ANALYSIS OF INDIGENOUS COPING STRATEGIES AGAINST CLIMATE CHANGE FOR FOOD SECURITY AMONG IRRIGATION FARMERS IN KATSINA STATE, NIGERIA.

BY

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN AGRICULTURAL EXTENSION AND RURAL SOCIOLOGY.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, FACULTY OF AGRICULTURE, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.

AUGUST, 2014

DECLARATION

I hereby declare that this thesis titled "**ANALYSIS OF INDIGENOUS COPING STRATEGIES AGAINST CLIMATE CHANGE FOR FOOD SECURITY AMONG IRRIGATION FARMERS IN KATSINA STATE, NIGERIA"** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been duly acknowledged in the text and a list of references provided.

_____ _____

Sulaiman UMAR Date

Student

CERTIFICATION

This thesis titled "**ANALYSIS OF INDIGENOUS COPING STRATEGIES AGAINST CLIMATE CHANGE FOR FOOD SECURITY AMONG IRRIGATION FARMERS IN KATSINA STATE, NIGERIA"** by Sulaiman **UMAR** meets the regulations governing the award of the Degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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This thesis is dedicated to my parents:

Alhaji Umar Sulaiman Mani and Hajia A'ishat Ma'aruf Mani.

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Sulaiman Umar.

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ABSTRACT

This study assessed the indigenous strategies employed by irrigation farmers to cope with adverse effects of climate change in Katsina State. It also related the use of those strategies on one hand and food security situation of households in the study area on the other hand. It was carried out in two out of the three zones of Katsina State Agricultural and Rural Development. A sample of 200 farmers was randomly selected from a sample frame of 1332 irrigation farmers. Structured interview and focus group discussion were employed for data collection. The data obtained were analyzed using descriptive statistics, coping strategy index and regression analyses. The study found out that farmers are aware of climate change in the study area. Important sources of information on climate change were found to be: other farmers (96%), radio (88.5%), cooperative group activities (71%), open market (63.5%), government extension agents (59.5%), soothsayers (24.5%), mobile phone (22.5%) and the internet (11.5%). Important indicators of climate change in the area include longer dry season, erratic rain pattern, severe harmattan, drought, increased pest incidence, warmer temperature, flooding and increased disease incidence in that order.Mixed cropping, changed sowing date, seed selection, animal husbandry, traditional irrigation system, afforestation, seasonal migration, change in date of harvest and use of organic manure were the most important indigenous strategies used by the respondents to cope with climate change. Coping strategy index (CSI), which is a summation of product of the score of communal usage of each coping strategy and its duration by the respondent, was computed for each household. The minimum and maximum values were 2083 and 4664 respectively, while the arithmetic mean was 3170.99 with standard deviation of 454.964.Age of respondents, total land size, total annual income and years of membership of farmers' cooperatives were found to be positively related to the use of indigenous coping strategies against climate change and significant at 1% probability. It was also established that 91.5% of the respondents complement the indigenous coping strategies with the use of modern coping strategies to cope with climate change.The study also found that the use of indigenous coping strategies against climate change positively influences the food security statuses of households at 5% level of statistical significance ($p<0.05$). Likewise, extension visit was found to be significant in influencing the food security of households in the study area. Also, the relationship was direct and at 5% level of significance. The constraints to effective use of indigenous coping strategies against climate change were identified to be: poverty (identified by 87.5% of the respondents), poor record keeping and documentation (84%), poor access to information on climate change (72%), low level of education (59.5%), uncertainty in the agricultural enterprises due to reliance on natural conditions (46.5%), land tenure system (39%) and inadequate physical and social infrastructure in the rural areas (29.5%). Capacity building and advisory services that enhance documentation and complementing the use of indigenous and modern strategies against climate change particularly in areas of information accessibility and weather prediction are recommended.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

It has been confirmed that global climate is indeed getting warmer and the effect of climate change and ozone layer depletion on the society is enormous (Intergovernmental Panel on Climate Change, 2001). Global warming leads to erratic weather conditions in most places worldwide (Fayiga and Adedoyin, 2011). The International Panel on Climate Change (IPCC), defines climate change as statistically significant variations in climate condition that persists for an extended period, typically for decades or longer. It is any change in climate, rainfall or productivity caused by natural variability and direct or indirect human activities that alter the composition of the atmosphere (IPCC, 2001; IPCC, 2007; United Nations, 1998).

A research sponsored by the International Food Policy Research Institute also shows that agriculture and human development will continue to be adversely affected by climate change (Nelson *et al.,* 2009). It further shows that populations in the developing nations, which are already vulnerable and food insecure are likely to be the worst hit and that further climatic changes pose huge challenges to food security. Hence, efforts should be geared towards improving the strategies for coping with this global phenomenon. It is increasingly realized that mitigation and adaptation (both of which constitute coping strategies) shall not be pursued independent of each other but as compliments (Nyong *et al.,* 2007).

It was also established that, climate change is not a completely new idea to Africa and Africans (Musa and Omokore, 2011a). Local populations through their indigenous knowledge systems (IKS) have developed and implemented extensive coping strategies that have enabled them reduce their vulnerability to past climate variability and change, which exceed those predicted by models of future climate change. The fact that local communities have survived till today with fast population growth rates testifies that they have developed indigenous mechanisms and strategies to cope with changes in environmental conditions such as climate. It has been recommended that community-based coping strategies to climate change should be supported as farming and climate change are location specific (Nelson *et al.* 2009).

Through irrigation, it has been possible to increase and protect harvest and grow crops that could not otherwise be cultivated under conditions of extreme drought. Irrigation also involves increased use of labour, leading to higher quality of life for farmers, increasing their income and eliminating the uncertainty that comes from variable yearly and seasonal rainfall (Oriola, 2009). According to the United Nations (2007) food security can be defined as: people having at all times, physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Having effective coping strategies against climate change are expected to enhance food security among users.

1.2 Problem Statement

Effective response of farmers to climate change means higher food security, and any increase in food security translates into more resources for the (rural) poor. These

resources, in turn, enhance their resilience to climate change (Nelson *et al.,* 2009). Unfortunately, despite their relevance in the design and implementation of sustainable development projects, farmers' indigenous knowledge and practices are rarely taken into the requisite consideration in the design and implementation of modern mitigation and adaptation strategies. Such incorporation can promote local participation in the development of sustainable, cost-effective climate change mitigation and adaptation strategies rich in local content which will improve the food security situation of the people (Nyong *et al.,* 2007).

However, inasmuch as the import of IKS is acknowledged, incorporating it into climate change concerns shall not be done at the expense of modern global scientific knowledge. Rather, both shall complement rather than compete with each other in order to achieve the best practices. Programmes and projects aimed at improving livelihood statuses including food security situations in rural communities are usually created, funded and managed by outside resources and introduced with the hope and promises of improving livelihoods. Ignoring the indigenous values and culture of the people resulted in low participation and little success of such endeavours (Woodley, 1991; Nyong and Kanaroglou, 1999).

As a result of these failures, there is a growing interest by stakeholders in the incorporation of local knowledge and traditions to increase project participation rate and provide environmentally sound approaches to development. A major constraint is that, unlike global scientific knowledge, indigenous knowledge is seldom documented in the formal ways. It is usually transmitted through informal ways such as orally which render it prone to distortion and in some cases lead to loss of veritable information. Hence, there is need to document

important aspects of indigenous knowledge and practices. Furthermore, although research is gradually recognizing the importance of IKS in developmental studies, the value of IKS in climate change has received little attention. This is despite the fact that, through continuous adjustments, rural communities have over time exhibited their competence in sustaining livelihoods in both urban and rural sectors as well as contributed to the development of the national economy (Musa and Omokore, 2011b; Nyong *et al.*, 2007). Literature has shown that one of the enormous challenges facing rural development today is how to recognize, integrate and strengthen the indigenous resource management system of rural people in Nigeria's development policy (Musa, 2006). This brings to the fore the need for climate change mitigation and adaptation efforts, especially those aimed at combating hunger, to learn from the experiences of other developmental projects by recognizing the role of the IKS. This study aimed at investigating the indigenous strategies employed by irrigation farmers in Katsina State, in response to changing climate and the implication of such measures on their food security status. Hence, the following research questions were formulated to guide this thesis:

i. what are the farmers' perceptions of climate change in the study area?
ii. what are the indigenous coping strategies against climate change employed by irrigation farmers in the study area?
iii. what are the socio-economic and institutional factors that influence the use of indigenous coping strategies in the study area?
iv. what is the level of complementing the use of indigenous with the modern coping strategies against climate change in the study area?
v. how do these coping strategies against climate change affect food security in the study area? and

vi. what are the constraints to the use of coping strategies against climate change in the study area?

1.3 Objectives of the Study

The broad objective of this study was to critically analyze the indigenous coping strategies against climate change for food security among irrigation farmers in Katsina State. Specifically, the objectives of this research were to:

i. assess the farmers' perceptions of climate change;
ii. describe the indigenous coping strategies against climate change employed by irrigation farmers;
iii. determine the socio-economic and institutional factors that influence the use of indigenous coping strategies;
iv. investigate the complementarity of the use of indigenous and modern coping strategies against climate change;
v. evaluate the influence of these coping strategies against climate change on food security; and
vi. examine the constraints to the use of coping strategies against climate change.

1.4 Justification for the Study

With the current spate of climate change, millions of children in Africa and Asia are at the risk of malnourishment by the year 2050. Hence, the need for this type of research that associates with the rural farmers and try to assess problems and solutions from their point of view is right and timely (Nelson *et al.*, 2010). IKS proved to be effective in tackling the vagaries of climate and other environmental aspects and sustaining livelihoods in

developing nations far before the advent of modern scientific knowledge (Adesiji and Obaniyi, 2012).

Research has shown that indigenous people in this region are able through adjustments to sustain livelihoods and contribute to the future development of the national economy (Musa and Omokore, 2011b). This study intends to find out and document how the indigenous people of Katsina State in sub-Saharan Africa are able to apply IKS to ensure and insure food security and survival in the face of global climatic inconsistencies. Such findings would be of relevance to governmental, inter-governmental and non-governmental agencies in designing and implementing policies, programmes and projects aimed at combating climate change and/or food insecurity and improving standards of living in rural Africa.

The importance of documenting indigenous knowledge is to widen and accelerate research, planning and development (Choudhury and De, 1993). Indigenous knowledge (IK) is readily available at little or no cost, but is universally facing the threat of extinction (Das Gupta and Saha, 2009). Hence, there is need to document and preserve indigenous knowledge and practices for the sake of future reference and improvement. The study would also contribute to existing literature by documenting indigenous coping strategies in the face of environmental adversities in the specific locations studied, opportunities for improvement and their implication for rural livelihood, thereby filling certain academic lacunae.

