VIETNAM NATIONAL UNIVERSITY, HANOI
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NKOM NTON BOLA

CLIMATE CHANGE AND VIOLENT CONFLICT IN TRANSBOUNDARY WATER: LAKE CHAD CASE STUDY

MASTER’S THESIS
NKOM NTON BOLA

CLIMATE CHANGE AND VIOLENT CONFLICT IN TRANSBOUNDARY WATER: LAKE CHAD CASE STUDY

MAJOR: CLIMATE CHANGE AND DEVELOPMENT
CODE: 8900201.02QTD

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Hanoi, 2020
PLEDGE

I affirm that all the result of this thesis are my personal research and has not been published. All the research materials that were used were done in accordance with regulations. The citations and references to documents, books, research papers, and websites used in this research are all in the list of references of the thesis.

NKOM NTON BOLA
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR4</td>
<td>Fourth Assessment Report 4</td>
</tr>
<tr>
<td>CCR</td>
<td>Climate change response</td>
</tr>
<tr>
<td>CEOAS</td>
<td>College of Earth, Ocean, and Atmospheric Sciences</td>
</tr>
<tr>
<td>CO2</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>LCBC</td>
<td>Lake Chad Basin Commission</td>
</tr>
<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
</tr>
<tr>
<td>NEPAD</td>
<td>New Partnership for Africa's Development</td>
</tr>
<tr>
<td>PAC</td>
<td>Paris Agreement on climate</td>
</tr>
<tr>
<td>SD</td>
<td>Sustainable development</td>
</tr>
<tr>
<td>USGS</td>
<td>Federal Interagency Sedimentation Project</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENT

I will like to express my deep appreciation to my supervisor, Prof. Hasui Seiichiro who was always enthusiastic to welcome my questions and giving me guidance and useful ideas. I genuinely appreciate all you did for me for the success of my master thesis.

My special thanks goes to my thesis advisor Dr. Kotera, who stood by me giving me all the support- morally, financially, and useful tips for the success of my master thesis. I thank him particularly for his great support and encouragement -which help me to overcome my health challenges.

I also wish to extend my gratitude to all my course-mates “MCCDers”, Students, and staff of Vietnam Japan University for all the special support given to me, especially Ms. Hoa thank you so much. I say a big thanks to JICA for the scholarship that assisted me in my Master's degree journey.

I cannot forget my friends and HIF (Hanoi International Fellowship) – Jemi, Honour, Gladys, Ms. Linda, My dad JV who stood by me and help me to overcome my health challenges.

My Previous family members – my parents, my beloved and caring sister – Bridget Osoabi- thank you so much.

Above all, I am very grateful to God Almighty for his goodness and Mercy. Without God, the story will not be the same.
ABSTRACT

The issue of climate change and conflict is causing controversy globally. Although comparative research on climate change is rapidly increasing, significant gaps in knowledge still exists as far as its relationship with conflict is concerned. Many existing studies provide mostly inconclusive insights, with contradictory or weak demonstrated effects of climate variability and change on violent conflict. This article reviews the empirical relationship between climate change conflicts. Making an enormous analysis of the causality pathways of Climate change and conflict, using the Case study that falls under the most climate-vulnerable regions - Lake Chad Basin. From the analysis -the fact remains that climate change does not cause conflict directly, but cause conflict indirectly, this is confirmed through the three stages of the causal pathways analysis of the Lake Chad case study.
CHAPTER 1. INTRODUCTION

1.1. Introduction

Intergovernmental Panel on Climate Change (IPCC) climate science's report on 2018 confirmed that the most vulnerable regions to climate change are the most conflict-oriented (climate science, 2018) also it was declared that global climate warming is clear and real - and it exists a high risk of violent conflict. However, some current investigations by a group of scientists recorded that climate change rarely influences violent conflict as there are still ambiguities about the overall result concerning the relationship between climate change and conflict due to the inconclusive result (Selby & Hoffmann, 2014) But, recent IPCC report highlights this viewpoint and illustrates the proof of a direct connection between climate change and violent conflict as questioned [Adger et al, 2014]. Because of the great controversies about whether climate change is the cause of conflict or not, this thesis decided to streamline the relationship between climate change and conflict, making a critical analysis of the causal pathway of climate change and violent conflict using a scenario that falls under the most climate change vulnerable region in the world - Lake Chad basin -

