the conduct of this research is by all standards timely and justifiable since this is the first time work of this nature is carried out in Kaduna State the study area. Although the study focuses on Kaduna State, it is believed that the result generated from this study will be relevant to other states of the country as well as other countries with similar climate and socio-economic structures.

CHAPTER TWO

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Concept of gender

Gender refers not to male and female, but to masculine and feminine - that is, to qualities or characteristics that society ascribes to each sex. People are born female or male, but learn to be women and men. Perceptions of gender are deeply rooted; vary widely both within and between cultures, and change over time. But in all cultures, gender determines power and resources for females and males (FAO, 2011). Gender is a central organizing factor in societies, and it can significantly affect the processes of production, consumption and distribution. In fact, the influence of gender on rural people's lives and livelihoods is so substantial that "by any indicator of human development, female power and resources are lowest in rural areas of the developing world. Notwithstanding recent improvements in their status, they have the world's lowest levels of schooling and the highest rates of illiteracy. In all developing regions, female headed rural households are among the poorest of the poor." (FAO, 2011) Social and economic inequalities between men and women undermine food security and hold back economic growth and advances in agriculture (FAO, 2011).

Gender often constrains women to an unequal position in society in comparison to men. The goal of development interventions, legal and institutional strategies is gender equality. This means equal participation of women and men in decision-making, equal ability to exercise their human rights, equal access to and control of resources and the benefits of development, and equal opportunities in employment and in all other aspects of their livelihoods.

Enhancing gender equality and promoting women's empowerment has been enshrined in many international commitments. These included the United Nations Millennium Development Goals,

the Universal Declaration of Human Rights and the Convention on the Elimination of All Forms of Discrimination against Women. Despite international commitments, gender inequalities persist. One way toward reducing gender inequalities is through the pursuit of gender equity. That is, "fairness and impartiality in the treatment of women and men in terms of rights, benefits, obligations and opportunities. By creating social relations in which neither of the sexes suffers discrimination, gender equity aims at improving gender relations and gender roles, and achieving gender equality. The essence of equity is not identical treatment - treatment may be equal or different, but should always be considered equivalent in terms of rights, benefits, obligations and opportunities" (FAO, 2011). FAO (2011) recommends that development must encompass rural women's long-term needs and aspirations, their decision-making power, and their access to and control of critical resources such as land and their own labor. The reason for this is that it is typically women's needs that have been overlooked; hence there is a specific need for their inclusion. However, it should also be borne in mind that gender equity must consider both men and women. It is important to remember that women's and men's roles are a result of negotiations and relations between them.

Gender relations are socially constructed power relations between men and women in a given society; they determine the different benefits that men and women can derive from natural resources (Watson 2006). Women's and men's differential access to social and economic resources is one of the key aspects of gender inequality (Brody, Demetriades and Esplen, 2008).

However, women are expected to assume primary responsibility for their families' subsistence, agricultural production and sustainable livelihood (Brody, Demetriades and Esplen, 2008 and Banda and Mehlwana, 2005). Studies in Southern Africa and in Namibia particularly are

documented in Meena (1992) and Iipinge and Williams (2000) respectively. The rationale is to explore issues related to relationships between men and women, gender household's power relations, understanding issues of empowerment, access to economic and market facilities, access and control issues as well as examining participation of women in decision-making.

2.1.2 Concept of climate change

The United Nations Framework Convention on Climate Change (UNFCCC, 2015) defines climate change as change of climate that is observed over long period of time minimum of 30 years, attributed directly or indirectly to human activity, above that caused by natural climate variability. However, according to IPCC (2007), Climate change refers to any change in climate over time, whether as a result of human activity or due to natural variability. Schneider *et al*, (2007) defined an impact as a specific change in a system caused by its exposure to climate change. This exposure may be judged as harmful or beneficial.

Human societies and activities are sensitive to climate in some way or other. Where people live and the way they generate a livelihood and wealth is influenced by the ambient climate. Climate is naturally variable and human societies have always had to develop coping strategies when faced with unwelcome variations in climate or weather extremes (Adger, 2006). Vulnerability is a concept that has been used in various disciplines, notably in the field of disaster and risk management (Kasperson and Kasperson, 2001, Galloppin, 2006). Adger (2006) concluded that vulnerability is conceptualized as being constituted by components that include exposure to perturbations or external stresses, sensitivity to perturbations and the capacity to adapt. Adaptive capacity is therefore a component of vulnerability (Adger and Vincent, 2007). Furthermore, Babugura (2005) argues that vulnerability can be viewed as a state of well-being.

2.1.3 Concept of Adaptation

The Intergovernmental Panel on Climate Change (IPCC 2001) defines climate adaptation as adjustments in ecological, social, or economic system in response to actual or expected climate stimuli and their effects of impacts. This term refers to change in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.

Again, the IPCC (2001), define adaptation as the adjustment of natural or human systems in response to current or expected climate change (or to its effects), to moderate negative consequences and take advantage of any opportunities. Adaptation strategies can also be defined along the lines of Mendelsohn (2006) as the changes that people, companies or governments make to reduce the damage (or increase the benefit) of climate change. More recently, the Copenhagen Agreement (2009) has expanded the concept of adaptation by adding a new point to the current generally accepted definition of the concept of adaptation to the negative effects of climate change, i.e. adaptation to the impacts of mitigation measures.

All these definitions point to the anticipation of a future climate that is different from the current must lead to changes in the current behaviors of individuals and systems on the basis of predictions about the future climate. Adapting therefore does not consist solely of analyzing the vulnerability of territories to expected climatic evolutions, but also of implementing suitable measures. That is why the analysis of the impacts of climate change differs significantly from the analysis of the adaptation to these impacts, which is the subject of this study.

Adaptation is an important response option or strategy together with mitigation (Frankhauser, 1996, Kane and Shogren, 2000). Adaptation strategies became prominent in literature from the 1990s and often associated with climate change by American National Academy of Science. IPCC (2001) stated that adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emission. Adaptation, is because setting limits on emissions will not be enough, or happens soon enough, to avoid all impacts of climate change (EPA, 2008). Adaptation is imperative because the world's climate is changing and will continue to change. The risks associated with those changes are real but highly uncertain. Risks are apparent in every area which will affect development goals especially in developing nations. Sadly, however, these nations have been declared most vulnerable to climate change.

2.1.4 Clarification of the Concept of Adaptation

The definition of the mitigation of greenhouse gas emissions is clear and unambiguous. Mitigation means reducing emissions or increasing the storage of emissions in non-atmospheric sinks. On the other hand, adaptation measures can be defined in a number of different ways.

2.1.4.1 Reactive adaptation versus anticipatory adaptation

An adaptation measure is called "reactive" when it is taken in direct response to a major climatic event. A good example of a reactive adaptation measure is the case of the city of New Orleans and its vulnerability to hurricanes. In contrast to the previous example, adaptation measures can be taken before the occurrence of the extreme phenomenon. For example, a Dutch law defines a maximum acceptable risk of flooding. Adaptation measures are taken when the maximum acceptable risk is reached. This type of adaptation measure is called anticipatory (or proactive) when it is taken before the climatic risks actually occur.

Reactive adaptation measures do not include a continuous management of the climatic risk. Anticipatory adaptation policies manage this risk over the long term by keeping the level of the risk within an interval defined by political and social consensus. It should be noted in this context that regardless of the type of adaptation measures, it is not possible to completely eliminate the climatic risk, partly on account of the magnitude of the costs associated with eliminating the risk altogether, but above all because even without any change in climate, absolute protection from risk is impossible.

2.1.4.2 Spontaneous adaptation versus planned adaptation

Spontaneous adaptation includes the adaptation measures that are taken naturally without any specific coordination. Since the beginning of history, human societies have adapted to changes in their weather and climate. For example by changing the crops they raise or modifying their building methods. Nevertheless, this spontaneous adaptation by itself will not necessarily be sufficient, given the scope and rapidity of the climate change expected by the IPCC. Moreover, it should be emphasized that the actions taken by certain parties to protect themselves against climate risks can simply result in shifting the risk to other geographical areas or populations or can trigger other impacts. The overall effect of several spontaneous adaptations can be the opposite of what was intended, which is one reason for the importance of implementing planned adaptation measures.

Spontaneous and planned adaptations are intimately linked, as spontaneous adaptation actions can frequently be carried out to the existence of a preexisting environment which was the result of prior planning. For example, the irrigation of fields during a drought is a spontaneous adaptation measure only if the infrastructure that makes irrigation possible is already in place.

2.1.5 Relationship between Gender, Climate Change and Adaptation

Gender relations and social discrimination cut across all facets of human endeavor -but the precise nature of the process varies. Similarly, climate change will affect all human societies in all their activities, albeit in different ways and to different degrees. It is therefore necessary to look in more detail at some of the many, varied ways in which gender and climate change issues intersect.

The lack of recognition of gender relations in climate policy-making and the efforts to rectify this situation are then discussed. The particular gender issues arising in disaster and long-term, slow onset climatic changes are explored, followed by a synthesis of current debates on gender and mitigation. Finally, this section of the thematic review considers how pathways of environmental change are gendered, and reflects on the debates relating to the potential limits to adaptation and the role of migration in women's and men's adaptation strategies.

2.1.5.1Gendered dimensions of climate change

Attention to gender and equity has lagged behind in climate change research, programming, national policy-making and in the international negotiations (Masika, 2002; Wamukonya and Skutsch, 2002; Nelson *et al*, 2002; Cannon, 2002; Skutsch, 2002; Dankelman, 2008; FAO, 2007; Lambrou and Grazia, 2007; Terry, 2009). Studies on climate change and gender have initially and by necessity been somewhat speculative in nature. The impacts of climate change are affecting and will continue to affect disproportionately poorer rural and urban communities in developing countries, but few of the vulnerability and adaptation assessments adequately explore the gendered or socially differentiated nature of those impacts. This is starting to change with

more evidence being gathered from the field of how increased climate variability and climate change is affecting developing countries' populations and with potential future scenarios being explored - but a great deal more of this kind of analysis and understanding is needed.

There is a great deal of convergence and similar threads of argument running through the gender and climate change literature. It has only been recognized fairly recently that women will be disproportionately affected by climate change compared to men, because of widespread entrenched gender inequalities. Gender inequalities mean that women and men have differing roles, resources, rights, knowledge and time with which to cope with climate change (Cannon, 2002; Nelson *et al*, 2002; Denton, 2004; FAO, 2007; Babagura, 2010; Petrie, 2010). Further, women are disproportionately represented in poor populations, and are relatively more reliant on climate-sensitive livelihoods (FAO, 2007).

There is a lack of representation of women and of gender issues in climate change policy and decision-making from the local to the international levels. At national levels vulnerability assessments and the National Adaptation Programmes of Action (NAPAs) for Least Development Countries have lacked adequate gender analysis (Dankelman, 2008; Dankelman *et al*, 2008; Nelson, 2009), although there are a few positive elements in a small number of cases (UNFPA, 2009). At the international level in the climate negotiations this absence has been noted for some time and gender activists are attempting to tackle it, with some progress on inclusion in the UNFCCC texts (Dankelman, 2008).

It is important to recognize that the discourse framing women as 'vulnerable, passive victims', risks reinforcing the exclusion of women as 'active agents' in responding to climate change, and ignores their capabilities, knowledge and relevant skills, which should be built upon in climate responses (FAO, 2007; CARE, 2009). With appropriate support, they can be successful protagonists in action on climate change at all levels. Many of the publications rightly emphasize women's capacity to act and the fact that gender norms and division of labour also creates gender-differentiated knowledge. Thus women may have specific skills, for example as seed managers, which can be built upon in climate change adaptation. Women's knowledge and capacity as managers of natural resources are discussed (the 14 case studies in ISDR, 2008, which demonstrate grassroots women's leadership in disaster risk reduction, adaptation and development). But at the same time other papers note the importance of not conflating 'women' with 'nature' (Nelson *et al*., 2002) and of exploring how gender roles are constantly changing (Babagura, 2010).

Inequality based on gender is the most widespread form of oppression, and development and climate change can only be equitable if they place women's empowerment and the tackling of gender inequality centre-stage - it cannot be treated as an optional extra (Neefjes *et al*, 2009).

Gender inequality intersects with other types of discrimination such as ethnicity, caste, class and age, but analysis of these other forms of discrimination in the context of climate change is relatively undeveloped (Enarson, Fothergill and Peek, 2006).It is not enough just to 'add on' a concern for women's issues in climate responses -gender equality and women's empowerment is not an optional extra but a critical part of equitable development.

2.1.5.2 Gender and climate change impacts

Conceptual frameworks for understanding the gendered nature of climate change impacts are just beginning to emerge (Neefjes, *et al* 2009;) and analyses tend to be necessarily fairly speculative and general in nature, although there is also likely to be practice on the ground which has not yet be written up and shared internationally.

Gender inequalities exist in all societies and shape the ways in which climate change impacts play out in society (FAO, 2007). Women have lesser access to participation in policy and decision-making and fewer resources to cope with climate shocks and stresses, including income, other livelihood resources, information and decision-making authority (Lambrou and Grazia, 2007). Men and women have different access to resources, including physical resources like land, social resources such as networks, and financial resources like income-generating work and credit. In times of stress, they will have different options and 'safety nets' for coping with change (FAO, 2007). Based on their distinct roles, women and men have different sets of knowledge and skills, such as knowing which seeds to plant during a dry spell or knowing how to dig a well. Recognizing their contributions will result in a wider range of options for preparing for and coping with change (FAO, 2007).

Women tend to be more reliant on climate sensitive resources (FAO, 2007) and generally have lesser adaptive capacity because of the gendered nature of resource entitlements, such as access to land (Nelson and Stathers, 2009) – although whole communities in less affluent areas will be vulnerable to climate change.

There are also studies emerging which suggest that perceptions of risk, including climate risk, are gendered, and that this affects women's and men's responses to those risks (David, *et al.*2007). This is because there is a gender-based division of labour and social norms which mean that men and women often have differing roles and responsibilities, knowledge, and skills and will therefore be exposed to different risks (FAO, 2007). Gender dynamics vary from place to place and are not fixed – changing rapidly in some parts of the world - and the outcomes for women's and men's wellbeing will vary. But frequently women are disadvantaged and discriminated against, facing tougher workloads and less resources and livelihood options. Women's perceptions of risk also tend to be given less attention than those of their male counterparts (David, *et al*, 2007; Boko, *et al*, 2007,).

As roles and responsibilities are socially and culturally constructed, so are interpretations of the weather and climate. People understand and interpret the weather and climate in culturally constructed ways (Nelson and Stathers, 2009). Discussion of weather and climate is a means of constructing a shared understanding of the past and the present and a common conception of social relations and moral conduct. The British discuss the weather to avoid tensions and embarrassments related to strong social class divisions (Harley, 2003), and Tanzanian rainmaking rituals have gendered and symbolic meanings (Harley, 2003). Social memory of climate is unreliable and whilst research is increasing on local observations of climate change, it is important to remember that cultural constructions of climate, particularly climate memories, are as much to do with working out proper moral conduct and societal relations as they are about economic goals and commemorating climate events.

Seasonal forecasting is one area of increasing focus in climate-change research, but scientific information cannot be pre-packaged and delivered to users without attention to how that information will be perceived, understood and used. As scientific information is delivered it is inserted into on-going power dynamics, potentially catalyzing further change – in some cases reinforcement of inequalities. For example, ethnic, gender, and seniority hierarchies were found to shape the processing of climate information amongst groups of Ugandan farmers who were discussing climate information (Orlove, 2009; Roncoli, 2003). Local farmers will interpret the information they receive depending on their own worldview, concerns, culture, and accumulated experience of climate events (Roncoli, 2003).

Farmers in Burkina Faso were retaining only part of or completely different messages from those intended by scientific forecasters. Their interpretations depended largely on how they view rainfall, what they are interested in knowing about rainfall, and the risks they perceive – all of which may be gendered. Understanding this cultural construction of climate, and in fact the broader relationships between nature and society as conceived by different people and groups, is important as it will shape the framing of any particular problem relating to a changing climate and the potential solutions proffered by externally facilitated adaptation processes or autonomous responses.

Gender analysis is about changing relations between women and men, and different groups of women and men. Due to the fact that livelihood activities can be gendered there are also instances in which men will be more affected than women by climate change. The gender division of labour in Cameroon may mean, for example, that male fisher folk are likely to be increasingly exposed to river blindness (the epidemiology of which will be changed by climate

change) and more so than women in the household that do not fish. In the Arctic, where climate change impacts are already having a significant human cost, whole communities are being negatively affected, but male hunters are particularly hit by the increased difficulties and dangers they face from a shorter hunting season (Parbring, 2010). Further, the inability of male hunters to support the household – a traditional masculine role - is creating social problems and tensions (Parbring, 2010). It is therefore critical that men need to be involved in gender equality work, including in adaptation to climate change.

Anderson (2009) explores how gender relations are changing in the Pacific. Gender differences are embedded in the complex Pacific island social systems: diverse systems, including matrilineal and patrilineal property rights and inheritance are changing over time. For example, colonial processes dispossessed women of their land rights in Polynesian islands, and shifts are now occurring as patrilineal land rights and inheritance systems come further to the fore at the expense of matrilineal systems. Divisions of labour follow gender lines but also family heritage, with some skills such as traditional healing methods and canoe building skills being passed by lineage in some communities. In some communities, men take care of building and maintenance, whilst women clean and take care of the children, but these stereotypes do not exist uniformly (Anderson, 2009).

In some islands, women may not be involved in community fishing activities and may be more involved in land-based activities such as gardening. As livelihoods shift from subsistence to cash economies and from rural to urbanized settings, these roles have changed. In some cases women are involved in near-shore fishing, whilst men fish in deeper waters, but climate change is thought to be having a greater impact on the former, thus affecting women disproportionately

(Anderson, 2009). A sophisticated understanding of gendered forms of vulnerability and resilience is therefore important to identify how climatic (and other) changes will interact with gender differences in forming new rural and urban realities for poorer populations. A stronger commitment of resources (financial, technical, and human) to tackling inequalities is important for equitable and effective adaptation (Ahmed and Fajber, 2009; Neefjes *et al*, 2009).

The authors of a recent study of climate adaptation and DRR in southern Africa (Ziervogel, *et al*, 2006) conclude that whilst national vulnerability assessments may help in identifying particular areas and communities requiring assistance and in prioritizing and designing adaptation programmes, a more nuanced understanding of changing intra-community and intra-household vulnerabilities and marginality is also needed. Their study found that women's workload in particular was increased in times of hardship. As has been found in other studies, women's workloads were found to increase in times of low rainfall/drought because of the extra work involved in collecting water and firewood, and because of the need to undertake casual work to buy food and make ends meet (Ziervogel, *et al*, 2006). Both women and men engage in brick moulding and piece work on other people's farms in rural areas, but men spend more time selling charcoal in distant locations reducing labour availability and leading to increased work for women in the fields. Whilst two adult households can earn more income, in a female headed household, there it is sometimes easier for women to find work off-farm, because they do not have to obtain a husband's permission. Low yields and income insecurity leads to increases in crime and prostitution, particularly in the critical period (from December to January) when some women turn to prostitution to obtain food for their children and male members are absent, exacerbating the spread of HIV.

A recent study by the Women's Environmental Network (WEN, 2010), also concludes that women are more likely to live in poverty, and because of gendered social roles, they are more likely to be negatively affected by climate change. For example, they women in poor communities are more likely to:

1. die in climate change-related disasters, experience increasing work, income losses and negative health impacts, and suffer from violence and harassment following disaster events;
2. be displaced, or encounter problems when other (usually male) family members migrate for economic reasons;
3. experience increased burdens of water and fuel collection, and resulting health problems, due to increased incidence of drought or other changes in climate;
4. feel the effects of rising food prices most acutely, and be the first to suffer during food shortages;
5. suffer exacerbated health inequalities due to biological differences but also gender roles;
6. suffer from violence, including sexual violence, in resource conflicts;
7. be expected to, and need to, adapt to the effects of climate change, increasing their workload; although roles, responsibilities and workloads of women and men vary throughout the world and are differentiated by wealth and other social characteristics, it is widely the case that women have higher workloads than men due to their domestic responsibilities, reproductive responsibilities as well as possible roles in agriculture, petty trading, marketing etc. As we have explained earlier, disadvantaged men may also be vulnerable to climate change, but the subordination of women is widespread.
8. suffer as a result of unintended consequences of responses to climate change, such as forestry projects and biofuel production (WEN, 2010) .

As an example of some of these points, young girls' lives can be negatively impacted by the extra time spent collecting water in drought affected areas, contributing to the barriers to their education and potentially with health impacts. Additional to the gender-related causes,(ascription of different livelihood roles and responsibilities along gender lines), there are sex related factors stemming from biological differences which increase women's vulnerability. For example, reproductive health issues, the need for sanitation during menstruation and after giving birth, constrained mobility during pregnancy, and higher nutritional needs during lactation are all examples. The cumulative impact of these factors will result in a larger number of women being severely affected by the impacts of climate change and fewer options for women to cope with climate variability (Alber, 2009).

2.1.5.3 Gender dimensions of climate change mitigation

There is limited empirical evidence of the differentiated impacts of climate change mitigation interventions, mainly because some schemes and investments have only recently being implemented. However, as mitigation schemes are implemented, more understanding of the gender dynamics are likely to emerge. Analyses are emerging particularly in two areas: i) the gender issues in Reduced Emissions from Deforestation and Forest Degradation (REDD) schemes; ii) the gender dimensions of liquid biofuels for transportation schemes, investment in which is driven by developed country policies and mandates, which have been formulated partly in response to climate change mitigation imperatives.

2.1.6 Livelihood Adaptation

Livelihood adaptation is an increasingly widely used theory today in contemporary writings on poverty, gender and rural development. Livelihood is dynamic and universal. People adapt and

change their livelihoods with internal and external stressors. However, the adverse impacts of weather and climate events increasingly threaten and erode basic needs, capabilities, and rights, particularly among women, poor and marginalized people, in turn reshaping their livelihoods (Adger, 2010; Quinn, Ziervogel, Taylor, Takama, and Thomalla, 2011; Abdulkarim, Balarebe, and Oladipo, 2013; Olsson *et al,* 2014). Some livelihoods are directly climate sensitive, such as rain-fed agriculture, seasonal employment in agriculture (for examples, coffee and sugar, among others), fishing, and pastoralism (Olsson *et al*, 2014).

Livelihood is a means, activities, entitlements and assets by which people (both the poor and the rich) pursue to make a living (Olsson *et al,* 2014). Assets, in this particular context, are defined as not only natural/biological, but also social, human, financial, and physical (Elasha *et al*, 2005).IISD (2003) defines livelihoods as being "concerned with people's capacities to generate and maintain their means of living, enhance their well-being, and that of future generations". A popular definition is that provided by Chambers and Conway (1992) that a livelihood is capabilities, assets (including both materials and social resources), and strategies activities required for a means of living by the communities. Livelihoods, thus, do not mean just income; they encompass social institutions, gender relations, and property rights required to support and sustain a given standard of living (Sharma, 2010). Livelihoods are considered sustainable when they can cope with, and recover from, stresses and shocks and maintain or enhance their capabilities, assets and capacities to meet a people's needs both now and in the future, while not undermining or compromising the natural resource base (Carney, 1998).

The important feature of this livelihood definition is to direct attention to the links between assets and the options people possess in practice to pursue alternative activities that can generate

the income level required for survival. These assets are the basis on which livelihoods are built upon (IISD, 2003).

2.2 Literature Review

2.2.1 Nature of Climate Change

Basically, climate change is caused by two factors: natural processes (bio-geographical) and human activities (anthropogenic) (Odjugo, 2010). Figure 2.1shows the causal factors of climate change.

2.2.1.1 Natural factors

According to Ayoade (2003; 2004) and Odjugo (2010) the natural processes of climate change can be grouped as terrestrial, astronomical and extraterrestrial factors.

i. *Terrestrial causes of climate change*: The terrestrial factors according to Ayoade (2003,2004) include polar wandering and continental drift, changes in the earth's topography, changes in atmospheric composition or chemistry, changes in the distribution of land and water surfaces, and changes in the variation of snow and ice cover of the earth's surface.

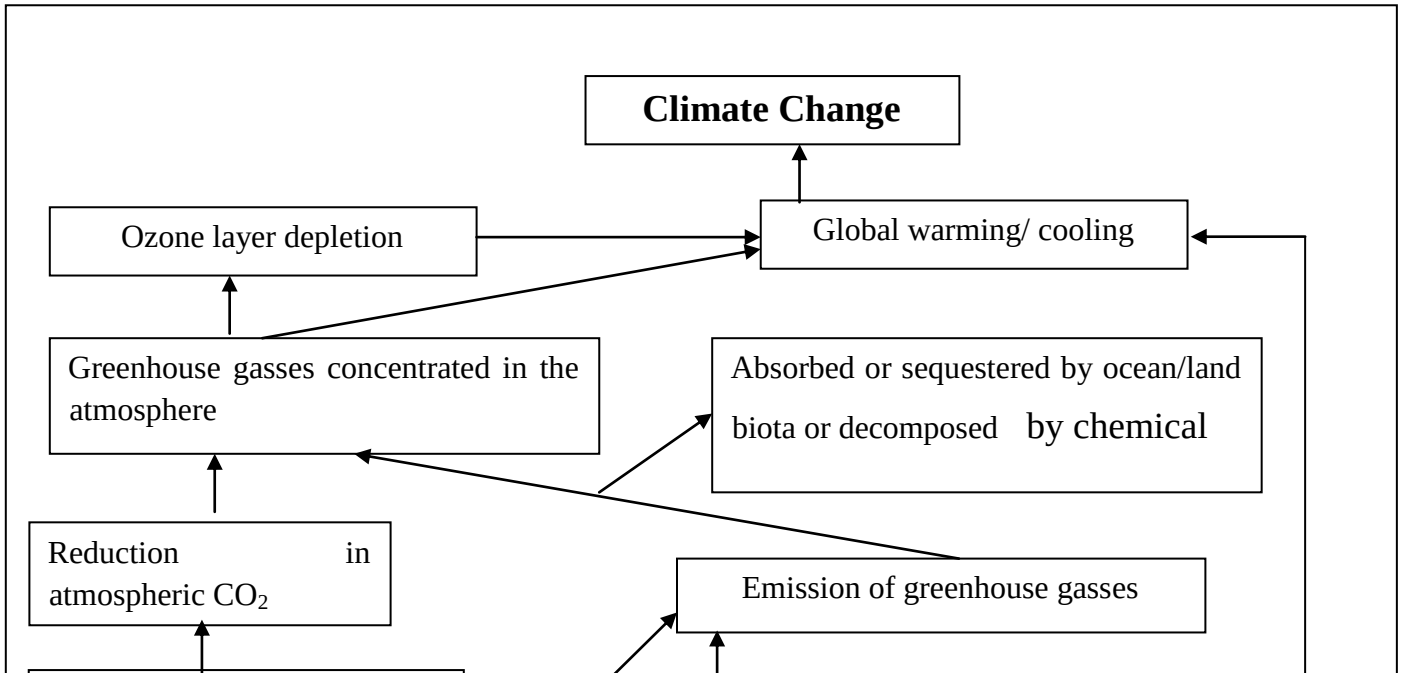

Figure 2:1 Causal Factors of Climate Change (Adapted from Odjugo, 2010)

Figure 2.1: Causal Factors of Climate Change (Adapted from Odjugo, 2010)

Changes in the distribution of land and ocean would bring about a change in the energy distribution and hence general atmospheric circulation and climate because of the well-known differences in the thermal characteristics of land and water surfaces (Ayoade, 2003, 2004). Several theories that have been put forward include those of Polar Wandering and Continental Drift and more recently, the theory of Plate Tectonic. Apart from the well-known different thermal properties of land and water surfaces and their effects on pattern of radiation distribution, shift in the location of continents and oceans will mean that giving area of the earth will be located nearer or farther away from the poles or equator with attendant changes in climate (Ayoade, 2003). According to Ayoade (2004), there are also other theories relating to changes in the topography of the continents and the oceans. The topography is changed with the attendant

changes in the influence exerted on the air flow, insolation and other weather elements such as temperature and precipitation.

Also, orogenesis may involve vulcanicity which would provide aerosols and other pollutants that would affect the transparency and the composition of the atmosphere and hence the amount of energy reaching or leaving the earth's surface. Volcanic eruptions are associated with the discharge of surphur dioxide (SO_2), water vapor, dust and ash into the atmosphere (Ajaero, Akukwe, and Asuoha, 2010). Whereas volcanic pollution of the lower atmosphere is removed by the effects of rainfall and gravity within days, stratospheric pollution may remain there for several years. These gases, dusts, and ashes influence climatic patterns for years (Ajaero, Akukwe, and Asuoha, 2010; Amos, Musa, Abashiya and Abaje, 2015). For example, millions of tons of SO_2 can reach the Stratosphere from a major eruption. These gases and dust particles tend to partially block the incoming solar radiation and this result in the cooling of the atmosphere. SO2 may also combine with water to form tiny droplets of sulphuric acid which can remain in the upper atmosphere for years as efficient reflector of solar radiation (Ajaero, Akukwe, and Asuoha, 2010; Igwebuike, Udoh, Ezeugwu, Oparaku and Oparaku, 2010). All these will have effect of the energy balance of the earth and, hence, a change in climate.

ii .Astronomical Causes of Climate Change: These are based on changes in the earth's geometry and the effects of these on the radiation balance of the earth-atmosphere system and hence climate. The major parameters involved are: changes in the eccentricity of the earth's orbit, changes in the precession of the equinoxes, and changes in the obliquity of the point of the ecliptic (Ayoade, 2003, 2004). Changes in these three parameters are together called the Milankovich theory. The theory suggests that normal cyclical variations in three of the earth's

orbital characteristics are probably responsible for some past climatic change. The theory assumes that these three cyclic events vary the amount of solar radiation that is received on the earth's surface over time (Pidwirny, 2006; Igwebuike *et al* ,2010*)*. The eccentricity controls the shape of the earth's orbit around the sun. The amount of solar radiations received by the earth varies with the eccentricity of the orbit, The eccentricity of the earth's orbit also affects the elliptical orbits, the smaller will be the differences in the length of ,the seasons and the greater the eccentricity; the greater will be the variations between the seasons (Ayoade, 2003, 2004). At the perihelion, receipt of solar radiation is 6% more than at the aphelion. The eccentricity of the earth's orbit fluctuates with a periodicity of between 92,000 to 100,000 years (Ayoade, 2003, 2004; pidwirmy, 2006; Igwebuike *et al,* 2010). The earth is currently experiencing a period of low eccentricity. The regular change in the earth is at a given distance from the sun is referred to as the precession of the equinoxes. As the earth rotate on its polar axis, it wobbles like a spinning top changing the orbital timing of the equinoxes and solstices and this will affects the intensity of the seasons (Pidwirny, 2006; Igwebuike *et al*,2010).

There are also variations in the tilt (obliquity) of the earth's axis of rotation over 41,000 year period. The title has varied in the past from approximately 21.5^0. At present, the tilt of the earth axis is 23.5^0. A decrease in the obliquity of the ecliptic would result to less climatic variation between the summer and winter seasons in the middle and high latitudes. The net effect of this smaller tilt would be more extensive formation of glaciers in the polar latitudes. On the other hand, periods of larger tilt in greter seasonal climatic variation in the middle and high latitudes (Pidwairny, 2006; Igwebuike *et al*, 2010).

iv. *Extraterrestrial causes of climate change*: Extraterrestrial causes of climatic change postulate change in the amount of solar energy reaching the earth either because of changes in the solar output or changes in the amount of solar rendition absorbed outside the earth's atmosphere (Ayoade, 2003 and 2004). Until recently, many scientists thought that the sun's output of radiation only varied by a fraction of a percent over many years. However, measurements made by satellites in the 1980s and 1990s suggested that the solar energy output may be more variable than was once thought. Numerical climatic models predict that a change in solar output of only 1% per century would alter the earth's climate. The number and size of sunspots show cyclical patterns, reaching a maximum about every 11, 90, and 180 years. The decrease in solar energy observed in the early 1980s corresponds to a period of maximum sunspot activity based on the cooler and wetter conditions, whereas decrease in sunspots have been associated with warm and drier conditions (Ayoade, 2003, 2004).

2.2.1.2 Anthropogenic factors

The anthropogenic factors of climate change involve s human activities that either emits large amount of greenhouse gases (GHGs) into the atmosphere deplete the ozone layer or activities that activities result in emissions of four principal GHGs. Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20) and halocarbons (a group of gasses containing fluorine, chlorine and bromine) such as chlorofluorocarbons (CFCs), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), hydrochlororocarbons (HCFCa) and sulphuric hexafluoride (sf_3) among others (IPCC, 2007b). There GHGs act like a blanket in the atmosphere, holding heat closer to the earth and not permitting it to radiate away as it would otherwise do. Since the Industrial Revolution, humanity has been emitting more GHGs mostly through the burning of fossil fuels, gas flaring, urbanization and agriculture, increasing the concentration of GHGs in the atmosphere and thus

increasing the warming effect (IPCC, 2007b;) Hoffmann,2011). On the other hand, human activities that reduce the amount of carbon sinks are deforestation, alterations in land use, water pollution and agricultural practices (Odjugo, 2010).

The concentration of CO_2 in the atmosphere since the industrial revolution has increased globally from 278 ppm per year during the last decade (Thornton and Lipper, 2014). This increase over the past two hundred and sixty years is largely due to the combustion of fossil fuels for energy production. By 2100, it is estimated that, the value may either double or even triple (Myhre *et al*, 2013). Naturally, a CO_2 emission per year is 6.1 times higher than the anthropogenic sources. Even through the natural emission is higher, a balance is maintained by nature since the excess is sequestered as carbon sinks in the rivers, lakes oceans, and forests (Odjugo, 2010). Anyadike (2009) stated that humans induce the emission of CO_2 into the atmosphere through energy creating activities like heating homes and building, transportation and cooking food, treating water to make it drinkable, gas flaring, bush burning, among others.

Ifeanyi-obi, Etuk, and Jike-wai (2012) studied that deforestation accounts for 20% of the world's carbon emissions. Deforestation makes such a huge contribution to carbon emission because trees absorb CO_2 as they grow and produce oxygen (O_2). If the trees are cut down without replacement, only fewer trees will be left to absorb CO_2 which would result in the building up of CO_2 in the atmosphere. The emission of CO_2 from fossil fuel burning coupled with deforestation has disturbed the balance of the carbon cycle, because the natural processes that could restore the balance are too slow compared to the rates at which human activities are adding CO_2 to the atmosphere, where some of it will remain not just for decades or centuries, buts for thousands of years (IPCC, 2007; Myhre *et al*, 2013).