1.5 Hypotheses

The following null hypotheses were tested in this study:

$H_0$1: Socio-economic and institutional factors do not influence the use of indigenous coping strategies.

$H_0$2: Use of indigenous coping strategies against climate change does not have significant effect on food security status of irrigation farmers.

CHAPTER TWO

LITERATURE REVIEW

2.1 An Overview of Irrigation Agriculture in Nigeria:

Nigeria is located in the tropical zone of West Africa between latitudes 4°N and 14°N and longitudes 2°2'E and 14°30'E and has a total area of 923 770 km2. The climate is semi-arid in the north and humid in the south. Except for an ultrahumid strip along the coast with rainfall averages of over 2000 mm/year, where it rains almost all year round, rainfall patterns are marked by distinct wet and dry seasons. Rainfall is concentrated in the period June-September. Problems associated with total annual precipitation range from deficiency in the north to distribution in time and space and the low dependability of rainfall in most other areas (AQUASTAT, 2005). Hence, the need to supplement rainfall with artificial application of water in agricultural production arises. Furthermore, Nigeria is listed by FAO among those nations that are at the moment technically unable to meet their food needs from rainfed production at a low level of inputs and appear likely to remain so even at intermediate levels of inputs at some points between 2000 and 2025 (FAO, 2000).

According to AQUASTAT (2005) farming systems are mainly smallholder-based and agricultural landholdings are scattered. Total cultivable area is estimated at 61 million ha, which is 66% of the total area of the country. However, in 2002, the cultivated area was 33 million ha, of which arable land covered 30.2 million ha and permanent crops 2.8 million ha. About two-thirds of the cropped area is in the north, with the rest about equally distributed between the Middle Belt and the south. Total irrigation potential in Nigeria is estimated at about 2.1 million ha, of which about 1.6 million is from surface water and 0.5

million ha from groundwater. Nigeria is well drained with a close network of rivers and streams. Some of these, particularly the smaller ones in the north, are seasonal.

There are four principal surface water basins in Nigeria. These are: The Niger Basin with an area of 584,193 km^2 within the country, which is 63 percent of the total area of the country; the Lake Chad Basin in the northeast with an area of 179,282 km^2, or 20 percent of the total area of the country; the south-western littoral basins have an area of 101,802 km^2, which is 11 percent of the total area of the country; and the south-eastern littoral basins, with the major watercourses being the Cross and Imo Rivers, have an area of 58,493 km^2, which is 6 percent of the total area of the country. Also, Nigeria has extensive groundwater resources, located in recognized hydrogeological areas together with local groundwater in shallow alluvial (fadama) aquifers adjacent to major rivers (AQUASTAT, 2005).

Irrigation has been defined as the application of water to the soil for the purpose of supplying moisture essential for plant growth. It is also undertaken to provide an insurance against droughts, for cooling the soil and atmosphere. It equally provides a more favourable environment for plant growth. Irrigation washes out or dilutes salts in the soil and reduces the hazards of piping and softening tillage pans (Yahaya, 2002).

2.1.1 Irrigation Strategies in Nigeria

Irrigation schemes can be public or private projects. Public irrigation in Nigeria refers to those schemes run either by River Basin Development Authorities (RBDAs) or by the States. During the oil boom of the 1970s, an investment programme in support of public irrigation was launched. The programme included the construction of large dams and

pumping stations, especially in the drier northern part of the country. By 1990, 162 dams had been constructed with a total storage capacity sufficient to irrigate 725,000 ha if developed. Many of these dams, however, were built with little or no infrastructure and the sites chosen do not always have sufficient irrigable areas close by. The schemes that were developed have not been brought into production fully or they have been implemented with inappropriate infrastructure. By 2004, only about 20 percent of the area planned for public sector irrigation had been developed and only 32 percent of the developed area was being irrigated.

According to AQUASTAT (2005), the poor utilization of the developed irrigation area in the public irrigation sector can be attributed to, but not limited to the following factors: i) the lack of a coherent irrigation subsector development policy and strategy; ii) insufficient attention to management systems; iii) inadequate funding (including poor cost recovery); iv) high capital and operating costs; v) inadequate farm support services; vi) poor operation, repair and maintenance; vii) a low level of project ownership acceptance by the direct beneficiaries; and viii) uncertain financial and economic viability.

Because of these lapses, a number of schemes have already deteriorated badly and are in urgent need of major renovation and repair, less than 20 years after their construction. Traditionally many farm families in Nigeria had cultivated small areas in fadamas during the dry season, using water manually drawn from shallow wells or streams.

Private sector irrigation in Nigeria is small-scale with the exception of two sugar estates, which operate as private companies but receive government support (but they are almost

non-existent at present; for example, of the 7,000 ha equipped for irrigation in Savannah sugar estate only 500 ha were cropped and irrigated in 2004). About two thirds of the irrigated area of the private sector is small-scale areas of commercial vegetable, horticulture and flower producing schemes around larger cities. The remaining is classified as fadama irrigation, which resulted from the National Fadama Development Project.

Yahaya (2002) presents another perspective. According to him, the commonest irrigation strategies in Nigeria include both traditional and modern irrigation technologies. Some of the traditional techniques adopted in many farm sites especially in northern parts of Nigeria include: shadoof, pump, gravity or natural flow and calabash/bucket methods. These are generally referred to as small-scale irrigation enterprises covering small land area and with less sophisticated irrigation equipment. Under the traditional system, water sources for this system are mainly residual soil moisture, locally dug shallow wells, ponds and other depressions. There is virtually no government or any external organization's assistance and interference. The system is usually under local people in response to their wishes and felt needs. The Fadama concept is an age-old tradition in Hausa land, where Fadama land is flooded on seasonal basis and valley bottom, which allows for the growth of a variety of crops under small scale irrigation farming system. While the Fadama irrigation concept emerged in one of the World Bank assisted programmes with the launching of the National Fadama Development Programmes (NFDP) in the early nineties. On the other hand, modern irrigation systems in agriculture depend on damming major streams to store and control the flow of water and to allow delivery in the desired amount whenever it's needed. Examples of modern irrigation in general use are surface irrigation, border or drip

irrigation; corrugation and sprinkler irrigation (Cox and Akin 1979). In another dimension, the modern irrigation types are further divided into two:

i. Large-scale (gravity flow irrigation) by which dams or water diversion structures and channels are built to transfer water to the field. This is very common in the dry belt of northern Nigeria and the

ii. Pump irrigation, by which water is pumped either from the groundwater or surface water sources to farm layout.

The existing water lifting options for small-scale basin irrigation in the northern States of Nigeria were found to be:

(i) Manual lifting from an open well using a calabash or similar container to irrigate 0.01-0.05 ha. Resource poor farmers with very small land holdings and limited water supplies use this option.

(ii) Manual lifting with a mechanical advantage using a *Shadouf* (a traditional water raising technology consisting of a suspended pivoting pole with a calabash on one end and a counter weight on the other) or treadle pump to irrigate 0.05-0.1 ha. The use of Shadoufs is declining with the introduction of small-motorized pumps. Treadle pumps are little known and in general not liked by both men and women. Costs for a pump and well are estimated at US$5-20 for the Shadouf and US$70 for the treadle pump.

(iii) Fully mechanized lifting using 3.5-5.5 HP petrol motors driving small centrifugal pumps. Irrigated areas are 0.5-1.5 ha, and costs are between US$500-700 for a motor, pump and well, depending on the water source. Extraction from a river is the cheapest and from a tubule the most expensive option. Before the 1980s, water

sources were mostly rivers or open wells in fadamas. Today, washbores and tubewells are most common in fadamas.

(iv) Single-cylinder water-cooled diesel motor driving a pump and extracting from a tubewell in a fadama or in alluvial plains. Irrigated areas are 0.5-2.0 ha, and costs for a motor, pump and well are about US$950. This technology is not widely found and usually installed by well-off farmers for multipurpose use. A problem is that diesel is difficult to buy in rural areas, while petrol is always available.

2.1.2 Socio-Economic Importance of Irrigation:

According to Food and Agricultural Organization (FAO), irrigation has put smiles in the face of many people in semi arid and arid regions where crop production without irrigation is inevitable. For instance, in Egypt, 80% of the food requirement comes from irrigated lands (FAO, 1988). Through the introduction of irrigation, it has been possible to increase and protect harvest and grow crops that could not otherwise be cultivated under conditions of extreme drought. Irrigation also involves increased use of labour, leading to higher quality of life for farmers, increasing their income and eliminating the uncertainty that comes from variable yearly and seasonal rainfall (Oriola, 2009). The impact of irrigation is felt mainly with regard to specific crops such as wheat, sugar cane, rice and vegetables. Other irrigated crops include rice, potatoes, cotton, cowpeas, oil palm, citrus fruits, cocoa, rubber, taro and cashew nuts. The crop with the highest increase in net return resulting from irrigation is sugar cane, due to a four-fold per hectare yield increase. Next are onions and tomatoes, the least profitable crops being rice and wheat (AQUASTAT, 2005).

Dry-season farming on fadama lands has two main advantages for rural farmers:

- Fadama cultivation in the dry and wet season in addition to wet season upland farming allows crop diversification so that if one crop fails other crops will ensure food security;
- The income realized from dry-season cash crops improves household economics allowing investments for improving productivity and provides money to buy food in the event of crop failure.

According to Norman (1996) some of the benefits of indigenous irrigation schemes as follows:

i. Increasing the range of choice of crops and of livestock, thus providing flexibility in decision-making;
ii. Focusing more complete and efficient resource use;
iii. Lessening the danger of crop failure and the range of yield fluctuations, hence reducing uncertainties;
iv. Increasing the capacity of the land for input of other factors;
v. Increasing the size of total farm business; and
vi. Shifting the factor- product curves towards higher input and greater production.

2.1.3 Irrigation and the Environment:

In the past, no serious attention was paid to environmental considerations in the planning and implementation of water resources development projects, resulting in environmental damage. Hydrology downstream from dams and major diversions and pumping stations has been modified, especially in the north. Extensive areas of fadama, fisheries and wildlife

habitats were wiped out. The Hadejia Nguru Wetlands in the northeast of the country receive their water from the Hadejia and Jama'are Rivers, which meet to form the Komadougou Yobe River, flowing northeast into Lake Chad. So far, more than half of the wetlands have been lost due to drought and upstream dams (AQUASTAT, 2005).

Dams have environmental implications of serving as buffering controls. Excess water is reserved, which could otherwise cause flooding. This water is used for irrigation, animal husbandry and urban and semi-urban water supply especially in the dry season. Irrigation modifies the microclimate of areas where it is practised and reduces the effect of global warming. This is apart from its being a coping strategy by supplying more of the much required food in vulnerable areas thereby cushioning the negative impacts (Nelson, *et al.*, 2010).