The case study of Lake Chad is a unique case scenario with glaring historical facts linking climate change and conflict being number one in the list of the top 15 most. Severest diminishing Lakes in the World. In the 1960s, Lake Chad basin was a mega Lake with a Surface-water area of about -25,000 km² but shrank to 1,350 km² due to multiple drought occurrences.

The world statistical data of violent conflict reveals that the regions with the highest figures for the numbers of recorded conflict events are the developing nations and have the highest climate vulnerability index in which Lake Chad is top on the list (UN – OCHA, 2017). The previous researches of scientists made mention that Lake Chad region is characterized with insecure,
because of the insurgency of the rebels - Boko Haram and also mentioned that drought, water, and food insecurity contributed to creating the socio-economic conditions which have a direct influence on livelihood and his led to the emergence and escalation of the Boko Haram conflict in Lake Chad. The loss of livelihood increases the pool of potential rebel recruits. (CCER, 2014). The UN news 2018, confirmed that Climate change act as - threat multiplier –as it catalyzed water and food scarcity which have fueled the ongoing conflict in Lake Chad basin. This master thesis explored the causal pathways between climate change and Lake Chad basin's conflict using the framework from the academic literature field of environmental change and conflict (Ole Magnus, 2008)

This enable the investigation of the “cause and effects” of the three conflict types in Lake Chad basin - Water conflict, Farmers-Pastoralists Conflicts and the Boko haram insurgency. Synergy of the three conflicts - shows an explicit explanation of the relationship of climate change and conflict. The Framework of the Causal pathways to climate conflict goes through three stages: ‘Early Stage’, ‘Middle Stage’ and ‘Conflict - Last stage’. (Ole Magnus, 2008)

Early Stage- shows a direct link to climate change – it is a stage where climate change extreme events impact directly on the natural resources causing -resources scarcity – numerous evidence and past researches have confirm that the freshwater scarcity in Lake Chad was partly caused by the drying of Lake Chad basin due to drought - 70% of rainfall in Lake Chad is lose through evaporation (LCBC, © 2010-2016). This have caused about 30 million people who were depending on Lake Chad water to lose their livelihood.

Middle Stage – describes the Causal link between Resource Scarcity and Social Effect –Synthesis of the outcome of resources scarcity - socioeconomic and political instability. Migration of large number of people
(mainly herdsmen) from the North to the South pool of the Lake Chad to secure their livelihood.

Last Stage- shows a direct link to Conflict - Social effect resulting to conflicts.

Between 2014 and 2015 the Boko Haram conflict expanded across Nigeria to other neighboring nations with about 10,849 death rate and many people displaced (UCDP, 2008)). The Boko Haram conflict increase swiftly due to high recruitment of helpless victims who lose their livelihoods as a result of drought. The governing body -Lake Chad Basin Commission (LCBC) has a weak institution with poor coordination of activities including - water management policies and strategies, which have caused a great number of violent conflict - In 1990s LCBC started playing a security role, after the surge of Boko Haram Lake Chad.

1.2. Problem Statement

The problem that this research deals with is to clarify the relationship between climate and conflict, this is because of the misconceptions about the relationship between climate change and conflict that need clarifications (2014; Selby and Hoffmann 2014), most of the results of the past researchers are still inconclusive. This call for a need of more researches to be done in other to give a clear insight of the role climate change plays in conflict matters. It is one of the most important question scientists are researching on - in the 21st century according to (UN Climate science, 2018).

1.3. Objectives

The objectives of the research is to explore the relationship between climate change and conflict focusing on the developing countries as it is glaring that they are most susceptible to climate variation due to the following reasons: low adaptive capacity, existing stresses and pressures like poverty, political conflicts, and ecosystem degradation and according to the report of
IPCC climate science, developing countries are the most vulnerable Regions to climate change and also the most conflict oriented (IPCC climate science, 2018).