Methane (CH_4) is generated naturally by the decay of organic matter in the absence of oxygen (anaerobic processes). About 50% of the excess CH_4 comes from bacterial action in the intestinal tracts of livestock and from organic activity in flooded rice fields. Burning of the vegetation causes another 20% of the excess CH_4 (Christopherson, 2006). Methane is now believed to be responsible for about 19% of the total atmospheric warming, complementing the warming caused by CO_2. The concentrations of CH_4 in the atmosphere have been measured continuously since 1978, and by 2005 the concentration was 1750 ppb indicating an increase of about 150% since pre-industrial times, with projection indicating a further doubling by the year 2100 (Odjugo, 2010; Myhre *et al*, 2013).

Concentration of Nitrous oxides have risen from about 270ppb in 1750 to about 324.2ppb in 2011, an increase of 5 ppb since 2005 (Myhre *et al*, 2013).N2O concentration in the atmosphere according to Odjugo (2010) is now increasing by 0.2 to 0.3% per year. It has the third largest forcing of the anthropogenic gases in the atmosphere. Anthropogenic emissions of N_2O represent about 30 45% of the present day global total and are mostly from fossil-fuel activities, fertilizer use and soil sources. Natural emissions come mostly from micro activity in the soil (Myhre *et al* 2013). According to IPCC (2007b) report, the concentrations of halocarbon gas have increased primarily due to human activities. The natural processes are just a small source. Principal halocarbons include the CFCs (especially CFC-11, CFC-12 and CFC-13). CFCs are used as solvent for cleaning in the electronic industry and for aerosols propellants, they are use as home insulation and upholstery; they are also used in fire extinguishers as well as in foam industries as blowing agents (Christperson, 2006; Getis, Bjelland and Fellmam, 2011; Lucon *et al*, 2014). The presence CFCs in the atmosphere was found to cause stratospheric ozone depletion with

concomitant changes in climate. In 1985, a hole was discover in the ozone layer over Antarctica ozone hole of 2006 was the largest on record covering about 29.5 million km^2 (Strahler, 2011). This trend, if continues will result to a reduction in agricultural production due to cell and tissue damage in plants, and also an increase in the number of skin cancer cases. When CFCs reach the stratosphere, intense UV radiation Split them, freeing chlorine (CI) atoms. This process produced a complex set of reaction that breaks up ozone molecules (O_3) and leaved oxygen gas molecules (O_2) in their place. A single chlorine atom decomposes more than 100,000 ozone molecules (Christperson, 2006). Ozone which is essentially in the stratosphere forms a protective blanket called the ozone layer which shields all form the sun (Getis *et al*, 2011; Ayoade, 2004). Even though the abundance of clorofluorocarbon gases is decreasing as a result of international regulations designed to protect the ozone layer (IPCC, 2014a), the long resident time of chlorine atoms in the ozone layer (40 to 100 years) is likely to produce long –term climate change consequences through the21st century from the chlorine already in place.

Currently, Co_2 contributes the highest rate of GHs in the atmosphere followed by CH_4 CFs, N_2O, and others like halons, tropospheric ozone, among others. Even though CO_2 is the highest contributor of GHGs, its potency is very low. For example, a gram of CH_4 is about 23 times higher than the effects of the same volume of CO_2 and a gram of SF_6 released into the atmosphere is about 22,000 times that of CO_2 with (Odjugo. 2010).

Ajaero *et al* (2010) stated that some of the human activities in Nigeria that are associated with increased in temperature and consequently climate change include: domestication of animals such as cattle, in the northern part of the country where nearly 70% of Nigerian cattle concentrated; process of oil drilling, minerals mining (for example, Niger Delta and Jos Plateau

respectively), and also leaking and vandalization of pipelines (for example Niger Delta); and deforestation for either construction or fuel wood. The increasing population of the country is one other factor that causes climate change, this is because the available land area for agriculture is reducing as a result of ecological degradation and the used of large quantities of fertilizers to increase the agricultural output. More fertilizer means more emissions of N_2O to the atmosphere. Odjugo (2010) also found out that in Nigeria, with particular reference to Benin City and Warri, the major source of GHG is from automobiles. This is because most of the vehicles imported into the country are either old or fairly used which have incomplete combustion and therefore, emit a lot of carbons into the atmosphere. The study further revealed that the carbons emitted by motorcycles are even worse than those from vehicles because they usually add about $^1/_4$ to $^1/_2$ liter of engine oil to 4 liter of petrol before use, and this emits more carbons similarly, Dankani (2012) examine electricity generator usage in Kano walled city and the result revealed that generator usage is one of the major means of carbon emissions in the area, and that other means in which carbon is emitted into the environment are through fuel wood and vehicles. The study concluded that if the current trend of carbon emissions should continue, the result could be more than doubling of global carbon emissions by 2050, and hence increase in global warming.

Ariko, Sawa and Ibrahim (2014) studied the variability in carbon monoxide (CO) concentration in Kaduna metropolis, and the result revealed that the high CO concentrations in the atmosphere is mainly from the urban area which is as a result of the combustion in the fossil fuel. High CO concentration is associated with health problems, by reducing oxygen delivery to the body's organs and tissues, and at extremely high levels, CO can lead to death. Apart from the health problems, CO concentration in the atmosphere can lead to an increase troposphere O_3 and a build-up of other trace gases in the atmosphere which may in turn cause widespread perturbations of tropospheric chemistry, global warming, and other climatic changes.

2.2.2 Climate Change Adaptation Strategies

The tendency of systems to adapt to impacts of climate change is influenced by certain system characteristics called *determinants of adaptation* (Olmos, 2001). These terms, among others include: *sensitivity* (degree to which a system is affected by, or responsive to, climate stimuli); *vulnerability* (degree to which a system is susceptible to injury, damage or harm); *resilience* (degree to which a system rebounds, recoups or recovers from a stimulus); *adaptability* (the ability or competency of a system to alter in order to suit climatic stimuli); and, *adaptive capacity* (the potential or capability of a system to adapt or alter to better suit climatic stimuli).

It is noteworthy to state here that the relationship between a changed climate system (for examples, higher temperatures, and altered precipitation regime, among others) and impacts on human systems is not necessarily linear. This is because human agencies and institutions can play a crucial role in minimizing the adverse impacts of climate change and in seizing opportunities resulting from the impacts.

2.2.2.1 Adaptive Capacity

Most of the research works on adaptive capacity, for examples, Smithers and Smit (1997), Dolan and Walker (2003), Smit and Wandel (2006), Wall and Marzall (2006), Fussel and Klein (2006), Deressa, *et al*, 2008a, Deressa, *et al*, 2008b; Kuriakose, Bizikova and Bachofen (2009), Gbetibouo *et al*, (2010), Ruhl (2011) and Abdulkarim *et al* (2013) among others are closely linked to climate change adaptation . This may be due to the fact that adaptive capacity helps in reducing climate change vulnerability.

Adaptive capacity is the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change (Gbetibouo *et al,* 2010). The IPCC (2014b) glossary, defines adaptive capacity as the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Smithers and Smit (1997) and Dolan and Walker (2003) viewed adaptive capacity as an inherent property of the system that defines its capability to deal with exposure. It is a' reflective of resiliency, in which a resilient system has the capacity to prepare for, avoid, moderate and recover from climate change impacts.

Adaptive capacity varies from country to country, from state to state, from community to community, from household to household, among social groups and individuals, and over time. It varies not only in terms of its value but also according to its nature. The scales of adaptive capacity are not independent or separate. The capacity of a household to cope with climate impacts or risks depends to some degree on the enabling environment of the community, and the adaptive capacity of the community is reflective of the resources and processes of the region (Yohe and Tol, 2002; Smit and Wandel, 2006)

The forces that influence the ability of the system to adapt are the drivers or determinants of adaptive capacity (Smit and Wandel, 2006). At the local or community level the ability to undertake adaptations can be influenced by such factors as managerial ability, access to financial, technological and information resources, infrastructure, the institutional environment within which adaptations occur, among others (Adger, 1999; Adger, 2000; Smit and Wandel, 2006). Some determinants of adaptive capacity according to Smit and Wandel (2006) are mainly local (for example, the presence of a strong kinship network which will absorb stress) while others

reflect more general socio-economic and political systems (for example, the availability of state subsidized crop insurance). These determinants are not independent of each other. For example, the presence of a strong kinship network may increase adaptive capacity by allowing greater access to economic resources, increasing managerial ability, supplying supplementary labor and buffering psychological stress. Similarly, economic resources may facilitate the implementation of a new technology and ensure access to training opportunities and may even lead to greater political influence.

IPCC (200I) identifies economic wealth, technology, education, information and skills, infrastructure, institutions and equity as the principal determinants of adaptive capacity, though no distinction is made between determinants at national and local level. Gbetibouo *et al* (2010) in a study of the vulnerability of the South African farming sector to climate change and variability using an indicator approach observed that the key determinant of individuals, households, communities or countries' adaptive capacity both to reduce risk and to cope with and adapt to increased risk levels is their asset portfolio. The study characterized adaptive capacity as dependent upon four livelihood assets: *social capital* which is represented by share of farmers in farm organizations; *human capital* which is represented by literacy level and also HIV prevalence; *financial capital* is represented by farm income, farm assets, farm holding size, share of agricultural GDP, share of people below the poverty line, and access to credit; and, *physical capital* which is represented by an infrastructure and institutions.

2.2.2.2 Adaptation Strategies

Climate change adaptation strategies or measures involves reducing risk and vulnerability, seeking opportunities and building the capacity of individuals, communities, cities, regions, nations, and natural systems to cope with climate impacts, as well as mobilizing that capacity by implementing decisions and actions (Tompkins *et al*, 2010). It requires adequate information on risks and vulnerabilities in order to identify needs and appropriate adaptation strategies to reduce risks and build capacity (Noble *et al,* 2014). Carter, Parry, Nishioka and Harasawa (1994) identified six types of strategies for adapting to the impacts of climate change as follows:

Prevention of Loss: This involves anticipatory actions to reduce the susceptibility of an exposure unit to the impacts of climate change. Ayoade (2003) defined an exposure unit as the activity, group, region or resource exposed to the effects of climate change.

Tolerating Loss: This is a situation where losses may be tolerated where adverse impacts are accepted in the short term because they can be absorbed by the exposure unit without long-term damage. In other words, nothing is done to protect the exposure unit against the impacts of climate change.

Spreading or Sharing Loss: In this situation, actions are taken in order to distribute the burden of climate change impacts over a larger region or population beyond those directly affected by the climatic event. Examples of such according to Ayoade (2003) include disaster relief measures by government and non-governmental organizations; and, insurance schemes against the negative impacts of climate change.

Changing Use or Activity: This involves a switch of activity or resource use to adjust to the adverse as well as positive consequences of climate change. For instance, there could be a switch from arable farming to pastoral farming or from the cultivation of water demanding crops to less water demanding crops (for example, millet may be grown instead of guinea corn or maize; also, cassava may be grown instead of yam).

Changing Location: This occurs where preservation of an activity is considered more important than its location, and migration occurs to areas that are more suitable under the changed climate. In other words, an activity relocated to a more suitable location under the changed climate. For example, a settlement or an industrial plant may be relocated to avoid inundation by a rise in sea level as a result of climate change.

Restoration: Here the aim is to restore a system to its original condition following damage or modification due to climate change.

The Nigeria's First National Communication report under the UNFCCC also stated that to minimize the adverse impacts of climate change on the ecosystem, water resources, socio-economic domains, a number of adaptation measures are open to the country. These adaptation measures are similar to the six types identified by Carter *et al* (1994). They range from education to inform and encourage behavioral change to changing location and use, preventing effects, modifying threats, sharing loss or simply bearing it (FRN, 2003).

The terms adaptation and coping strategies -are often used interchangeably, leading to confusion about the similarities and differences between these two important concepts. Daze, Ambrose and

Ehrhart (2009) listed some of the characteristics of these two concepts 'that were compiled during brainstorming sessions by groups of development practitioners in Ghana, Niger, and Nepal. Coping strategies according to these groups are short-term and immediate, not continuous, and are oriented towards survival, they are motivated by crisis or reactive, they often degrades resource base, and are always prompted by a lack of alternatives. Adaptation strategies on the other hand are oriented towards longer term livelihoods security, continuous process, results are sustained, and they use resources efficiently and sustainably, involving planning, combining new and old strategies and knowledge, and focused on finding alternatives.

2.2.2.3 Mitigation versus Adaptation

From the aforementioned, it is important to distinguish between mitigation and adaptation. This is because the two terms are often confused or used interchangeably by some researchers. The Fourth and Fifth Assessment Report of the IPCC used the following definitions of climate change mitigation and adaptation. Mitigation, according to the two reports, means implementing policies to reduce GHG emissions and enhance sinks, while adaptation on the other hand is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. It follows from these definitions that mitigation reduces all impacts (positive and negative) of climate change and thus reduces the adaptation challenge, whereas adaptation is selective; it can take advantage of positive impacts and reduce negative ones.

Klein *et al* (2007) noted that mitigation and adaptation are implemented on the same local or regional scale, but may be motivated by local and regional priorities and interests, as well as

global concerns. Mitigation has global benefits, although effective mitigation needs to involve a sufficient number of major greenhouse gas emitters to foreclose leakage. Adaptation on the other hand typically works on the scale of an impacted system, which is regional at best, but mostly local.

2.2.2.4 Climate Change Adaptation Frameworks

Adaptation to climate change involves the planning and activity by individuals, communities, regions and businesses to cope with the changing weather and climate conditions. Adaptation depends greatly on the adaptive capacity of an affected system, region, or community to cope with the impacts and risks of climate change (IPCC, 200 l). The adaptive capacity of households or communities is determined by their socioeconomic characteristics. Therefore, enhancement of adaptive capacity reduces the vulnerability of any region, community or household and promotes sustainable development.

Climate change adaptation framework will guide actions by the individuals, the community, non-governmental organizations, the research sectors, local government and state government agencies to develop a well-informed and timely adaptation strategies that will reduce the impacts and vulnerability of climate change (Government of South Australia [GSA], 2012). Appropriate investment in research, skills, innovations and general development of the workforce can improve the adaptive capacity of a nation, state or LGA to not only minimize the negative impacts of climate change but also to create new opportunities for the communities and the economy.

A range of adaptation frameworks designed to reduce the impacts and vulnerability of climate change exists for different countries. This is because each country or region has a different and possibly unique geographical landscape and socioeconomic features that affect its vulnerability to climate change.

Existing frameworks predominantly define adaptation in different contexts and propose tools that may be used to support climate change adaptation (Armstrong, Wilby and Nicholls, 2015). In 2009, the World Resources Institute (WRI) published a national adaptive capacity framework that identifies a fundamental set of national level functions that all countries will need to perform if only they are to adapt effectively to climate change risks over time. Under the National Adaptive Capacity (NAC) approach, adaptation is treated as an organic process, that is, one which will inevitably grow and evolve in unexpected ways, since every country or region has a unique set of actors who play different roles in adaptation (Government of Ireland, 2012). The framework consists of five key functions within which the national capacity is evaluated. These, five key functions are: assessment, prioritization, coordination, information management, and climate risk reduction.

A review of the climate change adaptation literature reveals three distinct adaptation framework approaches that stakeholders may utilize; Scenario-Led frameworks, Vulnerability-Led frameworks and Decision-Centric frameworks (Armstrong *et al,* 2015). The Scenario-Led frameworks apply conventional methods of regional climate downscaling from climate model projections under a range of greenhouse gas emissions scenarios.

Downscaled scenarios are then fed into impact models to examine how changes in climate might affect a given region or country. Only then adaptation options considered and implemented.

Vulnerability-Led frameworks seek to identify and reduce vulnerability to past and present climate variability and change. The frameworks recognize that complex socio-ecological demographics are some of the major factors that must be considered when implementing appropriate and effective adaptation to potential impacts of climate change. Therefore, the focus of this framework is to identify factors and controls that govern communities' ability to successfully cope with climate related threats (Van Aalst, Cannon and Burton, 2008).

Adaptation occurs in the form of improving coping strategies or by reducing exposure to known threats.

The Decision-Centric frameworks are situated between Scenario-Led and Vulnerability-Led approaches. The first step is the identification of the vulnerabilities in a given neighborhood by asking stakeholders and appropriate experts the degree to which the given area could cope with changes in environmental conditions and what level of climate change would require substantial infrastructure investment and/or policy shifts (Armstrong *et* al, 2015).

In northern Nigeria, Udeh (2014) developed a model of perception and adaptation in a traditional farming community in the dry land area of Kano state from the experience of individual local farmers using a bottom-up approach. The model is built from emphasis on stakeholders' participation and strengthening adaptive capacity. The model starts from the causes of climate change in the area, then assessed its impacts and adaptability to the changing climate in the area in order to build a resilient and improve productivity of the farmers. The most important aspect

of this model is its applicability to varieties of scales, from regional or state level to smaller communities.

2.2.3 Gender Differentials and Adaptation Strategies

According to Patt, Daze, and Suarez (2009), there are different gender attitudes towards risk responses (men are more likely to take risks than women) and in decision-making processes (women are more likely to seek and listen to advice, and learn from others with more experience). Those female tendencies make it easier for consulting agencies to offer help; women are more likely to take advice and carry out things that aid agencies suggest. ADBI Working Paper 309 Aoyagi, Suda, and Shinada, ‘ We primarily focus on two aspects of climate change adaptation—disaster recovery and agricultural production—along with the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report (Adger, *et al*. 2007) and other mapping efforts.

Many studies and reports have been published about climate change and its impacts, but the topic of gender issues and climate change adaptation has received relatively little attention. There are many papers on related topics, such as disaster recovery, agricultural practices, and water and energy issues. Some papers have emphasized the importance of gender consideration as part of the larger climate change issue. UNDP (2009) created a website for gender issues that has a section devoted to climate change. It is an informative guide to academic and nonacademic papers and reports, activities, and organizations related to climate change and gender issues.

Aguilar (2007) highlighted that women are the main producers of the world’s staple crops, providing up to 90% of the rural poor’s food intake and producing 60–80% of the food in most

developing countries. The impact of climate change in agricultural production has the potential to cause severe food shortages across the world, but the rural poor will be the most affected. Also to the researchers, climate change does not affect women and men in the same way and it has, and will have, a gender-differentiated impact. Therefore all aspects related to climate change (i.e., mitigation, adaptation, policy development, decision making) must include a gender perspective. The researcher went further to state that women are not just helpless victims of climate change, but are powerful agents of change and their leadership is critical.

The relationships among gender, human rights, and poverty in the context of climate change adaptation have been widely studied (Denton 2004; Brody, Demetriades and Esplen 2008; Terry 2009). Within these previous studies, the commonly held fact is that women are often described as victims of gender-biased social systems. To buttress the above statement, Terry (2009) wrote there could be no climate justice without gender justice. To the researcher, culturally and financially restricted poor women and men will be affected by the climate risk unevenly and that women will be even more restricted in response to the risk.

Many authors have investigated gender and migration and agricultural production systems (Aguilar, 2008; Carr 2008). These discussions are closely related with gender differentiated impacts from climate change, and the authors try to closely examine the impacts of climate change on the structure of society. Aguilar (2008) discussed climate change-induced migration in several regions in the world. “Characteristics like gender, age, socio-economic status will all affect unfolding patterns of environmentally induced migration. Aguilar, (2008, p410) essentially argues that those with money or other social support systems will be able to migrate earlier, while the poor and vulnerable will not initially be able to move.

Carr (2008), Nielsen and Reenberg (2010) discussed culture and agricultural production systems (including gender differences in agricultural production) in Africa. They stated that a person's social position is determined more by institutions, ethnicity, and gender than by individual ability. Aguilar, (2008) opined that gender and demographic structures play a role in environmentally induced migration patterns. Property rights, resource distribution and family roles affect men and women's migration patterns, particularly when the environment becomes a strong push factor.

Each of these authors has tried to construct an association or perspective for mainstreaming gender issues in the climate change adaptation discussion. There are several discussions in related sectors of climate change adaptation, including disaster prevention and recovery. One example is Arya's (2010) examination of drought policy and ongoing agricultural reconstruction in Australia. As part of the larger study, Alston pointed out that drought policy remains significantly gender blind.

Researchers have also examined the mental stress and vulnerability of female survivors of disasters. Bruce *et al* (2013) conducted research on New York City residents after 11 September 2001. They found gender was the most powerful predictor of resilience (ability to recover) and that female gender was associated with a reduced likelihood of resilience. Some researchers have focused on job recovery after a disaster. Roncoli (2003) used two waves of survey to examine the determinants of employment recovery status in New Orleans after Hurricane Katrina from the point of view of the interaction between location and race. Although displacement, income, and home ownership were significant determinants of job recovery, women were almost twice as likely to fail to recover employment conditions than men because, as Roncoli concluded, women

are expected to take care of their family members and generally had to remain away from their jobs for longer than men. Women are more likely to be affected by the impacts, as they are in a more vulnerable economic, institutional, and political situation, and this applies not only to the damage but also the recovery process. Society needs to improve its decision-making process to reflect the voices of a variety of groups, including women.

According to Brody, Demetriades, and Demetriades (2008) women are more likely than men to be absent from decision-making, whether in the household or at community, national or international levels – either because their contribution is not valued or because they do not have the time, confidence or resources to contribute. With more participative processes, these strategies and interventions can truly identify and meet the needs of those they aim to assist. In this way, processes can be forged that respond to local realities while feeding into a broader vision of climate change deceleration (Brody, Demetriades, and Demetriades, 2008).

To date, there is insufficient understanding of how the impacts of climate change will affect women and men, and different social groups, but it is clear that there will be differentiated impacts and that these are likely to intersect with and overlay existing patterns of inequality. Climate change pressures will only be one amongst many different stressors that may interact to worsen gender and other inequalities, including along the lines of caste, class and ethnicity, as well as spatial marginality. Women are disproportionately found in the poorest sections of society, have fewer resources to cope with climate change, and are more reliant on climate sensitive resources such as water and fuel because of the gender division of labour. They tend to have lesser access to livelihood resources and hence more limited capacity to participate in climate change adaptation processes.

Although, all members of poorer communities will be affected, women and female headed households are likely to be disproportionately affected by increasing extreme weather events, greater climate variability and long-term shifts in climate averages. Children and the elderly have certain unique vulnerabilities and capabilities with respect to climate change, but these are also shaped by social determinants. So whilst all societies will be affected by climate change, the impacts will vary by location and exposure, shaped by social characteristics, identity, power relations and political economy. Climate change responses can only be equitable if they place the empowerment of women and marginalised groups and the tackling of gender and social inequality centre-stage.

The uncertainties of climate change science and impact models and lack of downscaled data below national level means that it is difficult to predict climate change impacts in any particular locality. This is particularly the case when the inherent uncertainties of smallholder livelihoods are taken into account and the other myriad stresses and shocks which affect urban and rural livelihoods of the poor (and their interaction with climatic factors) are considered. Many accounts have emerged from around the world of observations of changes in climate variability and in the frequency of extreme events, and whilst these experiences are real, the ability to prove a link to global processes of climate change is still problematic. Understanding how gender and social difference, as expressed largely through inequalities and discrimination in policies, institutions and practices, will mediate the outcomes of climate change in the longer-term is therefore a real challenge. While national and sectorial assessments of vulnerability can identify some types of spatial marginality and vulnerability to climate change, more nuanced analyses are needed that unpack the cultural and social determinants of inequality and marginalization in a particular locality.

Some studies have begun to appear on the differing aspects of gender and climate change (e.g. Dankelman , 2008; Nelson and Stathers, 2009; Neefjes *et al,* 2009; FAO, 2007; Petrie, 2010; Dankelman, 2010), but even these tend to be studies limited to one or two communities, and are often undertaken over short periods of time. Further, they tend to focus necessarily on short-term horizons, on existing climate variability and incipient climate changes, rather than progressive climate change over decades, because of the difficulties of predicting social as well as climatic and broader environmental change. More in-depth qualitative and quantitative research may be required, however, to try and remedy this situation and to prepare for future climate change. This is especially the case as climate change responses (policies, programmes and actions) are put into action, which will also have secondary impacts upon differentiated rural communities.

More action-oriented research is required to support social learning on and preparation for adaptation responses - in a gender sensitive manner and combined with more emphasis on envisioning different gender pathways and targets. There appears to be an interesting opportunity, for example, to further develop gender learning and action methodologies that already support social groups to look to the future, envisioning the range of future gender pathways and scenarios, by integrating climate change thinking into these processes. Similarly, where processes of community and broader stakeholder participation are facilitated, aimed at informing and learning from participants on climate change and livelihoods, there is an opportunity to integrate gender action learning (envisioning different scenarios of gender relations, involving men and women in setting targets etc). In other words the range of possible futures in terms of gender, climate and broader development pathways should be considered and articulated in linked facilitated stakeholder learning processes. There is little point in

envisioning future pathways that lead to climate resilience, without seeking gender and social equality: in fact it is surely impossible to achieve resilience without tackling the latter.

The literature on adaptive management, in response to climate change in particular, is growing – and yet rarely is there explicit consideration of gender and marginality issues. Adaptive management is an approach to guiding intervention in the face of uncertainty – something that is increasing with climate change (World Bank 2008). Adaptive management actions are described as being informed by explicit learning from policy experiments for example (World Bank, 2008) and such learning should be gender sensitive. Adaptive management actions, according to the World Bank (2008) should use new scientific information and technical knowledge to improve understanding and inform future decisions, and there should be monitoring of the outcome of interventions as well as development of new practices. Again across all of these dimensions of adaptive management, gender awareness is critical. It is important that gender and socially differentiated local knowledge of climate, for example, is also shared and valued more in adaptation, mitigation, and development planning. The development of new practices, plus monitoring and impact assessment efforts should follow best practice and innovate in gender sensitive approaches. Where vulnerability/resilience is used as a proxy indicator in climate change impact evaluation, and locally specific indicators are formulated, this must of course be a gender sensitive process to ensure that both women and men's indicators are considered.

World Bank (2008) reiterated that women, children and the elderly are not just passive victims of development and climate change processes, but are active agents whose adaptive capacity is constrained by existing power relations, structures and development pathways. While there are some biological characteristics which contribute to the vulnerability of women, children and the

elderly (e.g. pregnancy can be a factor in constraining women's escape from flooding situations, for example), social characteristics are at least as important: as often stated, for example, women are less likely to be taught to swim in some cultures and have been overlooked in the past in disaster risk reduction efforts. Better integration of gender and social difference analysis and support for the empowerment of women and marginalised groups across all adaptation and mitigation policy-making, planning and programmes is needed.

None of the myriad climate financing initiatives is adequately gender-sensitive as yet, failing to incorporate gender criteria in their operating procedures and guidelines. To change this requires not only greater use of existing gender mainstreaming tools, but higher levels of political commitment and cross-scale alliances. The types of responses and economic development pathway chosen are also likely to have equity implications. Market-led mechanisms predominate in the new international climate mitigation agreements, yet women are thought by some scholars to be less likely to benefit from the large-scale industrial mitigation projects which have been funded to date.

The children and climate change literature is less extensive than the gender and climate change body of work, but it is expanding rapidly. As in the gender and climate change literature, the work on children and climate change seeks to delineate the potential impacts of climate change on children and challenges the dominant debates and activities in climate change arenas that ignore this (differentiated) social group. The physiological and social reasons which mean that children may be disproportionately vulnerable to climate change are analyzed in different, mainly exploratory studies. The assumption that children are a passive group that do not have a particular role in responding to climate change is challenged time and again, with many studies

positing a strong potential contribution of the group in question – naming them as active agents that may also have particular strengths – for example, children can act sometimes as trusted communicators on climate change and spell out (DRR) between parents and local government and development agencies.

Both instrumentalist and moral arguments are drawn upon in support of the argument for the take-up of child-sensitive approaches in climate change adaptation and disaster risk management. The rights of children are already protected at an international level by the Convention on the Rights of the Child, but the concept of inter-generational equity is also brought to the fore: children will inherit a changed climate, created by historical emissions and will have to deal with the consequences. It is therefore incumbent on current generations to act now to respect the rights of future generations. Reporting on climate change issues should be an integral part of existing UN child-rights conventions and mainstreamed across the emergent climate regime (e.g. in the mitigation market mechanisms, adaptation funding).

The literature on climate change and older people is particularly sparse for developing countries (more studies are emerging focusing on developed countries). Yet older people are also disproportionately at risk from climate change.

Chronological age is only an approximation of actual condition of risk, physical decline or frailty, and there is a difference between the vulnerability of those entering old age and the very oldest in society (precise definitions in terms of years of age will vary across cultures perhaps), but there are still potentially far-reaching health implications for all elderly people. Physical weakness and declining income levels mean that the elderly are more affected by extreme

weather (hot and cold) and they also face higher mortality risks in extreme weather events. Reduced mobility, changes in physiology and more limited access to resources undermine the adaptive capacity of the elderly. Greater susceptibility to vector-borne diseases, which may increase in incidence and range with climate change, is also expected.

According to the literature, limited as it is, elderly people are insufficiently involved in adaptation and mitigation planning and initiatives. Thus adaptation efforts should seek to build the adaptive capacity of older people, taking greater account of their specific susceptibilities and capabilities. It is important not to romanticize indigenous or traditional knowledge, not least because in some situations the pace of climate change may outstrip existing knowledge. But some authors argue that valuable knowledge of groups of elders is being lost (sustainable agricultural practices) – knowledge that may be useful for adaptation. Loss of support mechanisms, trends of outmigration and often a lack of statutory welfare support mean that older people increasingly need to earn an income and the design of social protection schemes should take this into account.

Intra-national rural-urban dynamics are thought likely to be affected by climate change. In some rural areas increased seasonal and permanent mobility/migration (to both rural and urban locations) may exacerbate a trend towards an ageing of the resident rural population. Pressure may mount on the elderly (often women) that are left looking after the land. This is sometimes combined with a feminization of rural populations, as gender and age issues intersect. Migration is not always possible for the very poorest, given the social networks, financial resources and health that it requires. It is important to avoid generalizations, however, and improved data is urgently needed on these patterns of movement, on urbanization and urban growth processes, and

on the differentiated impacts - not least to challenge many of the myths that abound in this field. There is a reported loss of support mechanisms in some rural areas, because of these migration and mobility dynamics and because of other stressors (e.g. the rise in grandparent headed households with rising rates of HIV/AIDS infection globally).

These processes need to be taken into account in climate change and territorial planning (the amount of labour and inputs implied by new agricultural adaptation practices, food security implications for different sectors of rural and urban populations, social protection policies and investment needs). As well as more in-depth research and data collection, it is also important that future scenario building processes are facilitated and take into account the visions of all different stakeholders – including migrants that may often be ignored and the residents left behind. Remittances are likely to become increasingly important as an adaptation strategy and easier to transmit using mobile phone networks and mechanisms – again questions of the digital divide need attention.

Because climate change will certainly mean more households will be affected by disasters and will require support in terms of increased funding, innovation in providing and targeting this support is needed. A number of SP measures have already been road-tested, such as safety nets and social cash transfers in tackling food insecurity and malnutrition. Other options are also being adopted such as social insurance, pensions, child grants, social-welfare and employment schemes (the latter based on public works labour to invest in environmental assets). These SP measures could be used for adaptation purposes as long as they themselves are adapted to take account of climate change and the changing nature of the risks faced by vulnerable communities. More evidence is needed of the poverty impacts of these different schemes and of their viability

and effectiveness, particularly the newer interventions such as climate-index insurance. Attention to the fundamental and structural root causes of inequality and discrimination is also important (at the transformative end of the SP spectrum) – because climate change impacts and responses will play out in these on-going norms, values and power dynamics.

There is increasing recognition amongst policy makers in the global South of the seriousness of the challenges posed by climate change, some of the potential opportunities for innovation and financing, and of the need to respond appropriately. Despite pressing immediate concerns, there is increasing discussion at international and national levels of (the inter-linkages between) low carbon pathways, green growth and the mainstreaming of climate change adaptation in development planning. These types of debate ultimately focus on the economic, financial and political systems which shape the possibilities for climate justice, equal rights to ecological services and the existence of healthy ecosystems upon which all human societies depend. More research is needed on the gender dimensions of the range of economic, financial and political pathways that may be possible.

It is also important that it is not only female researchers, practitioners and policy-makers work on gender. Male researchers should also recognize the centrality of this area of work in development: gender and social difference should not be a side thought, but should be considered a central basis of development thinking and practice – and especially so in a climate challenged world.

Meena,(1992) examines the opportunities for linking social protection, adaptation and DRR in the context of agriculture and rural growth, exploring whether linking these three approaches

together will help enhance resilience to shocks and stresses in agriculture-dependent rural communities. The study does this by;

1. Reviewing conceptual and policy-related similarities and differences between the three disciplines: Social protection, adaptation and DRR have much in common, but have developed as separate disciplines over the last two decades. They all seek to mitigate risks faced by poor people, they tackle the impact of and seek to build resilience against shocks and stresses on livelihoods and they are all in relatively formative stages of development and testing, rather than established components of development and poverty reduction. However, to date, despite ongoing efforts to link disasters and climate change communities (DFID, 2004), there has been little cross-fertilization with social protection policies and practices.
2. Collecting evidence from case studies where climate change-resilient social protection approaches have been trialed: Within the agricultural sector, social protection measures that could both build resilience to climate change and benefit from integrating climate change adaptation include: weather-indexed crop insurance, asset restocking (including direct livestock provision), and cash transfers. Assessing evidence from country's experiences of these measures indicates ways in which social protection measures could better integrate DRR and climate change adaptation.
3. Developing an adaptive social protection framework that highlight opportunities better co-ordination: The evidence presented in this paper suggests social protection and DRR measures designed to limit damages from shocks and stresses may simply not be sufficient in the longer term. For social protection to be resilient to climate change impacts, it will therefore need to consider how reducing dependence on climate sensitive livelihood activities can be part of adaptive strategies. Similarly, adaptation and DRR

cannot effectively address the root causes of poverty and vulnerability without taking a differentiated view of poverty, something that further integration with social protection can help with.

To offer a way forward, the study concludes by suggesting follow-up work and by establishing the concept of adaptive social protection, which features:

i. An emphasis on transforming productive livelihoods as well protecting, and adapting to changing climate conditions rather than simply reinforcing coping mechanisms.
ii. Grounding in an understanding of the structural root causes of poverty in a particular region or sector, permitting more effective targeting of vulnerability to multiple shocks and stresses.
iii. Incorporation of rights-based rationale for action, stressing equity and justice dimensions of chronic poverty and climate change adaptation in addition to instrumentalist rationale based primarily on economic efficiency.
iv. An enhanced role for research from both the natural and social sciences to inform the development and targeting of social protection policies and measures in the context of the burden of both geophysical hazards and changing climate-related hazards.
v. A longer-term perspective for social protection policies that takes into account the changing nature of shocks and stresses.

