Climate Change and Its Implication for Nigeria-Chad Relations, 2010-2020

Atsiya Godiya Pius[1]
Ajiya Sarah Tarfa[2]
[1&2]Department of Political Science, Nasarawa State University, Keffi
email:godiyap18@gmail.com

Abstract
The impact of climate change on the environment, aquatic population, and the general economic pattern of an agrarian society cannot be overemphasized. The plundering trends of dryness and global warming have adversely affected water resource, Lakes, bonds, tributaries and this is evidenced with the rapid shrinkage of Lake Chad water body which sustains over 30 million people. The problem of climate change is that climate change is not purely a scientific problem but, human actions are central to this warming. This study therefore appraised the impact of climate change on fish production in the region by investigating the nexus between decreasing fishery species, and production out-put (farming) as well as its impact on Nigeria-Chad relations. Theoretically, the study anchored on Frustration Aggression theory which was introduced by a group of Yale University Psychologists. Survey research design was adopted in the study. Data were obtained from primary and secondary sources. The primary data was obtained with the use of a research questionnaire. The findings revealed that climate change and consequent drying of Lake Chad affected the struggle for fishing resources between Nigeria and Chad. It has also affected the struggle for farming activities between Nigeria and Chad. The study however recommends among others that, there should be engagement and sustained sensitization/ awareness campaign on the impact of climate change on fisheries and the contribution of fisheries to household livelihoods, poverty reduction and national/regional economies. Also, agricultural education and extension

curricula should incorporate the knowledge and experiences of rural people, indigenous peoples and co-learning (such that extension agents also learn from others)

Keywords: *Climate change, Integrated farming, Poverty and Relations*

1.1 Introduction

The world is overwhelmingly confronted with the challenges of climate change and extreme poverty, both of which are on the increase globally with the rising dependency on fossil fuel. Natural cycles and human activities which have continued to emit Green House Gases (GHGs) into the atmosphere have been identified as the major causes of climate change by scientists.

Climate change in a layman's term is a change in the usual weather found in a place. It could be a change in the annual rainfall, temperature or general weather condition of a given place. Climate change can be caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, volcanic eruptions among others. Scientists have pinpointed human activities like emission of carbon-dioxide from cars, industrial plants, burning of fossil fuel; gas, coal, and oil, as the major causes of atmospheric greenhouse gases which heat-up the earth's temperature (Babagana, 2017). In short, the United Nation's Framework Convention on Climate Change (UNDP, 2014) report succinctly summed it up as thus:

> *Rising fossil fuel burning and land use changes have emitted, and are continuing to emit, increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO_2), methane (CH_4) and nitrogen dioxide (N_2O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, heat that would normally be radiated back into space. This increase in heat has led to the greenhouse effect, resulting in climate change. The main characteristics of*

climate change are increases in average global temperature (global warming); changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers and reduced snow cover; and increases in ocean temperatures and ocean acidity, drying of ponds, lakes and tributaries – due to seawater absorbing heat and carbon dioxide from the atmosphere.

In Africa, quite a number of states are faced with climate shocks that are intensifying poverty, inequality and the disruption of livelihoods. Indeed, concern in the early 1990s over the negative impact of climate change strengthened fears that environmental degradation and demographic pressures would displace millions of people in the developing world and lead to huge social upheaval. Sub-Saharan Africa is among the most vulnerable to the negative effects of climate change, and faces the greatest challenges of adaptation (Surhke, 2000).

The Intergovernmental Panel on Climate Change (IPCC) has found that Africa is already experiencing the negative effects of climate change and will experience greater changes in future (Wyk, 2014). In Africa, the lakes are among the major victims of the deleterious effects of climate change. Without doubt, the lakes are part of the essential natural capital that local people depend on for their livelihood and survival. Although Africa's lakes hold about 30000 cubic kilometers of water, and yield 1.4 million tons of freshwater fish each year, they are among the most heavily exploited of all the continent's freshwater resources (Selva, 2005). A recent United Nations report reveals that more than 600 lakes in Africa are declining rapidly owing to the combined impact of climate change and resource overuse (UNEP, 2018).