This gave me a motivation to look at the issues of climate and conflict using one of the vulnerable region - Lake Chad as case study to race the causality with the conceptual framework of the academic literature in the field of environmental change and conflict. At the end of the study, the research question should be answered.

1.4. Research Question and Hypothesis

The research question of this master thesis are designed as:

1. Does climate change have the potential to increase the risk of conflicts?
2. What are the main indicators of climate change and how do they impact on resource scarcity
3. How do resources scarcity intensify the conflict?

Hypothesis

“Is Climate change a threat Multiplier?”

1.5. Scope of the Research

The scope of the research is restricted to the climate-induced conflict and concentrated on the group of countries that are association with Lake Chad basin either has terminal depression or as a direct source for commissioning - creating economy and livelihood of the people. And choosing Lake Chad Basin as a case study is unique because it is a hub that hold together the North, West, East and Central African nations, and because of its central position in Africa, problems associated to the Lake Chad region spread fast across other part of the nations in Africa. The fast shrinking nature affect the livelihood of huge numbers of people which is contributing to conflicts spreading to others region like a wide fire in the desert.
1.6. Literature review

Most scholars assessed the phenomenon relating to climate and conflict around the causal account that climate change leads to resources scarcity and migration, and only results to violent conflict in compounding with other conflict-induced factors. Homer Dixon states that ‘environmental scarcity is never a sole or enough cause for massive migrations, poverty, or violence, but the combination of other socio-economic and political, factors to generate its effects’ (Homer Dixon, 1999).
In 2019 the United Nations Security Council held an open debate which aimed was to identify concrete measures to lessen the consequences of global warming in connection to peace and security as it was noticed that Climate change is increasingly identified as a “threat multiplier” by scientists, political delegates, and civil society across the globe. (UN News, 2019). In 2007 a study was carried out by eleven retired US generals and admirals inferred that climate change probably may act as a ‘threat multiplier’ in mostly unstable regions where there is a decline in food production and in freshwater accessibility. They acknowledge that ‘such changes will superimpose greatly on the current tensions and impact on the vulnerable governance, economic breakdowns, huge human migrations, and inherent conflicts’ (CNA, 2007).

Many studies, plus models and foresight exercises, pointed out explicitly, how alterations in climatic conditions could scale up to higher-order security situations, resulting in conflict. Some investigations focused on the links between climate change, increased rainfall variability, and conflict. Other climatic scenarios influences security showing intersect and link to form the basis of a new geopolitical landscape.

The Horn of Africa in East Africa is a clear case scenario which Sea-level rise have a great impact on the coastal cities like Mogadishu (Somalia), Djibouti City and Mombasa (Kenya) are the most the vulnerable to sea-level rise caused inundation of important infrastructure in these cities, contamination freshwater supplies through saltwater intrusion, reduction of arable land, and likely displace huge numbers of people. The stresses on natural resources had increased the chances of conflicts when compared to other drivers of international security risks, climate change can be modeled with a relatively high degree of certainty. On the 2018 the President of United Nations Security Council confirmed that the challenges of instability (conflict) in Africa are caused by climate change and ecological changes
which include drought, desertification, and land degradation causing water insecurity food insecurity. Conflict has excavated around 2.5 million people, (NTRS, NASA, 2006) which is due to long periods of hunger and malnutrition conditions. Millions of civilians have been subjected to extreme calamity as the resources diminish and this is due to the constantly changes in the climate pattern in the past decades.

Publication by International Studies Review, Volume 20, Issue 4, December 2018, Pages 547–575, with topic “Climate Change and Violent Conflict in East Africa: Integrating Qualitative and Quantitative Research to Probe the Mechanism” Qualitative and quantitative research about climate hazards linked to environmental degradation and conflict in East Africa. The authors shows a comprehensive analytical chain of stages interlinkage from climate-related environmental change to conflict. Declining livelihood contingencies led to increase in movement and the changes in periodical immigration patterns, this has led to increased terrorist activities.