2.2 Climate Change:

Climate is the long term average weather conditions of a region while weather refers to the daily fluctuating state of the atmosphere (Onwualu and Ogunwusi, 2012). The main elements of weather are temperature, rainfall, dew, humidity, mist, sunshine, clouds and haze. The International Panel on Climate Change (IPCC), defines climate change as statistically significant variations in climate condition that persists for an extended period, typically for decades or longer. It is any change in climate, rainfall or productivity caused by natural variability and direct or indirect human activities that alter the composition of the atmosphere (IPCC, 2001; IPCC, 2007; United Nations, 1998).

Climate change is as a result of global warming which is caused by green house effect (increase in greenhouse gases – these are notably carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), Ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphurhexafluoride (SF_6) and water vapor (H_2O)); variations in earth's orbital characteristics (example: solar output, earth-sun geometry and interstellar dust); and volcanic eruptions - which invariably release large amounts of sulphur dioxide into the atmosphere (Ibe, 2011). Other contributory factors to global warming include some human activities like deforestation, desertification, pollution, degradation, erosion, emission of greenhouse gases, bush burning, oil spills, gas flaring, waste disposal and population growth (Adejo, Ibrahim and Onuche, 2010; Onumadu, 2012).

Climate change assumes the centre stage in development research due to its numerous adverse effects on humankind and the environment which are more devastating on African agriculture and hence food security (Ozor and Madukwe, 2012). These effects/impacts range from drought events to flooding events, sea level rise, drying of rivers and streams, decrease in water quality, melting of glaciers, loss of biodiversity, changes in rainfall pattern and amounts, increases in temperature, more frequent and severe pest and diseases incidences among others. These effects have negative impacts on the economy, food security, agricultural production, health, and social statuses (conflicts and migration) of many nations especially the developing countries.

Even though it is anticipated to be the most vulnerable to and among the worst hit by climate change, Africa's contribution to global GHG emissions is relatively small: only 3.2% of the world's total carbon emissions, which is by far the most important GHG, in

1992. Its share of methane emission is also small, only 7.7% of the world's total in 1991 (Davidson, 1998). Agriculture and land use sectors dominate GHG emissions in Africa, accounting for 57%, with the energy sector accounting for 32%. Emission from gas flaring is increasing but still accounts for a very small share (Nyong *et al.,* 2007).

2.2.1 Impact of Climate Change on Nigerian Agriculture

Globally, climate change impacts are more severely felt by marginalized and resource-challenged communities (Mwangi, 2012). Climate change has serious consequences on agriculture in Nigeria, thereby affecting socioeconomic activities, environment and livelihood patterns of farmers in particular and Nigerians in general. Rainfall, being the most critical aspect of climate change in Nigeria, has its amount and patterns affected by climate change (Adejuwon, 2004). This manifests in form of late onset of rain, late establishment, dry spells, excessively heavy downpours and untimely cessation. Huge spatial and temporal variations in rainfall result in flooding, drought, delayed wet season and erratic rainfall.

Areas with hitherto optimum temperature experience excessive temperatures, while areas with high temperatures are further characterized by higher and unbearably excessive temperatures (Awotodunbo, 2012). Pests and diseases incidences and severity, competition for resources and biodiversity loss also increase due to climate change. All these and many other manifestations of climate change negatively affect crops, livestock and the farmer. Socioeconomically, impacts of climate change include decreasing crop and livestock yield, decreasing soil fertility and productivity, declining prices and fluctuating prices and diminishing gross domestic product (GDP) from agriculture. Far reaching consequences of

the phenomena above include food crises, worsening poverty, unemployment, social strife and unrest among others (Awotodunbo, 2012; Mwangi, 2012; and Onwualu and Ogunwusi, 2012).

2.2.2 Farmers' Perceptions of Climate Change

Perception is the process by which information or stimuli are received from the environment and transformed psychological awareness (Van den Ban and Hawkins, 2000). Farmers in northern Nigeria are found to be aware and knowledgeable of changing climatic conditions. A study in three states of the region found an overwhelming majority (84%) are aware of climate change, 79% also affirmed that they had knowledge of the changing climate, 81% of the respondents also noted that they had in various times experienced the incidence of climate change and 80.2% noted that they receive information on climate change, (Farauta, Egbule, Agwu, Idrisa and Onyekuru, 2012). It also showed that farmers' perceived manifestations of climate change include: unusual early rains that are followed by weeks of dryness, higher temperature, loss of soil fertility, reduction in farm yields, high rate of disease incidence, delay in onset of rain, less rainfall, erratic rainfall pattern, long period of dry season, no or reduced harmattan, long period of harmattan and heavy and long period of rainfall. The extreme weather events which support farmers' understanding of climate change are: desertification, heavy rainfall (which could lead to flooding), increase in atmospheric temperature and drought. These supported the findings of Hir (2010).

Another study in the southern part of the country showed that farmers perceive deforestation, bush burning, gases released from industries, use of excessive chemicals in

rice production, application of excess nitrogenous fertilizers, natural phenomena, violation of local custom and burning of firewood and farm residues (rice straws & husks) as causing adverse climate change to great extent (Nwalieji and Uzuegbunam, 2012).

However, a research by Ugwoke, Nnadi, Anaeto, Aja and Nwakwasi, (2012) claimed that although farmers are aware of climate change, they do not seem to know the cause(s). Their knowledge of climate change is mainly based on personal experience over time and information from social organizations. Elements of climate which they perceived to have changed significantly include rainfall pattern, sunlight and temperature. They seem to have perceived climate change to a fairly large extent. Perceived adverse effects of climate change include increased rainfall intensity, flooding, erosion, excessive heat and poor crop. However, it has been found from the literature that local people are aware of the changing climate and they devise their own adaptation measures based on their cultural practice and past experiences with dealing with environmental changes and natural disasters. These local knowledge and experience are used as a basis of decision making for food security, human and animal health, and resource management (Twinomugisha, 2005).

2.3 Indigenous Knowledge:

Indigenous knowledge has also been referred to as local knowledge or traditional knowledge. According to the 1989 Convention (No 169) of the International Labour Organization, indigenous peoples are defined as "peoples, who descended from the population which inhabited a country, or a geographical region to which the country belongs, at the time of conquest or colonization or the establishment of present state boundaries and who, irrespective of their legal status, retain some or all of their own social,

economic, cultural and political institutions". Indigenous knowledge, on the other hand, is a derivative of the indigenous peoples. It is the knowledge unique to a given culture or society, which has been acquired through accumulation of years of experiences of local people (Obasi, 2012). Indigenous knowledge is also acquired through informal experiments, and intimate understanding of the natural systems as stressed by climate change and socio-economic development (Srinivasan, 2002).

Indigenous peoples have over an extremely long period of time adapted their livelihoods to a wide variety of disturbances caused by environmental variability and change, in order to survive. This is more so as they rely on the environmental resources for their subsistence by way of agriculture, hunting, fishing among others. Their adaptation practices have the potential to alleviate adverse impacts and to capitalize on new opportunities brought about by the change. Therefore, it is advisable to include in any climate discourse, the indigenous peoples. This would enhance investigation, documentation, and dissemination of traditional adaptation strategies to climate change globally (Minard, 2010).

2.3.1 Indigenous Coping Strategies:

African regions are characterized by recurrent environmental mishaps such as flooding, epidemics and drought, the magnitude and intensity of which have been on the increase over the last 100 years and consequently in the destruction caused by it. The fact that the communities in this region have survived till today with a fast population growth rate is an indication that they have developed indigenous mechanisms and strategies to cope with these mishaps. Some of these actions combine elements of mitigation and adaptation (Nyong *et al.,* 2007). Until recently, mitigation and adaptation considered to be two

mutually exclusive strategies. However, strong linkages are found to exist between the two and it is increasingly realized that integration of both strategies may not only provide new opportunities, but may even be a prerequisite for the mutual success of both issues. Klein *et al.* (2003), observed that integration connects mitigation and adaptation with natural resource management, biodiversity conservation and measures to combat desertification.

2.3.1.1 Mitigation strategies: are procedures or activities that help prevent or minimize the process of climate change adaptation (Nyong *et al.,* 2007). Mitigation strategies can be grouped into two categories: those that represent mainly technological solutions; and those that involve changes in economic structure, societal organization, or individual behaviour. African peoples employ mitigation strategies traditionally in form of natural resources conservation measures, but they generally serve the dual purposes of reducing the emission of GHG from anthropogenetic sources, and enhancing carbon ‘‘sink’’. Strategies aimed at reducing GHG emission emphasize cutbacks in the burning of fossil fuel through improved energy-efficiency, use of clean energy sources particularly solar and discontinuation of gas flaring. Carbon sink enhancement generally involves forestry programmes that protect the forest and encourage afforestation in marginal areas including range lands (Adesina *et al.*, 1999).

2.3.1.2 Adaptation strategies: on the other hand, are those methods that enable the individual or the community to cope with or adjust to the impacts of the climate in the local areas. Such strategies will include, among others, the adoption of efficient environmental resources management practices such as the planting of early maturing crops, adoption of hardy varieties of crops and selective keeping of livestock in areas where rainfall declined.

They also include the use of technological products that enable the individual to function in the prevailing situation (Nyong *et al.,* 2007). Ability of the people to cope with climate change determines their level of food security and livelihood generally.

2.3.1.3 Some coping strategies used by African farmers

Some of the coping strategies used by Nigerian farmers against climate change include irrigation, farm enterprise diversification, improved technologies and practices and water harvesting (Awotodunbo, 2012). Indigenous adaptive measures being used by farmers to cushion the harmful effects of climate change include: changes in planting dates, changes in harvesting dates, multiple cropping, intensive manure application, intercropping, expansion of cultivated land area, movement to different site, mixed farming and use of wetland/river valley (e.g. Fadama) (Farauta *et al.*, 2012).

Furthermore, in separate studies, the Canada-Nigeria Climate Change Capacity Development project reports (2004) and Farauta *et al.* (2012) put forward the following emerging (modern) coping measures being used by farmers: planting of early maturing crops, use of chemicals example herbicides and pesticides, increased use of fertilizers, use of resistant varieties, processing to minimize post harvest losses, and afforestation.

Another study by Adesiji and Obaniyi (2012), showed that farmers use organic fertilizers, use of some plants to control pests, traditional erosion control, changing crop cycle, use of inorganic fertilizer, use of flood resistant rice. Planting maize, fruits and vegetables in mountain region have changed their cropping patterns to suit the climate as well as keep up with demand. Farmers have avoided planting crops that are easily damaged by water in

areas prone to flooding. On the other hand, farmers in the mountain region are taking advantage of higher temperature and are trying crops like corn and vegetables. Farmers replaced rice crops with sugarcane so as to cope with uncertain rainfall. Indigenous methods to ensure protection of the environment ranges from offering prayers for good harvest to use of organic fertilizer and pesticides.