Over the next decades, it is predicted that billions of people, particularly those in developing countries will face shortages of water and food and greater risks to health and life as a result of climate

change. By 2025, up to 300 million people in Africa could be exposed to greater risk of water stress and scarcity (UNDP, 2017).

According to Lake Chad Basin Commission Report 2014, the Lake was the world's sixth largest inland water body and the largest endoreic (closed) drainage Basin in Africa. It is located between latitude 12° and 14° 20 north, and longitude 13° and 15° 20 east, in the centre of Africa, on the Southern edge of the Sahara desert. In its original form and state, the Lake Chad Basin (LCB) was about 2.5 million km2, about 8 percent of the surface area of Africa and was shared between Algeria, Cameroon, Chad, Central Africa Republic (CAR), Libya, Niger, Nigeria and Sudan. The freshwater Lake itself is a terminal depression with only four of the basin countries in direct contact with it. It is located in the Sahelian zone of West-Central Africa shared by Chad, Niger, Nigeria, and Cameroon. It covers an approximated area of about 26,000 square kilometers with an ethnically diverse population of over 30 million people as of 2011, growing rapidly. The Lake is very shallow and extremely dynamic, constantly changing size, shape and depth, which occur annually and over decades and centuries. The Chari-Logone river subsystem, with a basin area of about 650 0000 km2 contributes 95% of its water (UNGP, 2004 cited in Ovie and Thomas, 2011).

Based on surveys of exporting firms in both Nigeria and Chad Republic, Climate Change and the Agri-Food Trade: Perceptions of Exporters in Nigeria and Chad, identifies threats arising from climate change and seeks to develop solutions to help the agriculture sector particularly in fishing.

It has been observed that since the 1972/73 drought, there has been a considerable reduction in the number of fish species. The drastic environmental changes which have affected the region have also impacted on the composition of the fish resources and in turn on the catch composition recorded by fishers (Neiland, 2005). During the drying period (1972-1978), natural selection operating on the fish communities favoured marshy species (e.g *Clarias* catfish, *Tilapiine cichclids* and *Heterotis* sp.) that physiologically and behaviourally are well adapted to survive this unstable hostile environment of low

water, high temperatures and low dissolved oxygen that now dominate the ecosystem. The changes in relative abundance of the freshwater sardine (*Alestes*) and the catfish (*Clarias*), two dominant fish species in the Lake basin. Over the past 4 decades, the two states (Nigeria and Chad) have experienced fluctuations in climatic and environmental conditions that have led to significant changes in the distribution of aquatic habitats. Most notably, as a consequence of the Sahelian drought of 1972-74 and 1982-84, which produced a lasting modification of the lacustrine hydrology, there has been marked changes in the taxonomic composition, distribution, diversity and production of the fisheries (Lemoalle, 1991).

Over the years, Researchers have aptly given their divergent views on the ongoing trend. Sequel to this, Ovie & Emma (2010), argue that the lake itself and the natural resources it holds are severely under threat from environmental, hydrological and biophysical changes due to anthropogenic climate change. These scenarios have accounted for the drastic reduction of water between Nigeria and Chad leading to loss of fishing, agriculture and pastoral grounds; with severe implications for the regional communities' source of livelihoods in terms of income generation, employment, food security and environmental sustainability. Similarly, Thomas (2011) and Burck (2018) agreed that the region has experienced a radical change in the atmospheric temperature, characterized by reduction in annual rainfall, increase in the rate of dryness, excessive heat, desertification, drought, and famine. As a result of the depletion of water resources, flora and fauna and agricultural products, the region has become horrible and unsustainable for both Man and aquatic lives. This scenario has forced the local population to drift southwards in search of a green and sustainable environment for their survival.

Against this background therefore, this study critically examined the nexus between climate change and the decreasing quantity of fish production, vis-à-vis the shrinkage of Nigeria-Chad water body.

1.2 Research Questions

i) To what extent has climate change and consequent drying of the Lake Chad affected the struggle for fishing resources between Nigeria and Chad?

ii) How has climate change and the drying of the Lake Chad affected the struggle for farming activities between Nigeria and Chad?

iii) What is the role of political leadership in managing the conflicts between Nigeria and Chad arising from climate change and the drying of the Lake Chad?

iv) How can the challenges in Nigeria-Chad relations arising from climate change and the drying up of Lake be ameliorated?