Lake Chad Basin is remarkable for its prehistory findings, its function in trans-Saharan commerce, and its connection with the famous old African kingdoms. The networks of Lake Chad basin with Senegal River basins so, we can see the necessity and urgency of researches of this nature especially for the more vulnerable regions of the world like Africa and landscape like coastal areas.

Researches of this nature will yield huge tons of benefits which include: Adaption and mitigation to drought and equitably management of the resources though sustainable development and protection of coastal areas in other to prevent or reduce the push and pull factors of population migration that inevitably culminates to violent conflict and also, reduces resources scrambling which always boils down to conflicts as appropriate measures will be taken. Drawing the attention of the governments and people in authorities to be conscious of the devastating results of changes in climate on our planet
and the condition of the nations in the nearest future and to take drastic steps for prevention or amelioration.

1.7. Conceptual Framework - Causality Pathways to Conflict in LCB

The framework gives an integrated description of the relationship and the pathways between climate change and Lake Chad basin's conflict. Climate change have indirect link to Conflict – The pathways relationship goes through 3 stages- Early, Middle and Last stage. This framework is a customization in line with "the field of environmental change and conflict academic literature’s framework.  Source: Ole Magnus, 2008, ISA's 49th, USA, Mar 26, p.14.

1.8. Research Model

The conceptual framework underlying this study is developed based on academic literature in the field of environmental change and conflict which is illustrated in Figure1. 1 above. And to investigate the connection between
climate change and violent conflict, some research questions and hypotheses are formulated, with the research questions, the link between climate change variables, socio-economic, and political effect variables (dependent and their Independent) will be examined to see their connection with conflict. The research question and hypothesis will be discussed alongside their respective variables in the various chapters below.

There are three main research questions and to examine them carefully some sub-headings are created. The first research question: “Does climate change have the potential to increase the risk of conflicts”? This is spitted into four sub-heading. Research question sub-heading (RQS1) which are:

RQS1: Does climate change lead to scarcity of resources
RQS1: Does scarcity of resources lead to socio-economic and political Instability
RQS1: Does socio-economic and political instability lead to migration?
RQS1: Does socio-economic and political instability and migration lead to Conflict.

The second research questions - ‘what are the main indicators of climate change and how do they impact on resource scarcity and the third research questions is – “How do resources scarcity intensify the conflict? The main indicator of climate change are the Independent variables: Temperature, Rainfall - drought and Dependent variables: Freshwater and food shortage and Livelihood insecurity. Analyzing the interrelationship of the variables result and how the independent variable impact on dependent variables bring about resource scarcity and with the combining effect of the independent and dependent variable multiplies threat. And this is connected to the research hypothesis which is ‘Is climate change Threat Multiplier?’ Climate change as a threat-multiplier: It has a direct and indirect impact on the livelihood of a society that leads to conflict breakout or intensifies the
existing violent conflict in society. The UN Secretary-General’s report on “Climate Change and its Possible Security Implications” (A/64/350).

1.9. Case Study - Lake Chad Basin LBC

1.9.1. Geographical Context of Lake Chad Basin

Lake Chad is one among the influential endorheic basins of the world (Data: USGS Hydro1k project) and also, one of the largest lowland area in the central Africa. Lake Chad stretches within 6°N - 24°N latitude and within 8°E - 24°E longitude. Lately, in the 60s, Lake Chad spread across about 8% of the landmass of the continent of Africa [FAO land and water bulletin, 4] approximately 25, 000km2 with an altitude of 280m, a depth of 4 meter, 275 meters (902 ft.) above sea level. Lake Chad Basin has a unique transboundary basin regional distribution that has terminal depression stretching across eight countries. Nigeria, Niger, Chad, and Cameroon are the major countries that are in direct contact with the lake thus, the basin is shared by these four countries.