In Sierra Leone, important indigenous climate change adaptation technologies/strategies include clearing around farm lands, manual fencing of farm and setting of rodent traps, green manure application, mulching, hunting, irrigation, change of farming dates and performance of ancestral ceremony/spiritual invocation among the numerous practices that were adopted by farmers (Morlai, Mansaray and Vandy, 2011). In a Tanzanian case study, various coping strategies have been developed by the local communities. These according to Shemdoe (2011) include traditional terracing (matuta), destocking, tree planting, traditional food preservation methods, drilling traditional wells, construction of locally based water reservoirs (Nkunisa), mixed cropping and crop diversification.

2.4 Factors Influencing the Use of Indigenous Coping Strategies

Socio-economic factors were found to be effective in coping with climate change in Nasarawa state, Nigeria (Salau, Onuk and Ibrahim 2012). Factors that were highly significant include farming experiences, number of extension contacts per year, income level and type of land tenure system used. Factors that were significant were age, educational level, and amount of farm credit received. However, socioeconomic variables are also found to constrain farmers' adaptation and management of climate change. Among those perceived as serious constraints by farmers include low income level, poor

technological status, low level of education, poor access to information on climate change, unfavourable land tenure system and poor physical and social infrastructures in rural areas. Elsewhere in parts of Africa such as Tanzania, it was found that age, education/awareness and income are significant in adopting coping strategies against climate change (Shemdoe, 2011).

2.5 Food Security:

The trend of food insecurity in Nigeria is worrisome. The proportion of food insecure in Nigeria people was reported to be about 18% in 1996, over 40% in 2005 and over 65% in 2008 (Busayo, 2011, Mohammed, 2008). The World Bank Records had about 325 million people in Sub-Saharan Africa living on less than $1 per day, there is a strong belief that more or less, the entire Nigerian farmers are inclusive. Since they live below the poverty line, they are plunged into a vicious cycle of poverty, inadequate information, environmental degradation, illiteracy and, of course, hunger.

The United Nations (2007) define food security as "People having at all times, physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life". Hence, food security encompasses availability, accessibility, consumer safety and preferences and biological utilization and stability of all the factors. Clearly, food security is about much more than just how much people have to eat. Yet, having "enough" food to eat is clearly the most important outcome of being food secure, and while physiological requirements differ, people largely know whether they have "enough" or not CARE / WFP, 2003).

In this study, food security will be measured in relation to the period of time (in months) in a year within which a household has enough food in terms of availability, accessibility and utilization (food system) (Onwualu and Ogunwusi, 2012).

2.6 Theoretical Framework:

This study was based on the Ethnomethodology theory. The term ethnomethodology was coined in the mid-1960s by Harold Garfinkel to denote the study (ology) of people's (ethno) methods (method) of creating social order (Scott and Marshall, 2005). In ethnomethodolgy, the research interest is the study of the everyday methods that people use for the production of social order. Ethnomethodology's goal is to document the methods and practices through which society's members make sense of their world (Garfinkel, 2002). According to Fakoya (2011), ethnomethodology is a sociological theory that examines how people make sense out of social life in the process of living in it, as if each were a researcher engaged in enquiry.

Therefore, this study sought out and documented how small-holder irrigation farmers made sense out of changes in environmental factors such as climate and how they affected their livelihood. The manifestations of climate change were assumed to be breaches in social order while, the coping strategies employed by farmers were their reactions to such breaches.

2.7 Conceptual Model:

This study aimed at finding out how socio-economic and institutional characteristics of irrigation farmers in Katsina State influenced their use of indigenous coping strategies

against climate change vis-à-vis the influence of these strategies on food security of the respondents' household (Figure 2.1). The model depicts certain socioeconomic and institutional variables as affecting the use of indigenous coping strategies. Such variables that are expected to determine the use of indigenous coping strategies in the study area are: age, level of educational, household size, marital status, farm size, extension contact, annual income, credit, and membership of cooperative society. It also shows modern coping strategies which are used to complement the indigenous strategies as it is expected that complementing the two sets of strategies would bring about the best-bet practices. Some modern coping strategies are use of improved germplasm, use of inorganic agrochemicals, water harvesting, insurance, agricultural mechanization and use of recommended practices. The use of indigenous coping strategies is expected to enhance the food security in terms of availability of food among the respondents' households this was measured using the HEFSSM. All these happen in the presence of certain intervening variables. Factors such as government policy, poverty situation, marketing issues, religion, ideologies and culture of the respondents continuously affect the other variables measured in this study. However, this study could not measure their specific effects, hence were considered as intervening variables.

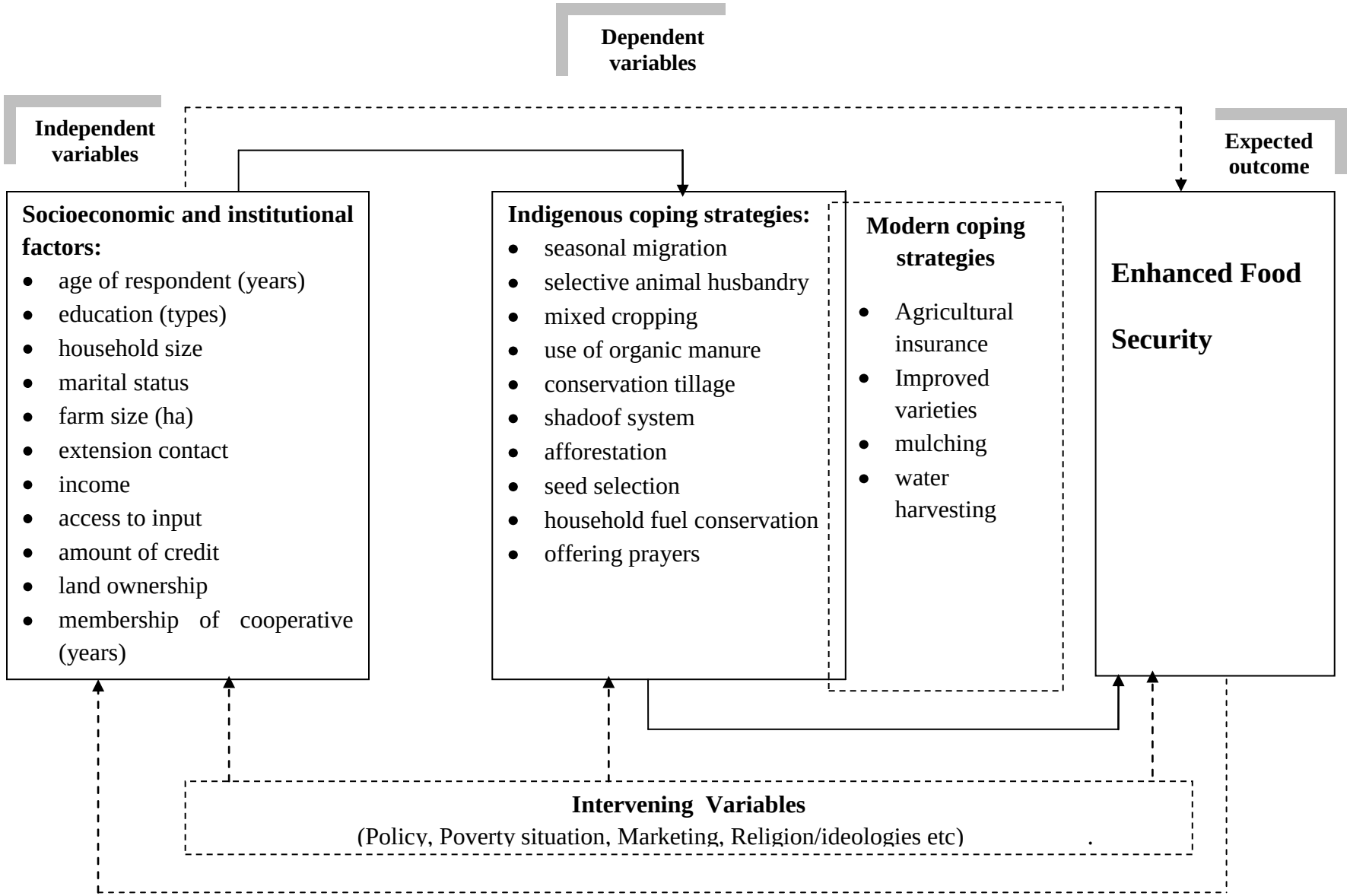

Figure 2.1: Conceptual model depicting factors influencing use of indigenous coping strategies and their influence on food security.

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

This study was conducted in Katsina State, North-Western Nigeria. Katsina State has a total land area of 23,938 square kilometres located between longitudes 11^0 and 13^0 East; and latitudes 6^0 and 9^0 North. The projected population of the state was put at 7,452,629 in 2014 from the 2006 figure of 5,792,578 at a growth rate of 3.2 percent per annum (National Population Commission, 2006). Majority of the population are Hausa/Fulani Muslims. It is a landlocked State neighbouring Niger Republic to the north; Jigawa and Kano States to the east; Kaduna to the south and Zamfara State to the west. The climate is semi-arid with average annual rainfall of about 689mm falling between May and September. The major crops grown are maize, cotton, groundnut, millet, sorghum, cowpea and vegetables among others.

The State lies within three agro-ecological zones: Sahel Savanna, Sudan Savannah and Northern Guinea Savannah. Likewise, Katsina State Agricultural and Rural Development Authority, the state apparatus responsible for agricultural and rural development and extension, stratified the state into three agricultural zones. These are: Zone I (Ajiwa), Zone II (Funtua) and Zone III (Dutsinma).

3.2 Sampling Procedure and Sample Size:

Multi-stage sampling procedure was applied for the purpose of this research. Zones I and III (Ajiwa and Dutsinma) were randomly selected out of the three agricultural zones of KTARDA. This study targeted household heads who happen to be registered irrigation

farmers in the study area as its respondents. After rigorous consultations with the relevant agencies lists of farmers that fit the demand of this study were compiled. Fifteen percent of the sample frame was selected via simple random sampling method giving rise to two hundred (200) respondents. Table 2.1 shows the distribution of the respondents according to zones in the study area.