1.3 Conceptual Framework

Climate Change

The term 'climate' refers to a statistical description of weather in terms of the mean and variability of temperature, precipitation and wind over a period of time, ranging from months to millions of years (the classical period is 30-35 years) and of the related conditions of oceans, land surfaces including human perturbations and ice sheets (Global Carbon Project, 2014). The climate in any given area is actually a complex and interactive system consisting of the atmosphere, land surface, snow and ice, oceans, other bodies of water and living things. The climate system also evolves over time under the influence of its own internal and external dynamics called 'forcing'(Urry, 2011). "Climate" is also the average of the weather conditions at a particular point on the Earth. Typically, climate is expressed in terms of expected temperature, rainfall and wind conditions based on historical observations.

"Climate change" is a change in either the average climate or climate variability that persists over an extended period. The Earth's climate has always changed. Changes in the Earth's orbit, the energy output of the sun, volcanic activity, the geographic distribution of the Earth's land masses and other internal or external processes can

influence climate. Scientists refer to this type of long-term climate change as "natural climate change". As a result of natural climate change, the Earth has experienced regular cold periods (or ice ages) in the past, when glaciers covered large parts of the Earth's surface. The Earth has also experienced warmer periods when sea levels were much higher than they are now. In the Earth's long-term history, the current period is characterized by a relatively warm, stable climate that has lasted since the end of the last ice age about 11,700 years ago. This period is known to geologists as the Holocene and is the period during which human civilization has flourished.

Over time, the enhanced greenhouse effect results in "global warming" - an increase in the Earth's average temperature. Global warming is one type of climate change and it drives other changes in the climate, such as changes in rainfall patterns and the frequency and distribution of weather events such as droughts, storms, floods and heat waves. Although the terms climate change and global warming are often used interchangeably, climate change is a broader term that incorporates both global warming and other observed changes in climate. Many scientists argue that the impacts of climate change will be devastating for natural and human systems and that climate change poses an existential threat to human civilization (Hackmann, 2012).

According to the US National Research Council definition (2010), Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (such as decades to millions of years). Some literature use the term global warming to describe 'climate change'. For example, NASA (2011) uses the term global warming to define climate change as the change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions.

The United Nations Framework Convention on Climate Change (UNFCCC, 2006), which happens to be the global coordinator of climate change related activities, applies a similar definition when it refers to Climate change as a change which is attributed directly or indirectly to human activity that alters the composition of the global

atmosphere and which is in addition to natural climate variability observed over comparable time periods. For UNFCCC (2006) the Earth's climate has always changed and evolved. Some of these changes have been due to natural causes but others can be attributed to human activities such as deforestation and atmospheric emissions from industry and transport, which have led to gases and aerosols being stored in the atmosphere. These gases and aerosols are known as Greenhouse Gases (GHGs) because they trap heat and raise air temperatures near the ground, acting like a greenhouse on the surface of the planet. From scientific investigation, chemical elements called Green House Gases (GHG) are responsible for absorption of heat, thus preventing the cooling of the atmosphere (CCC, London). This process is called the greenhouse effect and the primary GHG in the earth's atmosphere include water vapour, carbon dioxide, methane, nitrous oxide and ozone (Hefron, 2015). These are all combination (compound) of chemical atoms. Methane is a gaseous chemical compound in which one carbon atom is bonded to four atoms of hydrogen. Carbon dioxide is a gaseous chemical compound in which each carbon atom is bonded to two atoms of oxygen. Nitrous Oxide is a gaseous chemical compound in which one nitrogen atom is bonded to two atoms of oxygen. Per fluorocarbon is a gaseous chemical compound in which one atom of fluorine is bonded to one atom of carbon. Hydro fluorocarbon is a gaseous chemical compound in which one atom of hydrogen is bonded to one atom of fluorine and carbon. Sulphur-Hexafluoride is a gaseous chemical compound in which one atom of sulphur is bonded to six atoms of fluorine.