The impact of climate change is deepening the risks already faced by poor and vulnerable people in rural areas. Without doubt, recent studies have shown that adapting to these impacts has grown from a minor environmental concern to a major challenge for human development, and a crucial element in eradicating poverty and achieving the Sustainable Development Goals. As approaches to minimizing the risks faced by these vulnerable people, social protection and climate change adaptation have much in common, as they both seek to protect the most vulnerable and promote

resilience. They, however, argue that while social protection aims to build resilience to some climate-related disasters, insufficient attention has been in the social protection sphere to the long-term risks posed by climate change. Climate change adaptation on the other hand has not fully considered the policy and programmatic options that social protection can provide. Whilst social protection can enhance climate change adaptation with respect to different categories of the poor and vulnerable, climate change adaptation cannot effectively address the root causes of poverty without taking a differentiated view of poverty and vulnerability. Thus, they suggest that more recent social protection policies and programmes should refer to the need for 'long term' interventions

According to Wamukonya and Rukota (2001), the main rationale for differentiating between men and women as far as climate change is concerned, is the different roles that the two sexes play in different societies. Understanding how the different expectations, roles, status and economic power of men and women affect and are affected by climate change will improve interventions to reduce vulnerability in the developing world. Effective design and implementation of adaptation measures could be enhanced by acknowledging and taking into account different ways in which climate change impacts on men and women. The differences in gender roles indicate that climate change will impact women and men differently, based on their different roles and responsibilities in their community and their level of access to natural and other resources including knowledge (Wamukonya and Rukota,(2001); Iipinge and Williams, (2000) and Meena,(1992) in Southern Africa, confirm gender inequality, lack of empowerment and limited access to and control of assets.

Lopi (2004) claimed that in southern Africa, women experience subordinate legal status, limited access to productive resources such as land, technology, credit, education and training, formal employment and training, as well as susceptibility to HIV and AIDS. These factors not only intensify inequalities between men and women but also, make woman more vulnerable to poverty, disasters, risks and climate change. Such an understanding would highlight ways in which these inequalities can intensify the impacts of climate change for individuals and communities. Brody, Dementred and Esplen, (2008), also cautioned that a gender approach to climate change study should not only be about women. Men, women, youths and children are vulnerable to impacts of climate change but in different ways. Existing frameworks for gender and poverty (Chant, 2000) as well as gender and disaster studies (Bradshaw, 2004) provided a conceptual framework applicable for gender and climate change studies. In addition, gender and climate change analyses could draw on studies conducted on gender-specific aspects of disaster prevention and mitigation (Dankelman, 2002).

Denton (2002) argues that women play a major role in natural resource and environmental management yet their contribution is ignored. Dankelman (2002) adds that it is helpful to consider studies of the relationship between gender and the environment, in order to determine the gender dimension of climate change. Women in developing countries are responsible for climatically sensitive tasks such as securing food, water and energy which ensure food security and household well-being (Aguilar, 2007).

It is clear that ways in which individuals, groups of people and communities interact with their natural environment are different. It is also clear that climate change does not affect women and men in the same ways. The study explores differentiated impacts of climate change on women

and men. Studies on disasters risk management and adaptation discuss differentiated impacts of climate change in relation to disaster, health, food security, water and income (Aguilar, 2007; Bradshaw, 2004). These discussions differentiate how women and men are affected by impacts of climate change and variability and further show how women are vulnerable to adapt and cope with these changes.

2.2.3.1 Intersection of gender, assets and adaptation interventions

The role of assets in climate change adaptation and in agricultural development cannot be over emphasized. It accents the vital needs for understanding the intersectionality of gender and access to power and to control assets in influencing adaptation needs. Gender equality and intra-household dynamics in access to both tangible and intangible assets are essential in reducing vulnerability, managing climate-related risk and stimulating adaptation decisions, particularly regarding the uptake of climate-smart agricultural practices (Nelson, 2002). In the Millennium Development Goals and Post-2015 Development Agenda for attaining Sustainable Development Goals, gender equality has been highlighted as a key strategy in attaining sustainable development. However, gender inequality persists in climate change governance and leadership, decision-making arena and in access to social institutions particularly in developing countries (UNFCCC 2015).

Access to financial assets is a catalyst for uptake of innovations, technologies and inputs such as improved seed varieties and agrochemicals (FAO, 2011) that are important for adapting to climate change. However, overwhelming evidence indicates that there is differential access to agricultural inputs (Peterman *et al*. 2010). Female farmers have limited ability to secure loans

(FAO, 2011) and often have no savings since they spend a higher proportion of their income on the household's food, health and education. This has far-reaching consequences on gendered input use and low agricultural productivity besides impacting on women's adaptive capacity. Nonetheless, women easily access informal credit through group-based saving and credit associations, thereby investing credit in productive livelihood activities. With limited access to other crucial assets such as land and credit, new forms of group-based approaches offer novel pathways to access productive assets, particularly for asset-poor and female farmers. Evidence indicates that when women have access and control over key productive assets such as land, financial capital, inputs and bargaining power, it translates positively into household's well-being outcomes including food security, children's nutrition, education, health and survival rates, agricultural productivity and conservation of natural resources (FAO, 2011).

Social capital, so called 'group-based approaches', helps households or individuals in reducing vulnerability and enhancing coping, adaptive capacity and recovery from adverse events (Adger *et al.* 2003; Adger *and Kelly,*1999) and adapting to climate change. At community level, social capital supports accumulation of assets, knowledge and building resilience to climate change (Mueller *et al.* 2013). However, strong social ties may also hamper adaptation options such as soil management practices. There has been little attention to gender-differentiated group-based approaches in the context of improving men's and women's abilities to manage climate risk, protect assets and improve welfare. Besides, a research gap exists with respect to what kinds of groups are most effective for empowering men and women in the face of fast-track climate change. Men and women are likely to accumulate different forms of social capital that would apparently have different influences on adaptation to climate change and their welfare.

2.2.4 Causes of Gender Differentials to Climate Change

Climate change impacts and adaptation on gender are different because of different vulnerabilities. The poor, women, and children are among the most vulnerable to the effects of climate change, and climate change may in fact worsen gender inequality, create extra work for women, and exacerbate the vulnerability of women in poor households (Campbell *et al*. 2009). In many parts of the world, women are more vulnerable to climate change as they have less access to education and information that would help them to manage climate-related risks to agriculture and food security (Jost *et al*. 2015). Evidence from Uganda, Ghana, and Bangladesh showed that many women had considerably less access than men to critical information on weather alerts and cropping patterns (Jost *et al*. 2015). Less access to information has weakened women's capacity to respond effectively to climate variability and, consequently, women appear to be less adaptive to climate-smart agriculture because of less access to resources such as financing, information, and extension services (Jost *et al*. 2015).

Agricultural resources are not equally available to men and women. Globally, it is estimated that, if rural women had the same access to agricultural resources (physical, financial, educational, etc.) as men, yields could increase by 20–30% and hunger could be decreased by 12–17% globally (FAO, 2011). Climate change risk is also greater for women because they typically lack the necessary tools to adapt to climate change such as land rights, financial and material resources, as well as the relevant skills to adapt to climate change (Mitchell *et al.* 2007). Furthermore, cultural barriers can often limit women's access to the services required to adapt to climate change (Mitchell *et al*. 2007; Dankelman *et al*. 2008).

The social role of women in many countries can also limit their abilities to adapt to climate change. This enhanced sensitivity to climate change is the result of women's household responsibilities such as childcare, water collection, cooking fuel collection, and an increased participation in agricultural production with less access to agricultural resources (land, extension services, and inputs) as men migrate for work outside of agriculture (Doss 2011; FAO 2011; Kakota *et al.* 2011; Nelson and Stathers 2009; Peterman *et al*. 2011). Although temporary out-migration is a common coping strategy for households affected by natural disasters and other shocks, this option is primarily open to men and to households with some labor capital and resilience (Campbell *et al.* 2009). Women's lack of access is alarming because, at the household level, the ability to adapt to climate change depends on control over land, financial resources, and physical assets, as well as good health and mobility (Tran Thi Van Anh *et al*. 2008). Women are often more vulnerable than men to climate change because they have less education than men and are often refused property rights, thus making it much more difficult to access financial credit or extension agents (Gurung *et al.* 2006) when alternative income is required. Women also have fewer employment opportunities away from the farm (Oxfam, 2008)

Rural women in particular are reported to be at greater risk of negative impacts from climate change (Goh 2012; Kakota *et al.* 2011; Nellemann *et al*. 2011). Similar results were found in Ben Tre and Quang Tri provinces in Vietnam, where researchers from Oxfam (2008) reported that, in many villages, women have fewer assets to turn to during times of crop failure and they are the most vulnerable in the world to climate change because of their resource dependency and limited means to adapt to climate change (Adger *et al.* 2007; Moser and Luers 2008).

Gender-centric development and research discussions on climate change frequently focus on rural women because they are often considered the most vulnerable group to climate change as well as being reliable agents of sound adoption practices (Dankelman 2010; Enarson and Fordham 2001; Nelson *et al.* 2002; Speranza *et al.* 2010). The increased role that rural women are playing in agricultural production could provide an opportunity to positively impact food production as well as food security, even while adapting to a changing climate (Carvajal-Escobar *et al.* 2008). Poor communities in Vietnam's Ban Tre and Quang Tri provinces have already shown positive signs of climate change adaptation by planting different crops and changing their cropping cycles (Oxfam, 2008).

Although there has been much discussion on governmental and organizational platforms about how differentiated vulnerabilities, such as gender, may influence adaptation, and less energy has been devoted to academic research on the topic (Adger 1999; Kelkar *et al.* 2008; Young *et al.* 2009). There is still a need for better understanding gender perceptions and adaptation strategies toward climate-smart agriculture and food security. Women and men, because of their respective social roles, are affected differently by the impact of climate change. Consequently, adaptation policies and measures need to be gender sensitive. To understand the implications of adaptation measures for all people involved, it is necessary that all members of an adapting community be represented in climate change planning as well as in governance processes; however, women are often expected to contribute unpaid labor while being absent from the planning and governance processes (Roehr 2007). Equal involvement of men and women and their respective needs and perspectives in adaptation planning is important not only to ensure that the measures developed

actually benefit those who are supposed to implement them, but also to ensure that all relevant knowledge is integrated into policy and projects to ensure success (Roehr 2007).

2.2.5 Challenges / Barriers to Climate Change Adaptation

Most studies of specific adaptation plans and actions argue that there are likely to be both limits and barriers to adaptation as a response to climate change. Barriers refer to the conditions or factors that render adaptation ineffective as a response to climate change and are largely insurmountable. These barriers are necessarily subjective and dependent upon the values of diverse groups (IPCC, 2007 and Audu 2016). These barriers include:

2.2.5.1 Physical /environmental barrier

There is increasing evidence from ecological studies that the resilience of coupled socio-ecological systems to climate change will depend on the rate and magnitude of climate change, and that there may be critical thresholds beyond which some systems may not be able to adapt to changing climate conditions without radically altering their functional state and system integrity, Dramatic climatic changes may lead to transformations of the physical environment of a region that limit the possibilities for adaptation (Nicholls and Tol, 2006). In the Sudano-Sahel region of Africa, persistent below-average rainfall and recurrent droughts in the late 20th century have constricted physical and ecological limits by contributing to land degradation, diminished livelihood opportunities, food insecurity, internal displacement of people, cross-border migrations and civil strife (Mortimore and Adams, 2001; Leary, 2006; Osman-Elasha, *et al*., 2006).

2.2.5.2 Technological barrier

Technology is developed and applied in a social context, and decision-making under uncertainty may inhibit the adoption or development of technological solutions to climate change adaptation. Although some adaptations may be technologically possible, they may not be economically feasible or culturally desirable. For example, within the context of Africa, large-scale engineering measures for coastal protection are beyond the reach of many governments due to high costs (Ikeme, 2003).Adaptations that are effective in one location may be ineffective in other places, or create new vulnerabilities for other places or groups, particularly through negative side effects.

Three problems appear to impede the wider use of climate data for socioeconomic planning and decision making. First, climate change data are not available at the spatial resolution required by stakeholders and as such they struggle to reconcile their observations of the weather with climate projections and lose confidence in the projections. Second, the timeframes (or temporal resolution) over which climate data are reported is often of little relevance to users. Whilst one might expect policy makers to consider the implications of a 2050 projection, local people base their decision on more immediate issues. Third, there are very few African scientists with the requisite training and experience to interpret and apply climate change data in the agricultural context (Ikpe, 2014).

2.2.5.3 Financial barriers

The implementation of adaptation measures faces a number of financial barriers. Cost of identified adaptation options when budgets are limited; at the international level, preliminary estimates from the World Bank indicate that the total costs of 'climate proofing' development

could be as high as US$10 billion to US$40 billion per year(World Bank, 2006). While the analysis notes that such numbers are only rough estimates, the scale of investment implied constitutes a significant financial barrier. At a more local level, individuals and communities can be similarly constrained by the lack of adequate financial resources. Deep financial poverty is a factor that constrains the use of seemingly inexpensive health measures, such as insecticide-treated bed nets, while limited public finances contribute to choices by public health agencies to give low priority to measures that would reduce vulnerability to climate-related health risks (Taylor, *et al*., 2006). Lack of resources may also limit the ability of low-income groups to afford proposed adaptation mechanisms such as climate-risk insurance.

2.2.5.4 Social and cultural barriers

Social and cultural limits to adaptation can be related to the different ways in which people and groups experience, interpret and respond to climate change. Individuals and groups may have different risk tolerances as well as different preferences about adaptation measures, depending on their worldviews, values and beliefs. Conflicting understandings can impede adaptive actions. Differential power and access to decision makers may promote adaptive responses by some, while constraining them for others. Thomas and Twyman (2005) analyzed natural-resource policies in southern Africa and showed that even so-called community-based interventions to reduce vulnerability create excluded groups without access to decision-making. In addition, diverse understandings and prioritizations of climate change issues across different social and cultural groups can limit adaptive responses (Ford and Smit, 2004).

Asuquo (2009) also recognized additional barriers to include: Limited understanding of climate change risks and vulnerabilities- current and projected; lack of supportive policies, standard

regulations and design guidance encouraging status quo or presenting impediments to progress; existing legal or regulatory restrictions; Social/cultural/financial rigidity and conflicts; short-term nature of planning horizon-necessity of realizing returns on investments; uncertainty and confidence for the long-term mismatch between business planning horizons and time frame of projections of climate change; not seen as a big problem yet, so temptation to wait for impact to react; Belief that the uncertainty is too great to take action now; lack of useful precedents or evidence of adaptation actions; lack of acceptance/understanding of risks associated with implementing. Overcoming these barriers may need understanding and updating institutional and legal framework.

CHAPTER THREE

THE STUDY AREA AND METHODOLOGY

3.1 The Study Area

3.1.1 Location and size

Kaduna State is the study area. It is located between Latitudes 09^0 02′N and 11^0 32′ N of the Equator and between Longitude 06^0 15′ and 08^0 50′ E of the Greenwich Meridian. It is bounded to the north by Katsina, Zamfara and Kano States respectively, to the west by Niger State, to the east by Bauchi State and to the South by Plateau, Nasarawa and the Federal Capital Territory respectively. The State has a land area of about 43,460km^2, which makes it the largest in the north-west geo-political zone and has about 4.7 percent of the Nigerian land area (NPC, 2006). The longest distance by road from north to south is about 290 kilometers and from east to west is about 286 kilometers (Ministry of Lands and Survey, Kaduna State Government [KDSG], 2012).

3.1.2 Weather and Climate

The climate of Kaduna State is the Tropical dry-and-wet type classified by Koppen as AW. The wet season lasts from April through mid-October with a peak in September, while the dry season extends from mid-October to April of the next year (Abaje, *et al,* 2015). The average annual rainfall in the state as a whole is about 1323mm. The spatial distribution of the rain varies, decreasing from the southern part of the state to the northern part. The mean annual rainfall is about 1733 mm for the southern zone (around Kafanchan- Kagoro areas in the southeast), about 1203 mm for the central zone (around Kaduna, Kujama, and Kauru areas), and about 1032 mm for the northern zone (around Zaria, Ikara and Makarfi areas). The rainfall intensity is very high between the month of July and august (ranging from 60mm hour^{-1}to 90mm hour^{-1}). The pattern

of rainfall in the zone is highly variable in spatial and temporal dimensions with high inter-annual variability (Oladipo ,1993a; FRN, 2000).

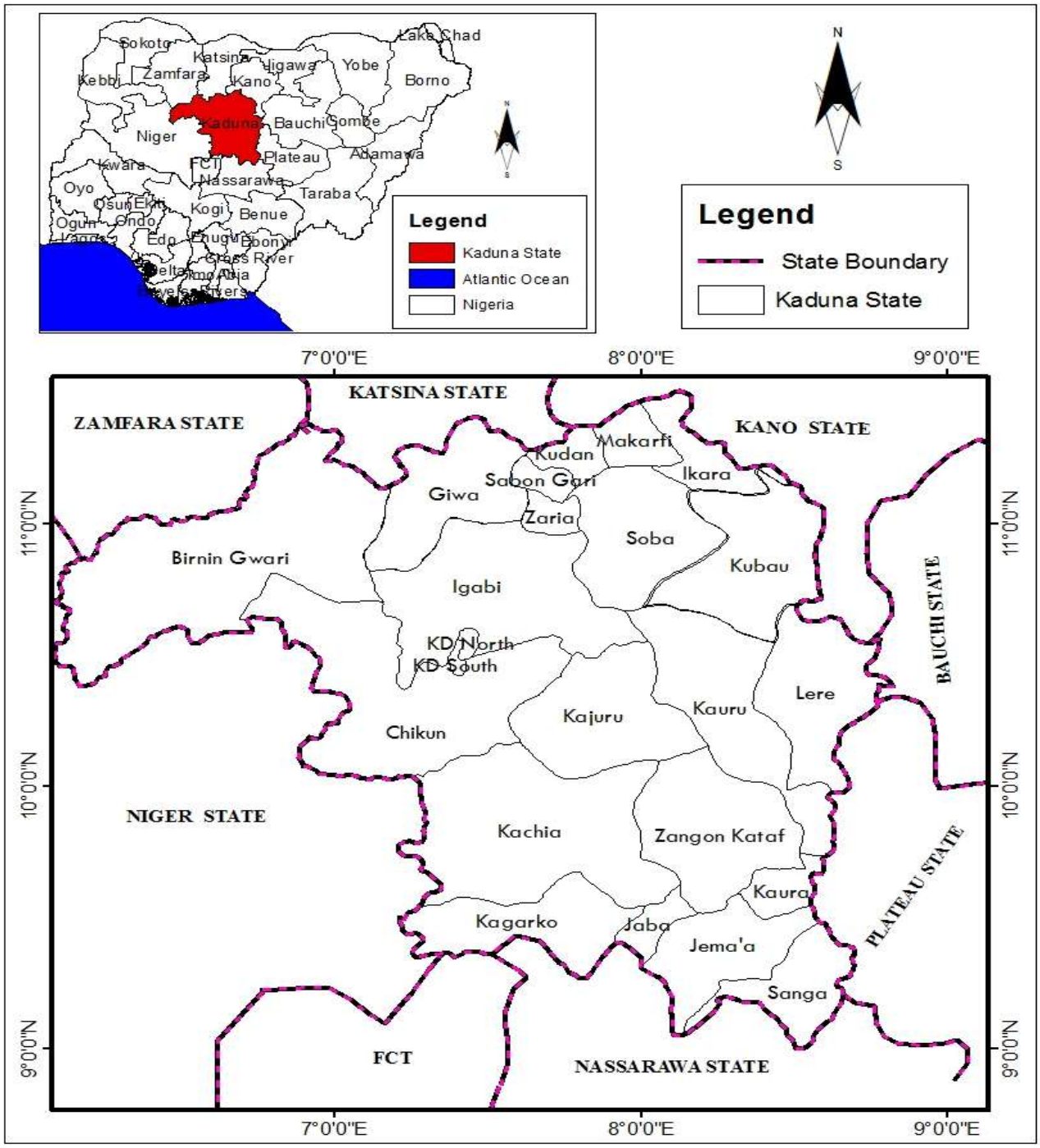

Figure 3:1 Kaduna State: The Study Area
Source: Adopted from Administrative Map of Kaduna State

As a result of the large inter-annual variability of rainfall, this state is prone to frequent dry spells which can result in severe and widespread droughts especially in the northern part that can impose serious socio-economic constraints (Oladipo, 1993a; FRN, 2000; Okorie, 2003).

Seasonal variation in rainfall in the state is directly influenced by the interaction of two air masses. These are relatively warm and moist Tropical maritime (mT) air mass, which originates from the Atlantic Ocean, associated with southwest winds in Nigeria and the relatively cool, dry and stable tropical continental (cT) air mass. This originates from the Sahara Desert and is associated with the dry cool, and dusty North East Trades known as the Harmattan (Ayoade, 1982a, Oguntoyibo, 1982; Oladipo and Salahu, 1993, FRN, 2000; Sawa, 2002; Ayoade, 2004). The boundary zone between these two air streams has been given various names by tropical weather analysts. Such terms as Inter-Tropical Front (ITF), Inter-Tropical Convergences Zone (ITCZ) Inter-Tropical Conference (ITC), Equatorial Front, and Inter-Tropical Discontinuity (ITD) have been used to describe this feature of tropical weather and climate (Ayoade, 1982a; 2004). ITD is widely used in West African Region.

The ITD is located between latitude 21^0 to 22^0N in August and marks the peak of the rainy season in the whole state while in January/February (approximately at 6^0N) is totally out of the state (FRN, 2000; Ayoade, 2005). ITD southward migration is assisted by the strengthening of the surface high pressure cells over the Sahara Desert. The surface position of the ITD in the study area exhibits not only seasonal but also day – to – day variations (Oladipo and Salahu, 1993). It tends to take a more southerly position when the pressure exceeds 1020 mb and to move slightly northwards when the Saharan pressure weaken (Ojo, 1977). The movement of the ITD is very irregular, varying according to the season from 2^0 to 5.6^0 of latitude per month

(Oladipo and Salahu 1993). The southward retreat of the ITD is faster than its northward advance. While the northward advance is at the rate of about 160m per month, that of the southward retreat is at about 320m per month. This accounts for the rather gentle onset of the rainy season in the state and its rather abrupt end (Oladipo and Salahu 1993).

Temporal characteristics of temperature are steadier than those of rainfall, but the highest diurnal ranges of temperature are in the dry seasons. The maximum mean monthly temperature normally occurs in April (28.9^0C) while minimum mean monthly temperature is in December (22.9^0C) through January (23.1^0C). The mean monthly atmospheric relative humidity ranges between 70-90% and 25-30% for the rainy and dry seasons respectively. The low relative humidity experienced in the dry season is a product of the dry, dusty and cold harmattan air (Abudlkarim and Sarki, 2013).

The highest amount of evapotranspiration occurs during the dry season (Ayoade, 1982b). This, however, creates water shortage problems in the state especially in Igabi, Giwa, Soba, Makarfi and Ikara LGAs. Sunshine hours vary with latitude, from the southern part of the state (for example, Gwantu and Kafanchan) to the northern part (Zaria, Makarfi, and Ikara) and with seasons. The mean annual total number of sunshine hours in the study area is high, when compared to the southern part of the country. In general, values are high during the dry season throughout the state, mainly because skies are less cloudy than during the rainy season (Ojo, 1977).

Olofin (2008), Danbazau (2008) and Abdulkarim and Sarki (2013) identified four seasons based on the effect of climatic controls and the temperature conditions.

i. *The dry and cool season*: This season is known as the harmattan period and it lasts from late November to the end of February of the following year. This period is characterized by cool, dry and dusty weather conditions. Sometimes the air becomes so dusty that the visibility becomes very poor. The wind originates from the Faya Largeau Birma region near the Ahaggar and Tibesti massifs in Chad. The ITD lies south of the state during this period and the prevailing winds are the Northeast Trades.

ii. *The dry and hot season:* This is a very short season that follows the harmattan period. Its length in a particular year is determined by the onset of the rains. On the average, it lasts from March to April and may extend to mid – May at the northern extreme parts of the state. This is the hottest period of the year and mid-day temperatures ranges from about 28^0C in the southern part of the state to about 30^0C in the northern part or even more in some cases. This period is characterized by the occurrence of sandstorm which originates from the Sahara desert where the ITD begins to move northwards. The dominant winds are still the Northeast trades. The sandstorm normally signifies the end of dry season and the beginning of the rainy season.

iii. *The wet and warm season*: This is the period the ITD runs through the state and moves southwards also. The period begins around May and ends in Mid-October. Over 90% of the annual rainfall of the state is recorded during this period, and has the lowest diurnal and monthly ranges temperature. The cessation of rains in the state starts from the extreme north around the middle of September, moving southwards, reaching the southern tips of the study area in mid-October or end of October in wet years.

iv. *The dry and warm season*: This period starts at the end of the rains, and ends about mid-November with the onset of the harmattan. It is the second hottest period, winds are very variable and the season records the highs number of calms in the year.

3.1.3 Geology

The geology of the study area is comprises gneisses, migmatites and metasediments of the Precambrian age which have been intruded by a series of granitic rocks of late Precambrian to lower Paleozoic age. These rocks have been variably metamorphosed and granitized through at least two tectonic metamorphic cycles so that they have been largely converted to migmatites and granite gneiss (McCurry, 1989). These rocks have had a complex history involving several phases of orogenesis and subsequent regional uplift and depression. These movements have determined the main pattern of drainage and the regional pattern of erosion and sedimentation since early cretaceous times (Ologe, 1985). The Palaezoic and Precambrian rocks are divided into four major groups: the basement complex, younger meta-sediments, the older granite series, and volcanic rocks.

The basement complex rocks were subjected to subaerial denudation for millions of years so that the original mountainous terrain had been reduced to plain relief. Rocks of sedimentary series (sedimentary basins) cover some parts of the surface of the basement complex. The sediments occur as sandstones, clayey grits, clay shale and as calcareous beds which were deposited under lacustrine conditions in a board, gentle synclinal centered in what is now Niger Republic (Ologe, 1985; Ogezi, 2002). Younger meta-sediments include the Birnin Gwari schist formation. It is believed that all these younger meta-sediments were deposited between 1000 and 800 million years ago (McCurry, 1989). The Kudaru hills consist of younger granites intruded into the

basement complex in Jurrasic times. The older granite series includes rocks intruded during the Pan – African orogenic circle.

Deep chemical weathering and fluvial erosion influenced by the bioclimatic nature of the environment have developed the characteristic high undulating plains with subdued interfluves (Mortimore, 1970). In some places, the interfluves are capped by high grade lateritic ironstone especially in the northwest. However, rocky granitic residuals from inselberges of varying sizes and shapes constitute the main local relief with Kufena hills, Kagoro hills, Dutsen-wai and Kudaru ring complex standing out very prominently. The valleys are shallow but wide, stretching several tens of kilometers into the head water areas with gentle sloping valley sides; imperceptibly grading into flat moist to marshy alleviated bottomlands or floodplains, called fadamas (Mortimore, 1970)..

Relief has many direct and indirect effects on local climate. It is responsible for creating particular conditions of moisture, temperature and light by providing an obstacle to air movement or by presenting slopes to different radiation loading (Abaje, 2007).. Altitude induces climatic changes. It lowers temperature and increases precipitation to a rise of 1000m corresponding to a fall of 6.5^0C (Abaje, 2007). Therefore, the orographic effects of the Kufena hills, Kagoro hills and Dutsen-Wai, Kudaru and Ring Complex have positive influence on the climate of the study area influencing rainfall, temperature and relative humidity.

3.1.4 Drainage System

The entire land structure consists of an undulating Plateau traversed by major rivers which include River Kaduna, River Wonderful in Kafanchan, River Kagom, River Gurara and River Galma. River Kaduna which has a long profile has its source from the Plateau highlands, and is one of the largest tributaries of River Niger, characterized by steep slopes. The shrinking in length of the rainy season has affected the seasonal flow of these rivers.

3.1.5 Soils

The geology, relief and geomorphologic process that shaped the land forms have greatly influenced the soils (FRN, 2000). The whole state is covered by the red brown to red yellow ferruginous tropical soils which are heavily weathered and markedly laterized (Oladipo, 1993a; FRN, 2000). They are mostly formed on granite and gneiss parent materials and on Aeolian and many sedimentary deposits (Abaje, 2007). These parents' materials from which the soils are formed give the soils their particle size characteristics that determine to some extent the texture (Olofin, 2008). A common feature of these soil is the downward movement of clay within the profile, a process which tends to produce a sandy surface soil rather low in organic matter, cation exchange capacity and nitrogen (Abaje, 2007), but may be adequate in phosphorus content.

The soils are inherently infertile and marginal in their productivity, which may be attributed largely to insufficient and erratic rainfall pattern. Since most of the soils have been developed from aeolian deposits, they have very little profile development. Furthermore, they are highly vulnerable to wind and water erosion (Rayar, 1996). Anthropogenic activities, such as extensive and indiscriminate land clearing, tree felling at an alarming rate and overgrazing accentuate soil erosion, and cause excessive flooding (Rayar 1996).

Generally, the soils in the upland areas are rich in red clay and sand but poor in organic matter. However, soils within the *fadama* areas are richer in Kaolinitic clay and organic matter, very heavy and poorly drained, characteristics of vertisols. It is important to note that flooding which is an extreme climate event has a positive effect on the soil. This is because the flood plains are good for agriculture due to the deposited fertile soils from the uplands.

3.1.6 Vegetation

The whole state is covered by Tropical grassland vegetation with the density of trees and other plants decreasing as one move northwards. Grasses grow tall and luxuriantly to about 1.5 to 3 meters in height, usually quick growing, coarse and stiff, and difficult to penetrate (Abaje, 2007). Trees are mostly broad leaved species up to about 9 to 15 meters in height and forming almost closed canopy of branches in some places they lose their leaves for only a short period in the year (Lawson, 1966; Abaje, 2007). The most typical trees are acaciase, baobab, *Isoberlinia doka, Burkea Africana* among others.

The vegetation is divided into two. The southern Guinea and northern guinea savanna. The southern guinea savanna covers the Southern part of the state to about Latitude $11^{0}00$'N of the equator. The trees here are generally taller than those of the northern guinea savanna, and it is typified by a mixture of trees species. There are good stands of hard tropical trees such as mahogany and raffia palm bushes which are being exploited for building construction. The vegetation is generally characterized by such species as *Lophira Lanceolata* and *Danielliaoliveri* (Lawson, 1966; Abaje, 2007). The northern guinea savanna covers the northern part of the state, stretching from Zaria down to Ikara and its environs. The grasses, with short trees are sparsely

distributed. The plants here are drought resistant. A common tree here is the Baobab which in appearance resembles an Oak tree. Also found are Acacia trees (KDSG, 2014).

Deforestation which is the deliberate destruction of the vegetation as a result of human activities and his domesticated animals have altered the vegetation of the study area so much that the natural vegetation or climatic climax vegetation no longer exists today. Instead what one finds include plagio climax vegetation, secondary forest, derived vegetation, plantations of tgree crops and cultivated lands (Abaje, 2007). Deforestation is one of the factors that cause climate change.

3.1.7 Population

Kaduna state is one of the most densely populated states in the federation. This is as a result of its liberal nature as it accommodates people of diverse culture. It has a population of 6,113, 503 people with an annual growth rate of 3% during the 2006 census (FRN, 2010a). The state has 23 Local Government Area, 46 Local Development Areas (LDAs), and there are 255 wards (KDSG, 2011). The most populated LGA is Igabi with a population of 430, 753 people while the least populated LGA is Kauru with a population of 109, 810 people (FRN, 2010a). Kaduna state is populated by Hausa, Fulani, Gbagyi, Adara, Ham, Atyap, Bajju, Ikulu, Ninzo, Kurama, Gure, Koro, Mada, Agworok, Chawai, Atakad, Kagoma, Kahugu, Numana ethnic and other minor tribes.

3.1.8 Socio-economic activities

3.1.8.1 Agriculture

Agriculture is the largest employer of labour and a key contributor to wealth, income creation and poverty alleviation in the state with about 80% of the people actively engaged in farming

(World Bank 2008). The people are engaged in different agricultural practices; however, crop production and livestock rearing are the dominant forms of agricultural practices.

Crop production: Grain cereals are the mainstay of the agricultural production in the state and include maize, millet, rice, beans, cowpeas, and sorghum among others; and root crops like potatoes, cassava, yam and cocoyam. Other crops are onions, cabbage, carrot, okra, Irish potato among others (KSDSG, 2001). In the north of latitude 10^0N, the soil is good for production of large quantities of cotton lint and seed for which Ikara, Makarfi, Soba, Kudan and Kubau LGAs are known. Yam and maize have successfully been producing high yields with the use of fertilizer, especially in Kauru, Lere, Igabi, Giwa and Birnin Gwari LGAs. In the well watered southern part of the state, the rich darker soils are used for cultivating cereals, cassava, yam, rice and ginger (*chitta*) Kachia LGA is the largest producer of ginger in Nigeria.

In the *fadamas,* the dark grey clay (vertisols) soils have become highly valued and are focused on for intensive agricultural activities especially during the dry season. Large areas of such *fadamas* are being used for economically valuable market gardening for growing tomatoes, onion, chilies, sweet pepper, cabbage, carrot, okra, Irish potato and sugar cane using both the modern and traditional *(shadoof*) irrigation system.

Of recent, cultivation of grapevine has been introduced in the state and has gained wide acceptance on small but intensively cultivated farms. A few large scale vineyards have also been established on the lower Galma valley near Zaria Small farm holdings of 10 to 15 vines produce between 200 and 300kg.

Livestock: Livestock resources in the state are still on a small scale, and are used mainly to raise cash during emergencies or meet demands during religious festival. Based on the 1991 livestock survey in urban Zaria and its rural fringe along, there were over 16, 000 heads of cattle (zebu) about 180, 000 goats, 138, 000 sheep and rams, 55, 000 rabbits and over 880, 000 birds (KDSG, 2001, KDSG, 2014)

In the southern part of the state, pig rearing is dominant. Most of the pigs are kept and owned by people from Zango Kataf, Jama'a Sanga, Jaba, Kachia and Kagarko LGAs. Zango kataf, has the largest pig market in the country which is located at Katsit. This market serves as a trade center for traders from different parts of the country.

3.1.8.2 Minerals resources

Kaduna state is blessed with minerals which include clay, serpentine, asbestos, amethyst, gold, corundum, mica, iron ore, phosphate, tantalite and graphite among others (KDSG, 2012). Graphite, Kyanite and rutile are reported to be in large quantities in Birin Gwari LGA. They are good sources of raw materials for pencils and welding electrodes and ceramic industries. Even the ease to mine magnetite/haematite in the same locality is still being exploited locally for making local iron implements; but it has the potential to support small to medium furnace for production of iron billets that can in turn be used in small scale industries.