Lake Chad Transboundary Waters, the geographical boundaries of the Chad basin as follows: from the north stretches to the highest tip of the Sahara and through the northwest to the mountains of Tassili n’Ajjer in Algeria. The east and northeast cover and 3,088 meters (10,131 ft.) and 1,450 meters (4,760 ft.) respectively. The Jos Plateau, the Biu Plateau, and the Mandara Mountains is the Southwestern. The west is bordered by the Termit Massif in Niger and the Aïr Mountains. The northwest boundary is distinguished by the mountains of Tassili n’Ajjer in Algeria. The east spread across the length of about 3,088 meters (10,131 ft.) of Jebel Marra in Darfur and the northeast 1,450 meters (4,760 ft.).LCBC© 2010-2016).
1.9.2. Lake Chad Basin Commission (LCBC) organizational history

The members states of Lake Chad basin resolve to forming a treaty after seeing the treaties of international organizations which Charters and Articles which are related to international cooperation in the regulation, the use and the harnessing of waters, the principles relating to the unitization of the water resources of a basin for economic purposes etc. for examples the charter of United Nation Organization (1945) Article: No. 417 of January, 1952, 533(XV111) of 2 August 1954, 599(XXX) of 3 May 1956 and 675(XXXV) of 2 May 1958 which is on the resolution of the economic and social council concerning international cooperation in the regulation and the use of waters. Article of the organization of African Unity (1963) concerning
the principles of the unitization of resources of the basin for economic purposes, including the harnessing of the water and coordination and intensification cooperation and efforts to achieve a better for people, the Lake Chad Basin Commission (LCBC) in 1964 (LCBC Review document 1990). LCBC is an intergovernmental organization that is established in order to supervise water and coordinate the use of all resource sustainably in the Lake basin. LCBC was established by the four-member states Chad, Niger, Nigeria, and Cameroon which was called Conventional Basin (LCBC © 2010-2016).

The Conventional Basin is the oldest lake-basin intergovernmental organization in Africa and a member of bodies - the African Network of Basin Organizations (ANBO) and the International Network of Basin Organizations (INBO). A member of the International Network of Basin Organizations (INBO). LCBC received the authority during the summit of 1985 to expand the organizational structure of the basin, this made it possible for the registration of two other nations Libya and Central African Republic (CAR) in 2008 and 1994. The countries with observation status are the Democratic Republic of Congo, Egypt, Sudan and the Republic of Congo (Commission (LCBC). ecdpm, pp. 1-24. The organization was founded immediately after the postcolonial rule. In the days of colonial powers, the Lake was used to demarcate borders France, UK, and Germany were the colonialist. Technical support was set up by France who is still curious about sustaining some influence in the basin. The 1990 Basic Review document of the treaty is structured two part the Convention and Statute and the Rule of Procedure. The Convention and Statute consists of 4 charters and 14 Rule of Procedure (LCBC Review document 1990). The Charters and Articles that are necessary for the report will be referred.

The Member states agreed upon the following charges:

Monitoring and managing water the used natural resources in the basin
Launching, developing and organizing natural resources development projects and research within the Lake.

Investigating complaints, promoting conflicts settlements and strengthening regional cooperation (Global Water Partnership (GWP), 2013)

Table 1.1: Surface Area of the Basin among the LCBC Member Nations

<table>
<thead>
<tr>
<th>Country</th>
<th>Basin surface area (km²)</th>
<th>Portion of basin (%)</th>
<th>Country surface area (km²)</th>
<th>Portion of basin in the country (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>1,109,201</td>
<td>44.3</td>
<td>1,284,000</td>
<td>86.4</td>
</tr>
<tr>
<td>Niger</td>
<td>671,868</td>
<td>28.0</td>
<td>1,267,000</td>
<td>53.0</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>217,340</td>
<td>9.1</td>
<td>622,980</td>
<td>34.9</td>
</tr>
<tr>
<td>Nigeria</td>
<td>180,364</td>
<td>7.5</td>
<td>923,770</td>
<td>19.5</td>
</tr>
<tr>
<td>Algeria</td>
<td>89,694</td>
<td>3.7</td>
<td>2,381,740</td>
<td>3.8</td>
</tr>
<tr>
<td>Sudan</td>
<td>81,360</td>
<td>3.4</td>
<td>2,505,810</td>
<td>3.2</td>
</tr>
<tr>
<td>Cameroon</td>
<td>46,049</td>
<td>1.9</td>
<td>475,440</td>
<td>9.7</td>
</tr>
<tr>
<td>Libya</td>
<td>1,548</td>
<td>0.1</td>
<td>1,759,540</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>2,397,423</td>
<td>100</td>
<td>11,220,280</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1.4: The Conventional Basin jurisdiction