Table 2.1: Sample Size

Zone	**Population**	**Sample (15%)**
Ajiwa (I)	702	105
Dutsinma (III)	630	95
Total	**1332**	**200**

3.3 Data Collection:

Primary data was used in this study. The data was obtained using complementary methodological approach combining the conventional approach in form of structured questionnaire and the participatory methodologies of inquiry as used by Musa (2006). Information was collected on: i) farmers socio-economic characteristics, ii) perception of climate change iii) indigenous and modern coping strategies, iv) availability and accessibility of food and v) constraints to the use/improvement of the coping strategies.

3.4 Analytical Techniques:

Descriptive statistics, coping strategy index and inferential statistics were used to analyze the data obtained for this study.

3.4.1 Descriptive Statistics:

Descriptive statistics such as frequency distribution and percentage were used to achieve objectives i, iv and vi.

3.4.2 Coping Strategy Index:

Coping strategy index was used to achieve objective ii. The Coping Strategies Index (CSI) was developed by East and Central Africa Regional Management Unit of the World Food Programme (CARE/WFP) in 2003 as an indicator of household food security that is relatively simple and quick to use, straightforward to understand, and correlates well with more complex measures of food security. A series of questions about how households manage to cope with a shortfall in food for consumption results in a simple numeric score. In its simplest form, monitoring changes in the CSI score indicates whether household food security status in declining or improving. It is much quicker, simpler, and cheaper to collect information on coping strategies than on actual household food consumption levels (CARE/WFP, 2003; Maxwell, Watkins, Wheeler and Collins 2003). It basically involves:

(i) Asking respondents a set of simple questions to capture people's basic consumption related coping responses to inadequate access to food in a given culture or location. The questions should be based on the right list of coping behaviours as there is no universal set of coping strategies;

(ii) then, respondents are asked how often they use those strategies to obtain a frequency value); and

(iii) then, questions are asked to find out ***how "severe"*** each of these individual coping strategies is perceived to be. This information is collected from

community-level focus groups and provides a weight for the perceived severity of each strategy (CARE/WFP, 2003; Maxwell, Watkins, Wheeler and Collins 2003).

(iv) The product of the frequency and severity of each coping strategy provides the CSI for that household.

Since then, the CSI has been adapted and used as a tool in various researches and studies involving coping strategies. For instance, it has been used by Islam and Kashem (1999) where they estimated the use of Ethno-veterinary medicine in livestock management and rearing. Furthermore, it was modified and used by Oluwatayo (2008) to study the implications of gender considerations in decision making on households' food security in rural Ekiti state, Nigeria. In this fashion, it was used in this study to score the various indigenous coping strategies used by farmers against the vagaries of climate change according to frequency of usage and severity. Implicitly, $CSI_i = \sum(D_{ij} * S_j)$

Where:

CSI_i = coping strategy index of the i^{th} respondent.

D_{ij} = duration of usage of j^{th} coping strategy by i^{th} respondent (years).

S_j = score of usage of j^{th} coping strategy by the sample, to be computed using the pairwise (paired needs) scoring and ranking method of the participatory rural appraisal adapted from Civil Society for Poverty Reduction, 2005 and Olawoye, 2004.

3.4.3 Inferential Statistics:

Linear regression analyses were used to achieve objectives iii and v and test the hypotheses. The multiple regression model for achieving objective iii and testing hypothesis i is given thus:

$Y= a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_8+b_9x_9+b_{10}x_{10}+b_{11}x_{11}+e$ .....*(equation i)*

Where:

Y = use of indigenous coping strategies against climate change (to be measured using coping strategy index – CSI)

a=constant

b_{1-n}= regression coefficients

x_1= age of respondent (years)

x_2 = educational attainment (years of schooling)

x_3 = household size (number of people)

x_4 = membership of cooperative (years of membership)

x_5 = farm size (hectares)

x_6 = extension contact (number of visits in a production cycle)

x_7 = income (naira)

x_8 = farming experience (years)

x_9 = amount of credit accessed (naira)

e = error term

Meanwhile, to achieve objective v and test hypothesis ii an ordinal logit regression model was employed:

$Y= a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_8+b_9x_9+b_{10}x_{10}+b_{11}x_{11}+e$ ..... *(equation ii)*

Where:

Y = food security status (1= food insecure with severe hunger, 2 = food insecure with moderate hunger, 3 = food insecure without hunger and 4 = food secure).

a = constant

b_{1-n}= regression coefficients

x_1= age of respondent (years)

x_2 = household size (number of people)

x_3 = membership of cooperative (years of membership)

x_4 = farm size (hectares)

x_5 = extension contact (number of visits in a production cycle)

x_6 = income (naira)

x_7 = farming experience (years)

x_8 = amount of credit accessed (naira)

x_9 = use of indigenous coping strategy (CSI)

e = error term

In this model all parameters found to be significant in equation (i) were excluded in equation (ii) to avoid multicollinearity.

3.5 Operationalization of Variables

3.5.1 Socioeconomic and Institutional Characteristics

***3.5.1.1 Age*:** this is the period of time an individual existed from birth to present. It is measured in number of years. Since climate change is a result of variations over a relatively long period of time, it is expected that older farmers would be more familiar with the concept and its impact on their agricultural activities. Also, indigenous practices are a result

of age-old experiences and it is widely assumed that the older the farmer, the more experienced s/he would be; older farmers are likely to stick more with the indigenous practices.

***3.5.1.2 Educational achievement*:** this is acquisition of formal education by farmers. It was measured ordinally according to level of attainment (primary, secondary, tertiary). It is expected that the higher the level of education attained by a farmer, the more exposed to modern technologies s/he would be and the more likely s/he would complement indigenous with modern coping strategies against climate change.

***3.5.1.3 Farm Size*:** this is the total land area cultivated by the household of the respondents. It was measured in hectares (ha). It is expected that farmers with larger farm sizes would practice more strategies and produce more output and hence have more food secured households.

***3.5.1.4 Extension Contact*:** this is the total number of times a farmer was visited by government extension agent in the previous production cycle. The number of visits in the last one year were counted and recorded for each respondent.

***3.5.1.5 Income*:** this is total amount accrued to a farmer in the last one year. It was measured by sum of income from irrigation, rainfed production, livestock production and non-farm activities in naira. The larger the income the more food secured a family would be.

***3.5.1.6 Amount of credit accessed*:** this is total amount of money borrowed by the farmer from all sources for the last one year. It will be measured in naira.

***3.5.1.7 Membership of Cooperative*:** this is the farmers' membership of cooperative group for agricultural activities. It is measured in number of years spent as a member. Cooperative membership brings about interaction and sharing of resources for attainment of common goals.

***3.5.1.8 Household Size*:** this is the number of people living together and eating from the same pot. Food demand increases with increase in the number of people in the household. However, larger households have more hands to supply manual labour which is important in small scale production.

***3.5.1.9 Farming Experience*:** this is the number of years the respondent has spent actively engaged in farming activities.

3.5.2 Food Security

As explained in section 2.5, United State Department of Agriculture (USDA) approach to food security measurement will be used for this study. It involves asking respondents a series of questions on observed changes in consumption patterns, behaviours and experiences known to characterize households having difficulty meeting their food needs (Fakayode *et al.* 2009). The responses come in affirmative (yes) or negative (no) form. If the response to a particular question is "yes", the respondent is further asked to tell how

frequently such incidence happens. While, a “no” response is recorded under the column “never”.

Afterwards, mean score will be found to place households on the food security continuum/scale ranging from 0 to 100 with households having lower scores being more food secured than those with higher score on the scale. Households will then be categorized as illustrated in Figure 3.1.

<table>
<tr><th>0 – 25</th><th>26-50</th><th>51-70</th><th>76-100</th></tr>
<tr><td rowspan="3">Food secure</td><td colspan="3">Food insecure</td></tr>
<tr><td>Food insecure without hunger</td><td colspan="2">Food insecure with hunger</td></tr>
<tr><td rowspan="2"></td><td>“moderate”</td><td>“severe”</td></tr>
</table>

Figure 3.1: Food security status. Source: Adapted from USDA (2000)

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Irrigation farmers' perception of climate change in the study area

All the respondents indicated that they are aware of climate change and they know that it was affecting their agricultural activities and irrigation agriculture in particular. However, the respondents differ on their sources of information regarding issues of climate change and how it has manifested in their communities. In Table 4.1, most farmers (96%) identified other farmers – comprising of friends, relatives and neighbours – as important source of information on climate change. This implies that information on climate change is majorly disseminated informally in the study area. This was followed by radio (88.5%), cooperative group activities (71%), open market (63.5%) and government extension agents (59.5%) in that order. Soothsayers (oracles and rainmakers that predict weather using supernatural powers) used to be very important source of information on climate. However, the advent of Islam in the study area has diminished their relevance that less than a quarter of the respondents have ever patronised their (soothsayers') services. Internet has the lowest frequency (11.5%) followed by mobile phone (22.5%). This indicates that information and communication technologies (ICTs) for agricultural activities are still not widely adopted in the study area. In another study, Umar *et al*., (2013) found that majority (55.00%) of the respondents obtained information on from friends and relatives through conversation. This was followed by cooperative societies (35.00%) and radio jingles (25.00%), while extension agents (20.83%) ranked fourth as a source of information.

Table 4.1: Sources of information on climate change

Source of information	Ajiwa Zone (n=105)	Dutsinma Zone (n=95)	Pooled data (n=200)	Rank
Other farmers	99 (94.3)	93 (97.9)	192 (96.0)	1
Radio	95 (90.5)	82 (86.3)	177 (88.5)	2
Cooperatives	68 (64.8)	74 (77.9)	142 (71)	3
Market	69 (65.7)	58 (61.1)	127 (63.5)	4
Ext. agents	56 (53.3)	63 (66.3)	119 (59.5)	5
Print media	21 (20.0)	41 (43.2)	62 (31.0)	6
Television	32 (30.5)	24 (25.3)	56 (28.0)	7
Soothsayer	21 (20.0)	28 (29.5)	49 (24.5)	8
Phone	24 (22.9)	21 (22.1)	45 (22.5)	9
Internet	15 (14.3)	8 (8.4)	23 (11.5)	10

Note: multiple responses accepted. Figures in parentheses are percentages.

Table 4.2 shows what the respondents consider as indicators of climate change. Further investigations revealed that all of these indicators have been occurring in the study area, however, their intensity and the rate at which they occur in recent times indicate that the climate is changing. The most important manifestation of climate change in the area is relatively long dry seasons with 166 respondents (83%) identifying it. Conversely, this means shorter rainy season which have negative consequences on agricultural production and intensifies the need for irrigation. There is a Hausa saying which connotes when rains are normally expected to start. It goes: *watan bakwai makarar rani, ko ba ruwa da alamu.* It can be loosely translated: the seventh (lunar) month is the end of dry season, even if there

are no rains there would be signs (that rainy season is about to start). This corresponds to second-half of April early May. Going by this saying, farmers believed that rains normally start within the seventh lunar month (each month having 28 to 30 days) after the last harvest, to the extent they used to practice what they termed *bizne*. *Bizne* is a practice whereby farmers sow their crops in the seventh lunar month though rains have not established, breaking the dry soil and putting their seeds, hoping for arrival of rains. In recent years, to the dismay of the indigenous people, rains do not get established in this area until late June rendering their adage invalid and making *bizne* no longer feasible.