Causes of Climate Change in the Lake Chad Basin

The progressive diminution of the waters of Lake Chad over the years has been a subject of growing concern for political leaders of its riparian states, environmentalists and scholars. Its progressive shrinkage is attributed to three key forces: resource misoveruse population surge and climate change variability.

a. Resource mis/overuse

Unsustainable exploitation of the water of the lake by riparian states to support poorly planned irrigation projects appears to be the critical factor in the misuse of the water of the lake. The signing of the Lake Chad Basin Commission (LCBC) Convention as far back as 1964, to a large extent, signaled an early cooperative impulse by the riparian states to promote and regulate the joint exploitation of the resources of Lake Chad. The primary objectives of the LCBC are to regulate and control the utilization of water and other natural resources in the basin; initiate, promote and coordinate natural resources development projects and research within the basin area; examine complaints, and promote the settlement of disputes, thereby promoting regional cooperation.

Regrettably, the pattern of exploitation of the lake's water by riparian states has been in sharp contrast to the institutional provisions envisaged in the Convention. By the mid-1970s, riparian states were resorting to unilateral exploitation of the lake's water to sustain agricultural irrigation and development projects. Of particular relevance were the construction of the Yaguou-Tekele Dyke and the Maga Dam by Cameroon in 1979, the Mamdi Polder Project in Chad and a series of dams in Nigeria. The most extensive irrigation project, the South Chad Irrigation Project (SCIP), has been developed in Nigeria (Surhke, 2000).

Coe and Foley, for instance, have found that competing demands for fresh water by the four riparian states of Lake Chad, mostly through massive irrigation projects, account for almost 30 per cent of the observed decrease in lake area since the early 1960s. Until about 1979, irrigation had a modest impact on the hydrology of the region. However, between 1983 and 1994, the volume of water diverted for irrigation quadrupled compared with the previous 25 years, accounting for 50 per cent of the additional decrease in the size of the lake. While irrigation projects have contributed to the drying up of the lake, the decreasing water level, in turn, affected irrigation projects. For instance, the SCIP was designed to irrigate 67 000

hectares, but as water levels in the lake dropped in the late 1980s, no irrigation could take place (James, 2017).

b. Population explosion

The surge in the human population around the lake in the last few decades has also contributed to resource overuse. Harden has long hypothesized that 'Africa's growing population is the major cause of the degradation and pollution of most of the continent's lakes'. Since the 1960s, human demands for water near Lake Chad have increased rapidly. Between 1960 and 1990, the number of people living in the lake's catchment area has doubled from 13 million to 26 million. In 2007, the basin population was estimated to be slightly above 37 million. Yet, the population is expected to increase by 75 per cent by 2025 (Surhke, 2000).

The growing human population in the lake region necessitated the raising of increased numbers of livestock to feed the teeming masses. The combined surge in human and livestock populations led to overgrazing, unhealthy agricultural practices, intense fishing and pollution of the lake. Consequently, the lake's carrying and replenishment capacity has been greatly undermined. This portends serious danger for the future survival of the lake, given the predicted impact of climate change on the basin (Odada, 2005).

c. Climate change and climate variability

The chemical composition of the Earth's atmosphere is undergoing rapid change, with consequent effects on Africa's lakes. Increases in atmospheric concentrations of greenhouse gases are expected to cause more rapid changes in the Earth's climate than have been experienced for millennia. Recent environmental trends suggest that Africa is experiencing dangerous extremes in terms of rising temperature and weather events attributable to climate change. Climate change causes alterations in rainfall patterns, water levels and volumes in lakes, ponds, rivers and streams, and the frequency of droughts and storms. Consequently, the arid and semi-arid areas in northern, western, eastern and some parts of southern

Africa are becoming drier, while equatorial Africa is getting wetter. Natural watercourses such as Lake Victoria, Lake Chad and parts of the Nile River are gradually drying up due to warmer temperatures (Murray, 2007).

Historically, Lake Chad received most of its water from the annual monsoon rains that fell from June to August. However, since the late 1960s the region has experienced a series of declines in rainfall, culminating in two major droughts in 1972 to 1974 and 1983 to 1984. Areas of the lake that once experienced a mean annual rainfall of 320 millimeters received less than 210 millimeters. Recently, the United Nations concluded that 'the size of the region affected by this change and its duration are without precedent in hydro-climatic chronicles'.