Span across - the entire territory of Chad, Six regions in Nigeria, three regions of Cameroon, three regions of CAR, two. Regions of Niger: the LCBC Member Nations and the Surface Area of the Basin.
1.9.3. Administrative Structure of Lake Chad Basin Commission

LCBC is headed by Executive Secretary and deputy Executive Secretary. The Executive Secretary of the Lake Chad Basin Commission cumulatively Head of Mission of the Multinational Joint Force. The position of Executive Secretary can be held by a member from any of the state and its tenure last just for 4 years. The Central services of Office of the Executive Secretary include: the Basin Observatory, Legal Advice, Cooperation and Security, the Directorate of General Communication and Protocol Services, Financial Control, the Directorate of Regional Integration. The LCBC is made of three bodies.

Function of LCBC

Heads of State Summit - In charge of making decisions and orientation body of the Commission

The Council of Ministers - Supervision and control quarter, who responsible for budget allocations and program executions.

Executive Secretariat - Executive body who decide about the resolutions to be enforced by Ministers of councils. Which is based on
reformation adopted on principles which include Inclusiveness, Skill, Effectiveness, Performance, and Flexibility.

The governing bodies of the organization seat for Summit yearly they include the State members and the governing body of the LCBC.

The ECDPM identified Common challenges faced by the member states such as

- They tasks and obligations include the supervision of Lake’s resources. But the structure for water administration are usually inadequate - poor coordination of projects on water control
- Policies and procedures concerning water management on the national level are always not comprehensive (e.g. performance, indicators, plans for action, rule of laws, etc.) beside poor execution of control methods to enforce regulation of resources acquisition like (water, land) and the penalty for violations of rules are weak.
- The operating programs to observe water levels exist are incomplete
- Lacking sensitization of water users for operating programs to monitor water levels exist ineffective
- Inadequate sensitization of water users (ECDPM, 2016)
- Lack Knowledge on management issues - enforcement of laws and roles especially on the extraction of the groundwater between the upstream and downstream. The members on the downstream lake pool are always ready to cooperate more the members on the upstream this because the downstream lake is faced higher and faster decease in groundwater resources

**Operational budget and Funding of LCBC**

LCBC Operational budget is rise through contribution by its member States and external financing Funding from other bodies toward different programs carried out in different years. External organization like-
The member States contribute according to the following key as shown in the bar chart in figure 3:6 (CBLT 2008):

![Operational Budget Chart](image)

**Figure 1.6: Breakdown of Operational budget and funding of LCBC**

(Source: ECDPM, 2016)

The bar Chad shows the agreed-upon formula of the annual budget for the funding of the commission by each member state: Nigeria 52%, Cameroon 26%, Chad 11%, Niger 7%, the Central African Republic 4%. A master plan was generated in the 1980s by LCBC in support of United Nations Environment Program (UNEP) and FAO after a study on the diagnosis of degradation of environment in the conventional basin of Lake Chad by LCBC. The master plan consists the overview of the problems, constraints and opportunities that have been identified for conservation and development. The 36 projects of action plan and the water transfer from Oubangui to Lake Chad listed.