Some broad river valleys in the northwestern part of the state are also rich sources of sand and granite rocks which are used for crushing and clay (especially kaolinite) that are being exploited in the building industry (KDSG, 2014).

3.2 Methodology

3.2.1 Reconnaissance Survey

A reconnaissance survey was carried out between April and July, 2014. The main objective of the visit was to become familiar with the study area in terms of geographical landscape, cultural characteristics and social structure of the inhabitants. It helped to identify socio- economic and biophysical conditions of some of the wards within the study area. The reconnaissance survey to some of the wards within the study area also created contacts between the communities' people, most specially the community leaders, representatives of community-based organizations, and the researcher.

3.2.2 Types of data

The data used for this study were obtained from both primary and secondary sources through a combination of quantitative and qualitative methods of data collection. Data on socio-economic characteristic, nature of climate change, gender differential issues, adaptation strategies, pattern of climate change, adaptation capacities and vulnerability to climate change, extent of climate change, adaptation strategies, causal factors and possible challenges were used. Also, adaptive capacity and other related characteristics of the respondents were collected by using questionnaire survey both closed and open ended, and likert- type. Focus Group Discussions (FGD), Key Informant Survey (KIS), and field observations was also adopted. A monthly mean temperature and total annual rainfall data for 35 years (1981-2015) were used.

Methodological triangulation was used in collecting the data, which is, obtaining data from different sources, such as questionnaires, observations, documentaries, and interviews (Olsen, 2004). This according to Senbeta (2009) helps to harness diverse ideas about the same issues and assisted in cross- checking the results, and consequently helped to increase the validity and reliability of the findings and eased data analysis.

3.2.3 Sources of data

3.2.3.1 Primary source data

Information on socio-economic characteristic, nature of climate change, gender differential issues, adaptation strategies and other related characteristics of the respondents were collected by using questionnaire survey, Focus Group Discussions (FGD), Key Informant Survey (KIS), and field observations.

Household Questionnaire Survey; Household questionnaire survey was used to collect data on trend of climate change, gender adaptation strategies, adaptation capacities and vulnerability to climate change. Both closed and open ended questions were used for this purpose. The survey questions focused on a wide range of issues such as socio- economic characteristic, nature of climate change, gender differentials, causal factors and possible challenges of climate change adaptive capacity.

Focus Group Discussions; Focus group discussions were also used to collect data. Semi-structured questions designed based on gender were used to guide the focus group discussions (Appendix B). Before undertaking the FGDs, the wards were informed through their ward leaders, motives and intentions were made clear to eliminate mistrust and suspicion. One person was picked from each ward by the ward leader based on their age group, which forms the group for discussion. There were nine (9) people per group since there are nine wards as samples in each senatorial zone. There was one FGD in each of the senatorial zone. A central place in each of the senatorial zone was agreed upon and monies were given as a transport fare to each participant to convey them to the agreed location. Government Girls Secondary School, Kongo Zaria, was picked as the venue for

Kaduna North senatorial zone, Government Day Secondary School, Rigachikun for Kaduna Central senatorial zone while Kajuru Local Government Area Secretarial as the venue for Kaduna South senatorial zone. As a result, attendance and cooperation was high and the people showed great interest in the discussion. To make communication more effective interpreters were used to translate from English to Hausa. Through the focus group discussions, men and women were given the opportunity to voice out their experiences and concerns regarding past and current climatic events. Both men and women provided knowledge that enhanced the capacity to understand how men and women are currently affected by climate and how future climate change is likely to affect them.

Before establishing the groups, participants were asked whether they preferred to be divided in groups of male and female. To the researcher's surprise, men and women wanted to be together in the groups. Their reason for this was that both women and men were interested in each other's views on the subject of climate change adaptation. They said it was an opportunity for them to share views, experiences and fears. In the group there was fear of men dominating the discussions and women not being able to express themselves but this was not the case. Women were very vocal and freely voiced their views. They spoke with confidence in the presence of men. The discussions were flexible in order to accommodate unexpected issues that may come up. (Appendix B)

*Interviews with Key Informants***;** Interviews were conducted with key informants (4 from each senatorial zone). These individuals consisted of farmers, ward leaders, women leaders and the *sarkin noma* in each of the senatorial zones. The purpose is to gather detailed information on climate change adaptation; that is what they know about the

nature of climate change, their adaptation strategies, gender differentials in adaptation, what causes these differences, and their challenges of climate change in their area. Information obtained from these individuals was used to compliment data collected from focus groups and secondary sources.

3.2.3.2 Secondary source data

Monthly mean temperature and total annual rainfall data for 35 years (1981–2015) were used for this study. These data were obtained from two different sources: (1) the archives of the (Nigerian Meteorological Agency (NIMET), Lagos; and (2) Department of Hydrology (Meteorological Unit), Kaduna State Water Board, Kaduna. Southern Zone of the study area was represented by data from Kafanchan station (Samaru Kataf), Central Zone was represented by data from Kaduna station (Kaduna Airport), and Northern Zone was represented by data from Zaria station (IAR, Samaru-Zaria).

The use of single station to represent a zone was adopted due to the fact that recent records of temperature and rainfall data are not available in most of the study LGAs. These three stations were then chosen based on the following criteria:

1. Each of the stations fall within a zone.
2. The stations have long period of recorded temperature and rainfall data that cover the period of study.
3. The stations have no significant missing data for the period under investigation.
4. The stations have not been relocated since their establishments.
5. Kaduna and Zaria are synoptic stations while Kafanchan is a climatological station.

Other relevant publications like research journals, textbooks, the internet, and existing official and unofficial statistics from both national and international publications, including articles, conference papers, thesis and dissertations were used to get information regarding the research. National Population Commission (NPC) publications, analytical reports and other commissioned papers, reports of conferences of national and international agencies from several web sites were used to gather information regarding the research topic.

3.2.4 Sampling Technique for Local Government Areas

Systematic sampling technique was used to select the Local Government Areas from the three senatorial zones. Each Local Government Area from each of the three senatorial zones was given equal opportunity. For proper representation of the twenty-three Local Government Areas in the three senatorial zones, the Local Government Areas in each of the senatorial zones were arranged in alphabetical order and every second Local Government Area or even number was selected. (Tables 3.1)

Table 3.1: Local Government Areas in Each Senatorial Zone and their Population

S/NO	**Kaduna North**	**Male**	**Female**	**Total**
1	Ikara	95,598	99,125	194,723
2	**Kubau**	**141,528**	**139,176**	**280,704**
3	Kudan	71,704	67,252	138,956
4	**Lere**	**170,396**	**169,344**	**339,740**
5.	Makarfi	73,292	73,282	146,574
6.	**Sabon Gari**	**149,111**	**142,247**	**291,358**
7	Soba	145,145	146,028	291,173
8.	**Zaria**	**210,906**	**196,090**	**406,990**
S/NO	**Kaduna Central**	**Male**	**Female**	**Total**
1	Birnin Gwari	130,919	127,662	258,581

2	**Chikun**	**187,433**	**184,839**	**372,272**
3	Giwa	145,608	146,776	292,384
4	**Igabi**	**217,414**	**213,339**	**430,753**
5	Kaduna North	187,075	177,500	364,575
6	**Kaduna South**	**204,969**	**197,762**	**402,731**
7	Kauru	54,506	55,304	109,810
S/NO	**Kaduna South**	**MALE**		**TOTAL**
1	Jaba	77,415	78,558	155,973
2	**Jama'a**	**140,724**	**137,478**	**278,202**
3	Kachia	124,944	252,568	252,568
4	**Kagarko**	**121,041**	**118,017**	**239,058**
5	Kaura	88,565	86,061	174,626
6	**Kajuru**	**111,119**	**110,157**	**221,276**
7	Sanga	76,482	75,003	151,485
8	**Zangon Kataf**	**161,870**	**157,121**	**318,991**

Source: National Population Commission, (2009).
Selected LGAs in bold

Based on this, eleven (11) Local Government Areas were selected as samples. Four (4) Local Government Areas each from Kaduna North and South Senatorial Zones respectively and Three (3) from Kaduna Central Senatorial Zone because it has seven LGA

Table 3.2: Selected Local Government Areas in Each Senatorial Zone and their Population

S/NO	**Kaduna North**	**Male**	**Female**	**Total**
1	Kubau	141,528	139,176	280,704
2	Lere	170,396	169,344	339,740
3.	Sabon Gari	149,111	142,247	291,358
4.	Zaria	210,906	196,090	406,990
S/NO	**Kaduna Central**	**Male**	**Female**	**Total**
5	Chikun	187,433	184,839	372,272
6	Igabi	217,414	213,339	430,753
7	Kaduna South	204,969	197,762	402,731
S/NO	**Kaduna South**	**Male**	**Female**	**TOTAL**
8	Jama'a	140,724	137,478	278,202

9	Kagarko	121,041	118,017	239,058
10	Kajuru	111,119	110,157	221,276
11	Zangon Kataf	161,870	157,121	318,991

Source: National Population Commission, (2009).

The selected Local Government Areas are as follows; Kaduna North Senatorial District; Kubau, Lere, Sabon Gari, Zaria;Kaduna Central Senatorial District; Chikun, Kaduna South, Igabi; Kaduna South Senatorial District; Jema'a, Kagarko, Kajuru and Zango Kataf (Figure 3.2). Kaduna central is having only three selected Local Government Areas compared with the other two zones because the entire zone is having seven Local Government Areas while North and South are having eight each.

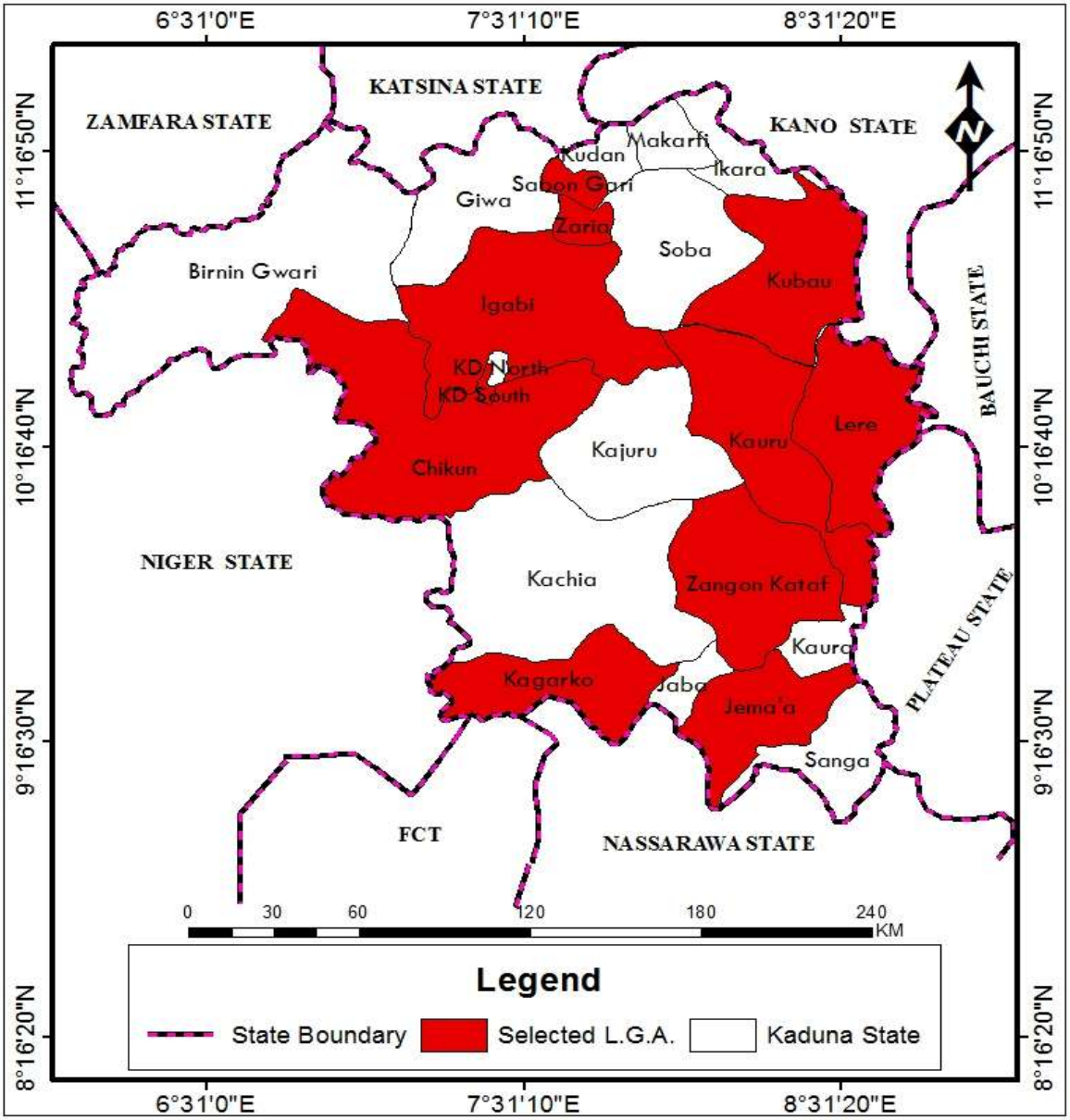

Figure 3:2: The Selected Local Government Areas
Source: Adapted and Modified from the Administrative Map of Kaduna State, (2014)

3.2.5 Sampling of Wards

Systematic sampling of wards in each of the selected LGAs was done after arranging the wards alphabetically and every fourth ward was selected totaling twenty-seven (27) wards. (Table 3.4)

Table 3.3: Wards in the Selected Local Government Areas

Senatorial District	Selected LGAs	Wards
Kaduna North	Kubau	Anchau, Damau, Dutsen-wai, **Haskiya**, Kareh, Kargi, Kubau, **Mah,** Pambeguwa, Zabi, Zuntu.
	Lere	Abadawa, Dan Alhaji, Garu, **Gure Kahuga**, Kayarda, Lazuru, Lere, **Raminkura,** Sabonbirni, Saminaka, Yarkasuwa
	Sabon Gari	Basawa, Bomo, Chikaji, **Dogarawa**, Hanwa, Jushi, Muchiya**, Samaru**, Unguwa Gabas, Zabi
	Zaria	Angwan Fatika, Angwan Juma, Dambo **Dutsen Abba**, Gyellesu, Kauran Limanci ,Kufena, **Kwarbai A**., Kwarbai B., Kona, Tudun Wada **Tukurtukur,** Wuciciri
Kaduna Central	Chikun	Chukun, Barnawa, Narayi, **Kujama,** Sabon Tasha, Television, Unguwa gimbiya**, Nasarawa**, Kamanzo, Unguwa Sunday, Kasuwa Magani, **Unguwa Yelwa.**
	Igabi	Afaka, BirninYero, Gadan Gayan, **Gwaraji**, Igabi, Kerawa, Kwarau, **Rigachikun,** Rigasa, Sabon Birni Daji, Turunku, **Zangonaya.**
	K/South	Asso, Atuku, Angwan Sanusi**, Badiko**, Barnawa, Kakuri Gwari, Kakuri Hausa, **Makera**, Sabongari North, Sabongari South, Television. **Tudun Nupawa**, Tudun Wada North, Tudun Wada South, Tudun Wada West
Kaduna South	Jama'a	Barde, Gidan Waya, Godogodo, **Jagindi ,**Kagoma, Kafanchan A., KafanchanB. **Koninkon,** Maigizo, Takau
	Kagarko	Aribi, Iddah, Jere North, **Jere South**, Kagarko North, Kagarko South, Katugal**, Kukui**, Kurmin Jibri, Kushe
	Kajuru	Afogo, Buda, Idon, **Kajuru**, Kallah, Kasuwa Magani, Kufana, **Maro,** Rimau, Tantalu
	Z/Kataf	Gidan Jatau, Gora, Ikulu, **Kamantan**, Madakiya, Unguwan Gaya, Unguwan Rimi, **Zangon Urban ,** Zamandabo, Zonkwa, Zonzon
TOTAL	**11**	**26**

Selected Wards in bold

Table 3.4: Selected Wards in the Selected Local Government Areas

Senatorial District	Selected LGAs	Wards
Kaduna North	Kubau	Haskiya, Mah
	Lere	Gure Kahuga, Raminkura
	Sabon Gari	Dogarawa, Samaru
	Zaria	Dutsen Abba, Kwarbai A., Tukur-tukur
Kaduna Central	Chikun	Kujama, Nasarawa, Unguwa Yelwa
	Igabi	Gwaraji, Rigachikun, Zangon-aya
	K/South	Badiko, Makera, Tudun Nupawa,
Kaduna South	Jama'a	Jagindi , Koninkon
	Kagarko	Jere South, Kukui,
	Kajuru	Kajuru, Maro
	Z/Kataf	Kamantan, Zangon Urban ,
TOTAL	**11**	**26**

3.2.6 Determining Sample Size

A number of models have been developed to estimate sample size. Yamane (1976) provides a simple formula for calculating sample size with 95% confidence level and 5% sampling error assumption given as:

$$n = \frac{N}{1+N\,(e)^2}$$

Where:

n = Sample Size

N = Population size

e = Level of significance (0.05)

This study used the above formula to obtain a total of 399 respondents drawn from the senatorial zones to which were administered questionnaire. To determine the proportion of the population respondents per ward, Yamane's (1976) sampling method was also used

$$\text{Sample size per ward} = \frac{\text{Ward Population}}{\text{Total Ward Population}} \times \text{Sample size}$$

The respondents were drawn from the sampled Local Government Areas in Kaduna State. (Table 3.5)

Table 3.5: Distribution of Respondents by Wards

Senatorial	LGA	Selected wards	Pop(Projectedto2017)		No of Respondents			
			Male	Female	Male	Female	Total	G/TOTAL
Kaduna North	Kubau	Haskiya	1254	1234	7	7	14	
		Mah	1163	1145	6	6	12	
	Lere	GureKahuga	1803	1789	10	10	20	
		Raminkura	2153	2135	12	12	24	
	Sabon Gari	Dogarawa	2683	2558	15	14	29	
		Samaru	9183	8753	51	48	99	
		Dutsen Abba	3032	2821	17	16	33	
	Zaria	Kwarbai A	12420	11557	68	64	132	
		Tukur Tukur	3342	3110	19	17	35	
Total			**37033**	**35102**	**205**	**194**	**399**	**399**
Kaduna Central	Chukun	Kujama	3302	3262	11	11	22	
		Nasarawa	3291	3252	11	11	22	
		Unguwa Yelwa	2341	2313	8	8	16	
	Igabi	Gwaraji	1593	1561	5	5	10	
		Rigachukun,	2577	2525	9	8	17	
		Zangon aya	4611	4519	15	15	30	
	Kaduna S	Badiko	2712	2616	9	9	18	
		Makera	15570	15020	52	51	103	
		Tudun Nupawa	24651	23779	82	79	161	
Total			**60648**	**58847**	**202**	**197**	**399**	**798**
Kaduna South	Jema'a	Jagindi,	9337	9115	41	39	80	
		Koninkon	8194	8000	35	34	69	
	Kagarko	Jere South	6522	6368	28	27	55	
		Kukui	2871	2802	12	12	24	
	Kajuru	Kajuru	6784	6730	29	29	58	
		Maro	5242	5199	22	22	44	
	Zangon K	Kamantan	3384	3291	15	14	29	
		Zangon Urban	4536	4410	21	19	39	
			46870	**45915**	**203**	**196**	**399**	**1197**

Source: NPC, 1991(Projected to 2017)

3.2.7 Sampling techniques

Due to the nature of the population in the selected LGAs in terms of livelihoods, religion, cultural background, among others, nine (9) wards were sampled in each of the senatorial

zones using systematic sampling, and the questionnaires were administered to the sampled wards proportionally (Table 3.4, 3.5). Sampling two to three wards in each LGA helped in making the sampling survey more thorough taking into consideration the time and cost involved in administering the questionnaires and monitoring the respondents. Purposive sampling was used to sample households from each selected ward.

3.2.8 Questionnaire administration

The questionnaire were purposively administered to sampled household heads that were 50 years and above, based on simple proportion, and must have been residing in the ward or community for at least 30 years. The basis for this was to enable the gathering of information from respondents who have had experiences in climate variability over the years and were more concerned and conscious about the imminent impacts and vulnerability of these changes on their environment. Some of the respondents were farmers interviewed in their nearby farms. Some were done at home around (2- 6pm) for those whose farms were far away from their homes and those who are not farmers. Regular supervision exercises were carried out to ensure effective questionnaire administration and collation. The main reason for this was to prevent poor completion of the questionnaire based on the fact that most of the target groups may not have the capacity to read or write.

3.2.9 Data analysis techniques

The data collected for this study were analyzed and presented using both descriptive and inferential statistics using the Statistical Package for Social Sciences (SPSS). The statistics used in achieving the objectives of the study were as follows:

3.2.9.1 Nature of climate change – Objective i

Trends in temperature and rainfall along a geographic transect for the period 1981-2015 in the study area were analyzed and presented graphically. Time series of rainfall totals for the months of April to October and the annual were used. These are the months during which the study area receives over 85% of its annual rainfall totals (Oladipo, 1993). To examine the nature of the trends in the temperature and rainfall series, linear trend lines and trend line equation were plotted and changes in temperature and rainfall amount were determined using Microsoft Excel Tool (2013) and SPSS 21. In ascertaining the nature of trends and measurement of variability of both rainfall and mean temperatures, the standard deviation, which provides the deviation from normal (average) for rainfall amount and temperature, was equally determined and plotted using Microsoft Excel Statistical Tool (2013)

3.2.9.2 Climate change adaptation strategies – Objective ii

To determine the various adaptation strategies to climate change in current practice in the area, the responses of the respondents were summarized using frequencies and percentages. More so, pair wise comparison matrix was used to identify the strongest adaptation strategies to climate change in the study area.

3.2.9.3 Determination of gender differentiation in adaptation strategies- Objective iii

To determine gender differentiation in adaptation strategies the Kruskal - Wallis was used to test if male adapt differently to climate change than female.

3.2.9.4 Causal factors of gender differentiation in climate change- Objective iv

To determine causal factors of gender differentials in climate change adaptation strategies, the Kruskal- Wallis was used to test if the factors that influence males to adapt to climate change differ with that of the females in the study area.

3.2.9.5 Challenges of climate change- Objective v

Frequency tables and charts were used to summarize the various challenges of climate as identified by the respondents in the study area.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Respondents

Socio-demographic characteristics of respondents considered in this study were gender, age, marital status, religion, ethnicity, highest level of education, occupation, income and length of stay.

4.1.1 Sex.

The results of the responders interviewed show that the majority were males. Out of the 1197 administered questionnaires, 74.2% were males while females' respondents accounted for only 25.8% (Figure 4.1). Some of the reasons for this lopsidedness of the result has to do with the culture and religion of the people in the study area, especially the northern zone, where women are restricted from some certain social activities; some of them are always confined inside their houses. Another reason is that most of the rural activities, especially the agricultural sector, and some of the tedious activities related to climate change, for example farming, are dominated by the males.

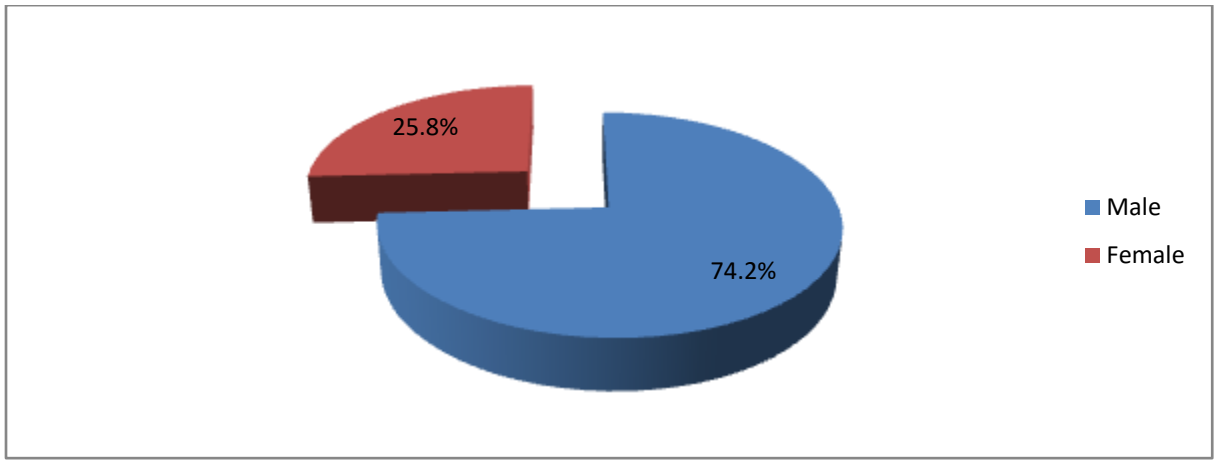

Figure 4.1: Gender of the Respondents
Source: Fieldwork (2017)

This present research is in consonance with other related studies on climate change in some areas in the northern parts of the country and other countries having the same socio-cultural and environmental conditions. For instance, the results of the studies of Ishaya and Abaje (2008);

Abraham, Bamidele, Adebola, and Kobe (2012), Abaje *et al* (2014) and Udeh (2014) in the northern parts of the country which showed that the percentage of male is always higher than the female.

4.1.2 Age

The distribution of the respondents by age group is given in Table 4.1.

Table 4.1: Age Distribution of the Respondents

Age Group	Frequency	Percentage
50-55 years	492	41.1
56-60 years	321	26.8
61-65 years	217	18.1
66-70 years	90	7.5
Above 70 years	77	6.4
Total	**1197**	**100**

Source: Field work (2017)

As shown in Table 4.1, majority (41%) of the respondents fall within the age group of 50-55 years, while 27% fall within the age bracket of 56-60 years. However, 6% are above the age of 70 years. This indicates that the respondents were within the working age and might have income sources to adopt one or two adaptation strategies to climate change. Also, they are capable of providing needed information.

This population to some extent is active and could commit their energy in crop and livestock production that would determine the variation between the two gender adaptations to climate change issues. This corresponds with the findings of Onubuogu and Esiobu (2014) that household heads within that age range are still in their active ages. However, the older ones have had experiences in climate change over the year especially natural climatic variability and some

of the traditional/local coping and adaptation strategies that would enable the differences between the genders to be adequately verified.

4.1.3 Marital Status

The distribution of the respondents by their marital status is provided in Table 4.2.

Table 4.2: Marital Status of the Respondents

Marital Status	Frequency	Percentage
Married	1078	90.1
Single	11	0.9
Widowed	49	4.1
Divorced	59	4.9
Total	**1197**	**100**

Source: Field work (2017)

Table 4.2 indicates that 90% of the respondents are married while 0.9% are single. It also shows that only approximately 5% were divorced. The above findings shows that the high number of respondents are married couples amongst the households due to the fact that the study area is largely a Muslims setting, where early marriage is encouraged due to cultural and religious beliefs.

4.1.4 Religion

The distribution of respondents by their religious beliefs is presented in Table 4.3.

Table 4.3 revealed that 50% of the respondents were Muslims, 44% were Christians while 5% were traditional worshipers.

Table 4.3 Religion of the Respondents

Religion	Frequency	Percentage
Islam	602	50.3
Christianity	532	44.4

Traditional Worshipers	63	5.3
Total	**1197**	**100**

Source: Field work (2017)

The religious belief of the people in the study area has an influence on the household size. Large household sizes were found in the northern parts than the southern parts. This may be attributed to the fact that the southern part is dominated by Christians, and their religion does not allow the marrying of more than one wife, while the northern part is dominated by Muslims in which their religion allow the marrying of a maximum of four wives which might have led to multiplication of children in the northern part of the study area. The large household size is believed to provide cheap labor that will assist in adaptation practices that will mitigate the impacts of climate change in order to reduce the vulnerability in their households and the community.

4.1.5 Ethnicity

The study area is made up of people from different ethnic and tribal background. Table 4.4 shows the distribution of respondents by their ethnic groups. From Table 4.4, it is observed that 39.1% of the respondents were of Hausa/Fulani ethnic group, followed by other ethnic groups (21.7%) with Yoruba (5.9%) accounting for the least. The high percentage of Hausa/Fulani tribe is not unconnected with the fact that Hausa/Fulani people are the predominant people residing in the entire study area.

Table 4.4: Distribution of the Respondents by Ethnicity

Tribe	Frequency	Percentage
Hausa/Fulani	468	39.1
Yoruba	71	5.9

Igbo	89	7.5
Gwari	78	6.5
Bajju/Kataf	129	10.8
Nupe	102	8.5
Others	260	21.7
Total	**1197**	**100**

Source: Field work (2017)

However, the presence of other ethnic groups also shows that there are diverse ethnic groups living in the study area. This would probably give reliable responses with regards to the respondents varied experiences based on their culture as it relates to the study.

4.1.6 Educational Status

Education provides individuals with the ability to understand and his environment. The level of educational attainment of the respondents would determine their comprehension of climate change and their responses to it. The educational attainment of the respondents is shown in Table 4.5.

Table 4.5 reveals that 41.7% of the respondents had attended secondary school education while 24.9% attended up to primary school level and 10% do not have any formal education.

Table 4.5: Educational Level of the Respondents

Level	Frequency	Percentage
No Formal Education	120	10.0
Primary School	298	24.9

Secondary School	499	41.7
Tertiary Education	155	12.9
Qur'anic Education	125	10.5
Total	**1197**	**100**

Source: Field work (2017)

The survey results show that the highest level of education most of the respondents have acquired across the study area is secondary school (41.7%), and about (10.0%) had no formal education; 24.9% attended primary school, tertiary accounts for 12.9% while Qur'anic accounts for 10.5%. Generally, the literacy levels of the respondents in the study area are relatively high since only 10.0% had no formal education.

The education level of the household head is considered to be important since heads of households are the decision makers of the household. A more educated head of a household is considered to be in a better position to make informed decisions on climate change adaptation and mitigation strategies that will reduce the vulnerability in the household

4.1.7 Occupation

The study area by its nature is filled with different occupational activities people engage in. These ranged from primary, secondary and tertiary production occupations (Table 4.6).

Table 4.6: Occupation of the Respondents

Occupation	Frequency	Percentage
Farming	411	34.3
Civil service	275	23.0
Trader/Business	179	14.9

House wife	98	8.2
Unemployed	97	8.1
Others	137	11.5
Total	**1197**	**100**

Source: Field work (2017)

Table 4.6 reveals that majorities (34%) of the respondents were farmers, 23% were civil servants while 8% were unemployed. The highest percentage engaging in farming is a reflection of one of the common characteristics of the study area. This is because of the low level of education of the rural dwellers when compared to urban dwellers and therefore, farming becomes there major source of livelihood (income). Some of the civil servants are teachers. Some of them especially the older ones with large family sizes also engage in farming as their secondary occupation in order to augment their income.

4.1.8 Income

The incomes of the respondents derivable from the various occupations they engage in determine their level of coping and adapting to the effects of climate change. Any of the gender with low incomes generally would severely feel the effects of climate change. Table 4.7 displays the income per month of the respondents in the study area.

Table 4.7: Monthly Income of the Respondents

Monthly Income	**Frequency**	**Percentage**
No Fixed Income	514	42.9
Less than ₦20,000	249	20.8
₦20,000- ₦39,999	97	8.1
₦40,000- ₦59,999	123	10.3

₦60,000- ₦79,999	127	10.6
₦80,000 and Above	87	7.3
Total	**1197**	**100**

Source: Field work (2017)

Table 4.7 shows that 43% of the respondents have no fixed income, 21 % earn less than ₦20, 000 while only 7% had an income level of ₦80,000 and above. The implication of this is that there is a high vulnerability of the people to the adverse effects of climate change given their low income level. The low level of income implies that most of the respondents are peasant farmers. This may be responsible for the high level of poverty in those communities. As a result, it may be difficult for them to combat climate change because some resources and items that could be used in combating the impacts of climate change cannot be afforded, and thus, vulnerable to climate change impacts. This corroborates the view of Semenza *et al.,* (2008) that individuals with higher income are more likely to cope with climate change than individuals with low income.

4.1.9 Duration of Residency

The period of time a person resides in a particular geographical area determines the person's level of understanding of the environment and the prevailing climatic activities. Accordingly, Figure 4.2 reveals the respondents duration of residency in the study area.

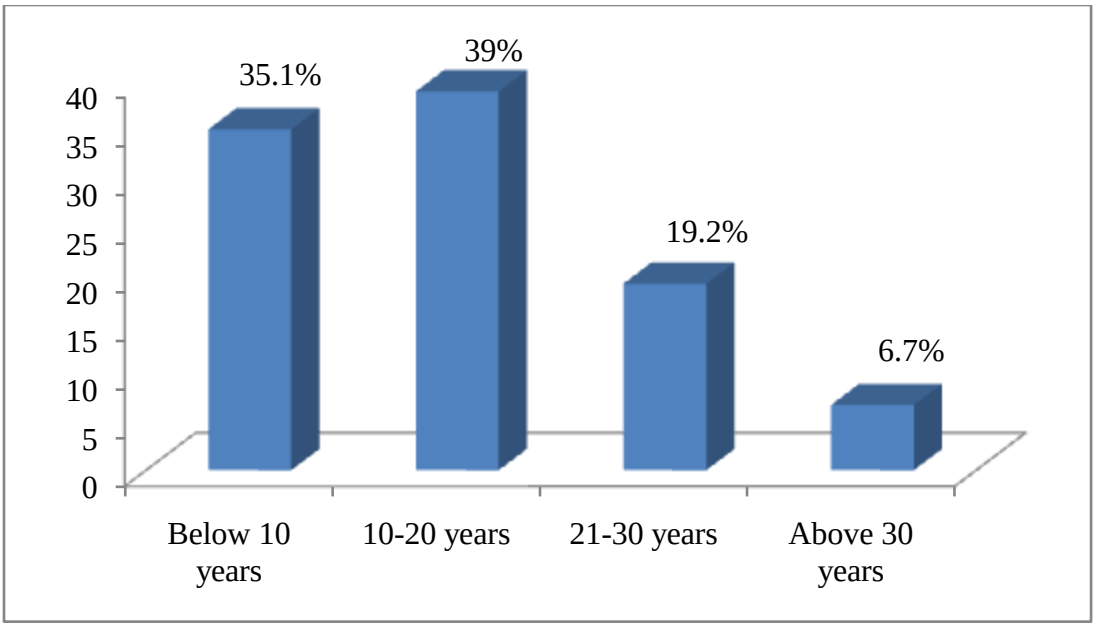

Figure 4.2: Duration of Residency in the Area
Source: Fieldwork (2017)

Figure 4.2, reveals that 39% have stayed in the study area between 10-20 years, 35% have stayed below 10 years whereas only 7% have above 30 years length of stay. This implies that the residents might possess adequate knowledge on the observable changes in the climatic conditions of the area given that most have stayed over 10 years. Also, it is believe that the higher the number of years spent in a community, the higher the experience in maintaining the natural and physical resources of the community, which are climate sensitive, through adopting proper mitigation and adaptation strategies

4.2 Nature of Climate Change in Kaduna State

4.2.1 Temperature Characteristics in Kafanchan (Southern Zone)

Table 4.8 presents the statistical characteristics of temperature for Kafanchan zone between the periods of 1981-2015.