Early studies on the hydrological history of the lake have found that the balance between water intake and evaporation is continually fluctuating, with the result that Lake Chad, owing to its shallowness, is continually changing its size and shape. These fluctuations reflect variations in rainfall not only in the area of the lake itself but particularly in the watershed areas of the Feeder Rivers. Connah, therefore, concludes that 'fluctuations in Lake Chad are a fairly sensitive indicator of climate change over a substantial area of Africa'. Although specifics on the impact of climate change on Lake Chad are still unclear, a United Nations study has identified 'climate change as the most important global change relevant to Lake Chad Basin'. A recent study has used parameters like temperature, humidity, evaporation and transpiration to assess the effects of climate change on Lake Chad (Connah, 2016).

The series of satellite images shows the dramatic decrease in the size of the lake over the past four decades owing to a combination of climate change and human impact. As the lake shrinks, it moves towards the Chadian and Cameroonian territories, a factor that underpins potential interstate conflicts in the lake's area.

Once the progressive diminution of Lake Chad became more obvious and devastating in the 1980s, the LCBC, in collaboration with the riparian states and donor partners, embarked on several projects

to help salvage the lake. Besides the parliaments of the five member countries of the LCBC establishing the Regional Parliamentary Committee in 2004, other initiatives, including studies and environmental projects, have been undertaken. One of these initiatives seeks to reverse land and water degradation trends, and to regenerate the lake's ecosystem. Its implementation is estimated to cost US$ 10, 6 million, which will be provided by the World Bank through the Global Environment Facility (GEF) for the integrated management of Lake Chad. Another priority intervention identified has been a major inter-basin water transfer project, the Lake Chad Replenishment Project. This project entails damming the Oubangui River at Palambo in the Central African Republic and channeling some of its water through a navigable canal via the Chari River to Lake Chad. However, the successful implementation of these projects has been stifled mainly by financial constraints (Murray, 2007).

1.4 Frustration Aggression Theory

The frustration Aggression Theory was introduced by a group of Yale University Psychologists namely John Dolland, Neil Miller, Leonard Doob, Orvale Mourer and Robert Sears in 1993.

The theory says aggression is the result of blocking or frustrating a person's efforts to attain a goal. The Theory further states that aggressive behavior is the result of frustration which is not sufficient, but a necessary condition for aggression. According to Dolland and Colleagues, frustration is a condition which exists when a goal response suffers interference, while aggression is defined as act whose goal response is injury to an organism.

The Theory was applied in studies of scapegoating and hate crimes which indicated that as sources of frustration accumulate during an economic crisis, frustrated groups may unleash their aggression.

Social production and reproduction in the Lake Chad region is agrarian, communal, with primitive production forces. Within the Lake Chad region, fishing is the dominant occupation of individuals and families, and production is essentially for direct consumption and

subsistence, with few commercial fishery sectors. Fish and fisheries provide the commonest and cheapest source of protein for a population of 30 million people and above with over 200,000 people directly involved in the sector and 10 million others supported by it. However, another production force from a distance civilization; the industrial West, has emitted and continues to emit Green House Gases (GHGs) into the atmosphere which has caused an increase in the earth's temperature popularly called global warming. This warming has led to a change in the climatic pattern, changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers, reduction of snow cover, increase in ocean temperatures and ocean acidity, decrease in annual rainfall, drying of ponds, lakes and tributaries. These unfortunate natural disasters have negated the tradition means of production, which is agriculture; fishing, farming and livestock production, all of which largely depend on the availability of water resources. With the uncontrollable and radical shrinkage of the Lake Chad water, the fishery sector is experiencing rapid decrease in the out-put of fish sector in the region.

We can therefore make the following deductions from the foregoing theoretical analysis.

- Climate change has caused an environmental degradation, alteration of the pattern of rainfall, precipitation, food insecurity, poverty, unemployment, low GDP, and hunger in the Lake Chad basin. This scenario however truncated Nigeria's relations with Republic of Chad particularly in fisheries.
- It has truncated the traditional and natural means of production (by the drying of Lake Chad, ponds and other tributaries) in the region leaving hundreds of thousands impoverished including the farmers whose business relies on the lake for survival.
- Lake Chad's changing hydrography has provided violent Extremist to increase their foothold in the water scarce Lake Chad.