Table 4.2: Manifestations of climate change as perceived by the respondents

Manifestations	**Ajiwa Zone (n=105)**	**Dutsinma Zone (n=95)**	**Pooled data (n=200)**	**Rank**
Longer dry season	89 (84.8)	77 (81.1)	166 (83.0)	1
Erratic rain pattern	90 (85.7)	69 (72.6)	159 (79.5)	2
Severe harmattan	71 (67.6)	73 (76.8)	144 (72.0)	3
Drought	70 (66.7)	59 (62.1)	129 (64.5)	4
Increased pest incidence	47 (44.8)	57 (60.0)	104 (52.0)	5
Warmer temperature	37 (35.2)	42 (44.2)	79 (39.5)	6
Flooding	38 (36.2)	37 (39.0)	75 (37.5)	7
Increased disease incidence	39 (37.1)	33 (34.7)	72 (36.0)	8

Note: multiple responses accepted. Figures in parentheses are percentages.

The respondents also identified erratic rain pattern as another indication of climate change. They cited examples with the recent rains that fell in some parts of the area in January of 2014. They said such are strange occurrences that signify that the climate is changing.

Other indicators of climate change in the area include more intense and severe harmattan [144 (72%)], higher rates of drought [129 (64.5%)], increased pest incidence [104 (52%)], warmer temperature [79(39.5%)], increased cases of flooding [75 (37.5%)] and increased disease incidence [72 (36%)].

These corroborate the findings of Farauta *et al.,* (2012) that an overwhelming majority of farmers in northern Nigeria are aware and knowledgeable of climate change; and 80.2% receive information on climate change. Different studies show farmers' perceived manifestations of climate change to include: unusual early rains that are followed by weeks of dryness, higher temperature, loss of soil fertility, reduction in farm yields, high rate of disease incidence, delay in onset of rain, less rainfall, erratic rainfall pattern, long period of dry season, no or reduced harmattan, long period of harmattan and heavy and long period of rainfall (Farauta *et al.,* 2012; Hir, 2010).

4.2 Indigenous coping strategies against climate change employed by the respondents.

As the farmers exist in their rural societies, changes are inevitable phenomena and as these changes occur farmers adapt and readjust in order to cope and survive. The theory of ethnomethodology explains this scenario. Among the prominent changes affecting farmers and their environment is the issue of climate change. Respondents have identified the strategies they employ in adapting to and mitigating the adverse effects of climate change on their irrigation production. This information was obtained using the participatory rural appraisal approach (PRA) of pairwise scoring and ranking the results of which are shown in Table 4.3. Mixed cropping was identified as the most important strategy used. This is because different crops have different climatic requirements. Hence, several crops on a plot

reduce the risk of loss due to unfavourable climatic conditions. This is in line with the findings of Shemdoe (2011) where farmers in Tanzania employ mixed cropping and crop diversification among other strategies to cope with climate change. Other important strategies in the study area include change in date of sowing, seed selection and prayers and supplication.

Farmers in the study area, as in most rural societies, are religious and spiritual people. Hence, they seek spiritual intervention to ameliorate problems threatening their well being. For instance, during periods of dry spell and droughts all members of the affected community – including men, women, children and livestock – move to the outskirts of the village for a special prayer in the Islamic tradition known as *salatul-istisqa'a.* They also practice *Rokon ruwa;* where old women dressed in their husbands' attire go round town chanting songs, seeking forgiveness from God while children follow them clapping and drumming.

In the same vein, in Sierra Leone, important indigenous climate change adaptation technologies/strategies include performance of ancestral ceremony/spiritual invocation (Morlai *et al.,* 2011). Other strategies employed such as *Shadouf* irrigation system, afforestation, household fuel conservation and minimum tillage could help in minimizing green house effect through use of clean energy sources and enhancing carbon and overall mitigation of climate change (Adesina *et al.,* 1999).

Table 4.3: Result of Pairwise Scoring and Ranking of Indigenous coping strategies used by irrigation farmers in the study area

Indigenous coping strategy	**Ajiwa Zone**	**Dutsinma Zone**	**Pooled data**	**Rank**
Mixed cropping	10	11	21	1
Changed sowing date	10	10	20	2
Seed selection	9	9	18	3
Prayers and supplication	7	8	15	4
Animal husbandry	6	7	13	5
Traditional irrigation system	5	6	11	6
Afforestation	5	5	10	7
Seasonal migration	4	4	8	8
Changed harvest date	4	3	7	9
Organic manure use	4	1	5	10
Fuel conservation	1	2	3	11
Minimum tillage	1	0	1	12
TOTAL	**66**	**66**	**132**	**N/A**

However, to attach more objective values to the coping strategies, coping strategy indices (CSIs) were computed thus:

$CSI_i = \sum (D_{ij} * S_j)$

Where:

$\mathbf{CSI_i}$ = coping strategy index of the i^{th} respondent.

$\mathbf{D_{ij}}$ = duration of usage of j^{th} coping strategy by i^{th} respondent (years).

$\mathbf{S_j}$ = score of usage of j^{th} coping strategy by the sample, computed in table 4.3 above.

Therefore, the product obtained ranged from a minimum 2083 to a maximum of 4664 with an arithmetic mean of 3170.99 and a standard deviation 454.964. These measures of central tendency and dispersion are shown in Table 4.4 below.

Table 4.4: Statistical distribution of coping strategy indices (CSI).

Statistic	Ajiwa Zone (I)	Dutsinma Zone (III)	Pooled data
Minimum	2083	2321	2083
Maximum	4664	4644	4664
Mean	3143.7	3201.14	3170.99
Standard deviation	447.735	463.318	454.964
Sum	330089	304108	634197

4.3 Socioeconomic and Institutional Factors Influencing the Use of Indigenous Coping Strategies in the Study Area

As shown in Table 4.5, the respondents in this study are middle-aged to elderly irrigation farmers aged 42 to 79 years old with a mean age of 55.335 years and a standard deviation of 7.9. This group of respondents are expected to have acquired substantial knowledge and understanding of the subject matters of this research: indigenous coping strategies,

irrigation farming and climate change in their environment. Furthermore, all the respondents are household heads who are major stakeholders in the decision making processes of the household-farm socio-economic unit and are believed to have the required information for this study. This is compounded by the farming experience of the respondents accumulated between 21 to 63 years of active involvement in agricultural activities.

The mean years of formal education are 4.66 which imply that the average respondent does not have up to complete primary education. The range of 0 to 23 years indicates that though some farmers have not acquired any formal education there others that have obtained up to tertiary education among the respondents. Further investigation showed that all the farmers have acquired various levels of Qur'anic education. The study area is characterized by relatively large households ranging from 3 to 31 members with a mean of 14 and standard deviation of 5.93. Large households have more hands to partake in the rigours of irrigation agriculture even though smaller households have fewer mouths to feed which could their food security.

Even though agricultural lands in the study area have been subjected to fragmentation, the average total farm (irrigated and rainfed) size of a household is 3.35 hectares with a hectrage range of 1 to 12 and standard deviation of 1.064503. Land is a vital resource in agriculture; hence, larger farm sizes are expected to enable farmers to experiment with different coping strategies and technologies and to enhance their food security. The household cumulative annual income has an average of ₦242,085.00, a range of ₦ 76,000.00 to ₦ 760,300.00 and a standard deviation of 106,361. Meanwhile, the average

credit obtained by a household in the last production cycle from all sources – formal and informal – and for all purposes was ₦ 22,620.00 with a range of ₦ 0.00 to ₦ 300,000.00 and standard deviation of 57142.03.

The average respondent received less than 1 extension visit in the production cycle. The number of visits ranges from 0 to 5 with a standard deviation of 0.99. This implies that none of the farmers acquired the recommended 24 visits per year. The mean years of membership of cooperative group was 5.625 years with a range of 3 to 16 years and a standard deviation of 7.151229.

Table 4.5: Statistical distribution of socio-economic characteristics of respondents

Variable	Mean	Standard Deviation	Min	Max
Age of the respondents	55.335	7.895853	42	79
Educational attainment	4.66	5.2538	0	23
Farming experience	39.425	9.093284	21	63
Household size	14.165	5.928195	3	31
Land size	3.35	1.064503	1	12
Income	242085	106361	76000	760300
Extension visit	0.53	0.9919779	0	5
Credit obtained	22620	57142.03	0	300000
Membership of cooperative	5.625	7.151229	2	16

Furthermore, the study found that some of the socioeconomic and institutional factors above determine the use of indigenous coping strategies (CSI) in the study area. This was achieved using a linear regression analysis. The analysis depicted that the parameters regressed are responsible for 59.1% of variation in the CSI. Therefore, the null hypothesis

(i) is hereby rejected as the analysis indicates that certain socioeconomic and institutional factors influence the use of indigenous coping strategies.

Individually, as shown in Table 4.6, each of age of respondents, total land size, total annual income and years of membership of farmers' cooperatives were found to be positive and significant at 1% probability. Age was found to be positively related to CSI and significant at 1%. The coefficient of 20.407 means that a farmer who is a year older would have a CSI that is higher by 20.407. This implies that older farmers tend to have higher CSIs than younger ones. This is because elderly people are the custodians of indigenous knowledge and practices. Also, the CSI is a factor of duration of usage of indigenous coping strategies which is related to age. This supports the findings of Salau, *et al.* (2012) that age, educational level, and amount of farm credit received were found to be significant in managing effects of climate change among farmers.

Years of membership of cooperatives also are positively related to CSI and significant at 1%. This implies that more years a farmer spends in cooperative group, the more (s)he would learn and get exposed to in terms of beneficial knowledge and practices abound in the society. However, contrary to Salau, *et al.* (2012), this study found that farm size is highly significant and positively related to CSI. This implies that an increase in one hectare of farm size results in a higher CSI by 68.582. Likewise, level of income is positively related to CSI and significant at 1%. This implies that more well to do households have a higher tendencies of using indigenous coping strategies against climate change. This is in line with findings of Salau, *et al.* (2012) and Shemdoe (2011) in separate studies in Nigeria (Nasarawa State) and Tanzania respectively.