Table 4.8: Temperature Characteristics in Kafanchan (Southern Zone)

Statistical Characteristics	Minimum Temperature (^{0}C)	Maximum Temperature (^{0}C)	Average Temperature (^{0}C)
Mean	16.09	33.87	25.00
Standard Deviation	0.60	0.83	0.53
Range	2.50	3.25	1.92
Minimum Value	14.75	32.5	24.04
Maximum Value	17.25	35.75	25.96
Trend (mm/year)	-0.003	0.031	0.013
Total Change (mm/35 years)	-0.071	1.14	0.541

Source: Field Survey (2017)

Table 4.8, shows the linear trend lines, estimation of changes of the minimum temperature (Figure 4.3) expressed in ^{0}C for the period of 35 years indicates an insignificant decrease of approximately -0.071^{0}C at the rate of -0.003 per year. The linear trend line for the maximum temperature (Figure 4.4) indicates an increase in temperature of 1.14^{0}C for the period of study at the rate of 0.031^{0}C per year. An examination of the linear trend line of the average temperature (Figure 4.5) revealed an increase of 0.541^{0}C for the 35 years period of study at the rate of 0.013^{0}C per year. Generally, there is a clear indication that the temperature is increasing in the southern zone.

Trend in Temperature of Kafanchan (Southern Zone)

Trend in minimum, maximum and average temperatures are as shown in Fig. 4.3, 4.4 and 4.5 respectively.

Trend in minimum temperature of Kafanchan

Figure 4.3 is the graphical representation of minimum temperature pattern in Kafanchan between the periods of 1981-2015.

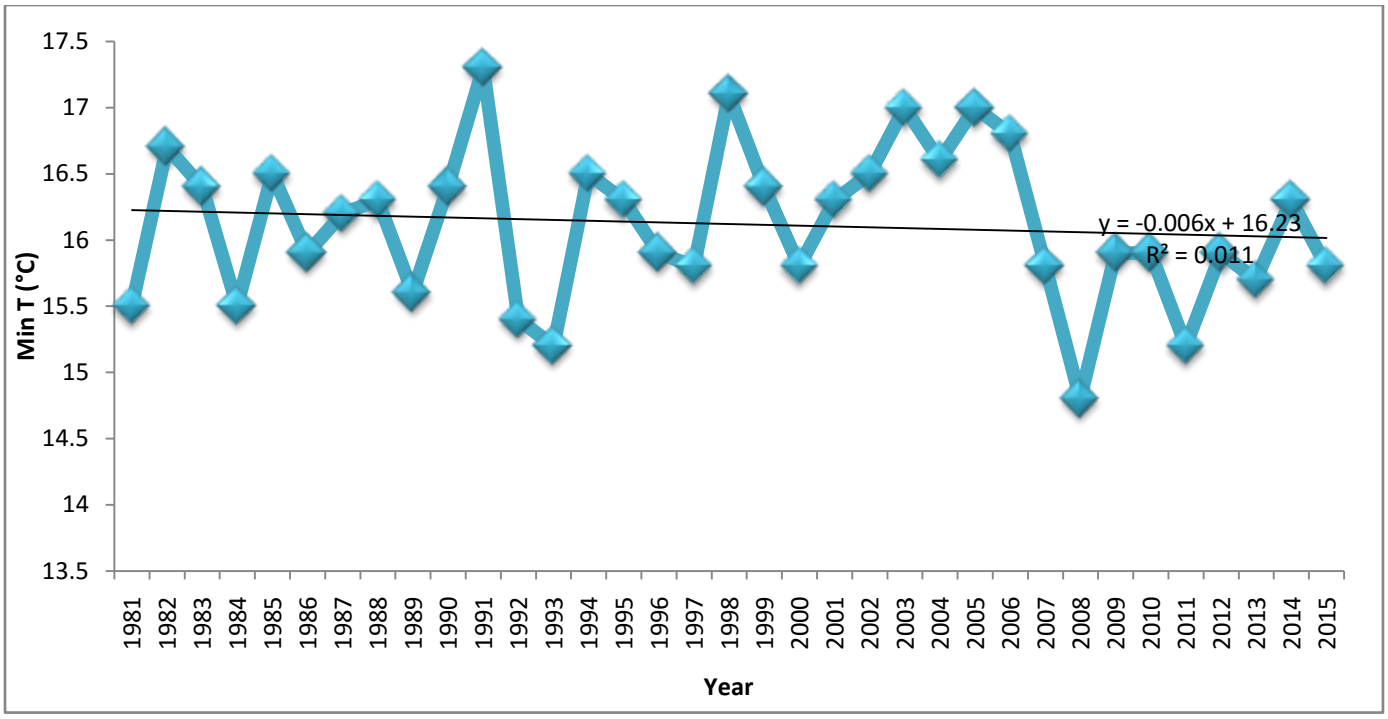

Figure 4.3: Trend of Minimum Temperature in Kafanchan Zone
Source: Fieldwork (2017)

The trend line in Figure 4.3 indicates a fluctuating pattern of minimum temperature of Kafanchan with the lowest minimum temperature recorded in year 2008 with 14.8ºC and highest was in 1991at 17.3ºC. On a general note, minimum temperature in Kafanchan shows a decrease with an R^2value of 0.0152. Even though the variation of the minimum temperature pattern indicates a fluctuating pattern from year to year, yet on the average a decrease is beeing observed. This finding is in line with the study of Kubai (2012) which opines that despite the general effects of climate change with its associated increase in temperature, some areas as a result of the prevailing micro-climate could result to decrease temperature as observed in Kafanchan.

Trend in maximum temperature of Kafanchan

Figure 4.4 shows the graphical representation of maximum temperature pattern in Kafanchan between the periods of 1981-2015.

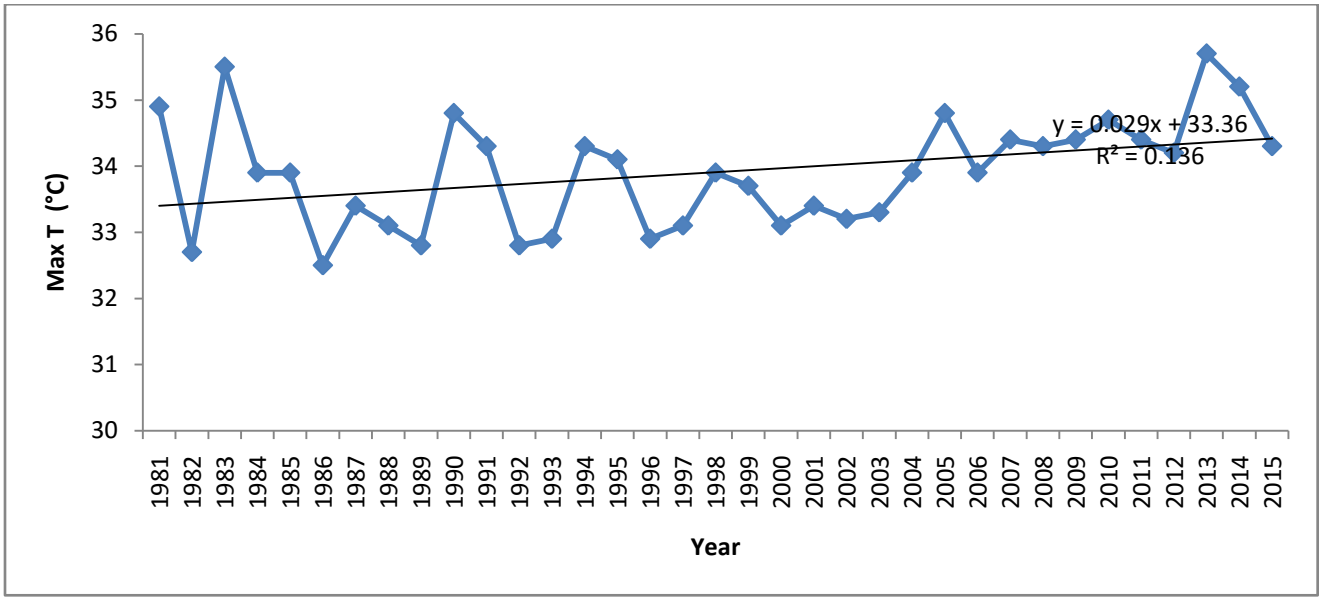

Figure 4.4: Trend of Maximum Temperature in Kafanchan Zone
Source: Fieldwork (2017)

Figure 4.4 shows the trend line of a fluctuating pattern of maximun temperature. The lowest was recorded in year 1986 with 32.5ºC and highest in 2013 with 35.75ºC. On the average, it however reveals an increase in the maximum temperature in Kafanchan with an R^2 value of 0.1543.

Trend in average temperature of Kafanchan

Figure 4.5 shows the graphical representation of daily average temperature pattern in Kafanchan between the periods of 1981-2015.

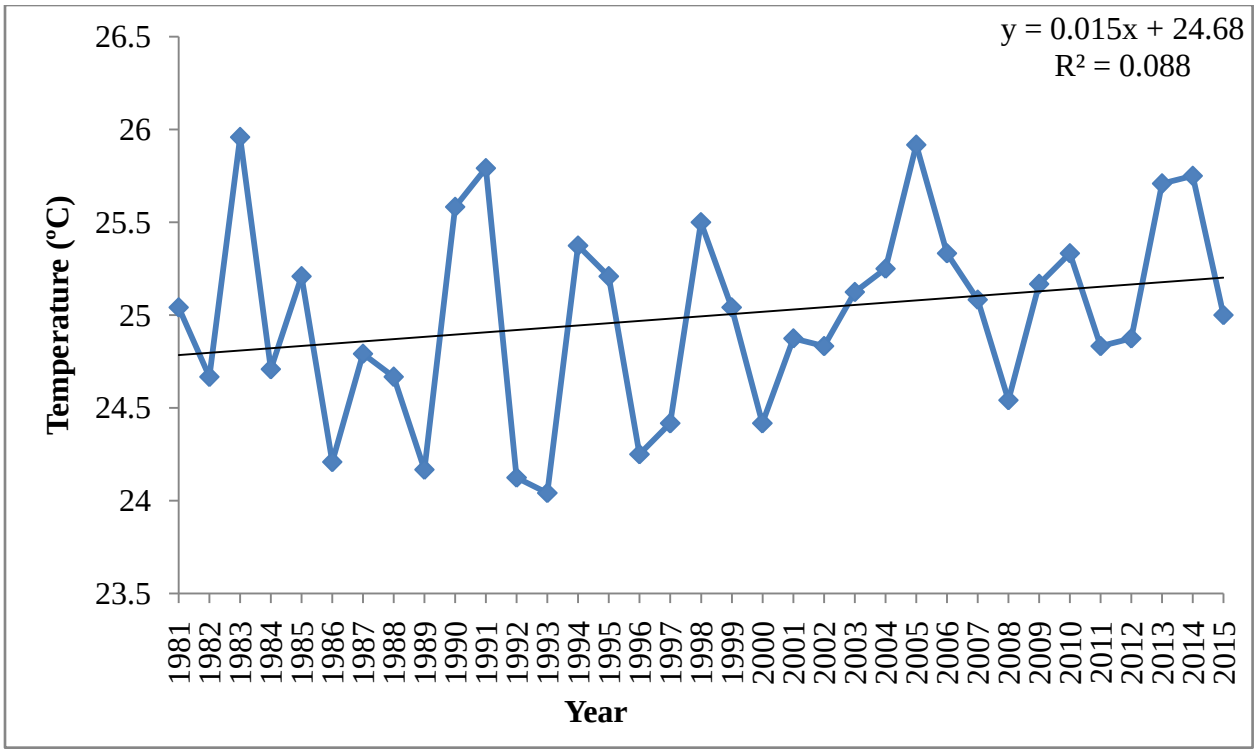

Figure 4.5: Trend in Average Temperature in Kafanchan Zone
Source: Fieldwork (2017)

The average temperature of Kafanchan also revealed a fluctuating pattern, the least temperature was recorded in the year 1993 (24.04ºC) and the highest was in the year 1983 with 25.95ºC. Figure 4.5 shows an R^2 value 0.088 and an increase recorded across the years under review. The findings on fluctuating pattern of temperature in Kafanchan are not unexpected. Variation in temperature in the study area could be mainly attributed to micro –climatic variations. The study of Ishaya and Abaje (2008) supports the fact that temperature fluctuations are not unexpected due to climatic variability,

4.2.2 Temperature Characteristics in Kaduna (Central Zone)

Table 4.9 presents statistical characteristics of temperature for Kaduna zone between the periods of 1981-2015.

Table 4.9: Temperature Characteristics in Kaduna (Central Zone)

Statistical Characteristics	Minimum Temperature (^{0}C)	Maximum Temperature (^{0}C)	Average Temperature (^{0}C)
Mean	19.31	31.81	25.56
Standard Deviation	1.20	0.40	0.61
Range	4.55	1.70	2.59
Minimum Value	17.74	30.43	23.65
Maximum Value	21.89	32.73	26.23
Trend (mm/year)	0.027	0.003	0.021
Total Change (mm/35 years)	0.947	0.651	0.761

Source: Compiled from NIMET Records

Table 4.9 indicated that the minimum temperature for the period of 35 years of the study which increased approximately by 0.95^{0}C at the rate of 0.027^{0}C per year. However, the maximum and minimum values were revealed to be 19.89^{0}C and 17.74^{0}C respectively.

Trend in Temperature of Kaduna Zone

Trend in minimum, maximum and average temperatures are as shown in Fig. 4.6, 4.7 and 4.8 respectively.

Trend in minimum temperature of Kaduna Zone

Figure 4.6 shows the graphical representation of minimum temperature pattern in Kaduna between the periods of 1981-2015.

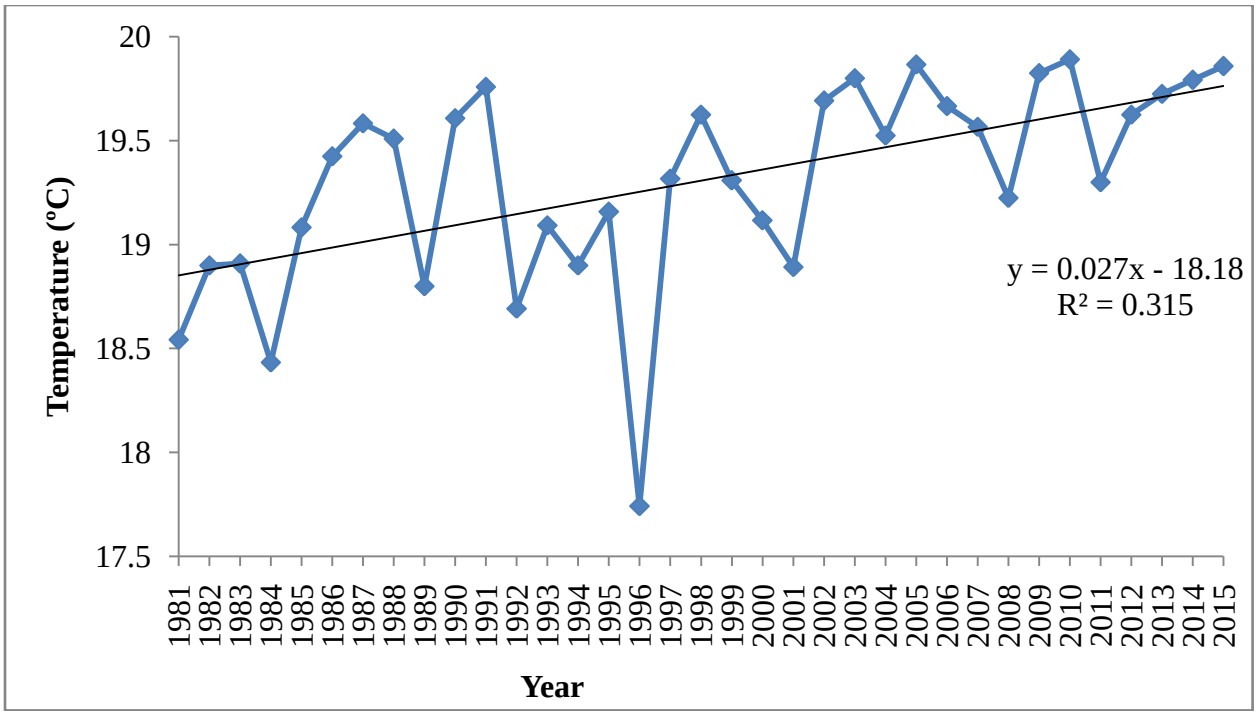

Figure 4.6: Trend of Minimum Temperature in Kaduna Zone
Source: Fieldwork (2017)

The trend line indicated a fluctuating pattern of minimum temperature of Kaduna with the lowest minimum temperature recorded in year 1996 with 17.74ºC and highest was in 2010 with 19.89ºC (Figure 4.6). On a general note, minimum temperature in Kaduna shows an increase with anR^2value of 0.315 and it was also observed that in the last four years (2012-2015) under review witness continuous increase on the minimum temperature. Even though the variation of the minimum temperature pattern indicates a fluctuating pattern from year to year, yet on the average an increase was noted.

Trend in maximum temperature of Kaduna Zone

Figure 4.7 shows the graphical representation of maximum temperature pattern in Kaduna between the periods of 1981-2015.

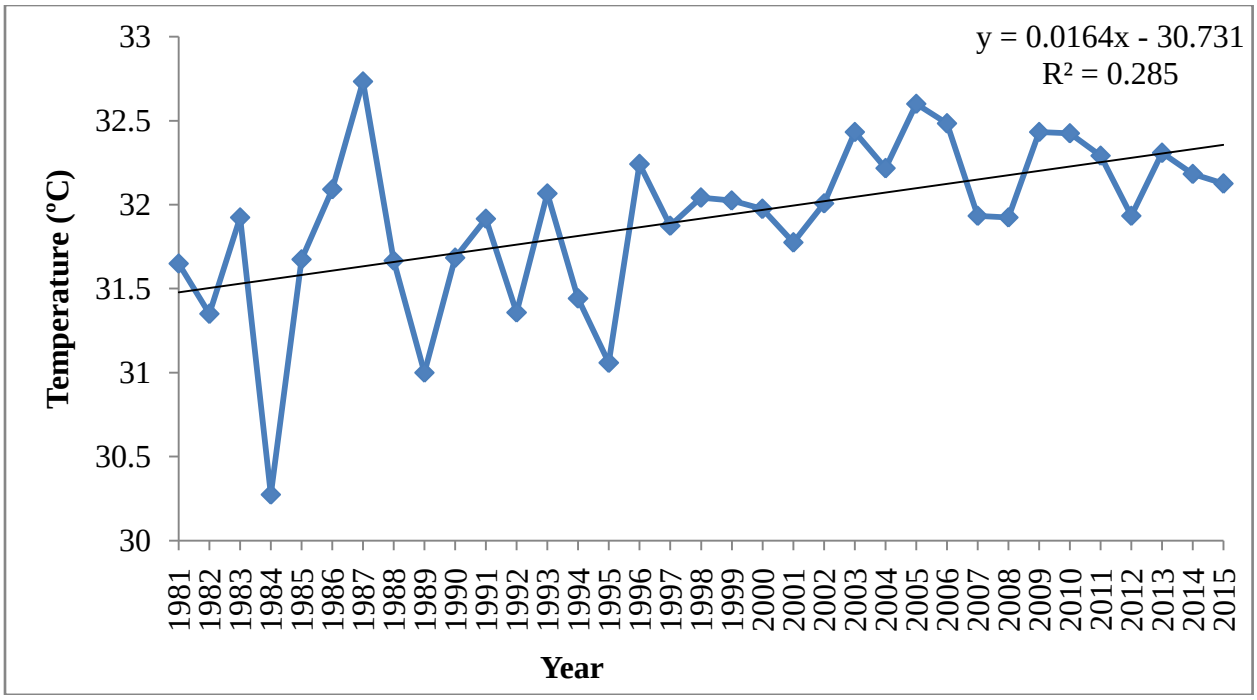

Figure 4.7: Trend of Maximum Temperature in Kaduna Zone
Source: Fieldwork (2017)

The lowest was recorded in year 1984 with 30.28ºC. While the highest in 1987 with 32.73ºC. On the the average, it however reveals an increase in the average maximum temperature in Kaduna with an R^2 value of 0.285.

Trend in average temperature of Kaduna Zone

Figure 4.8 shows the graphical representation of average temperature pattern in Kaduna between the periods of 1981-2015.

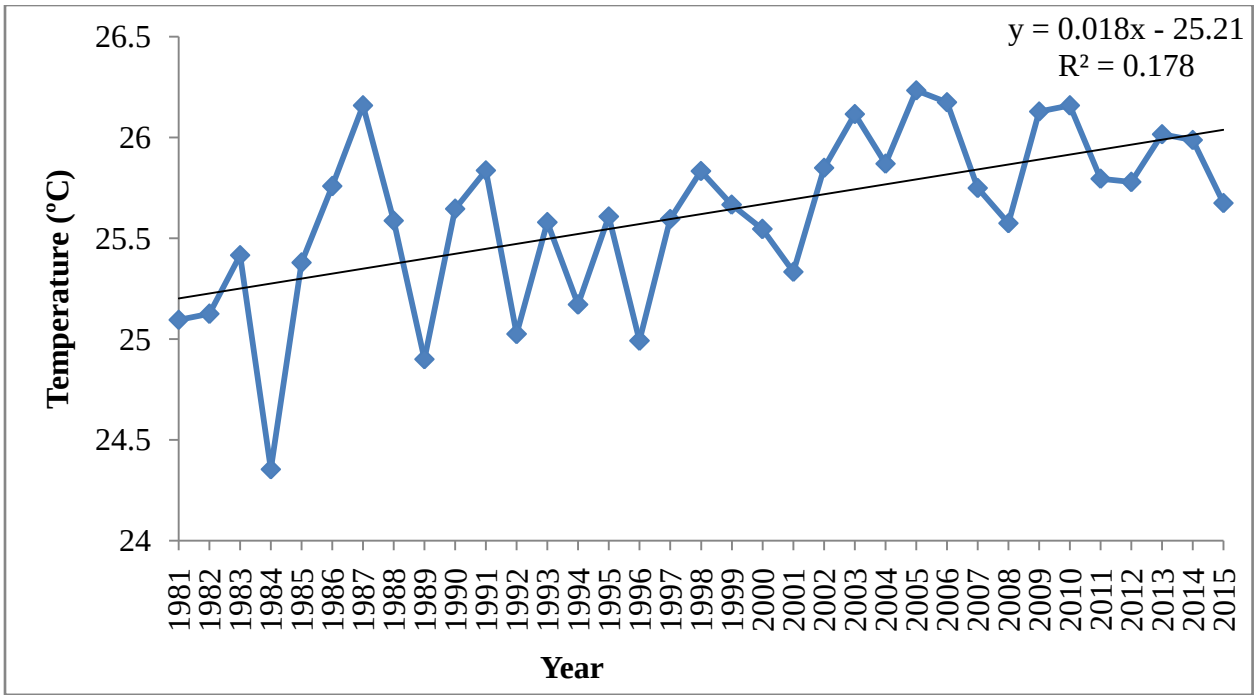

Figure 4.8: Trend of Daily Average Temperature in Kaduna Zone
Source: Fieldwork (2017)

The average temperature of Kaduna revealed a fluctuating pattern, the first three years (1981-1983) shows a continuous increase while the reverse is the case for the last three years (2013-2015) which show a continuous decline. The least temperature was recorded in the year 1984 (24.35ºC) and the highest was in the year 2005 with 26.23ºC. Figure 4.7 further revealed that generally the average daily temperature of the area was on the increase with an R^2value 0.178 across the years under review.

4.2.3 Temperature Characteristics in Zaria (Northern Zone)

Table 4.10 presents statistical characteristics of temperature for Zaria zone between the periods of 1981-2015.

Table 4.10: Temperature Characteristics in Zaria Zone

Statistical Characteristics	Minimum Temperature (^{0}C)	Maximum Temperature (^{0}C)	Average Temperature (^{0}C)
Mean	19.02	30.58	24.80
Standard Deviation	0.55	0.68	0.52
Range	2.50	4.23	2.61
Minimum Value	16.98	29.21	23.59
Maximum Value	20.28	33.13	26.47
Trend (mm/year)	0.021	0.020	0.019
Total Change (mm/35 years)	0.914	1.981	0.944

Source: Compiled from NIMET Records

The minimum temperature for the period of 35 years in the zone indicates an increase of 0.914^{0}C at the rate of 0.021^{0}C per year with the maximum and minimum values at 20.28^{0}C and 16.98^{0}C respectively (Table 4.10).

Trend in Temperature of Zaria Zone

Trend in minimum, maximum and daily temperatures are as shown in Fig. 4.9, 4.10 and 4.11 respectively.

Trend in minimum temperature of Zaria Zone

Figure 4.9 shows the graphical representation of minimum temperature pattern in Zaria between the periods of 1981-2015.

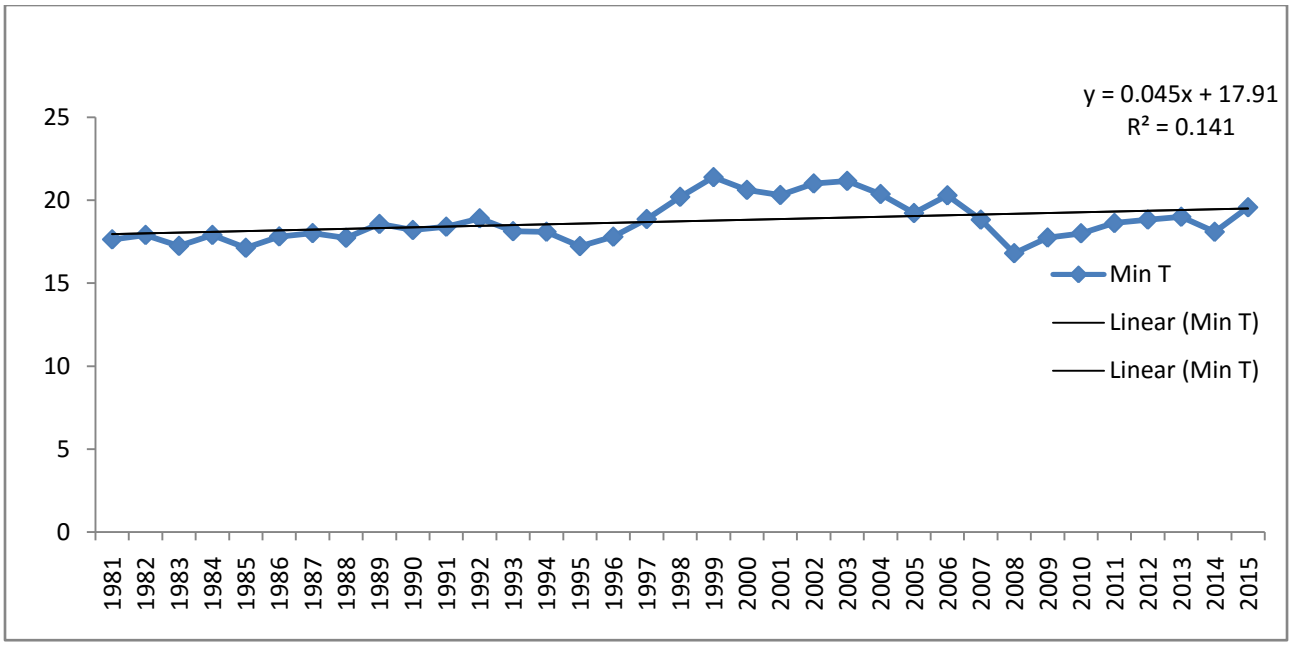

Figure 4.9: Trend of Minimum Temperature in Zaria Zone
Source: Fieldwork (2017)

Figure 4.9 show that the trend line is a linear best-fit. With a regression of $R^2 = 0.141$, it suggest an increase in Temperature. However, the graph has shown the lowest minimum temperature in 2008 with 16.8^0C while the highest in 1999 with 21.4^0C, a rise in the minimum temperatures in Zaria was noted.

Trend in maximum temperature of Zaria Zone

Figure 4.10 shows the graphical representation of maximum temperature pattern in Zaria between the periods of 1981-2015.

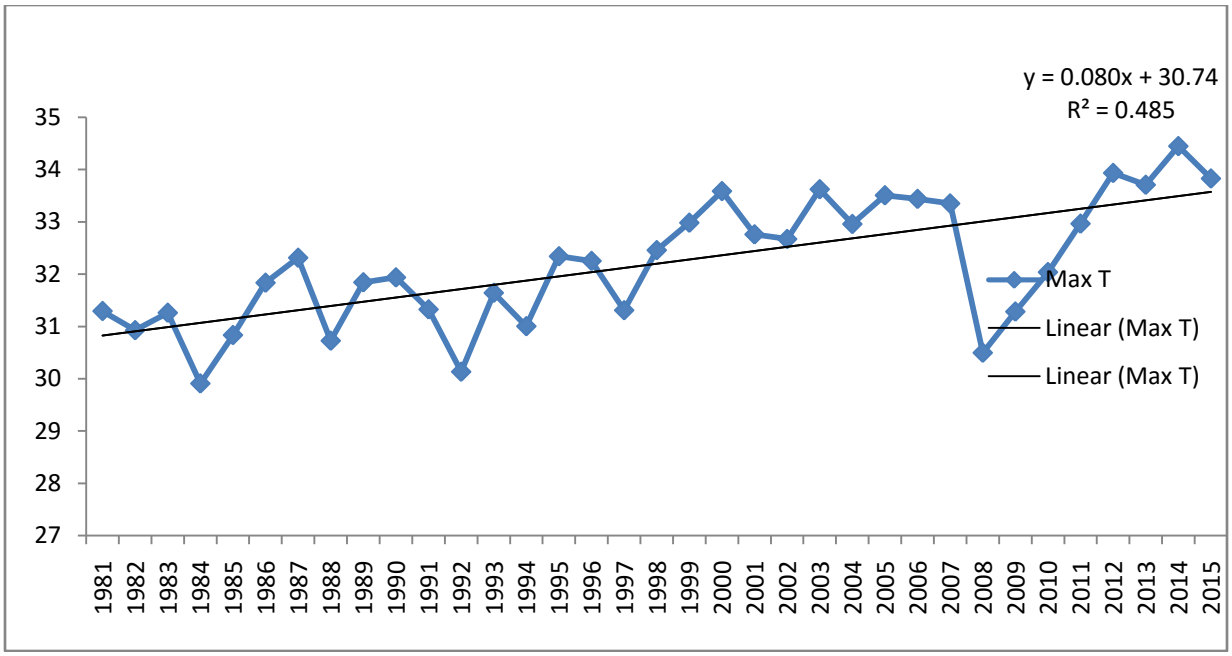

Figure 4.10: Trend of Maximum Temperature in Zaria Zone
Source: Fieldwork (2017)

Figure 4.10 revealed the trend line of a increasing pattern of maximum temperature of Zaria. It is increasing from the first year under study 1981 to the last year 2015 but with sharp decrease in 2008 with 30.5ºC. The lowest was recorded in 1984 with 29.9 ºC and the highest in 2014 with 34.5ºC. On the the average, it however reveals a general increase in the average maximum temperature in Zaria with a positive correlation of R^2 value (0.0485).

Trend in average temperature of Zaria Zone

Figure 4.11 shows the graphical representation of average temperature pattern in Zaria between the periods of 1981-2015.

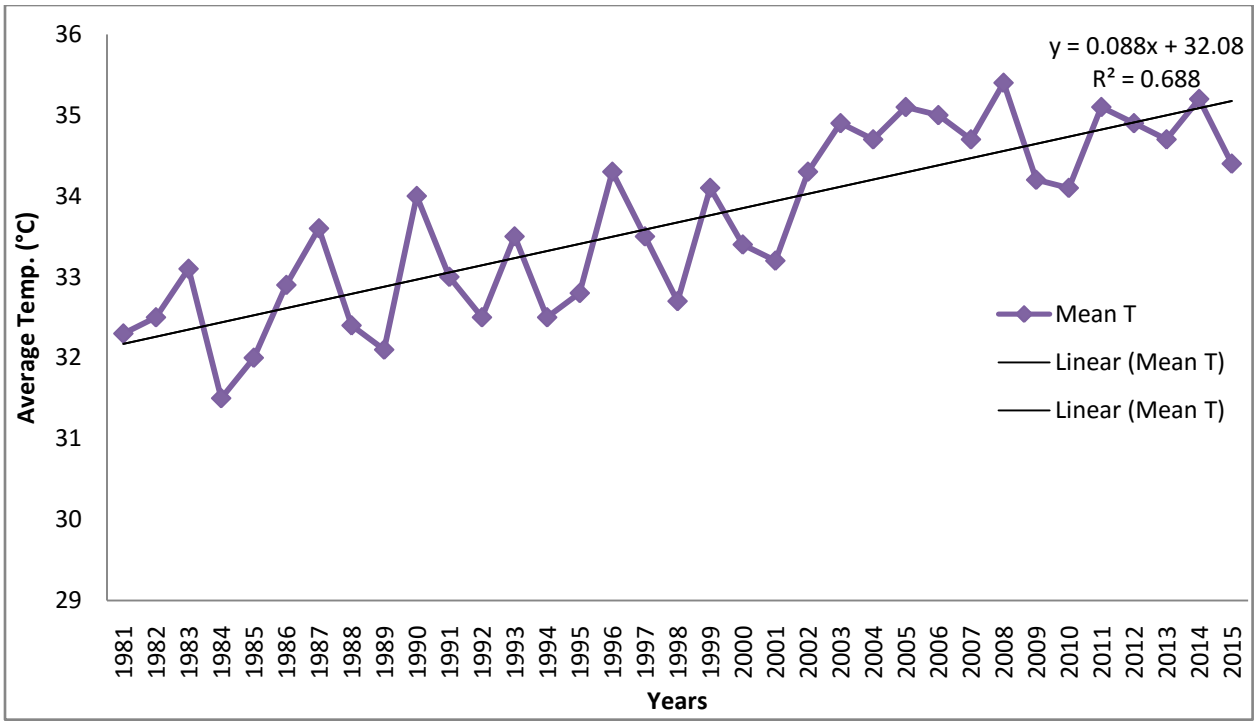

Figure 4.11: Trend of Average Temperature in Zaria Zone
Source: Fieldwork (2017)

The average temperature of Zaria revealed a fluctuating pattern. The least temperature was recorded in 1984 with 31.5 ºC and the highest was in the 2008 (35.4ºC). Figure 4.10 further revealed that generally the average daily temperature of Zaria area was on the increase with an R^2 value (0.688) across the years under review.