1.5 Methods

In carrying out this study, a survey method was utilized. Survey represents one of the most commonly used types of quantitative social sciences research. This study employed both primary and secondary sources of data collection. It involved methodological collection of both qualitative and quantitative data. This is with a view to providing holistic perspective in respect of the study variable.

The target population of the study comprises of relevant agencies which includes Federal Ministry of Environment, Nigerian Meteorological Agency (NIMET), and Chadian Embassy in Nigeria as well as fish traders and farming communities at the Nigeria/Chad border which had a total population of one thousand four hundred and twenty eight (1,428).

To determine the sample size of participants drawn from the population of 1428, this study adopted Taro Yamani formula (1964) for sample size, thus:

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

Where n = The sample size

N = The population size

e = error of sampling $(0.05)^2$

$$n = \frac{1428}{1 + 1428(0.05)^2}$$

$$n = \frac{1428}{1 + 1428(0.0025)}$$

$$n = \frac{1428}{1 + 3.57}$$

$$n = \frac{1428}{3.58}$$

n = 399.8826

n = 400 (sample size)

Therefore, the sample size for the study is 400 respondents

NIMET $\frac{400\times283}{1428} = 79$

FMOE $\frac{400\times125}{1428} = 65$

Chadian Embassy $\frac{400\times69}{1428} = 19$

Fish traders and farmers $\frac{400\times845}{1428} = 237$

The study sample size is 400; respondents were sampled using purposive sampling techniques.

1.6 Discussion of Findings

1. The study found that shrinkage of the Lake Chad has caused a depletion in fish species and population, which have massively contributed to the decrease in the out-put of fish production and inflation of the price of fish stocks between Nigeria and Chad. The result of the findings clearly shows that the ecosystems of the Lake Chad Basin are being pushed towards collapse. In recent years, the lake and riparian systems are slowly recovering from severe drought in 2008. Population growth and geographic redistributions of displaced populations have placed a heavy and growing demand on the lake's ecosystem services. Climatic variability has disrupted patterns of flooding and recession to which indigenous populations had relied upon for fishing, grazing, and agriculture.

   The finding coincides with the view of Burck (2018) that following the shrinkage of water volume, in the recent phase, and the emergence of swamp ecosystems, natural selection has favored marshy species (*Clarias*, *Cichlids* and *Heterotis*) in the Lake Chad Basin, there has been an associated decrease in species diversity over the past years. Burck noted that overall the combined impacts on both the human and ecological system are; alteration of fish breeding and migration time, constrained access to preferred spawning grounds, increased

migration and mobility of fishers southwards in search of more productive grounds and wetter ecosystems in the region. While reduced precipitation and water volume have caused; increased alkalinity, increased primary productivity of algal bloom, anoxic conditions, and concentrated effects of eutrophication.

2. It was revealed that climate change and the drying of Lake Chad has negatively affected water resources; precipitation, pond and tributaries, inland water acidification, and environmental degradation. Similarly, unsustainable exploitation of the water of the lake by riparian states to support poorly planned irrigation projects appears to be the critical factor in the misuse of the water of the lake. This scenario drastically affected the struggle for farming activities between Nigeria and Chad.

   The above finding corroborates with Wahab (2012) and Nebesum (2016) views who observes that land degradation, desert encroachment, drying up of surface waters, coastal inundations, and shift in cultivated crops over time affected the food security in Nigeria which has led to inflation, hunger and starvation. Climate change warming cause's unpredictable and extreme weather events impact and increasingly affect crop growth, availability of soil water, forest fires, soil erosion, and droughts". Climate change has adversely affected the nature and characteristics of water resources in which 90% of the population in the region depends. This factor has increased the vulnerability of humans to infection.

   Similarly, the findings also supports Babagana's (2002) view who highlights depletion of water resources, crop production, livestock, aquatic population, and the alteration of fish breeding and migration. The investigation revealed that about 15.9 million people are currently severely food unsecured. Food prices have risen outrageously. The nutritional status of

the affected population is a serious concern. In fact, the Global Acute Malnutrition (GAM) reported that "over 10% of the population in the region is food malnourished".