Table 4.6: Factors influencing the use of indigenous coping strategies in the study area

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1248.278*	176.017		7.092	.000
Age	20.407*	3.350	.357	6.092	.000
Educational attainment	27.256	33.977	.037	.802	.423
Farming experience	-1.020	2.470	-.021	-.413	.680
Household size	1.501	3.541	.020	.424	.672
Land size	68.528*	20.637	.162	3.321	.001
Income	.001*	.000	.144	2.817	.005
Extension visit	-27.945	21.161	-.061	-1.321	.188
Credit	.000	.000	-.017	-.365	.715
Cooperative membership	23.533*	3.689	.373	6.380	.000

a. Dependent Variable: Coping Strategy Index. * = significant at 1% level of probability.

4.4 Complementing Indigenous with Modern Coping Strategies against Climate Change.

Apart from indigenous strategies there are many modern strategies developed to combat the negative effects of climate change in the societies. Table 4.7 shows the distribution of respondents in terms of awareness and usage of some of these modern coping strategies. It shows that 188 respondents (94%) are aware of modern coping strategies against climate change. However, a total of 17 respondents (8.5%) expressed that they have not used any of the modern coping strategies against climate change. Since all the respondents admitted to using at least one indigenous coping strategy against climate change it could be deduced that all those using modern coping strategies (91.5%) were involved in complementing both.

Table 4.7: Distribution of respondents according to awareness and usage of modern coping strategies

	Ajiwa Zone (n=105)		**Dutsinma Zone (n=95)**		**Pooled data (n=200)**	
	Frequency	%	Frequency	%	Frequency	%
Awareness						
Aware	96	91.43	92	96.84	188	94
Not aware	9	8.57	3	3.16	12	6
Usage						
Used	94	89.52	89	93.68	183	91.5
Never used	11	10.48	6	6.32	17	8.5

Table 4.8 went a step further to disclose the reasons why 17 of the respondents did not use any of the modern coping strategies and therefore did not complement the two. The most important reason for not complementing is lack of awareness with 12 respondents followed by satisfaction with the indigenous strategies. These 9 respondents reported that they are satisfied with the effectiveness of the indigenous strategies in coping with climate change and therefore saw no need to use the modern strategies. His is followed by high cost of modern strategies such as improved seeds (41.18%) and their difficulty of usage (complexity) (35.29%). No sociocultural reason such as taboo or religious prohibition was identified as a constraint to using modern coping strategies against climate change.

Table 4.8: Reasons for not complementing indigenous with modern coping strategies

Reasons	**Frequency (n=17)**	**Percentage**	**Rank**
Unaware	12	70.59	1
Satisfied with the indigenous	9	52.94	2
Cost of modern strategies	7	41.18	3
Complexity	6	35.29	4

Table 4.9 shows the modern coping strategies, number of farmers using each and their ranking. Majority of the respondents (95.63%) use improved crop varieties to cope with the impact of climate on their irrigation activities. Commonly used improved varieties include early maturing cultivars, pest and resistant varieties, drought tolerant varieties and, more recently, heat tolerant varieties (of tomato). Inorganic pesticides are also used among the modern coping strategies (90.71%). Incidences of pests and diseases have increased with the phenomenon of climate change. Of particular importance in Ajiwa Zone (I) is the fungal infection devastating dry season pepper plots. Farmers attributed the epidemic, which increased the demand for fungicides in the area, to climate change. Other chemicals used include herbicides, insecticides and rodenticides.

Other important modern coping strategies include use of inorganic fertilizer (83.61%), application of recommended agronomic practices (65.57%) and mechanization (45.90%). Mechanization includes usage of machineries ranging from diesel irrigation pumps to

tractors in all production activities including post-harvest processing. A newer strategy with lower level of adoption is water harvesting with only 6.01% of the respondents using it. These buttresses the findings of Canada-Nigeria Climate Change Capacity Development project reports (2004) and Farauta *et al.* (2012). None of the farmers subscribed the services of agricultural insurance.

Table 4.9: Modern coping strategies against climate change used in the study area.

Modern coping strategy	**Ajiwa Zone (n=94)**	**Dutsinma Zone (n=89)**	**Pooled data (n=183)**	**Rank**
Improved varieties	89 (94.68)	86 (96.63)	175 (95.63)	1
Inorganic pesticides	85 (90.43)	81 (91.01)	166 (90.71)	2
Inorganic fertilizer	81 (86.17)	72 (80.90)	153 (83.61)	3
Recommended practices	67 (71.28)	53 (59.55)	120 (65.57)	4
Mechanization	46 (48.94)	38 (42.70)	84 (45.90)	5
Water harvesting	5 (5.32)	6 (6.74)	11 (6.01)	6

Note: multiple responses accepted. Figures in parentheses are percentages.

4.5 Influence of the Use of Indigenous Coping Strategies against Climate Change on Food Security

Table 4.10 shows the food security status of the respondents. It indicates that only 43 respondents (21.5%) are food secure, while the majority (78.5%) are in various degrees of food insecurity. However, 82 respondents (41%) fall in the category of "food secure

without hunger", while 66 (33%) are "food insecure with moderate hunger" and 9 (4.5%) are "food insecure with severe hunger".

Table 4.10: Distribution of respondents according to their food security situation

Level of food security	Frequency	Percent	Cumulative Percent
Food insecure with severe hunger	9	4.5	4.5
Food insecure with moderate hunger	66	33.0	37.5
Food insecure without hunger	82	41.0	78.5
Food secured	43	21.5	100.0
Total	200	100.0	

Results from an ordinal logit regression analysis (Table 4.11) have shown that, the use of indigenous coping strategies against climate change (CSI) significantly affects and is positively related to food security situation of the respondents' households. Therefore, the null hypothesis (ii) which stated that, "use of indigenous coping strategies against climate change does not have significant effect on food security status of irrigation farmers in the study area" is also rejected. To this end, as shown in Table 12, use of indigenous coping strategies against climate change positively influences the food security statuses of households at 5% level of statistical significance ($p<0.05$). This implies that households that have higher coping strategies indices (CSIs) are more food secured than households with lower CSIs.

It was also found that extension visit was positively related to food security and significant at 5%. Consequently, households that received more extension visits were more food secured than those that received less.

Table 4.11: Some factors affecting the level of food security of the respondents

Variables	**Coefficient**	**Standard Error**	**z**	**P>|z|**
Coping Strategy Index	0.0007254**	0.0003075	2.36	0.018
Credit	-1.25E-06	2.38E-06	-0.53	0.599
Extension visit	0.296286**	0.1402459	2.11	0.035
Household size	0.0093355	0.0225555	0.41	0.679
Farming experience	- 0.0142306	0.0157859	-0.9	0.367
Years of education	0.0134154	0.0254929	0.53	0.599

Dependent variable: Food security, ** = significant at 5% level of probability

4.6: Constraints to the Use of Indigenous Coping Strategies against Climate Change in the Study Area

The respondents identified what they believed are constraints militating against efficient utilization of indigenous coping strategies against climate change (Table 4.12). The first was poverty which was identified by a total of 175 respondents (87.5%). Dearth of resources constrains any venture, inhibits diversification and minimizes options for survival. This supports Salau *et al.* (2012). Following poverty was poor record keeping and documentation. Farmers commit happenings, activities and experiences to memory and oral transmission. This makes information to become faded out, distorted and, in some cases, lost completely. Proper documentation is required for effective reference to environmental

challenges encountered and best possible remedies tested, thereby enabling transmission to subsequent generations and improvement.

Poor access to information on climate and climate change was identified by a total of 144 respondents (72%). This was followed by low level of education (59.5%), uncertainty in the agricultural enterprises due to reliance on natural conditions (46.5%), land tenure system (39%) and inadequate physical and social infrastructure in the rural areas (29.5%) in that order.

Table 4.12: Constraints to the use of indigenous coping strategies in the study area

Constraint	**Ajiwa Zone (n=105)**	**Dutsinma Zone (n=95)**	**Pooled data (n=200)**	**Rank**
Poverty	93 (88.57)	82 (86.32)	175 (87.5)	1
Poor record keeping and documentation of IK	90 (85.71)	78 (82.11)	168 (84)	2
Poor access to information on climate change	91 (86.67)	53 (55.79)	144 (72)	3
Low level of education	70 (66.67)	49 (51.58)	119 (59.5)	4
High level of uncertainty in agricultural enterprises	56 (53.33)	37 (38.95)	93 (46.5)	5
Land tenure system	35 (33.33)	23 (24.21)	78 (39)	6
Poor physical and social infrastructure	26 (24.76)	23 (24.21)	49 (29.5)	7

Note: multiple responses accepted. Figures in parentheses are percentages.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study assessed the indigenous strategies employed by irrigation farmers to cope with adverse effects of climate change in Katsina State. It also related the use of those strategies on one hand and food security situation of households in the study area on the other hand. It was carried out in two out of the three zones of Katsina State Agricultural and Rural Development Authority (KTARDA). A sample size of 15% was randomly selected from a sample frame of 1332 irrigation farmers in the study area giving rise to 200 respondents. Structured interview and focus group discussion were employed for data collection. The data obtained were analyzed using descriptive statistics, coping strategy index and regression analyses.

The study found out that farmers are aware of climate change in the study area. Important sources of information on climate change were found to be: other farmers (96%), radio (88.5%), cooperative group activities (71%), open market (63.5%) and government extension agents. Important indicators of climate change in the area include longer dry season, erratic rain pattern, severe harmattan, drought, increased pest incidence, warmer temperature, flooding and increased disease incidence in that order. Mixed cropping, changed sowing date, seed selection, animal husbandry, traditional irrigation system, afforestation, seasonal migration, change in date of harvest and use of organic manure were the most important indigenous strategies used by the respondents to cope with climate change. Coping strategy index (CSI), which is a summation of product of the score of

communal usage of each coping strategy and its duration by the respondent, was computed for each household. The minimum and maximum values were 2083 and 4664 respectively, while the arithmetic mean was 3170.99 with standard deviation of 454.964.

Age of respondents, total land size, total annual income and years of membership of farmers' cooperatives were found to be positively related to the use of indigenous coping strategies against climate change and significant at 1% probability. It was also established that 91.5% of the respondents complement the indigenous coping strategies with the use of modern coping strategies to cope with climate change.

The study also found that the use of indigenous coping strategies against climate change positively influences the food security statuses of households at 5% level of statistical significance ($p<0.05$). Likewise, extension visit was found to be significant in influencing the food security of households in the study area. Also, the relationship was direct and at 5% level of significance. The constraints to effective use indigenous coping strategies against climate change were identified to be: poverty (identified by 87.5% of the respondents), poor record keeping and documentation (84%), poor access to information on climate change (72%), low level of education (59.5%), uncertainty in the agricultural enterprises due to reliance on natural conditions (46.5%), land tenure system (39%) and inadequate physical and social infrastructure in the rural areas (29.5%).