4.2.4 Temperature Characteristics and Variation across the Zones

Table 4.11 shows the variation in minimum, maximum and average temperatures in the three zones by means of ANOVA.

Table 4.11: Variation in Temperature (°C) Characteristics in the three Zones

		Mean	Minimum	Maximum	F Ratio
Minimum Temperature	Kafanchan	16.09	14.75	17.25	
	Kaduna	19.31	17.74	19.89	153.58*
	Zaria	19.02	15.98	23.28	
Maximum Temperature	Kafanchan	33.90	32.50	35.75	
	Kaduna	31.81	27.43	32.73	15.52*
	Zaria	30.58	19.21	37.13	
Daily Average Temperature	Kafanchan	24.99	24.04	25.96	
	Kaduna	25.56	23.65	26.23	2.45
	Zaria	24.80	17.59	28.47	

Source: Compiled from NIMET Record * 0.05 Significant Level

A critical examination of Table 4.11 reveals that there is a statistically significant difference in minimum and maximum temperature across the zones at 0.05 levels while variation in the average temperature across the zones indicated a significant rate of increase for the 35 years period of study in the area. This is a clear indication of increasing warming of the earth's atmosphere in the northern zone which is having the highest rate of increase in average temperature.

4.2.5 Rainfall Characteristics in Kafanchan (Northern Zone)

Table 4.12 presents rainfall characteristics in Kafanchan zone between the periods of 1981-2015.

Table 4.12: Rainfall Characteristics in Kafanchan Zone

Statistical characteristics	Jan (mm)	Feb (mm)	Mar (mm)	Apr (mm)	May (mm)	Jun (mm)	Jul (mm)	Aug (mm)	Sept (mm)	Oct (mm)	Nov (mm)	Dec (mm)	Annual (mm)
Mean	2.11	3.61	15.49	107.77	209.63	235.05	330.33	364.46	322.79	137.85	6.44	0.82	1715.14
Standard Dev	6.69	10.0	16.46	70.45	77.50	66.03	119.98	105.12	83.29	84.05	14.83	4.83	659.23
Range	26.50	40.9	59.5	388.60	290.60	250.80	474.80	481.80	317.20	375.70	56.10	28.60	2791.1
Minimum Value	0.00	0.0	0.0	4.00	69.00	141.20	174.40	170.60	144.60	11.30	0.0	0.0	715.1
MaximumValue	26.50	40.0	59.5	372.60	359.60	392.00	649.20	652.40	461.80	387.00	56.10	28.60	3485.3
Trend(mm/year)	-.056	0.102	-0.291	2.719	2.726	0.898	5.058	2.583	3.188	2.308	-0.365	0.080	18.95
Total Change (mm/35 years)	-1.96	3.57	-10.19	95.17	95.41	31.43	177.03	90.41	111.58	80.78	-12.78	2.80	663.25

Source: Author's Computation (2017)

The analysis of the characteristics in the rainfall for 35 years period of study in Kafanchan Zone reveals that there is a decrease in the amount of rainfall in January (-1.96mm), March (-10.19mm), and November (-12.78mm) while other months indicated an increase in the amount of monthly rainfall received for the period of the study (Table 4.12). The month of August recorded the highest amount of mean monthly rainfall of 364.46mm, followed by July 330.33mm and September 322.79mm. Thus, the result therefore indicates a total increase in the annual rainfall of approximately 663.25mm at the rate of 18.95mm per year.

Trend in Annual Rainfall in Kafanchan (Northern Zone)

Figure 4.12 shows the graphical representation of the annual rainfall pattern in Kafanchan zone over the years (1981-2015).

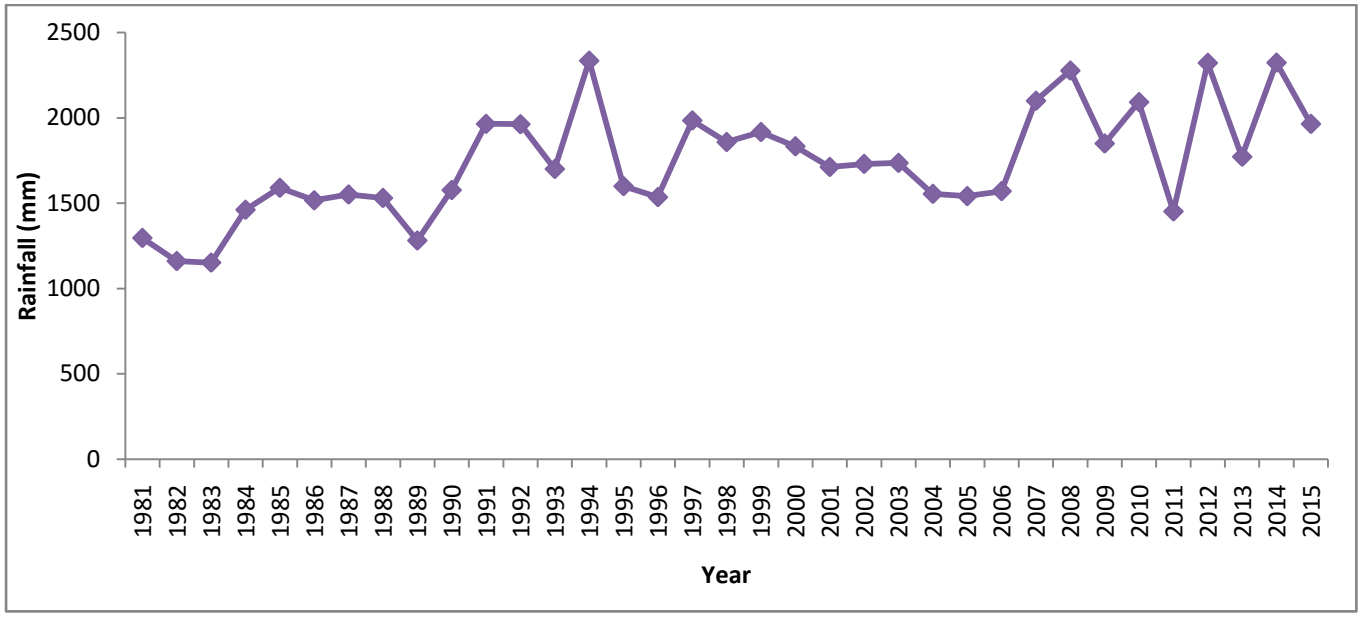

Figure 4.12: Trend of Annual Rainfall in Kafanchan Zone
Source:Fieldwork(2017)

The trend line indicated a fluctuating pattern of rainfall in Kafanchan. The lowest rainfall was recorded in year 1983 with a mean annual rainfall of 1151.5mm and highest was in 1994 with 2333.4mm. On a general note, the annual rainfall shows an increase. Even though the variation of the annual rainfall pattern indicates a fluctuating pattern from year to year, yet on the average an increase was observed.

4.2.6 Rainfall Characteristics in Kaduna Zone

Table 4.13 presents annual rainfall characteristics in Kaduna zone between the periods of 1981-2015. The analysis of rainfall for 35 years of the study in Kaduna Zone reveals that there is a decrease of rainfall in the month of January (-0.81mm) and February (-0.07mm), while other months indicates an increase in rainfall during the period of study. Also the linear trend line; revealed there was a substantial increase in the amount of rainfall received in the month of September. Thus, these indicate a total increase of approximately 230.59mm at the rate of 6.584mm per year.

Table 4.13: Rainfall Characteristics in Kaduna Zone

Statistical characteristics	Feb (mm)	Mar (mm)	Apr (mm)	May (mm)	Jun (mm)	Jul (mm)	Aug (mm)	Sept (mm)	Oct (mm)	Nov (mm)	Annual (mm)
Mean	0.42	8.02	42.53	116.02	168.56	232.18	318.51	259.22	74.27	0.04	1219.77
Standard Deviation	2.01	16.57	28.45	48.03	52.22	83.07	96.55	89.10	47.27	0.22	463.49
Range	11.80	70.50	121.50	184.90	205.60	295.30	377.90	376.20	179.10	1.30	1824.1
Minimum Value	0.0	0.0	0.00	47.90	80.90	111.30	170.90	59.80	5.70	0.0	476.5
Maximum Value	11.80	70.50	121.50	232.80	286.50	406.60	548.80	436.00	184.80	1.30	2300.6
Trend (mm/year)	-0.023	-0.002	0.151	0.608	0.060	0.583	1.554	2.708	0.947	-0.002	6.584
Total Change (mm/35 yrs)	-0.81	-0.07	5.29	21.28	2.10	20.41	54.39	94.78	33.15	0.07	230.59

Source: Author's Computation (2017)

Trend in Annual Rainfall in Kaduna Zone

Figure 4.13 shows the graphical representation of the annual rainfall pattern in Kaduna zone over the years (1981-2015).

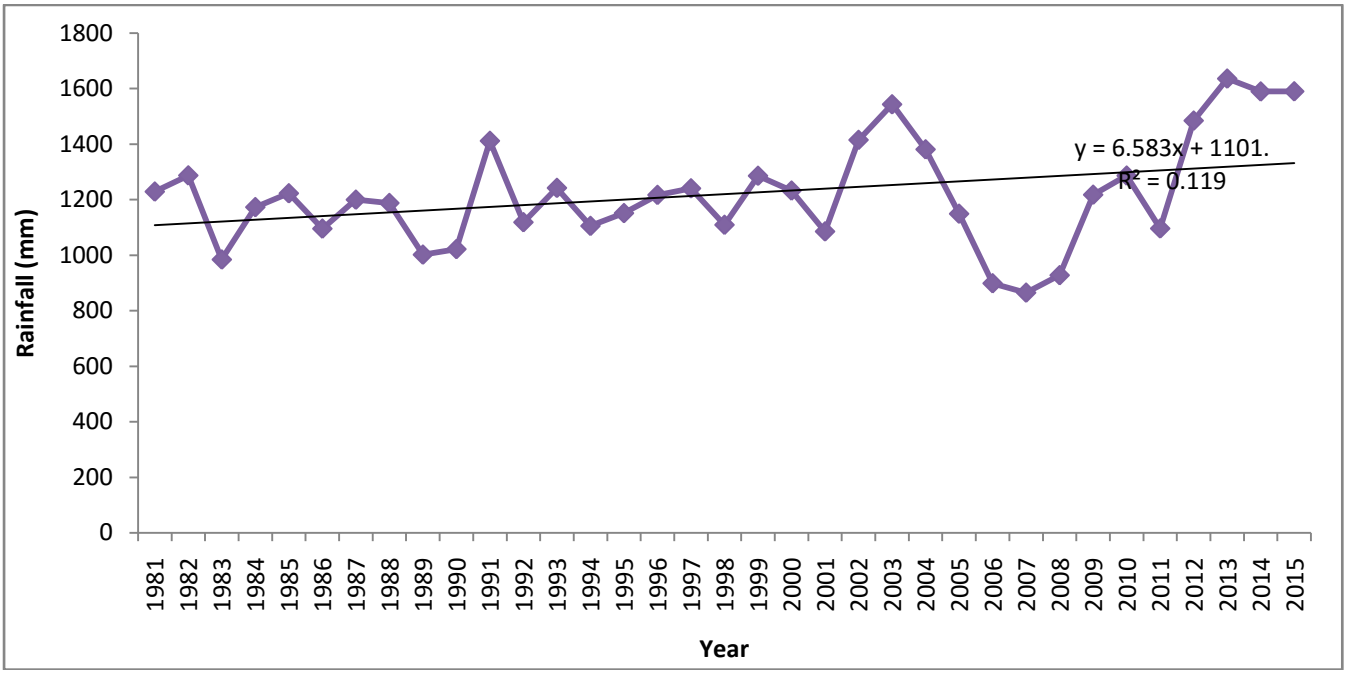

Figure 4.13: Trend of Annual Rainfall in Kaduna Zone
Source: Fieldwork (2017)

The trend line indicated a fluctuating pattern of rainfall in Kaduna across the year under review. The lowest rainfall was recorded in year 2007 with 865mm and highest was in 2013 with 1636.3mm (Figure 4.13). Also, the annual rainfall shows an increase with a correlation R^2value of 0.119. Even though the variation of the annual rainfall pattern indicates a fluctuating pattern from year to year, yet on the average an increase could be seen.

4.2.7 Rainfall Characteristics in Zaria Zone

Table 4.14 presents rainfall characteristics in Zaria zone between the periods of 1981-2015.

Table 4.14: Rainfall Characteristics in Zaria Zone

Statistical characteristics	Jan (mm)	Feb (mm)	Mar (mm)	Apr (mm)	May (mm)	Jun (mm)	Jul (mm)	Aug (mm)	Sept (mm)	Oct (mm)	Nov (mm)	Dec (mm)	Annual (mm)
Mean	0.24	0.11	6.68	33.18	107.50	136.05	226.17	300.11	177.77	49.08	0.07	0.08	1037.04
Standard Dev	1.42	0.63	15.97	27.90	66.72	46.42	56.63	82.55	75.46	43.38	0.41	0.46	417.95
Range	8.40	3.70	64.30	99.80	315.90	191.50	230.50	328.40	333.90	166.10	2.40	2.70	1747.6
Minimum Value	0.00	0.00	0.00	0.00	7.20	47.50	120.00	144.70	22.10	0.00	0.00	0.00	341.5
Maximum Valu	8.40	3.70	64.30	99.80	323.10	239.00	350.50	473.10	356.00	166.10	2.40	2.70	2089.1
Trend(mm/year)	0.038	-0.010	-0.245	0.325	-0.257	1.807	0.083	2.810	1.948	0.301	-0.004	-0.006	0.566
Total Change (mm/35 years)	1.33	-0.35	-8.58	11.38	-9.00	63.25	2.91	98.35	68.18	10.54	-0.14	-0.21	246.94

Source: Fieldwork (2017)

Table 4.14 shows a decrease in the amount of rainfall received in the month of February (-0.35mm), March (-8.58mm), May (-9.00mm), November (-0.14mm) and December (-0.21mm) while increase was recorded for the rest months during the period of the study. The highest amount of mean rainfall received is in the month of August (300.1mm) followed by July (226.17mm). Also the result indicates a total increase of approximately 246.94mm at the rate of 0.566mm yearly.

Trend in Annual Rainfall in Zaria Zone

Figure 4.14 shows the graphical representation of the annual rainfall pattern in Zaria zone over the years (1981-2015).

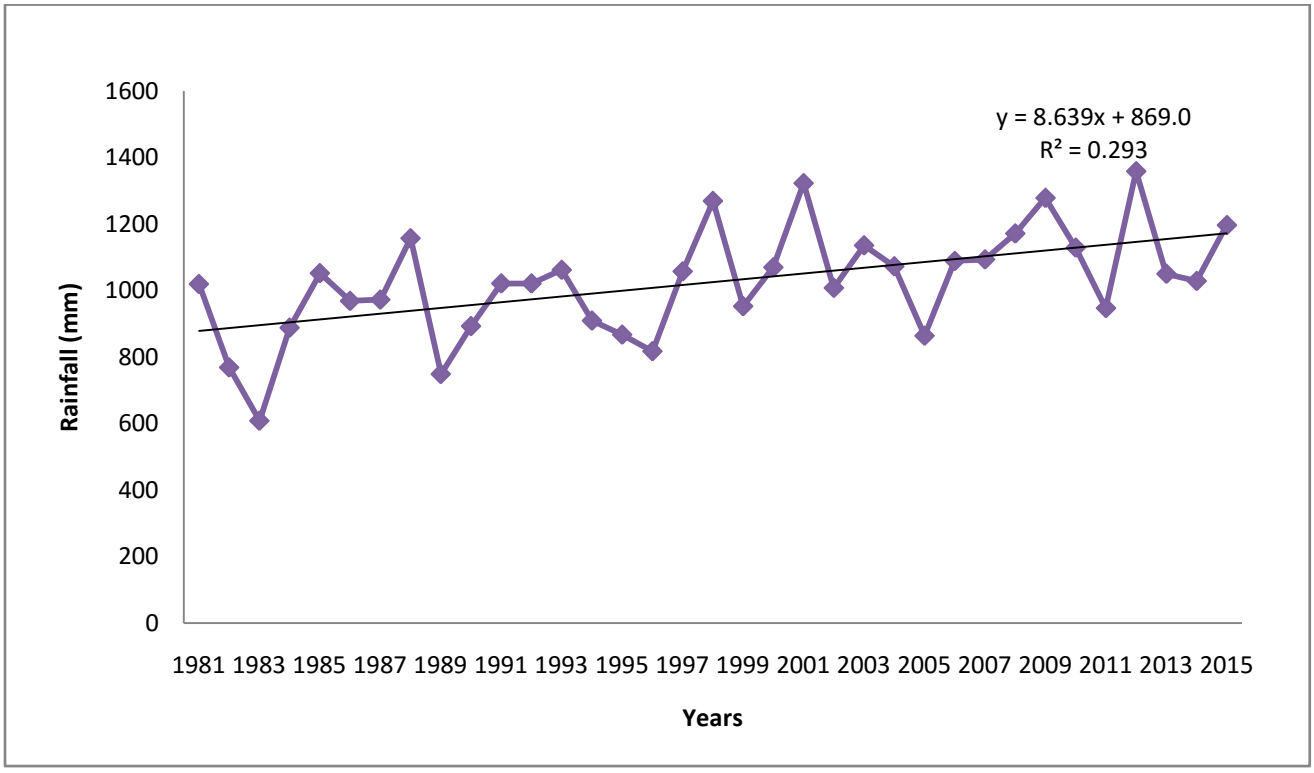

Figure 4.14: Trend of Annual Rainfall in Zaria Zone
Source: Fieldwork (2017)

Figure 4.14 indicated a fluctuating pattern of rainfall in Zaria across the years. The lowest rainfall was recorded in year 1983 with 608.2 mm and highest was in 2012 with 1358.1mm. The annual rainfall shows an increase with a correlation R^2 value of 0.293. In 1998, there was a sharp increase of the amount of annual rainfall with 1268.9mm; in 2001 there was an increase too with 1322.3mm. Though the variation of the annual rainfall pattern indicates a fluctuating pattern from year to year, yet on the average an increase is seen in the amount of rainfall.

4.2.8 Rainfall Variation across the Zones

Table 4.15 shows variation in rainfall in the three zones by means of ANOVA.

Table 4.15: Variation in Rainfall Pattern in the three Zones

Month		Mean	Minimum	Maximum	F Ratio
January	Kafanchan	2.14	0.00	26.50	3.08*
	Kaduna	0.00	0.00	0.00	
	Zaria	0.24	0.00	8.40	
February	Kafanchan	3.61	0.00	40.90	3.78*
	Kaduna	0.42	0.00	11.80	
	Zaria	0.11	0.00	3.70	
March	Kafanchan	15.49	0.00	59.50	2.96
	Kaduna	8.02	0.00	70.50	
	Zaria	6.68	0.00	64.30	
April	Kafanchan	107.77	4.00	372.60	26.46*
	Kaduna	42.53	0.00	121.50	
	Zaria	33.18	0.00	99.80	
May	Kafanchan	209.63	69.00	359.60	26.46*
	Kaduna	116.02	47.90	232.80	
	Zaria	107.50	7.20	323.10	
June	Kafanchan	235.05	141.20	392.00	28.93*
	Kaduna	168.56	80.90	286.50	
	Zaria	136.05	47.50	239.00	
July	Kafanchan	330.33	174.40	649.20	14.66*
	Kaduna	232.18	111.30	406.60	
	Zaria	226.17	120.00	350.50	
August	Kafanchan	364.46	170.60	652.40	4.24*
	Kaduna	318.51	170.90	548.80	
	Zaria	300.11	144.70	473.10	
September	Kafanchan	322.79	144.60	461.80	26.97*
	Kaduna	259.22	59.80	436.00	
	Zaria	177.77	22.10	356.00	
October	Kafanchan	137.85	11.30	387.00	19.66*
	Kaduna	74.27	5.70	184.80	
	Zaria	49.08	0.00	166.10	
November	Kafanchan	6.44	0.00	56.10	6.49*
	Kaduna	0.04	0.00	1.30	
	Zaria	0.07	0.00	2.40	
December	Kafanchan	0.82	0.00	28.60	0.91
	Kaduna	0.00	0.00	0.00	
	Zaria	0.08	0.00	2.70	
Annual	Kafanchan	144.70	95.94	194.45	84.11*
	Kaduna	101.65	72.08	136.36	
	Zaria	86.42	57.13	117.19	

Source: Source: Fieldwork (2017)* 0.05 Significant Level

Table 4.15 revealed that there is no statistical significant difference in the amount of monthly rainfall recorded in March and December across the three zones while in other months there was statistical significant difference. This is an indication of variation in climate change across the three zones in the study area.

4.2.9 Level of Awareness of Climate Change

Table 4.16 shows the respondent's awareness on climate change in the study area.

Table 4.16: Awareness of Climate Change

Response	**Kaduna North**				**Kaduna Central**				**Kaduna South**				**Total**			
	Freq		%		Freq		%		Freq		%		Freq		%	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Yes	188	159	47.1	39.8	199	197	49.8	49.4	209	166	52.4	41.6	596	522	49.8	43.6
No	13	39	3.3	9.8	1	2	0.2	0.5	5	19	1.2	4.8	19	60	1.6	5.0
Total	**201**	**198**	**50.4**	**49.6**	**200**	**199**	**50.1**	**49.9**	**214**	**185**	**53.6**	**46.4**	**615**	**582**	**51.4**	**48.6**

Source: Field work (2017)

It was observed that 94% of the respondents are aware of the climate change of which 49.8% are male and 43.6% are female, while 7% were not aware of climate change (Table 4.16). This result is similar to Farauta *et al.* (2011) that about 84% of the respondents were aware of climate change. Furthermore, the result reveals that 99% of the total numbers of respondents in Kaduna Central were aware of the climate change of which 49.8% are male and 49.4, in Kaduna South (94%) of which 52.4% are male and 41.6% are female while 87% of the respondents in Kaduna North were aware of the climate change of which 47.1% are male and 39.8% are female. This indicates that the people from the Kaduna Central were most aware of climate change with Kaduna North representing the least. It is evident that there is high climate change awareness level in the study area. This could possibly inform their available climate change adaptation strategies/practices options given the assertion of Speranza (2010) that the awareness and perception of a problem shapes action or inaction on the problem even that of climate change.

4.2.10 Source of Climate Change Awareness

Table 4.17 shows the respondent's various sources of climate change awareness in the study area which includes television, radio, mosque and church.

Table 4.17: Source of the Respondents on Climate Change Awareness

Source	Kaduna North				Kaduna Central				Kaduna South				Total			
	Freq		%		Freq		%		Freq		%		Freq		%	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Television	80	138	20.0	34.6	104	111	26.1	27.8	82	110	20.6	27.6	266	359	22.2	29.9
Radio	51	41	12.7	10.3	29	38	7.3	9.5	27	68	6.8	17.0	107	147	8.9	12.3
Newspaper/Magazines	16	6	4.0	1.5	56	33	14.0	8.3	11	3	2.7	0.7	83	42	6.9	3.5
Mosque/Church	12	22	3.0	5.5	0	0	0.0	0.0	8	21	2.0	5.3	20	43	1.7	3.5
Friends	21	5	5.3	1.2	17	8	4.2	2.0	29	7	7.2	1.7	67	21	5.6	1.7
Others	5	2	1.3	0.5	3	0	0.7	0	16	17	4.0	4.3	24	18	2.0	1.5
Total	**185**	**214**	**46.4**	**53.6**	**209**	**190**	**52.4**	**47.6**	**173**	**226**	**43.4**	**56.6**	**567**	**630**	**47.4**	**52.6**

Source: Field work (2017)

Table 4.17 reveals 52% of the respondents got to be aware of climate change through television of which 22.2% are male and 29.9% are female, followed by radio (21%) of which 8.9% are male and 12.3% are female with other sources like internet accounting for the least. This finding is similar with Isife and Ofuoku (2008), who documented that radio, has the highest audience and strength of reaching large population especially rural dwellers faster than other means of communication. This is an indication that the mass media (television, radio and newspaper) plays a major role in climate change awareness among the people. Consequently, the power of the mass media to bring about behavioural change cannot be underestimated because communication will improve perception and understanding of the activities and impacts of climate change on the people. The use of television tends to be more among the people from the Kaduna Central whereas respondents from the Kaduna North recorded the highest among radio climate change awareness source.

4.2.11 Observable Change in the Climate Perceived by the People

Table 4.18 indicates the various changes observable in the climate of the study area as perceived by the respondents. The likert scale scores of each perceived observable climate change was used to obtain the mean value and the decision point was put at 3.5. This is above average of the mean value of five plus four, plus three, plus two, plus one divided by five which is equal to three. This implies that a mean rating of less than 3.5 was regarded as not significant while 3.5 and above was regarded as significant. After which the average value of each perceived climate change across the three zones was calculated and ranked from the highest to the least.

Table 4.18: Change in Climate Observed by the People

Change	Kaduna North	Kaduna Central	Kaduna South	Average	Rank
Increase in temperature	4.54*	4.52*	4.74*	4.60*	1
Increased heat wave	3.88*	4.24*	4.21*	4.11*	2
Stronger wind/Harmattan	3.89*	4.36*	4.05*	4.10*	3
Early cessation of rains	3.78*	4.08*	3.85*	3.90*	4
Low vegetation growth	3.68*	4.13*	3.70*	3.84*	5
Disappearance of plant/animal species	3.43	3.92*	3.57*	3.64*	6
Incidences of pest infestation	3.51*	3.69*	3.66*	3.62*	7
Reduction in fuel wood supplies	3.38	3.85*	3.44	3.56*	8
More run-off causing erosion	3.22	3.70*	3.68*	3.53*	9
Reduced amount of rainfall/intensity	3.55*	3.55*	3.46	3.52*	10
Increased drought occurrence	3.22	3.74*	3.11	3.36	11
Frequent flooding incidence	3.02	3.24	3.00	3.09	12
Total	**3.59**	**3.92**	**3.71**		

Source: Field work (2017) * Significant

Table 4.18 shows that climate change was more observable in Kaduna Central given the mean score of 3.92, while respondents from Kaduna North (3.59) perceived observable climate change least. However, increase in temperature (4.60) ranked the highest observed climate change in the study area, followed by increase in heat wave (4.11) while the least observed was frequent flooding incidence (3.09). The increase in temperature as perceived by the respondents agrees with the findings of Ishaya and Abaje (2008) where 73% of the respondents believed that temperature has been on the increase in Jema'a, a similar LGA in Kaduna state. This increase in

temperature increases plant tissues and thus reduces the digestibility and rate of degradation of plant tissues although it hastens plant maturity especially in some crop species, shortens growth stages during which pods, seeds and grains can absorb photosynthetic products (IFAD, 2009).

Early cessation of rains as perceived by the respondents is supported with the result of the FGD:

> *The rain used to start in March to October with high intensity in our community before, but in the last 4 to 5 years, it starts in April and end in October or early November with the intensity being low (Koninkon, Jama'a LGA).*

The perception of the people regarding decrease in drought occurrences in the study area given its being 11th ranked agrees with Odekunle *et al.* (2008) that at present, the climate of the Sudano-Sahelian zone of Nigeria indicates a tendency towards a wetter condition rather than increasing dryness that was a feature of 1960s to 1980s periods. Linking this to the variations in temperature and rainfall from the NIMET record there is corroboration between the perception of the people and the meteorological records for only increase in temperature and not increase in rainfall given their view on early cessation of rainfall.

4.2.12 Duration of Perceived Observable Change in the Climate

Table 4.19 shows the respondents' duration of observable changes in the climate of the study area.

Table 4.19: Duration of Observable Changes in the Climate

Duration	Kaduna North		Kaduna Central		Kaduna South		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Less than 10 years	193	45.6	207	50.2	242	55.9	642	50.7
10-20 years	131	44.6	135	39.9	89	27.2	355	37.3
21-30 years	39	4.4	21	3.8	55	13.8	115	7.2
Above 30 years	36	5.4	36	6.1	13	3.1	85	4.8
Total	399	100	399	100	399	100	1197	100

As shown in Table 4.19, 51% of the respondents observed climate change less than 10 years, followed by 10-20 years (37%) with only 5% accounting for above 30 years duration of observable climate change in the study area. It can be deduced that this duration of observable changes in climate is the reflection of majority of the respondents having below 20 years length of stay in the area.

4.3 Climate Change Adaptation Strategies in the Study Area

Table 4.20 shows the various strategies adopted by the respondents in mitigating the impact of climate change in the study area. The adaptation initiatives range from traditional to modern methods which are made known to people through communities meetings with extension workers. The people's livelihoods are highly dependent on natural resources, which are climate sensitive, for crop and livestock production. Selling of livestock to augment cost of crop production is not a sustainable strategy for combating the impacts of climate change. This is because most the communities especially in the northern part of the study area rely on these animals (donkeys and cattle) as a source of draught for ploughing, conveyance of animals' dung (manure) to the farm and harvested crops from farms among others. They equally serve as source of transportation of people and goods to markets and other communities. But in a situation where these animals are sold, most of the people have to resort to manual farming especially if they do not have enough money to hire tractors or oxen for draught power (Abaje *et al*, 2014). The implication of this is the inability of food to sustain such household to the next harvesting season.

Table 4.20: Climate Change Adaptation Strategies

Strategy	Kaduna North		Kaduna Central		Kaduna South	
	Agree	Disagree	Agree	Disagree	Agree	Disagree
Early cultivation/planting	340	28	220	48	320	45
	92.4%	7.6%	82.1%	17.9%	87.7%	12.3%
Use of early maturing varieties of crops	316	28	348	6	294	44
	91.9%	8.1%	98.3%	1.7%	87.0%	13.0%
Irrigation farming	227	83	388	11	262	76
	73.2%	26.8%	97.2%	2.8%	77.5%	22.5%
Digging of wells in Fadama areas	210	123	365	26	218	86
	63.1%	36.9%	93.4%	6.6%	71.7%	28.3%
Use of soil conservation techniques like fallowing, etc.	233	48	249	69	213	88
	82.9%	17.1%	78.3%	21.7%	70.8%	29.2%
Engagement in off-farming jobs	176	98	335	17	226	79
	64.2%	35.8%	95.2%	4.8%	74.1%	25.9%
Selling of livestock in order to augment cost of crop production	230	94	352	23	241	72
	71.0%	29.0%	93.9%	6.1%	77.0%	23.0%
Praying for God to intervene	257	57	290	32	291	39
	81.8%	18.2%	90.1%	9.9%	88.2%	11.8%
Purchase of water from vendors	186	85	365	19	222	74
	68.6%	31.4%	95.1%	4.9%	75.0%	25.0%
Use of fertilizers	263	60	370	29	302	40
	81.4%	18.6%	92.7%	7.3%	88.3%	11.7%
Migrate to neighbouring town	171	113	351	42	205	105
	60.2%	39.8%	89.3%	10.7%	66.1%	33.9%
Planting of economic trees	291	48	345	48	276	52
	85.8%	14.2%	87.8%	12.2%	84.1%	15.9%
Diverging from crops production to livestock keeping	209	97	214	42	218	107
	68.3%	31.7%	83.6%	16.4%	67.1%	32.9%

Source: Field work (2017)

As presented in Table 4.20, it shows different adaptive strategies employed by the respondents in the study area to curb effects of climate change. It was observed that Kaduna Central (4.09) and Kaduna South (3.79) have more adaptation strategies to climate change. This implies that vulnerability to the impacts of climate change is expected to be high in Kaduna North. The most used adaptation strategies in the study area was the use of fertilizer given its mean score of 4.23, followed by early cultivation/planting (4.15),the respondents adopt planting early matured varieties as one of the used adaptation strategy in the area. This is in agreement with the findings

of Suleiman (2014) that predominant crops/plants grown in areas exacerbated by climate risk in Nigeria which are characterized by erratic and unreliable rainfall in the beginning and towards the end of the season in adopting early maturing varieties that could escape terminal drought cannot be overstated. While the least practiced strategy common was change from crop production to life stock keeping (3.51). This also corroborates Ishaya and Abaje (2008) findings that adaptation to climate change entailed cultivation of different/varieties of crops which are tolerant to climate change and shortening of the growing season. This suggest that despite the effect of climatic change on crops, most people in the study area still prefer to use other adaptive strategies rather than abandoning crop production to life stock keeping, hence, climate change does not result into change of livelihood sources. Among other climate change adaptation strategies identified during the FGD conducted in Koninkon ward were:

> *Wearing of thick clothes during harmattan, use of hand fans and hot water for bathing, warming of oneself beside the fire as well as relaxing under the trees.*

Water harvesting during the raining season, used of fertilizer/animals dung to improve crop yield, engaging in irrigation agriculture during dry season, planting of economic trees and drought resistant crops, planting of crop varieties with a wide range of maturity and climatic variability tolerance are sustainable adaptation strategies that should be adopted.

In terms of praying for God to intervene as adaptation strategy, a participant practicing Islam from Raminkura ward during the FGD said that:

> *Whenever there is late onset of the rainy season, or the occurrence of drought during the rainy season, or any form of weather and climate anomalies, the village leader will then call for prayers. The Muslims will pray in their mosques while the Christian pray in their churches and our prayers are always answered by Almighty Allah (God).*

Prayers for *Allah* (God) to intervene is in agreement with the findings of Farauta et al. (2011) in which 88.2% of the respondents were on the opinion that prayers is one of the major adaptation strategies of combating the impacts of climate change.

4.4 Gender Differentiation in Climate Change Adaptation Strategies

4.4.1 Gender Variation and Climate Change Adaptation Strategies

Kruskal – Wallis non-parametric inferential statistics was used to determine whether there is statistical significant variation in gender across climate change adaptation strategies as shown in Table 4.21.