In addition to the agricultural perspective, the above finding corroborates with United Nations food and Agricultural organization (2017) which noted that, considering the typical growing periods for crops in the Lake Chad Basin, made predictions of the locations in the basin where the growing period would be 120 days by the end of the 21st century and compared this prediction with current conditions. Modeling results showed that the position of the "120-day line" will shift southward, requiring from 70,000 to 135,000 km² of land to be reclassified for more arid agriculture. The effects on ecosystems will be most pronounced at transition zones between ecosystem types. The boundary between arid and hyper-arid conditions remains almost unchanged under all climate change scenarios. Impacts of climate change increase southward in the basin, as growing seasons lengthen. Toward the end of the century, areas that have sufficiently long growing seasons to be considered tropical, decrease in size and become fragmented or disappear.

3. The findings of this study revealed that in response to changing water environments and general ecology, fishing communities and farmers in Nigeria and Chad, Leaders of the two states have adopted different patterns of fishing strategies to overcome or cope with the impacts of climate change and lake variability, However, the policies did not produce desired results as some of the policies were not implemented or diverted by the political gladiators.

It is in view of this development that the LCBC was established in 1964 with mandates to coordinate and promote regional cooperation for the sustainable and equitable management of the Lake Chad Basin, the preservation and protection of its ecosystems, and the promotion of peace and security in the

region. Within the original mandate, the LCBC had limited authority to implement Trans-boundary regulations. Progress in Trans-boundary management of the basin was further impeded, because national legal and institutional instruments required harmonization.

This finding is supported by Steiner (2018) who noted that the regional governments particularly Nigeria and Chad Republic through relevant agencies adopt plethora policies with no positive outcome.

In Nigeria, the Ministry of Water Resources is the principal coordinating body with regards to water policy in Nigeria. It handles irrigation, hydrological and meteorological statistics and studies, as well as legislation. Other Nigerian institutions are involved in the formulation of water policies, particularly the National Council of Water Resources, the National Technical Committee on Water Resources, the Ministry of Agriculture and Rural Development and the River Basin Development Authorities. The key feature of water management in Nigeria is that its administration is decentralized but lacks adequate coordination. Integrated water resource management has not been enshrined in a single founding policy instrument, but is instead embedded in a range of legislation relating to irrigation, agriculture, decentralization and navigation.

In Chad, water governance is distributed among several ministries and public and quasi-public institutions, some which operate regional services. They comprise:

a. The Ministry of the Environment and Water, which is responsible for managing and developing water resources;
b. The Ministry of Agriculture's Directorate of Rural Engineering and Agriculture Hydraulics (DGRHA), which is responsible for the development of irrigation;

c. The National Office of Rural Development (ONDR), which is the quasi-public implementing agency for agricultural development programs;
d. The Lake Chad Development Company (SODELAC);
e. The Ministry of Livestock. The water sector remained fairly unregulated up until the National Assembly's adoption in 1999 of the Water Code (Law No. 016/PR/99). This aims to regulate the sector and at the same time deliver decentralization and substantially involve the private and voluntary sectors as well as end-users. Legislation approving irrigation schemes has come into force, but is being poorly implemented.

4. We also found that the decrease in fish catches has caused unemployment, hunger, and poverty in the region. In fact, the region is suffering from food insecurity, acute malnutrition and humanitarian crisis orchestrated by both human and environmental factors. Therefore, there is need for adoption and implementation of formal co-management approaches that would formally bring the management and use of the basin's natural resources closer to the local people and make them part of the decision-making process.

This finding supports Okpara et al' (2016) views that in spite of these dire conditions, there is the potential to stabilize environmental conditions in the Lake Chad Basin. For millennia the lake has experienced extreme fluctuations in size. As a result, every component of the ecosystem has developed an inherent resilience allowing the system to adapt to constantly changing conditions. The human occupants have adapted as well.

Climatic variability resulting in patterns of wetting and drying along lake margins may impair fisheries, but the deposition of organic sediment may improve conditions for grazing and certain agricultural practices. In their study of livelihood dynamics in the Lake Chad area, Okpara et al. (2016) recognize

that an attribute of robust societies is the capability to create livelihood options under uncertain conditions.