5.2 Conclusion

It is evident that rural farmers in the study area are among the victims of the global danger of climate change. Fortunately, they are aware and have even identified indicators of the

environmental phenomenon. It is also clear that despite the constraints hindering effective use of indigenous coping strategies among irrigation farmers in the study area, they were able to, over time, develop and fine-tune such strategies. Socioeconomic and institutional factors affect the use of such strategies significantly in the study area. Indigenous coping strategies against climate change are effective in tackling environmental challenges and enhancing livelihood of rural farmers to the extent that of such strategies have become important determinants of food security in the study area.

5.3 Recommendations

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

i. The study has shown that farmers complement the use of both indigenous and modern coping strategies in combating the effects of climate change. There is need for capacity building and advisory services that enhance complementing the use of indigenous and modern strategies against climate change particularly in areas of information accessibility and weather prediction by the relevant government agencies. This should target both the extension personnel and the farmers.

ii. Governmental, intergovernmental and non-governmental organizations involved in intervention projects and programmes should take into cognizance the documentation and prioritisation of indigenous coping strategies as used by farmers for further development and utilization. This is because; it has been found that the indigenous practices are working for the communities and starting from there would enhance participation and sustainability in the projects/programmes.

iii. It has also been found that poverty is a major constraint in using coping strategies against climate change. However, the problem of poverty can be resolved by pooling resources in form of cooperative groups. Also, farmers can access loans from government and commercial banks easier through cooperative groups. Although most farmers these days belong to one cooperative group or the other, they are not involved in cooperative activities. They joined such groups when they are expecting certain benefits from intervention projects. Therefore, farmers are enjoined to imbibe the idea of group formation with the aim of cooperation.

iv. Though majority of the farmers possess little or no formal education, they are mostly literate in Arabic and *Ajami* (Hausa language written in Arabic transcription). Hence, farmers should endeavour to keep records of their indigenous knowledge and practices for future use, comparisons and improvements. Also, agencies responsible for adult literacy should intensify their efforts especially in rural areas.

v. This study found that use of indigenous coping strategies positively influences household food security in the study. Hence, there is need for policy framework that incorporates the community level knowledge and practices in planning and implementing food security and other rural development initiatives.

5.4 Contributions to knowledge:

Among the major contributions of this study to knowledge are:

i. Coping strategy index (CSI) was used to assess the level of resilience of households to the negative effects of climate change in the study area. The study found a CSI range of 2083 to 4664 with a mean of 3170.99 and standard deviation of 454.964.

ii. The study found that use of indigenous coping strategies against climate change affects the availability of food – which is an important determinant of food security – among the households in the study area. The relationship was positive and at 5% p-value.

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APPENDIX 1: QUESTIONNAIRE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, AHMADU BELLO UNIVERSITY, ZARIA.
QUESTIONNAIRE FOR IRRIGATION FARMERS.

Dear sir/madam,

I am a post graduate student of the aforementioned department carrying out a research on the topic: **ANALYSIS OF INDIGENOUS COPING STRATEGIES AGAINST CLIMATE CHANGE FOR FOOD SECURITY AMONG IRRIGATION FARMERS IN KATSINA STATE**. Please answer the following questions to the best of your knowledge. Information provided will be treated confidentially.

Best regards,

Sulaiman Umar.

SECTION A: SOCIO-ECONOMIC VARIABLES

S.No.	Question	Response
1	Name of respondent	
2	Mobile number	
3	Village	
4	LGA	
5	Name of cooperative group	
6	Sex	Male [ ], female [ ]
7	Age	

8	Educational attainment	None[ ], Qur'anic [ ], Primary[ ], Secondary[ ], Tertiary[ ], Apprenticeship [ ], others [ ]
9	Total years of formal education	
10	Farming experience (years)	
11	Household size	Male headed [ ], female headed [ ]
12	Household headship	Fadama [ ], Upland [ ], both [ ]
13	Land type	
14	Land units	
15	Land size	₦
16	Annual income from irrigation	₦
17	Annual income from rainfed production	₦
18	Annual income from animal husbandry	₦
19	Total annual income	
20		
21		

SECTION B: INSTITUTIONAL VARIABLES

S/No.	Question	Response	Codes
1.1	Do extension agents visit you?		1=Yes, 0= No.
1.2	How many times were you visited by extension agents in the last one year?		
1.3	Provider of extension services		1=ADP, 2= NGO, 3=Private extension provider, 4=farmer organization, 99= others (specify)
1.4	Type of agricultural technology promoted via extension		1=Improved varieties /planting material, 2=Chemical Fertilizer, 3=Organic fertilizer, 4=Spacing, 5=Soil Water management practices (e.g. mulching), 6=Plant protection, 7=Weed control, 8=mechanization, 9=Postharvest, 10=climate change, 11=environmental conservation, 99=others (specify)
2.1	What are your major sources of these agro-inputs?		1=ADP, 2= NGO, 3=farmer organization, 4=Agro-dealers, 5=open market, 6=other farmers, 99=others (specify)
	Fertilizer		

	Seed		
	Agrochemicals		
	Farm implements		
2.2	What is the distance from your farm to the main sources of these agro-inputs? (km)		
	Fertilizer		
	Seed		
	Agrochemicals		
	Farm implements		
3.1	What are your major sources of agricultural information?		1=ADP/ extension agents, 2= NGO, 3=farmer organization, 4=Agro-dealers, 5=open market, 6=other farmers, 7=Radio, 8=television, 9=internet, 10=print media, 99=others (specify)
4.1	Did you obtain credit?		1=yes, 0=no
4.2	How much credit did you obtain? (~~N~~)		
4.3	Main source of credit		1=ADP/government, 2= NGO, 3=cooperative, 4=Agro-dealers, 6=commercial bank, 7=agric bank, 8=microfinance bank, 5=friends/relatives, 6=other farmers, 99=others

			(specify)
5.1	Are you a member of cooperative?		1=yes, 0=no
5.2	Type of cooperative		1=production, 2=processing, 3=social, 4=savings and credit, 5=kinship, 99=others (specify)
5.3	For how many years have you been a member?		
5.4	Are you an official of your cooperative?		

SECTION C: PERCEPTION

1. Are you aware of climate change? Yes [ ], no [ ]
2. The following are important sources of information on climate change:

S/no.	**Source of information**	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1	Radio					
2	Television					
3	Internet					
4	Mobile phone					
5	Print media					

6	Other farmers					
7	Market					
8	Cooperative					
9	Government extension agents					
10	*Others (specify)*					

3. The following are important manifestations of climate change that affect irrigation agriculture in this area:

S/no.	**Manifestations**	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1	Drought					
2	Flooding					
3	Erratic rain pattern					
4	Longer dry season					
5	Severe harmattan					
6	Warmer temperature					
7	Increased pest incidence					
8	Increased disease incidence					

9	*Others (specify)*					
10						
11						
12						

SECTION D: INDIGENOUS COPING STRATEGIES USED AGAINST CLIMATE CHANGE

Please fill the following table with respect to indigenous coping strategies you employ against climate change:

Coping strategy	**Usage** *(yes =1, no =2)*	**For how long have you been using this?** *(Years)*	**How would you rate the effectiveness of this strategy in coping with climate change?**				
			Very ineffective	*Ineffective*	*Undecided*	*Effective*	*Very effective*
Change in planting date							
Change in harvesting date							
Seasonal							

migration							
Selective animal husbandry							
Mixed cropping							
Use of organic manure							
Conservation tillage							
Traditional irrigation methods (such as Shadouf system)							
Afforestation							
Seed selection							
Household fuel conservation							
Offering prayers and supplications							
Others							

(specify)							

SECTION E: COMPLEMENTING INDIGENOUS STRATEGIES WITH MODERN

1. Are you aware of modern coping strategies against climate change? Yes [ ], No [ ]
2. Do you complement the use of indigenous with modern coping strategies against climate change? Yes [ ], No [ ]
3. If yes, please fill the following table with respect to modern coping strategies you employ against climate change:

Coping strategy	**Usage** *(yes=1 2 no =2)*	**For how long have you been using this?** *(Years)*	**How would you rate the effectiveness of this strategy in coping with climate change?**				
			Very ineffective	*Very ineffective*	*Very ineffective*	*Very ineffective*	*Very ineffective*
Agricultural insurance							
Water harvesting							
Early maturing							

varieties							
Pest resistant varieties							
Drought tolerant varieties							
Heat tolerant varieties							
Use of inorganic fertilizer							
Disease resistant varieties							
Use of herbicides							
Use of pesticides							
Afforestation							
Others							

(specify)							

4. If no, why?
    i. Satisfied with the indigenous strategies [ ]
    ii. High cost of modern strategies [ ]
    iii. Modern strategies are difficult to use [ ]
    iv. Socio-religious reasons [ ]
    v. Others (specify)_____

SECTION F: FOOD SECURITY

Please, answer the following questions with respect to your food security situation in the last 12 months:

S/No.	Question	Often	Sometimes	Never
1	Do you worry if your food stock will run out before you get another to eat?			
2	Do you have inadequate resource to acquire enough food?			

3	Could you not afford to eat balanced meals?			
4	Do you supplement your children's feed with low quality/less preferred foods?			
5	Are you unable to feed your children balanced meals?			
6	Are your children not eating enough because of inadequacy?			
	Do adults in your household cut the size of their usual meals?			
7	Do adults in your household skip meals ?			
8	Do you eat less than you feel you should			
9	Were you ever hungry but did not eat because there was no food?			
10	Did you ever cut the size of any of your children's meal because there wasn't food for all?			
12	Did any of the children ever skip meals because there wasn't enough food to eat?			
13	Did any of the children ever not eat for a whole day?			
14	Were the children ever hungry but you just couldn't provide more food?			
15				
16				

SECTION F: CONSTRAINTS

What, in your opinion, are the constraints to use of indigenous coping strategies against climate change in your area?

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How can the constraints above be ameliorated?

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What, in your opinion, are the potentials for the improvement of indigenous coping strategies against climate change?

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Any other comments:

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Thank you for your cooperation.

APPENDIX2: PAIRWISE SCORING AND RANKING SHEET

Which of the following strategies is more important to you in coping with climate change:

	Changed planting date	Changed harvest date	Seasonal migrati-on	Animal husband-dry	Mixed cropping	Use of organic manure	Conser-vation tillage	Traditio-nal irrigation	Afforest-tation	Seed sel.	Fuel cons.	Prayers and supp
Changed planting date												
Changed harvesting date												
Seasonal migration												
Animal husbandry												
Mixed cropping												
Use of organic manure												
Conservation tillage												
Traditional irrigation												
Afforestation												
Seed selection												
Fuel conservation												
Prayers and supplication												