**LCBC Water Charter Strategic Action Plan - Vision 2025**

The LCBC countries embraced a long-term vision following the River Basin development model under the programs - strategic action plan (PAS) and in a Water Charter in 2008 and April 2012 respectively. The Fonds Français pour l’Environnement Mondial (FFEM) and Nigeria supported the development of the Water Charter program. Nigeria played a principal role in
preparation (Lemoalle & Magrin, 2014, VI-2). The Water Charter intends to help the LCBC reach its Vision 2025 and Strategic Action Plan with an approach inspired by the principles of Integrated Water Resource Management (IWRM). Water management resources is a critical case due to the growing human populations and a drastic increase in the consumption of water in the basin Congo (Commission (LCBC). ecdpm, pp. 1-24.)

Lake Chad Development and Climate Resilience Action Plan (PADLT)

Global warming uncertainties coupled with the current geopolitical crisis have urged LCBC to institute Plans, projects/measures which also included a short-term vision Emergency Program main for the youth and vulnerable groups in the region of Lake Chad – “Lake Chad Development and Climate Resilience Action Plan (PADLT)”. The Action Plan is in line with the outlining records developed by LCBC within the years (Vision 2025; Strategic Action Plan; Water Charter). PADLT Emergency Program was created by Lake Chad Basin Commission (LCBC) and the member states (Cameroon, Central African Republic, Chad, Libya, Niger, and Nigeria). With the assistance and coordination of the World Bank and French Development Agency (AFD) respectively.

The core idea of the Action Plan is for the restoration of peace and security, by turning Lake Chad into a rural hub for regional development. Their Plan intention main to make contribution in the provision of food, employment opportunities, and the social insertion of the youth by the improvement of standard of life of the dwellers as well as to make flexible the system which will defined by the robustly growing population, against climate change, and hydrological variability.
1.9.4. Dynamics of the shrinking Lake Chad Basin

The genesis of the desertification of the Sahara is traced back to centuries after the post-glacial era. Sahara was extensively clothed by the proliferation of forestry, especially the central massifs were enriched by all kinds of wildlife, many lakes, and dry grasslands just like the Mediterranean vegetation. Lake Chad could stretch or retreat alternatively following the wet and dry phases of seasons. But, Lake Chad water begun to dry at high rate causing encroachment of desert (LCBC© 2010-2016). The scientists and researchers traced one of the root cause back to the Global warming which was due to the raised of carbon dioxide concentrations during the last deglaciation at the end of the Ice Age which altered the net global temperature resulting in climate change. CO2 was the big driver of global warming (Nature 484, 54 (2012)).

Many investigations concerning the deglaciation confirmed great correlation between deglaciation and Substantial temperature change at all latitudes. The nature research team from the National Oceanic and Atmospheric Administration in Harvard and Columbia universities, in 2012 researched on the concentrations of CO2 and its Substantial temperature change at all latitude with the help of the proxy database, the team had the opportunity in exploring what triggers deglacial warming given details on the consequential on the In the article doi: 10.1038/nature10915 explained that deglacial warming caused Actual temperature change at all latitudes of the earth. Lake Chad basin which spread across the list of countries in Africa lying in the Southern Hemisphere had a strong correlation between deglacial warming history and the history of the physical dynamic of Lake Chad watershed.
Figure 1.7: Chronological Landmark Date and-Lake Chad Watershed
(Source: LCBC© 2010-2016)
<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000 B.C.</td>
<td>The lake covered 2 million square kilometers</td>
</tr>
<tr>
<td>20,000 B.C.</td>
<td>The lake vanished totally because of the aridity of the tropics after the peak of glaciation</td>
</tr>
<tr>
<td>9500 B.C.</td>
<td>The lake was increased by rains drenching profusely on the Tibesti massif, it got a depth of 15 m, before restoring to the state of around 9000 B.C.</td>
</tr>
<tr>
<td>7000 B.C.</td>
<td>It has a depth of 38 m, before restoring to the current situation around 5500 B.C.</td>
</tr>
<tr>
<td>4000 B.C.</td>
<td>It has a depth of 65 m, and finally covers a region of over one million square kilometers, or many hundred times its current size before recovering to the current state around 2000 B.C.</td>
</tr>
<tr>
<td>2000 B.C.</td>
<td>The lake was then a real inland sea of Central Africa, which has dried but has packed up with sand;</td>
</tr>
<tr>
<td>1000 B.C.</td>
<td>The lake has a depth of 17 m, before falling back to the current state</td>
</tr>
<tr>
<td>1908</td>
<td>The lake was only a wetland with two small basins to the north and south, and then its level raises;</td>
</tr>
<tr>
<td>1963</td>
<td>The lake covers, according to sources, 22, 903 to 25,000 km²;</td>
</tr>
<tr>
<td>2001</td>
<td>The lake surface region shrinks to 4,000 km²;</td>
</tr>
<tr>
<td>2008</td>
<td>The lake dimensions are 30 by 40 km at the mouth of the Chari River - (Logone) with a surface area of 2500 km². Lake Chad covers less than 10% of the area it occupied in 1960.</td>
</tr>
</tbody>
</table>