The international community is aware of the crisis. In 2017, United Nations Security Council (UNSC) Resolution 2349 recognized the adverse effects of climate change and insecurity on environmental and socio-economic conditions in the basin (UNSC, 2017). The UNSC has continued to monitor conditions in the basin. In January 2018 the UNSC issued a Presidential Statement on the crisis (UNSC, 2018). In March 2018, at its 8212th Meeting, the UNSC called for significant humanitarian and development action.

This finding is in line with Mahaman's (2014) view that international aid efforts to address the challenges of Lake Chad Basin have been met with investments from the international community. As part of its five year investment plan, the Bologna Donor Conference in 2014 resulted in the financing of several major projects for implementation of the Lake Chad Basin Strategic Action Programme. In February 2017, a conference on the Lake Chad region co-hosted by Germany, Nigeria, Norway, and the United Nations took place in Oslo. Donors pledged US$672 million to emergency assistance and support in 2017 and beyond. The humanitarian response was scaled up significantly: more than six million people were reached with assistance in 2017, and a famine was averted in selected communities in Chad and north-east states of Nigeria. The co-hosts from Oslo organized a second conference, held in Berlin in September 2018, to maintain momentum and expand international support. Related efforts to address insecurity are bearing fruit. A comprehensive regional strategy to address root causes of insecurity has been proposed by the LCBC and the African Union Commission. If adopted, this plan has the potential to redefine some of the basic structural deficiencies in the basin associated with insecurity, governance, and socio-economic conditions.

1.7 Conclusion

There is no doubt that tackling global warming is an indisputable moral imperative and that climate change represents a significant threat to the Lake Chad region. Indeed, the securitization of climate change is shifting attention away from governments, which should be held accountable and which should address pressing governance challenges that have caused vulnerability in the first place and contributed to the slow pace of economic activities.

The study concludes that the adverse effects of climate change on the socio-economic and traditional lifestyle of the people of Nigeria and Chad are overwhelmingly devastating. This is evidenced on the shrinkage of the Lake Chad water body, decrease in annual rainfall, depletion of fishery/aquatic resources, environmental degradation etc. In fact, every means of production and livelihood has been affected one way or another by climate change. Scientists have attributed this change in average weather conditions to human activities; the emission of greenhouse gases.

1.8 Recommendations

Based on the findings of the study, the Researcher enumerates several feasible recommendations that could invariably address the effects of climate change on Nigeria-Chad relations.

1. There is need to adopt a more pragmatic ecological sustainability strategy that can help reproduce the already depleted aquatic population in the Lake Chad through proper adaptation. In addition, there should be engagement in a sustained and directed sensitization/ awareness campaign on the impact of climate change on fisheries and the contribution of fisheries to household livelihoods, poverty reduction and national/regional economies. There is a general lack of understanding on the contribution of the basin's fisheries to economic development, food security and poverty alleviation.
2. Agricultural education and extension curriculums should incorporate the knowledge and experiences of rural people,

indigenous peoples and co-learning (such that extension agents also learn from others). This would help farmers to develop skills to address the effects of climate change. Policy makers should also consider mainstreaming indigenous values and practice into policy guidelines to address climate change issues. This would allow for more comprehensive measures.

3. In general, government must strive to provide policy support to reduce the exposure of fishery people to climate related risks, including reducing the dependence of people's livelihoods on climate-sensitive resources and supporting people's capacity to anticipate and cope with climate related changes. Government can do this in a number of ways:
   a. Conduct climate change risk management and allow for the cost of adaptation and the potential changes in economic contribution from the fisheries sector.
   b. Sustained support for control of gear and effort regulation. Lightly fished stocks with standard recommended gears are known to be potentially more resilient in the face of climate induced environmental changes.
   c. There is need to strengthen and empower existing or new institutions such as the Federal Ministry of Environment and Nigerian Meteorological Agency that can respond to climate change threats along with other pressures such as over-fishing, pollution and changing hydrological conditions. Institutions need to be flexible with respect to rules, customs and taboos in order to accommodate the impact of climate variability.

4. Mitigation should be enforced and the resolution of 2015 Paris agreement on Climate change must be implemented by all parties. Government should drive the socio-economic sectors through the policy of adaptation by reducing the vulnerability of social and biological systems to relatively sudden change and thus offset the effects of global warming.

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