Table 4.21: Gender Variation on Climate Change Adaptation Strategies

Strategy	Gender	Mean Score	Test Statistics	Remark
Early cultivation/planting	Male	4.18	1.162	Not Significant
	Female	4.12		
Use of early maturing varieties of crops	Male	3.96	2.199	Not Significant
	Female	4.02		
Irrigation farming	Male	3.90	4.908	Significant
	Female	4.01		
Digging of wells in Fadama area	Male	3.67	0.834	Not Significant
	Female	3.74		
Use of soil conservation techniques	Male	3.54	0.619	Not Significant
	Female	3.58		
Engagement in off-farming jobs	Male	3.48	19.394	Significant
	Female	3.75		
Selling of livestock in order to augment cost of crop production	Male	3.73	0.053	Not Significant
	Female	3.76		
Praying for God to intervene	Male	3.97	0.065	Not Significant
	Female	3.98		
Purchase of water from vendors	Male	3.85	0.137	Not Significant
	Female	3.92		
Use of fertilizers	Male	4.23	0.035	Not Significant
	Female	4.23		
Migrate to neighbouring town	Male	3.57	4.478	Significant
	Female	3.77		
Planting of trees	Male	4.02	3.176	Not Significant
	Female	3.93		
Change from crop to animal production	Male	3.48	0.327	Not Significant
	Female	3.54		

Source: Field Survey (2017)

As indicated in Table 4.21, there is a significant difference between the gender and irrigation farming (test result = 4.908), engagement in off-farming jobs (test result = 19.394), and migration to neighbouring town (test result = 4.478) climate change adaptation strategies only with the rest not being significant. The difference in irrigation farming agrees with Yianna and Grazia (2006) that while both women and men would prefer labour-saving mechanized agriculture, men are always responsible for irrigation whereas women are usually involved in a very labour-intensive, low-emission subsistence agriculture. Also observed was that in all the three significant climate change adaptation strategies; irrigation farming (4.01), engagement in off-farming jobs (3.75), and migration to neighbouring town (3.77) the females mean score was higher than that of the males. This is similar to the Uganda Climate Change Unit (2015) result on gender and climate change that women are most vulnerable to the impacts of climate change, notably regards food insecurity, water and fuel wood scarcity.

During the FGD, gender variation in climate change coping strategies was observed given the assertion that:

> *In times of water shortage, the women walk long distances to fetch water while the men sit at home and regarding dressing during hot weather, men could wear half clothes outside to be comfortable whereas women were not allowed to attempt such else perceived as being a prostitute (Kukui ward).*

Women in haskiya ward have changed planting dates, planting variety of crops in order to minimize the risks of crop failure and some have even gone to an extent of planting trees on their farm. While for the women farmers in Jagindi ward, it is a different story; women in Maro ward don't have enough information on climate changes, and therefore don't see the need to adopt.

However, the result shows that women and men are not helpless victims of climate change, but use various methods and strategies to adapt to climate change. Factors such as age, poverty,

ethnicity and health status interact with gender in shaping the vulnerability of females to climate change. Women tend to be more reliant on climate sensitive resources and generally have lesser adaptive capacity because of the gender nature of resource entitlement, such as access to land. This result is in agreement with Diep (2015) which opines that around the world, women and girls are most likely to be responsible for gathering water and fuel for fire for their families.

Besides, the relationships among gender, human rights, and poverty in the context of climate change adaptation have been widely studied (e.g., Denton 2004; Brody, Demetriades and Esplen 2008; Terry 2009). Within these previous studies, the commonly held fact is that women are often described as victims of gender-biased social systems. To buttress the above statement, Terry (2009) wrote there could be no climate justice without gender justice. To the researcher, culturally and financially restricted poor women and men will be affected by the climate risk unevenly and that women will be even more restricted in response to the risk.

4.5 Causal Factors of Gender Differentials

Growing evidence suggests that men and women experience climate change adaptation differently and have different priorities and ability to respond to negative climate change impacts, but there are some factors responsible in way they adopt differently. Cultural patterns and social roles discriminate against women but vary from country to country. Table 4.22 shows the causal factors of gender differentials to climate change adaptation in the study area.

Table 4.22: Causal Factors of Gender Differentials to Climate Change Adaptation

Factors	Gender	Mean Score	Test Statistics	Remark
Age	Male	3.81	1.112	Not Significant
	Female	3.72		
Religion	Male	4.11	9.193	Significant
	Female	4.04		
Culture	Male	3.89	6.807	Significant
	Female	4.02		
Social status	Male	4.76	0.762	Not Significant
	Female	3.47		
Access to information	Male	3.45	0.906	Not Significant
	Female	3.85		
Empowerment to decision making	Male	3.78	1.794	Not Significant
	Female	3.89		
Economic roles	Male	3.48	0.064	Not Significant
	Female	3.64		
Gender differences to property rights	Male	3.89	0.258	Not Significant
	Female	3.92		
Physiological differences	Male	3.39	0.731	Not Significant
	Female	4.92		
Gender specific identities in the society	Male	3.32	0.039	Not Significant
	Female	3.33		
Lack of employment	Male	3.87	1.047	Not Significant
	Female	3.57		
Level of education	Male	3.98	7.073	Significant
	Female	4.73		
Occupation	Male	3.11	0.438	Not Significant
	Female	3.77		
Health status	Male	3.55	2.559	Not Significant
	Female	3.97		
Poverty	Male	4.09	8.028	Significant
	Female	4.00		

Source: Field Survey (2017)

As indicated in Table 4.22, it showed that many women had considerably less access than men to critical information on weather alerts and cropping patterns, also, Less access to information has

weakened women's capacity to respond effectively to climate change adaptation and, consequently, women appear to be less adaptive to climate-smart agriculture because of less access to resources such as financing, even though not too significant it agreed with the work of Jost *et al.* 2015.

It was observed that there are four major causal factor of gender differentials to climate change adaptation among others that are more significant in the study area as indicated in the table; Religion (9.13), Poverty (8.03), level of education (7.08) and culture (6.81) the females mean score was higher than that of the males. This is in agreement with the work of Gurung *et al* (2006) that women are often more vulnerable than men to climate change adaptation because they have less education than men and are often refused property rights. Also, women have fewer employment opportunities. Again, result on gender and climate change adaptation revealed that women are most vulnerable to the impacts of climate change adaptation, notably regards to food insecurity, water and fuel wood scarcity.

The findings also indicated that social differences between gender lines like age, household types, income, education and employment status amongst other social variables produce differentiated vulnerabilities and potential opportunities towards gender differentials to climate adaptation.

4.6 Challenges of Climate Change Adaptation Strategies

Table 4.23 shows the challenges experienced by the respondents in adopting a climate change adaptation strategy in the study area. These challenges greatly undermined the efforts of the

respondents to quickly adapt to climate change. This also increased their degree of susceptibility to the effects of climate change in the area.

Table 4.23: Challenges affecting Climate Change Adaptation Strategies

Challenges	Frequency Agreed		% Agreed		Ranking
	M	F	M	F	
Lack of capital and improved seeds/crop varieties	542	474	45.3	39.6	1
Lack of awareness/knowledge about adaptation measures	366	627	30.6	52.4	2
Poor government attention to climate change problems	491	477	41.0	39.9	3
None availability of credit	564	384	47.1	32.1	4
Absence of government policy on climate change	614	317	51.3	26.5	5
Irregularities of extension services	472	458	39.4	38.3	6
Access to fertile land	431	412	36.0	34.4	7
Ineffectiveness of indigenous methods	342	458	28.6	38.3	8
No subsidies for planting materials	502	251	41.9	21.0	9
Size of the household	241	503	20.1	42.0	10
Low institutional capacity	506	235	42.3	19.6	11
Lack of water for irrigation	596	123	49.8	10.3	12
Household head being a female	263	119	22.0	9.9	13

Source: Field Survey (2017)

Table 4.23 revealed that the lack of capital and improved seeds/crop varieties (85%), lack of knowledge about adaptation measures (83%) and poor government attention to climate change problems (81%) were the major challenges of the people to climate change adaptation strategies. Also, of these three major adopted strategies, agreement was more by male in the 1st and 3rd while the 2nd was agreed mostly by the female respondents. Among the least challenges were lack of water for irrigation and household head being a female which accounted for 60% and 32% respectively. These findings agreed with the result of Ishaya and Abaje (2008) that indigenous people on Kafanchan take the issue of climate change seriously. The perceived

challenges to adoption of modern technique as adaptation strategies of climate change include, lack of capital and improved seeds, poor government attention to climate change problem, absence of government policy on climate change, none availability of credit facilities .

Women are disproportionately found in the poorest sections of society, have fewer resources to cope with climate change, and are more reliant on climate – sensitive resources such as water and fuel because of the gender division of labour. They tend to have lesser access to livelihood resources and hence more limited capacity to participate in climate change adaptation processes.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This study analyzed gender differentials in adaptation to climate change using both primary and secondary data through a combination of qualitative and quantitative methods of data collection. Trends in temperature and rainfall along a geographic transect, from the Northern part to the Southern part of the state, were analyzed for the period 1981 -2015 (35 years). Linear trend lines and standard deviation were used in determining the recent changes in both the observed temperature and rainfall data.

The nature of climate change in Kaduna was examined using time series analysis on the temperature and rainfall data and the pattern of change in their occurrence was determined while linear trend lines and trend lines equations were fitted on each pattern thus, the rate of increase or decrease was indicated by the linear trend time equation.

The results of the questionnaire administered showed that the majority were males and married. The age of the respondents varies from 50 and above with an average age of 53 years. The highest level of education for most of the respondents have acquired is secondary education. Age and level of education are important factors in terms of gender differentials and climate change adaptation in the study area. The average number of years the respondents have been living in this area is 39 years. Majority of the respondents in all the sampled LGAs agreed that temperature has increased over the last thirty years and is likely to increase in the future. In terms of rainfall, most of the respondents said that rainfall intensity is increasing. The analyzed data of both the observed temperature and rainfall showed an upward trend in the data series.

In terms of gender differentiation in climate change adaptation strategies approximately 57% of the respondents revealed that men and women respond to climate change by coping differently. The Chi-square result shows that there is a significant relationship between gender and climate change coping strategies, which implies that climate change coping strategies are gender sensitive. Gender differentiated impacts of climate variability were manifested in the unequal distribution of roles and responsibilities of men and women. The results also show that gender roles are undergoing change due to climate related impacts which are further heightened by factors such as unemployment, and poverty which forces men and women to engage in different activities leading to new roles. Causal factors of gender differentials in climate change adaptation strategies were identified as level of education, occupation, religion, culture, health, poverty, age, among others. Challenges of climate change adaptation strategies in relation to gender differentials include poor government attention to climate change with a mean of (4.36) which ranked 1st, followed by poor knowledge of adaptation measures (4.29), absence of government policies on climate change (4.20), Lack of capital and improved seeds/crop varieties (4.19), lack of access to fertile land (4.02), None availability of credit facilities (3.94) and Irregular extension services (3.88) whereas female house-hold headship (2.66) has the least effect. The study revealed that although climate change creates hardships for both gender, however, it affects men and women differently. These climate change gender differentials exist and persist in proportion to the severity of climate change disasters and depend on the relative socio-economic status of men and women. Thus, where women have very low social economic and political status, for instance, the effects of climate change would be high on the female gender.

Given that men and women are poverty stricken with dependency on agriculture and natural resources for their livelihoods, climate change poses a risk for them. Results reveal that through socially constructed roles and responsibilities, women seem to bear the most burdens resulting from climate variability impacts. Women's burdens were more evident in their response to the impacts of climate variability. Women were found to have extra workloads when faced with climatic stress as they made efforts to cope with them

5.2 Conclusion

The result of analysis of the observed climatic data showed that the frequency of climate change is increasing both in terms of extreme weather events and gradual changes in climate. Majority of the respondents have a good knowledge of changes in climatic conditions. Also, most of the respondents and participants during the FGDs in all the LGAs and KIS perceived that rainfall pattern has now become more erratic.

Findings showed that climate change was more observable in Kaduna Central, while respondents from Kaduna North perceived observable climate change least. However, increase in temperature ranked the highest observed climate change in the study area, followed by increase in heat wave while the least observed was frequent flooding incidence. Approximately 73% of the respondents believed that temperature has been on the increase throughout the state. These increases in temperature increases plant tissues and thus reduce the digestibility and rate of degradation of plant tissues although it hastens plant maturity especially in some crop species.

The results also show the various strategies adopted by the respondents in mitigating the impact of climate change. The adaptation initiatives range from traditional to modern methods. The

people's livelihoods are highly dependent on natural resources, which are climate sensitive, for crop and livestock production. The people adopted different adaptive strategies employed by the respondents to curb effects of climate change. It was observed that Kaduna Central and Kaduna South have more adaptation strategies to climate change. This implies that vulnerability to the impacts of climate change is more in Kaduna North due to few adaptive strategies employed. Some of the most used adaptation strategies in the study area were the use of fertilizer, followed by early cultivation/planting, planting early matured varieties as one of the used adaptation strategy in the area. While the least practiced strategy common was change from crop production to life stock keeping.

The study revealed that many women had less access than men to critical information on weather alerts and cropping patterns, also, less access to information has weakened women's capacity to respond effectively to climate change adaptation compare to men.

It observed that Religion, Poverty, level of education, culture, lack of employment, physiological differences among others are causal factor of gender differentials to climate change adaptation Again, result on gender and climate change adaptation revealed that women are most vulnerable to the impacts of climate change adaptation, notably regards to food insecurity, water and fuel wood scarcity.

The findings also indicated that there are social differences between gender lines like age; household types, income, education and employment status amongst other social variables produce differentiated vulnerabilities and potential opportunities towards gender differentials to climate adaptation.

Findings revealed challenges experienced by the respondents in adopting a climate change adaptation strategy. These challenges greatly undermined the efforts of the respondents to quickly adapt to climate change. This also increased their degree of susceptibility to the effects of climate change in the area.

The findings revealed that lack of capital and improved seeds/crop varieties, lack of knowledge about adaptation measures, poor government attention to climate change problems, lack of water for irrigation, household head being a female, lack of capital and improved seeds, poor government attention to climate change problem, absence of government policy on climate change, none availability of credit facilities among others are some of the challenges affecting the people to adapt to climate change.

5.3 Recommendations

Based on the findings, the following recommendations are made:

Awareness programs on climate change challenges are critical in the process of enhancing people's adaptive capacities. This is because the ability to effectively respond to climate change challenges is determined by quality of information available to the people and how easily they can access it. This information, when coupled with traditional and religious beliefs of the people, may enable them able to combat the impacts of climate change. Information delivery can be done through radio and television programs and other media such as mosques (for Muslims) and churches (for Christians) to communities containing advice on sustainable coping/adaptation strategies to be adopted. Even though creating awareness is the role of everybody, it is expected that the government should take the lead.

There is need for the development of climate change policy by the government that will enhance the adaptive capacity of the people at both the state and local levels that is specifically geared toward more vulnerable areas of the state with emphasis on poverty reduction. Such policies should streamline roles and responsibilities, strategies for climate change adaptation on gender, and stakeholders' involvement in a systematic manner; and there should be regular workshops and conferences in order to provide updates on climate change issues.

Provision of irrigation facilities by the government for strategic irrigation farming, that is, making maximum effective use of River Kaduna and Gurara that cut through many Local Government Areas of the state and other areas with irrigation potentials for irrigation farming during the dry season. This will increase crop yield and the length of the growing season and, this makes possible the cultivation of greater variety of crops.

The density and distribution of meteorological, agricultural, and hydrological stations in the state is insufficient to provide adequate coverage for climate change monitoring. A wide range of data is necessary to adequately monitor climate change. These data are often not available at the density required for accurate assessments. Therefore, priority should be given to improving existing observation networks and establishing new climatological, agricultural, and hydrological stations in all the LGAs of the state and the country at large. Accurate and continuous record of data should be of utmost importance, and data need to be automated wherever possible to ensure their timely receipt.

There is need to introduce climate change and gender as a general course not only in higher institutions, but also as a subject in secondary schools. This will increase the level of general awareness of people, especially at the community level, on climate change science, gender and climate change, impacts, as well as appropriate adaptation and mitigating strategies against it.

5.4 Suggestions for Further Research

This research is a general attempt to fill some gaps in the present knowledge on gender differentials in climate change adaptation.

Findings here are indicative of the complexities in the field of gender and climate change adaptation, and signal that multidisciplinary research is needed in the State to further enhance the knowledge base on the differential climate change adaptation on gender and to understand what mechanism work best to help women and men in both rural and urban communities become more climate resilient

5.6 Contribution to Knowledge

- The study established that there are gender differentials to climate change adaptation strategies in Kaduna State.
- The result of the temperature and rainfall analysis showed an increasing trend in the study area
- This study established that climate change affects the genders in different dimensions and magnitude and validates the use of relevant adaptation measures to mitigate the variations in climate change impacts on male and female.
- The study is vital to policy makers and implementers in opening a new frontier in gender differentials and climate change adaptation for future research.

REFERENCES

Abaje, I.B. (2007). *Introduction to Soils and Vegetation*. Kafanchan: Personal Touch Productions.

Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014).Climate Variability and Change, Impacts and Adaptation Strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology; 6. (2);* Published by Canadian Center of Science and Education 103

Abaje, I. B, Sawa, B.A Iguisi, E.O, Abdulhamed A. I, (2015). Assessment of Rural Communities' Adaptive Capacity to Climate Change in Kaduna State, Nigeria. *Journal of Environment and Earth Science* www.iiste.org ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online). (5),(20), 2015.

Abaje, I.B. (2016). Assessment of Rural Communities' Perceptions, Vulnerability and Adaptation Strategies to Climate Change in Kaduna State, Nigeria. (Unpublished PhD. Thesis), Department of Geography, Ahmadu Bello University, Zaria- Nigeria

Abaje, I.B., Sawa, B.A, Iguisi, E.O and Ibrahim, A.A. (2016). Impacts of Climate Change and Adaptation Strategies in Rural Communities of Kaduna State. *Ethiopian Journal of Environmental Studies and Management.* 9 (1):97-108

Abdulkarim, B and Sarki, K.I (2013). Mitigating Climate Change Impact with Indigenous Technology in some Sahelian Communities of Northern Nigeria. *The Zaria Geographer, 20(10, 85-94.*

Abdulkarim, B., Balarabe, M. L. and Oladipo, E.O. (2013). *Building Resilience: Adaptive Strategies for Livelihoods Most at Risk to Climate Change Impacts in Desertification Prone Areas of Katsina State: Mid-Term Report;* Climate Change Research Unit, Ahmadu Bello University, Zaria, Nigeria.

Abraham F., Bamidele F.S. Adebola, A.J., and Kobe I.H. (2012). Climate Change Mitigation Activities and Determinants in the Rural Guinea Savannah of Nigeria. *Sustainable Agricultural Research,*1(2), 170-177

Adger, N. and Kelly, M. (1999). 'Social Vulnerability to Climate Change and the Architecture of Entitlements', in *Mitigations and Adaptations Strategies for Global Change,* 4, 253 – 266.

Adger, N.W. (1999). "Social Vulnerability to Climate Change and Extremes in Coastal Vietnam." *World Development* 27(2):249–269.

Adger, W.N., Huq, S., Brown, Conway, D. Hulma, M. (2003). Adaptation to Climate Change in the Developing World. *Progress in Development Studies*. 3(3), 179-195

Adger, W.N. (2006). Vulnerability. *Global Environmental Change*, 16, 268-281.

Adger, W.N. and Vincent, K. (2007)**.**Uncertainty in adaptive capacity. *External Geophysics, Climate and Environment*, 331: 399-410.

Adger, N.W., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, J. Pulwarty, B. Smit, and K. Takahashi.(2007). "Assessment of adaptation practices, options, constraints and capacity." In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson, eds. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Cambridge, UK: Cambridge University Press, pp. 717–743.

Adger, W.N. (2010). Climate Change, Human Well-Being and Insecurity. *New Political Economy*, 15(2), 275-292.

Aguilar, L. (2007)**.** Gender and Climate Change: Women as Agents of Change. *Climate Change Briefing.* The World Conservation Union (IUCN).

Aguilar, L. (2008). *Gender Perspectives on Climate Change*, 52nd Session of the Commission on the Status of Women. New York, 25 February- 7 March 2008.

Ahmed, S., and E. Fajber. (2009). Engendering Adaptation to Climate Variability in Gujarat, India. *Gender and Development* 17(1): 33–50.

Ajaero, C. K., Akukwe, T. I.and Asuoha, G.C.(2010). Climate Change Concepts and Issues. In R.N.C. Anyadike, I.A. Madu and C.K. Aaero (Eds), *Climate Change and the Nigerian Environment* (pp. 1-17. Enugu: Jamoe Publishers (Nigeria).

Akpodiogaga, P. and Odjugo O. (2010).'General Overview of Climate Change Impacts in Nigeria'.*Journal of Human Ecology*, 29 (1): 47-55

.

Alber, G. (2009). 'Reality and Perspectives of Climate Policy in Cities', in *Climate Change and the Cities of the Future: Art, Technology and Economics in the face of Climate Change* (eds) K. Hasselmann, A.R.d. Elvira and M. Welp, European Climate Forum, Potsdam

Amos, B.B.,Musa, I., Abashiya, M. and Abaje, I.B. (2015). Impacts of Cement Dust Emissions on Soils within 10km Radius in Ashaka Area, Gombe State, Nigeria. *Environment and Pollution*, 4 (1), 29-36.

Anderson. C. (2002*). 'Gender Matters: Implications for Climate Variability and Climate Change and for Disaster Management in the Pacific Islands'*. www.gencc.interconnection.org.

Anderson, C. (2009). *'Gendered dimensions of disaster risk management, natural resource management and climate change adaptation in the Pacific'*. The SPC Women in Fisheries Information Bulletin Number 20.
Accessibleat :(http://www.spc.int/Coastfish/News/WIF/WIF20/WIF20_03_Anderson.pdf)

Anyadike, R.N.C. (2009). Climate Change and Sustainable Development in Nigeria; conceptual and empirical issues. *Enugu forum policy Paper* 10. African Institute for Applied Economics, Nigeria.

Ariko, J.D, Sawa, B. A. and Ibrahim, A. A. (2014).Variability in Carbon Monoxide Concentration in Kaduna Metropolis, Nigeria. *Research Journal of Environmental and Earth Science,* 6(4), 189-190

Armstrong, J., Wilby, R. and Nicholls, R.J. (2015). *Climate Change Adaptation Frameworks: An Evaluation of Plans for Coastal, Suffolk, UK. National Hazards Earth System Science Discuss,* 3, 4059-4094. Retrieved from http://www.preventionweb.net/files/2287_CompendiumofAdaptationModelsforCC.pdf

Arya, D.(2010). Climate Change Influence on Phonological Events and Socio- Economic Status of Village Communities in Garhwal Himalaya. In P.D. Varma (Ed.), *Reflections of Climate Change Leader from the Himalayas: Case Studies Detailed* (pp.33-44). New Delhi: LEAD India.

Asuquo, E. O. (2009). Climate Change Adaptations an Area Paper. An Unpublished Ph.D Thesis Presented in the Department of Geography, University of Ibadan, Oyo State.

Audu, A. (2016). Assessment of Farmers' Adaptation Strategies to Climate Change in Parts of Yobe State, Nigeria. (Unpublished M.Sc. Thesis), Department of Geography, Ahmadu Bello University, Zaria- Nigeria.

Ayoade, J. O (1982a). Climate 1: ITD Movement and Winds. In Babour, K.M., Oguntoyinbo, J,S., Onyemelukwe, J.O.C., and Nwafor, J.C. (Eds). *Nigeria in Maps* (pp.14-15). Ibadan: Nigeria Publishers Services Ltd

Ayoade, J. O (1982b). Climate 4: Evaporation, Evapotranspiration and Humidity. In Babour, K.M., Oguntoyinbo, J,S., Onyemelukwe, J.O.C., and Nwafor, J.C. (Eds*). Nigeria in Maps* (pp.20-21). Ibadan: Nigeria Publishers Services Ltd

Ayoade J. O (2003*). Climate change*: *A synopsis of its nature, causes, effects and management.* Ibadan,Vantage Publishers Ltd .

Ayoade, J. O. (2004*). Introduction to Climatology for the Tropics*. Nigeria Spectrum Books Limited, Spectrum House, Ibadan. 297

Ayoade, J. O. (2005). *Introduction to Agro climatology* (2nd ed.). Ibaban: University Press Plc.

Babugura, A. (2005).Vulnerability to Climate Variability in Botswana 1972-2002'.PhD Dissertation. Johannesburg: University of Witwatersrand.

Babugura A. (2010). *"Gender and Climate Change: South African Case Study,* Heinrich B. Stiftung,Southern Africa. Available online at: http://www.boell.de/ecology/climate/climate-energy-South-Africa9074.html

Banda, K. and Mehlwana, M. (2005*). Equity and Gender in Climate Change*. NOVAFRICA.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M.,Osman-Elasha, B., Tabo, R., and Yanda, P. (2007). Africa. Climate Change 2007: 'Impacts, Adaptation and Vulnerability'. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry, M.L., Canziani, O.F Palutikof, J.P., vander Linden P.J., and Hanson, C.E. (Eds.). Cambridge University Press, Cambridge UK, 433-467.

Boyd, E., N. Grist, S. Juhola and V. Nelson (2009).'Exploring Development Futures in a Changing Climate: Frontiers for Development Policy and Practice. Editorial', p659674.In theme Issue: Development Futures in a Changing Climate. *Development Policy Review*.Vol.27, No. 6, November 2009, Wiley Blackwell

Boyd, E. (2002). The Noel Kempff project in Bolivia: Gender, Power, and Decision-making in Climate mitigation. *Gender and Development* 10 (2): 70–77.

Bradshaw, S. (2004**).** *Socio-economic Impacts of Natural Disasters: A Gender Analysis*. Santiago: Sustainable Development Human Settlements Division, Women and Development Unit. Series, 32. 102

Brett, W. P. (2009*). Awareness, Opinions About Global Warming Vary Worldwide.* [http://www.gallup.com/poll/117772/awareness-opinions-global-warmingvaryworldwide.aspx] Site Visited on 10/6/2014

Brody, A., Demetriades, J., and Esplen, E. (2008).Gender and Climate Change: Mapping Linkages, *A scoping study on knowledge and gaps.* Brighton: BRIDGE, University of Sussex

Bruce, A. El Ganzori, El- Shinnawi, I, Joel, B., McACarl, M.M. Muhammed, A. A Mossad, K., and Smith, C.,(2013). *Mitigation and Adaptation Strategies for Global change. B*

Buba A.D (2004). Climate Change and Water Problems in Chad Republic.*Journal of Arid Environment.*3 (2): 42-50.

Campbell, B.B., S. Mitchell, and M. Blackett. (2009). "Responding To Climate Change in Viet Nam: Opportunities for improving gender equality A policy discussion paper."

Cannon, T. (2002). *'Gender and Climate Hazards in Bangladesh'*. 10(2) 45-50. UK: Gender and Development. (http// pdfserve.informaworld.com/748777_666_741921480.pdf)

CARE,(2009). *International Climate Change Brief: Adaptation, gender and women's empowerment*. October 2009 www.careclimatechange.org.

Carr, E.R. (2008). Between structure and agency: Livelihoods and adaptation in Ghana's central region. *Global Environmental Change* 18 (4): 689–699.

Carney, D. (1998).Implementing the Sustainable Rural Livelihood Approach. In Carney, D. (Ed) *Sustainable Rural Livelihoods: What Contributions Can We Make?* (pp 83-92). Papers Presented at the Department for International Development's National Resource Advisory Conference. DFID, London

Carter, T., Parry, M., Nishioka, S., Harasawa, H. (1994). Technical Guidelines for Assessing Climate Change Impacts and Adaptations. University College London/Centre for Global Environmental Research.

Carvajal, Y, Quintero, M, and Garc'ia, M, (2008). *Women's Role in Adapting to Climate Change and variability, Advances in Geosciences* 14, 277-280, www.adv-geosci.net/ 14/277/280/

Chambers, R and Conway, G. (1992).Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Theme: *Agricultural and Rural Problems; Food Security; Environment*. Institute of Development Studies, IDS Discussion Paper No. 296

Chant, S. (2000)**.** *Female households' Headship and the Feminization of poverty: Facts, fictions and forward strategies*. London: London School of Economics, Gender Institute. New Working Paper Series Issue 9.

Christopherson R.W. (2006). *Geosystems: An Introduction to Physical Geography (6th ed.) New Jessey: Person Prentice Hall*

Cutter, S.L., Boruff, B.J. and Shirley, W.L. (2003).Social Vulnerability to Environmental hazards. *Social Science Quarterly,* 84 (2), 242- 261

Dankani, I.M. (2012). Electricity Generator Usage in Kano Walled City: The Climate Change Implication. In Iliya, M.A.,and Dankani, I.M. (Eds), *Climate Change and Sustainable Development in Nigeria*, (pp. 229- 249). Ibadan: Crown F. Publishers.

Dankelman, I. (2002). Climate Change: Learning from Gender Analysis and Women's Experiences of Organizing for Sustainable Development. *Gender and Development*, 2: 21-29.

Dankelman, I. ,A. , Khurshid, A, Wahida, B. , Gueye, Y. Diagne, F. ,Naureen and M. Rose. (2008). *Gender, Climate Change and Human Security*. Lessons from Bangladesh, Ghana and Senegal. New York: The Women's Environment and Development Organization,WEDO, New York with ABANTU for Development in Ghana, Action Aid Bangladesh and ENDA in Senegal.

Dankelman, I. (2008). *Mainstreaming gender in climate change policies: urgencies, challenges and perspectives.* Paper presented at the Third Global Congress of Women in politics and Governance on the theme of gender and climate change. The Philippines: CAPWIP.

Dankelman, I., K. Alam, W.B. Ahmed, Y.D. Gueye, N. Fatema, and R. Mensah-Kutin. (2008). *"Gender, Climate Change and Human Security Lessons from Bangladesh, Ghana and Senegal*." Available at: www.gdnonline.org/resources/WEDO_Gender_CC_Human_Security.pdf.

Dankelman, I. (2010*). Gender and climate change: an Introduction*. UK: Earthscan Publications

David, S., Thomas, G., Twyman, C., Osbahr, H.,and Hewiston, B. (2007). *Adaptation to Climate change and variability: farmer responses to intra seasonal precipitation Trends in South Africa climate change 83, 301-322.*

Daze, A., Ambrose. K. and Ehrhart, C. (2009). *Climate Vulnerability and Capacity Analysis* (1st ed.). Retrieved from http://www.careclimatechange.org.

DeeWeedt S. (2007). Climate Change coming home: Global Warming Effects on Populations, *World Watch*, 2 (3) 6-13.

Denton, F. (2002).Climate Change Vulnerability, Impacts and Adaptation: Why Gender Matter?' *Gender and Development*, 2: 10 – 20.

Denton, F. (2004). '*Gender and Climate Change: Giving the "Latecomer" a Head Start'.* Institute of Development Studies (IDS) *Bulletin*, 35(3):42-49. Brighton: IDS. (http://www.ids.ac.uk/ids/bookshop/index.html)

Department for International Development, (DFID) (2004).*The Impact of Climate Change on the Vulnerability of the Poor.* Key Sheet number 02. Retrieved from https//www.unpei.org/site/defauit/files

Deressa, T., Hassan, R. M., Alemu, T., Yesuf, M., and Ringler, C.(2008a). Analyzing the Determinants of Farmers' Choice of Adaptation Methods and Perceptrions of Climate Change in the Nile Basin of Ethiopia. *International Food Policy Research Institute (IFPRI),* (36pp). Discussion Paper 00798.

Deressa, T., Hassan, R. M., and Ringler, C.(2008b). Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States. *International Food Policy Research Institute (IFPRI),* (32pp). Discussion Paper 00806

Diop,M. (1996). A propos de la dureedela saison des pluies au Senegal. *Secheresse*, 7: 7-15. Doi: 10.1038/320602a0.

Dolan, A. H. and Walker, I. J. (2003). Understanding Vulnerability of Coastal Communities to Climate Change Related Risks. *Journal of Coastal Research*, Special Issue 39, 2004.

Doss, C. (2011)."If women hold up half the sky, how much of the world's food do they produce?" *ESA Working Paper* No. 11-04,

Eboh, E. (2009). *Implications of Climate Change for Economic Growth and Sustainable Development in Nigeria*. Enugu forum policy paper 10. African Institute for Applied Economics. Nigeria.

Elasha, B. O., Elhassan, N.G., Ahmed, H. and Zakieldin, S. (2005). Sustainable Livelihood Approach for Assessing Community Resilience to Climate Change: Case study from Sudan. *AIACC Working Paper* No, 17

Enarson, E., and M. Fordham. (2001). "From Women's Needs to Women's Rights in Disasters." *Environmental Hazards* 3(2001):133–136.

Enarson, E.,Forhergill, A.,Peek, L.(2006). *Gender and Disaster: Foundations and Directions*. Springer Science, New York.

EPA (2008).*Global Warming Resource Center: Publication.* Sea Level Rise: Sea Level Rise Report, 17A.

FAO (2007).Adaptation to climate change in agriculture, Forestry and Fisheries: Perspectives, Framework and priorities. *FAO*, Rome.08 May 2007. 153.

FAO (2011).The state of food and agriculture 2010–2011-*Women in agriculture: Closing the gender gap for development.* Rome: Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/docrep/013/i2050e/i2050e00.htm. (Accessed 17 Aug 2011)

Farauta B.K., Egbule, C.L., Idrisa Y.L., & Agu, V.C. (2011). *Farmer's perceptions of climate change and adaptation strategies in northern Nigeria: An empirical assessment*. African Technology Policy Studies Network. Research Paper No. 15. Retrieved from http://www.atpsnet.org/rps15.pdf

Federal Republic of Nigeria [FRN] (2000). National Action Program (NAP) to Combat Desertification and Mitigate the Effect of Drought. Towards the Implementation of the United Nations Convention to Combat Desertification and Mitigate the Effect of Drought in the Country

Federal Republic of Nigeria [FRN] (2003). Nigeria's First National Communication under the United Nations Framework Convention on Climate Change. The Ministry of Environment of the Federal Republic of Nigeria.

Federal Republic of Nigeria [FRN] (2010). Federal Republic of Nigeria 2006 Population and Housing Census, Priority Table Vol. III. Abuja: National Population Commission.

Ford, J. and B. Smit, (2004). A Framework for Assessing the Vulnerability of Communities in the Canadian Arctic to Risks Associated with Climate Change. *Arctic,* 57, 389-400.

Franhauser, S. (1996). *The Potential Cost of Climate Change Adaptation in Adapting to Climate Change: an International perspective.*Smith, N., Bhatti, M., Mezilin, G., Benoiff, M., Budykos Compos, M., Jallow, B. & Ridsberman, F. (eds) Springer - Verlag, New York, NY, USA, 80-96.

Fussel, H. and Klein, R.J.T. (2006). Climate Change Vulnerability Assessment: An Evolution of Conceptual Thinking. *Climatic Change*, 75, 301-329

Gallopin, G.C. (2006)**.** Linkages between vulnerability, resilience and adaptive capacity. Global *Environmental Change* 16: 293-303.

Gbetibouo, G. A., Ringler, C., and Hassan, R. (2010). Vulnerability of the South African Farming Sector to Climate Change and Variability: An Indicator Approach. *Natural Resources Forum*, 34, 175-187.

Getis A., Getis J., Bjelland, M.D. and Fellmann, J.D. (2011).*Introduction to Geography,* 13th Ed. New York: McGraw-Hill

Goh, A.H.X. (2012). *"A Literature Review of the Gender-Differentiated Impacts of Climate Change on Women's and Men's Assets and Well-Being in Developing Countries."* CAPRi Working Paper No. 106, Available at: www.capri.cgiar.org/wp/capriwp106.asp.

Government of South Ireland. (2012*). National Climate Change Adaptation Framework: Building Resilience to Climate Change. Department of the Environment, Community and Local Government.* Retrieved from
http://www.environ.ie/en/Publications/Environment/ClimateChange/FileDownLoad,32076,en.pd

Government of South Australia [GSA]. (2012*). Prospering in a Changing Climate: A Climate Change Adaptation Framework for South Australia*. Department of Environment, Water and Natural Resources. Retrieved from
http://www.sa.gov.au/_data/assets/pdf_file/0011/10901/CC_FRAMEWORK_2012_web_V3.pgf

Gurung, J.D., S. Mwanundu, A. Lubbock, M. Hartl, and I. Firmian. (2006). "Gender and Desertification: Expanding Roles for Women to Restore Dryland Areas."

Harley, T. A. (2003) 'Nice Weather for the Time of Year: The British Obsession with the Weather'. Chapter 6 in Strauss, S. and B. Orlove (2003) *Nature, Culture, Climate.* Oxford: Berg.

Hoffmann M.J. (2011). *Climate Governance at the Crossroads; Experimenting With a Gobal Response after Kyoto.* New York: Oxford University Press, Inc.

IFAD.(2009). Livestock and Climate Change Available [http:Iiwww.Ifad.Org/rikm/events/cops/papers/climate.pdf.]. 16 April 2009.

Ifeanyi-obi, C.C., Etuk, U.R. and Jike-wai, O. (2012). Climate change, effects and adaptation strategies: implication for agricultural extension system in Nigeria. *Greener Journal of Agricultural Science*. 2(2), 053-060

Igwebuike, M.N., Udoh, F.C., Ezeugwu, C.I., Oparaku, N.F. and Oparaku, O.U. (2010).Climate Change Concepts and Issues. In R.N.C. Anyadike, I.A. Madu and C.K. Ajaero (Eds), *Climate Change and the Nigerian Environment* (pp. 57-64). Enugu: Jamoe Publishers (Nigeria).

Iipinge, E.M., and Williams, M. (2000)**.***Gender and Development*. Windhoek: John Meinert Printing

Ikeme, J.(2003). Climate Change Adaptational Deficiencies in Developing Countries: The Case of Sub-Saharan Africa. *Mitigation and Adaptation Strategies for Global Change*, 8, 29-52

Ikpe, E. (2014). Adaptation to Climate change Among Grain Farmers in Goronyo Local Government Area, Sokoto State, Nigeria. (Unpublished M.Sc. Thesis), Department of Geography, Ahmadu Bello University, Zaria- Nigeria.

International Institute for Sustainable Development [IISD] (2003). Livelihoods and Climate Change: Combining Disaster Risk Reduction, Natural Resource Management and Climate Change Adaptation in a New Approach to the Reduction of Vulnerability and Poverty. A Conceptual Framework Paper Prepared by the Task Force on Climate Change, Vulnerable Communities and Adaptation

Ishaya, S. and Abaje, I.B. (2008). Indigenous People Perception on Climate Change and Adaptation Strategies in Jama'a Local Government Area of Kaduna state, Nigeria. *Journal of Geography and Regional Planning*, 1 (8), 138-143

IPCC.(2001). Summary for Policy Makers. In Climate Change 2001: *Impacts, Adaptation and vulnerability*. Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

IPCC.(2007a). Climate change (2007*). The Fourth Assessment Report (AR4). Synthesis report for* policymakers http*:* //www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf. (Access 10th August, 2009).

IPCC (2007b). *Climate Change (2007): The Physical Science Basis.* In Solomon S., Qin D., Manning M., Chen Z., Marquis M., Averyt K.B. … Miller, H.L. (Eds). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York NY, USA. Cambridge University Press

IPCC (2014a). Summary for policymakers. In Field C.B., Barros, V.R., Dokken D.J., Mach K.J., Mastrandrea M.D., Bilir, T.E., … White L.L. (Eds). *Climate Change 2014: Impacts, Adaptation and Vulnerability* (pp. 1-32). Contribution of working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2014b). Glossary. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (30pp). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

ISDR (2008). *Climate Change and Disaster Risk Reduction*. ISDR

Jamila A, Shaibu-Imodagbe E.M, Fatima M, Sa'idu A and Idris U.S (2009). *Rural-Urban Migration of the Nigerian Work Populace and Climate Change Effects on Food Supply*: A case study of Kaduna City in Northern Nigeria. Fifth Urban symposium. Available online at http://www.gcpurcm.org/../20110811110057.

Jost, C., F. Kyazze, J. Naab, S. Neelormi, J. Kinyangi, R. Zougmore, P. Aggarwal, G. Bhatta, M. Chaudhury, M.-L. Tapio-Bistrom, S. Nelson, and P. Kristjanson. (2015). "*Understanding gender dimensions of agriculture and climate change in smallholder farming communities." Climate and Development* 5529(October 2015):1–12. Available at: www.scopus.com/inward/record.url?eid=2-s2.0-84936970692&partnerID=tZOtx3y1

Kaduna State Government [KDSG] (2001).*Statistical Year Book of Kaduna State.*2001 Edition. Ministry of Economic Planning Statistics and Research Department

Kaduna State Government [KDSG] (2011).Names of Existing Wards in Kaduna State. *Ministry for Local Government, Kaduna State Government*

Kaduna State Government [KDSG]. (2012*). History: Kaduna State.* Retrieved June 9, 2013 from http://www.kadunastate.gov.ng/?q=node/96

Kaduna State Government [KDSG]. (2014*). Profile of Kaduna* State: Retrieved January 9, 2015 from htpp://www.ramalanyero.com/kaduna/

Kakota, T., D. Nyariki, D. Mkwambisi, and W. Kogi-Makau. 2011. "*Gender vulnerability to climate variability and household food insecurity." Climate and Development* 3(4):298–309. Available at: www.scopus.com/inward/record.url?eid=2-s2.0-84866872336&partnerID=tZOtx3y1.

Kane, S.M. and Shogren, J. (2000).Linking Adaptation and Mitigation. Climate Change Policy, *Climate* 45(1), 75-102.

Kasperson, R.E. and Kasperson, J.X. (2001).*Climate Change, Vulnerability and Social Justice*. Stockholm: Stockholm Environment Institute.

Kelkar, U., K.K. Narula, V.P. Sharma, and U. Chandna. (2008). "*Vulnerability and adaptation to climate variability and water stress in Uttarakh and State, India*." *Global Environmental Change* 18(4):564–574. Available at:

linkinghub.elsevier.com/retrieve/pii/S0959378008000824.

Khamis, M., T. Plush, C. S. Zelaya, (2009). '*Women's rights in climate change: using video as a tool for empowerment in Nepal' Gender & Development*. 17(1):125 — 135. (http://dx.doi.org/10.1080/13552070802697001)

Klein, P.J.T., Huq, S., Denton, F., Downing, T.E., Richels, R.G., Robinson, J.B. and Toth, F.L. (2007). Inter-Relationships between Adaptation and Mitigation. In Parry, M.L., Canziani, O.F., Palutikof, J.P., Van der Linden, P.J. and Hanson, C.E. (Eds*). Climate Change 2007: Impacts, Adaptation and Vulnerability* (pp. 745-777). Contribution of working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

Kubai.Z. (2012). Perception and Adaptation Strategies to Climate Change among Indigenous Farmers in Zangon Kataf Local Government Area, Kaduna State. Unpublished M.Sc thesis A.B.U Zaria.

Kuriakose, A. T.,Bizikova, L. and Bachofen, C. A.(2009). Assessing Vulnerability and Adaptive Capacity to Climate Risks: Methods for Investigating at Local and National Levels. Social Development Working Papers, Paper No. 116

Lambrou Y. and Grazia P. G. (2007).Gender: the Missing Component of the Response to Climate Change, Food and Agriculture Organization of the United Nations.

Lambrou, Y. and R. Lamb (2002) *Gender Perspectives on the Conventions on Biodiversity, Climate Change and Desertification*, Gender and Development Service, Rome: FAO Gender and Population Division. (http://www.fao.org/sd/dim_pe1/docs/pe1_041002d1

Lawson, G.W. (1966). *Plants in West Africa*. London: Oxford University Press

Leary, A. (2006). For Whom the Bell Tolls: *Vulnerabilities in a Changing Climate.* AIACC Working Paper No. 30, International START Secretariat, Washington District of Columbia, 31 pp.

Leduc, B. (2008). Case study: *Gender and climate change in the Hindu Kush Himalayas of Nepal*. WEDO Gender and Climate Change Workshop in Dakar, Senegal, June 2008. Available at: http://www.wedo.org/wp-content/uploads/nepalcasestudy.pdf.

Le Treut, H., Somerville, R., Cubasch, U., Ding, Y., Mauritzen, C., Mokssit, A.and Prather, M. (2007).Historical Overview of Climate Change. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H. L. Miller (Eds.), *Climate Change 2007: The Physical Science Basis* (pp. 93- 127). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom and New York, NY: Cambridge University Press. (93-127).

Lopi, B. (2004).Gender and Poverty in the Context of Human Development, Health, Education and the MDGs'. Paper presented to the Commission for Africa – Southern Africa Consultation, Lusaka. Matengu, K.M. 2003.The diffusion of Modern Technologies in Namibia. Licentiate Dissertation. University of Joensuu.

Lorraine, H. (2007). Climate Change: FAO Urges Changes to Ensure Food Security. 2000/2009. Decision News Media SAS-All Rights Reserved. 103-313

Lucon O., Urge-Vorsatx, D., Ahmed, A.Z., Akbari, H., Bertoldi, P., Cabeza, L.F.… Vilarino, M.V. (2014). Buildings. In *Climate Change 2014: Mitigation of Climate Change.* Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Mandelsohn, R, Dinar, A. and Williams L. (2006).The Distribution Impact of Climate Change on Rich and Poor Countries. *Environment and Development Economic* 11; 159-179

Masika, R. (2002). *Gender, Development and Climate Change*. UK: OXFAM Publishing.

McCurry P., (1989). A General Review of the Geology of the Precambrian to the Lower Palaezoic Rocks of Northern Nigeria. In Kogbe, C.A. (Ed).*Geology of Nigeria* 2nd Revised Edition (pp 13-37). Jos Rock View (Nigeria) Limited

Meena, R. (1992).Gender research/studies in southern Africa: An overview'. In Meena, R. (ed.) *Gender in Southern Africa: Conceptual and Theoretical Issues*. Harare: SAPES Books.

Mitchell, T., T. Tanner, and K. Lussier. (2007*). We know what we need*! South Asian women speak out on climate change adaptation. London: Action Aid International and the Institute of Development Studies. Available at: http://www.disasterwatch.net/climatechange/we-know-what-we-need.pdf. (Accessed 17 Aug 2011)

Mortimore, M. J. and Adams, W.M. (2001). Farmer Adaptation, Change and 'Crisis' in the Sahel. *Global Environmental Change*. *11*, 49-57.

Mortimore, M.J. (1970). "*Zaria and its Regions*". Department of Geography. Ahmadu Bello University, Zaria.

Moser, S.C., and A.L. Luers. (2008). *"Managing climate risks in California: the need to engage resource managers for successful adaptation to change*." *Climatic Change* 87(S1):309–322. Available at: www.scopus.com/inward/record.url?eid=2-s2.0-74349100015&partnerID=tZOtx3y1.

Mueller, E.N, Wainwright, J., Parsons, A. J. (2013). Spatial Variability of Soil and Nutrient Parameters within Grasslands and Shrublands of a Semi-arid Environment. Ecohydrology DOI: 10- 1002/eco1

Myhre G., Shindell, D. Breon, F.M. Collins, W. Fuglestvedt, J. Huang, J…Zhang, H. (2013). Anthropogenic and Natural Radiative Forcing. In Stocker, T.F., Qin D., Plattner, G.K Tignor, M. Allen, S.K Boschung, J. Nauels, A. Xia, Y. Bex, V. and Midgley, P.M. (Eds.), *Climate Change 2013: The Physical Science Basis.*Contribution of Working Group 1 to the fifth Assessment Report of the Integovernment Panel on Climate Change. United Kingdom and New York, NY: Cambridge University Press

Nasiru, I.M. (2012). The Effects of Climate Change in Nigeria. Sited at [http://environmentalsynergy.wordpress.com] visited on 23rd march 2013, permalink.

National Population Commission (1991).*Census 1991: Final Results* – Kaduna State. National Population Commission, Abuja, Nigeria.

National Population Commission (1998). *1991 Population Census of the Federal Republic of Nigeria;* Analytical Report at the National level. Published by the National Population Commission, Abuja, pp.1-5

National Population Commission (2006). *Estimated Population Figures*, National Population Figures Nigeria.

National Population Commission (2009). *Federal Government Gazette*. Lagos. Federal Government Printers.

Neefjes, K., Hai, V.M., Nelson, V., Dankelman, I, Anh, T.V and Fitzgerald, I.(2009).*Responding to Climate Change in Viet Nam: Opportunities for improving gender equality: A policy discussion paper.* Ha Noi, Vietnam: UNDP-Vietnam and Oxfam, Vietnam. (http://www.un.org.vn/index.php?option=com_docman&Itemid=266&lang=en

Neumayer, E and Plumber, T (2007). The Gendered nature of natural Disasters; The impact of Catastrophic events on the gender gap in life expectancy, 1981-2002. *Annals of the Association of American Geographers*, 97(3), 551-566

Nellemann, C., R. Verma, and L. Hislop eds.(2011). *Women at the Frontline of Climate Change: Gender Risks and Hopes* Oslo: United Nations Environment Programme, GRID-Arendal.

Nelson, V., K. Meadows, T. Cannon, J. Morton, and A. Martin. (2002*). "Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations*." *Gender & Development* 10(2):51–59. Available at: www.tandfonline.com/doi/abs/10.1080/13552070215911.

Nelson, G.C. (2002). *Food security, farming, and climate change to 2050: Scenarios, results, policy options*. Washington, D.C.: International Food Policy Research Institute. Available at http://www.ifpri.org/sites/default/files/publications/ib66.pdf. (Accessed 17 Aug 2011)

Nelson, V. and T. Stathers (2009). 'Resilience, Power, Culture and Climate: a case study from Semi-arid Tanzania and new research directions' *Oxfam Gender and Development Journal, Special Issue on Gender and Climate Change, Vol.17:1, Mar.2009. P81-94*. Also appearing in 'Climate Change and Gender Justice' (2009) ed. Geraldine Terry, Practical Action and Oxfam Publishing.

Nicholls, R. J. and Tol, R.S.J. (2006): Impacts and Responses to Sea-Level Rise: A global Analysis of the SRES Scenarios Over the 21st Century. Philos. T. *Roy. Soc*. A, 364, 1073- 1095

Nielsen, J.O., and A. Reenberg. (2010). Cultural barriers to climate change adaptation: A case Study from Northern Burkina Faso. *Global Environmental Change* 20:142-152.

Noble, I., Huq, S., Anokhin, Y., Carmin, J., Goudou, D., Lansigan, F….Wright, H. (2014). Adaptation Needs and Options. In Patt, A. and Takeuchi, K. (Eds), *Climate Change 2014: Impacts, Adaptation and Vulnerability*, (51 pp). Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom and New York, NY, USA: Cambridge University Press.

Odekunle, T.O.,Andrew, O. and Aremu, S.O. (2008). Towards a wetter sudano-sahelian ecological zone in twenty first century Nigeria. *Weather*, 63 (3).

Odjugo, P.O. (2001). Global Warming and Food Production in Mitchel, J. (ed). A Global and Regional Analysis. *Journal of Environmental Studies* vol. 2, No. 2, 85-91

Odjugo P.A.O (2007). The impacts of climate change on water resources in Nigeria: global and Regional Analysis. *Indonesia Journal Geography* 39 (1):23-44.

Odjugo, P.A.O. (2010). General Overview of Climate Change in Nigeria. *Journal of Human Ecology* 29 (1): 47-55.

Oguntoyinbo J.S. (1982). Climate 2: Precipitation (1). In Babour, C., and Abumere, S. (Eds). Africa Atlases: *Atlas of Nigeria*, (pp 60-61). Paris: Les Edition J.A.

Ogezi E.A. (2002). Geology. In Okafor, S., Osaghae, E., Ikporukpo, C., and Abumere, S. (Eds). *Africa Atlases: Atlas of Nigeria*, (pp 60-61). Paris: Les Editions J.A.

Ojo O. (1977). *The Climates of West Africa.* Ibadan: Hinemann Educational Books Ltd.

Okorie F.C. (2003). *Studies on Drought in the Sub-Sahara Region of Nigeria Using Satelite Remote Sensing and Precipitation Data*. Retrieved from http://www.mathaba.net/docs/research/nigeria-drought.html

Oladipo E.O. and Salahu S. (1993).Spatial and temporal variations in rainy days and means daily rainfall intensity in northern Nigeria. *Mausam*, 44(1), 85-95

Oladipo E.O. (1993). Some Aspects of the Spatial Characteristics of Drought in Northern Nigeria. *Natural Hazards*, 8, 171-188

Oladipo, E. O. (2010). *Towards Enhancing the Adaptive Capacity of Nigeria: A Review of the Country State of Preparedness for Climate Change Adaptation*. Heinrich Boll Foundation Nigeria. Retrieved January 09, 2012 from http;//www.boellnigeria.org/downloads/Nigeria

Olmos, S. (2001). *Vulnerability and Adaptation to Climate Change: Concepts, Issues, Assessment Methods. Climate Change Knowledge Network*. Retrieved from http://www.iisd.org/cckn/pdf/va_foundation_final.pdf

Olofin E.A. (2008). The Physical Setting. In Olofin E.A., Nabegu, A.B. and Dambazau (Eds) *Publication of the Department of Geography*, Kano State University of Science and Technology, Wudil

Ologe K.O. (1985). *An Atlas of Structural Landforms in Nigeria.* Occasional Paper No. 9. Department of Geography, Ahmadu Bello University, Zaria, Nigeria

Olsen, W.(2004). *Triangulation in Social Research: Qualitative and Quantitative Methods can really be mixed*. Retrieved January 19, 2011 from http:/ccsr.ac.uk/staff/Triangulation.pdf

Olsson, L. (2004). Desertification or Climate? Investigation Regarding the Relationship between Land and Climate in Central Sudan. Land Series in Geography, series A, 60, LUND.

Olsson, L., Opondo, M., Tschakert, P., Agrawal, A., Eriksen, S., Ma, Perch, L., and Zakieldeen, S. (2014). Livelihoods and Poverty. *Climate Change 2014: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Omolola, A. E. (2009). Climate Change and Adaptations. Staff/Post Graduate Seminar. Department of Geography University of Ibadan, 7-8.

Onubuogu and Esiobu (2014). Trend Perception and Adaptation Options of Arable Crop Farmers to Climate change in Imo State, Nigeria: A Logit Multinomial Model Approach. *World Journal of Agricultural Sciences,* 2(5): 108-122.

Orlove, B. (2009).The Past, Present and Some Possible Futures of Adaptation. In Adge W.N.;Lorenzoni, I. and O'Brien, K.L. (Eds), *Adapting to Climate Change*: Thresholds, Values, Governance. (pp. 131-164). Cambridge: Cambridge University Press

Osman-Elasha, B., Goutbi, N., Spanger-Siegfried, E., Dougherty, B., Hanafi, A., Zakieldeen,S.Sanjak, A., Atti, H. and El-hassan H. (2006). Adaptation Strategies to Increase Human Resilience against Climate Variability and Change: Lessons from the Arid Regions of Sudan. AIACC Working Paper 42, International START Secretariat, Washington, District of Columbia, pp. 42

Oxfam. 2008. "Vietnam: Climate Change, Adaptation and Poor People."

Patt, A., Daze, A. Suarez, P. (2009). Gender and Climate Change Vulnerability: What's the Problem, What's the Solution? In Ruth, M., Ibarraran, M.E.(eds) *Distributional Impacts of Climate Change and Disasters: Concepts and Cases.*

Parbring, B. (2010). 'Men in the Arctic Area Hit by Climate Change'. Oslo: Nordic Gender Institute.

Peterman, A., J. Behrman, and A.R. Quisumbing.(2011). *A review of empirical evidence on gender differences in non-land agricultural inputs, technology, and services in developing countries.* IFPRI DP 00975. Washington, D.C.: International Food Policy Research Institute. Available at: http://www.ifpri.org/sites/default/files/publications/ifpridp00975.pdf (Accessed 17 Aug 2011)

Petrie, B (2010).*Gender and Climate Change: Regional Summary*. Southern Africa: Heinrich Boll Stiftung. (http://www.boell.org.za/web/144-496.html)

Pidwirny, M. (2006).*Causes of Climate Change*. *Fundamentals of Physical Geography, 2nd Edition*. Retrieved from http://www.physicalgeography.net/fundamentals/y.html

Quinn, C.H., Ziervogel, G., Taylor, A., Takama, V., and Thomalla, F. (2011).Coping with Multiple Stresses in Rural South Africa. *Ecology and Society*, 16(3), 2.

Rayar A.J. (1996). Desertification and Soil Degradation in Arid and Semi-Arid Regions of Nigeria. *University of Maiduguri Inaugural Lecture Series No. 55.* University of Maiduguri Press, University of Maiduguri

Rodenberg, Birte (2009).*Climate Change Adaptation from a Gender Perspective: A cross Cutting Analysis of development policy instruments.* German Development Institute http://www.die-gdi.de/CMS Homepage/openwebcms3.nsf/%28ynDK _contentByKey%29/ANES- 7ZLHXG/$FILE/DP%2024.2009.pdf

Roehr, U. 2007. "Gender, climate change and adaptation. Introduction to the gender dimensions." Both Ends Briefing Paper Series

Roncoli, C, K. (2003). *The costs and risks of coping with drought: Livelihood impacts and farmers' responses in Burkina Faso*. Climate Research 19 (2): 119-132. Available at: http://www.int-res.com/articles/cr/19/c019p119.pdf. (Accessed 17 Aug 2011)

Ruhl, J.B. (2011). General Design Principles for Resilience and Adaptive Capacity in Legal Systems- With Applications to Climate Change Adaptation. *North Carolina Law Review*, Vol. 89

Sawa, B. A. and Adebayo, A. A. (2011). The Impact of Climate Change on Precipitation Effectiveness Indices in Northern Nigeria. *Research Journal of Environmental and Earth Sciences*, 3(5): 481-486

Sawa, B. A. (2002). Trend in the Temporal Variability of Occurrence of Wet and Dry Spells North of Latitude 10^0N in Nigeria. In: Iguisi, E.O (Ed). *The Zaria Geographer,* 15(1): 3441. Published by the Department of Geography, Faculty of Science, Ahmadu Bello University, Zaria

Schalatek, L. (2009*). 'Gender and Climate Finance: Double Mainstreaming for Sustainable Development',* Heinrich Böll Foundation North America, Washington, http://win. amarc.org/documents/DoubleMainstreaming_Final.pdf (last accessed 3 May 2010).

Schneider, S.H., Semenov, S., Patwardhan, A., Burton, I., Magadza, C.H.D., Oppenheimer M., Pittock, A.B., Rahman, A., Smith, J.B., Suarez, A., and Yamin, F. (2007). Assessing key vulnerabilities and the risk from climate change. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Parry M.L., Canziani, O.F., Palutikof, J.P., van der Linden P.J., & Hanson, C.E. (Eds.). Cambridge University Press, Cambridge, UK, 779 810.

Scholze, M; Knorr, Arnel, N.W, and Prentice, I. C (2006). A Climate Change Risk Analysis for World Ecosystems. *Proceedings of the National Academy of Science* 103 (53), 116-120

Scott, A.M (2010). *Global warming: Man or myth?* Available at http://www2.synysoffolk.edu /mandias/

Semenza, J.C., Hall, D.E., Wilson, D.J., Bontempo, B.D., Sailor, D.J. and George, L.A. (2008). Public Perception of Climate Change Voluntary Mitigation and Barriers to Behaviour Change. *American Journal of Preventive Medicine,* 35(5), 449-487.

Senbeta, A. F. (2009). *Climate Change Impact on Livelihood, Vulnerability and Coping Mechanisms; A Case Study of West-Arsi Zone, Ethiopia*. M.Sc. Thesis Submitted to Lund University Master's Program in Environmental Studies and Sustainability Science (LUMES), Sweden.

Sharma, R. (2010). Diversification in rural livelihood strategies: Amacro-level evidence from Jammu and Kashmir. *Working Paper 439*. Centre for Development Studies,Trivandrum, Kerala.

Skutsch M. (2002). Protocols, treaties, and action: The 'Climate Change Process' viewed through Gender spectacles. *Gender and Development*, 10 (2): 30-39.

Smit, B. and Wandel, J. (2006). Adaptation, Adaptive Capacity and Vulnerability. *Global Environmental Change*, 16, 282-292.

Smith, K. R., Woodward, A., Campbell-Lendrum, D., Chadee, D., Honda, Y., Liu, O., Sauerborn, R. (2014). Human Health: Impacts, Adaptation, and Co-Benefits. In Confalonieri, U. and Haines, A. (Eds), *Climate Change 2014: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, United Kingdom and New York, NY, USA: Cambridge University Press.

Speranza, I.C., E. Ayiemba, G. Mbeyale, E. Ludi, P. Ong'any, and D. Mwamfupe. (2010). "Strengthening policies and insti- tutions to support adaptation to climate variability and change in the drylands of East Africa." In H. Hurni and U. Wiesmann, eds. *Global change and sustainable development: A synthesis of regional experiences from research partnerships*. NCCR North-South Swiss National Centre of Competence in Research North-South, pp. 107–130.

Suleiman, U. B. (2014).Farmers Adaptation Strategies to Drought in Katsina and its environs. Unpublished M.Sc. Thesis Submitted to the School of Post Graduate studies, Ahmadu Bello University, Zaria- Nigeria.

Taylor, M., Chen, A., Rawlins, S. Heslop-Thomas, C. Amarakoon, A., Bailey, W., Chadee, Huntley, S., Rhoden, C. and Stennett, R. (2006),Adapting to Dengue Risk – what to do? AIACCWorking Paper No. 33, International Start Secretariat, Washington, District of Columbia,pp. 31.

Terry G. (2009). No Climate Justice without Gender Justice: An Overview of the issues. *Gender and Development,* 17 (1): 5-18.

Thomas, D.S.G. and Twyman, C (2005). Equity and Justice in Climate Change Adaptation amongst Natural-resource-dependent Societies. *Global Environmental Change*, 15, 115-124.

Thornton P. and Lipper L. (2014). How does climate change alter agricultural strategies to support food security? CGIAR *Research Program on Policies, Institutions, and Markets. IFPRI* Discussion Paper 01340

Tompkins, E.L., Adger, W.N., Boyd, E., Nicholson-Cole, S., Weatherhead, K. and Arnell, N. (2010). Observed Adaptation to Climate Change: UK Evidence of Transition to a Well-Adapting Society. *Global Environmental Change*, 20(40, 627-635

Tran Thi Van Anh, I. Fitzgerald, K. Neefjes, M. Parsons, V.P. Ly, A. Pham, S. Mitchell, H.T. Van Khanh, M.R. Tervonen, and S. Smith. (2008). "*Gender and Climate Change* in Viet Nam."

Udeh, L.E (2014).Assessment of Farmers' Perception and Adaptation Strategies to Climate Change in Kano State, Nigeria, Unpublished PhD thesis, Department of Geography, ABU, Zaria.

Uganda Climate Change Unit.(2015). *Uganda-Global Gender and Climate,* Alliance. www.genderclimate.org/resources/does

UNDP, (2009). *Resource Guide on Gender and Climate Change*. UNDP

UNFCCC. (2015). *The United Nations Framework Convention on Climate Change*. www.unfcc.int/.../7516.php.

UNFPA (2009) *State of world population 2009: Facing a changing world: women, population and climate.* New York: United Nations Population Fund. (http://www.unfpa.org/swp/2009/en/pdf/EN_SOWP09.pdf)

Wall, E. And Marzall, K. (2006). Adaptive Capacity for Climate Change in Canadian Rural Communities. *Local Environment*, 11 (4), 373-307

Wamukonya, N., and Rukato, H. (2001).*Climate Change Implications for Southern Africa: a Gendered Perspective*. Cape Town: Minerals and Energy Policy Centre.

Watson, E. (2006).*Gender and Natural Resources Management*. Cambridge: University of Cambridge.

WEN (Women's environmental network), (2010).*Gender and the Climate Change Agenda: The impacts of climate change on women and public policy.* UK: WEN. (http://www.wen.org.uk/wp-content/uploads/Gender-and-the-climate-change-agenda-21.pdf)

World Bank (2010*). Cities and Climate Change*. An Urgent Agenda. The international Bank for Reconstruction Development. The World Bank, Washington DC 20433

World Bank (2008). *Project Information Document*: Report No. AB3515, World Bank, Washington DC.

World Bank, (2006).*Clean Energy and Development: Towards an Investment Framework*, Annex K. World Bank, Washington, District of Columbia

Yamane, T. (1976).Sampling Method for Determining the Population Size. *International Journal for Statistical analysis. Vol.3*

Yavinsky (2012).*Effects of Climate Change on Women*. Population Reference Bureau. www.prb.org/publications/article.

Yelwa, S. A. and Dangulla, M. (2013). Impact of Climate on Nigeria Land cover during El-Nino Southern Oscillation (ENSO), Event of 1997 to 1998. *Research Journal of Applied Sciences* 8 (1): 33-41

Yohe, C. and Toh, R. (2002). Indicators for Social and Economic Coping Capacity- Moving Towards a Working Definition of Adaptive Capacity. *Global Environmental Change*, 12, 25-40

Young, G., H. Zavala, J. Wandel, B. Smit, S. Salas, E. Jimenez, M. Fiebig, R. Espinoza, H. Diaz, and J. Cepeda. (2009). "Vulnerability and adaptation in a dry land community of the Elqui Valley, Chile." *Climatic Change* 98(1-2):245–276.

Ziervogel, G. Nyong, A. Osman, B. Conde, C. Cortes, S. and Downing, T. (2006). *Climate Variability and Change: Implications for Household Food Security*. AIACC Working Paper No. 20. Retrieved July 09, 2011 from http://www.aiaccproject.org/working papers/Working%20papers/AIACC_WP_20_Ziervogel.pdf

Appendix A:

QUESTIONNAIRE

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

Dear Respondent,

I am a Ph.D student of the Department of Geography and Environmental Management, Ahmadu Bello University Zaria, carrying out a ***research on "Analysis of Gender Differentials in Adaptation to Climate Variability in Kaduna State, Nigeria***". I solicit for your cooperation to respond to the following questions by ticking [ ] at the appropriate item and where necessary, you fill in the blank spaces. All information given will be treated confidentially as the research work is only for academic purpose.

Thank you.

Name of Ward ……

Local Government Area ……

SOCIO-ECONOMIC CHARACTERISTICS OF THE PEOPLE

1. Gender: Male [ ] Female [ ]

2. Age:21-30 years [ ] 31-40 years [ ] 41-50 years [ ] 50-60 years [ ] Above 60 years [ ]

3. Marital Status: Married [ ] Single [ ] Widowed [ ] Divorced [ ]

4. Religion**:** Islam [ ] Christianity [ ] Traditional [ ] Others ……

5. Tribe/Ethnicity: Hausa/Fulani [ ] Koro [ ] Ikulu [ ] Gwari [ ] Bajju [ ] Kataf [ ] Others.

6. Occupation: Civil servant [ ] Trader/Business [ ] Farming [ ] House wife [ ] Unemployed [ ] others specify.....

7. Educational Status**:** No Formal Education [ ] Primary School [ ] Secondary School [ ] Tertiary [ ] others specify.....

8. Monthly Income: No fixed income [ ]Less than N20, 000 [ ] 20,000-39,999 [ ] 40,000-59,999 [ ] 60,000-79,999 [ ] 80,000 and Above [ ]

9. Length of Stay in this Community**:** Below 10years [ ]10-20years [ ] 21-30years [Above 30years [ ]

NATURE OF CLIMATE CHANGE

10. Have you heard about Climate Change: Yes [ ]No [ ]

11. If Yes, What is your Source of Information on Climate Change: Television [ ] Radio Newspaper/Magazines [ ] Mosque/Church [ ] Friends [ ] others …….

12. What are the indicators of Climate Change in the Community? Tick the option to indicate your Level of Agreement

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Increase in temperature					
Stronger wing/Harm tan					
Early cessation of rains					
Reduced amount of rainfall/intensity					
Frequent flooding incidence					
Increased drought occurrence					
Disappearance of plant/animal species					
Low vegetation growth					
Increased heat wave					
Reduction in fuel wood supplies					
Incidences of pest infestation					
More run-off causing erosion					

13. For how long have you observed this Climate Change in the community?

Less than 10yeras [ ] 10-20years [ ] 21-30years [ ] Above 30years [ ]

CLIMATE CHANGE ADAPTATION STRATEGIES

14. What are the current Climate Change Adaptation Strategies?

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Early cultivation/planting					
Use of early maturing varieties of crops					
Irrigation farming					
Digging of wells in Fadama areas					
Use of soil conservation techniques like fallowing, etc.					
Engagement in off-farming jobs					
Selling of livestock in order to augment cost of crop production					
Praying for God to intervene					
Purchase of water from vendors					
Use of fertilizers					
Migrate to neighboring town					
Planting of economic trees					
Diverging from crops production to livestock keeping					

GENDER DIFFERENTIAL IN CLIMATE CHANGE ADAPTATION STRATEGIES

15. Do Men and Women Cope to these Climate Changes differently**?** Yes [ ]
No [ ]

CAUSAL FACTORS OF DIFFERENTIALS IN CLIMATE CHANGE

16. If yes, mention the factors responsible for difference in climate change adaptation strategies

i)…… ii…… iii……

iv…… v ……... vi ……

vii……. Vii ……xv ……

x …….. xi ……. Xii ……..

CHALLENGES OF CLIMATE CHANGE ADAPTATION

17. What could the challenges affecting the adaptation strategies used by the people

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Lack of awareness/knowledge about adaptation measures					
None availability of credit					
Lack of capital and improved seeds/crop varieties					
Lack of water for irrigation					
Size of the household					
Irregularities of extension services					
Access to fertile land					
Poor government attention to climate change problems					
Absence of government policy on climate change					
Ineffectiveness of indigenous methods					
No subsidies for planting materials					
Low institutional capacity					
Household head being a female					

APPENDIX B

Focus group discussion guide

1 Have you being experiencing any change in climate

2 If yes, what are these changes?

3 Mention the strategies used in mitigating climate change in this community.

4 Are there difference in these adaptation strategies between the male and female

5 If yes, why

6 Mention some of the different adaptation strategies practiced by male and female in your community.

7 What are the challenges faced in adapting to climate change in your community.

8 How would you evaluate different coping mechanisms in combating disasters by men and women