Figure 1.8: Variations in Lake Chad
(Source: LCBC© 2010-2016)

The seventh largest lake in the world (and the fourth largest in Africa), Lake Chad is located in the sahelian zone, a region just south of the Sahara Desert. The Chari River contributes 95 percent of Lake Chad’s water, an average annual volume of 40 billion cubic meters, 95% of which is lost to evaporation.

Lake Chad basin experienced five significant phases of recessions between the nineteenth and twentieth centuries, in the process of shrinkage. The fluctuation of Lake Chad water surface depend greatly on the seasonal changes undergoing series of stretching or retreating in wet and dry season respectively.
The waters have shrunk at a fast pace, corresponding with the advent of aridity and desert encroachment with several origins.

The Lake was alternatively named as a Mega, Large or Normal, Average, Small and Dry Small Lake Chad according to its water levels, depth and areal dimensions (Leblanc et al. 2011; Table1; Fig.2).

<table>
<thead>
<tr>
<th>Lake Chad phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes</td>
</tr>
<tr>
<td>Inflows from the Chari-Logone (km³/year)</td>
</tr>
<tr>
<td>Water level (m asl)</td>
</tr>
<tr>
<td>Number of water bodies</td>
</tr>
<tr>
<td>Flooded area of the northern basin (km²)</td>
</tr>
<tr>
<td>Dominant landscape</td>
</tr>
<tr>
<td>Aquatic vegetation</td>
</tr>
<tr>
<td>Estimated size (km²)</td>
</tr>
</tbody>
</table>

To clarify the role and relative importance of CO2 to climate dynamic in Pleistocene ice age - the nature research team built a record of global surface temperature from 80 proxy records showing that the temperature is equalized with and usually lags CO2 during the last deglaciation, in observing the temperature Variations in Northern Hemisphere and Southern Hemisphere which correlate the fluctuations in the strength of the Atlantic meridional overturning circulation recorded in marine sediments.

The results together with transient global climate model simulations, brought the conclusive result that antiphase hemispheric temperature is driven by ocean circulation changes overplayed global in-phase warming induced by rising CO2 concentrations which consequently impact the changes in the climatic system of hemispheres owing to ocean heat uptake and ice melting. (Nature 484, 49 (2012)).
1.9.5. Population Dynamic

The Lakeshore population is around 2 million (Magrin, 2016), according to UNEP, Population has risen drastically over the last 50 years to about 37 million in the basin in 2003[5]). The population density is make up of Lake Chad about 70 ethnic groups predominantly are Hausa, Fulani and Kanuri along the western shores of the lake (Nigeria), the Mousgoun in Yaere (Cameroon) and the Sara and Kotoko in the Chari Delta (Chad). This population is dominantly rural, rising on climate-sensitive agriculture-related activities (NATO Hub 2018).

The changing environmental conditions which is due to high population density is creating overexploitation natural resources resulting in tribal conflict and violence, and mass migration and making resource users insecure and vulnerable to violence. The human population is rapidly and constantly increasing in the southern lake pool due to movement from the northern lake pool since 1970s and 1980s caused by the drying of Northern pool of the Lake. In 2018 the population around the southern region of the pool is over 30 million, growing at a rate of 2.5 to 3.0 percent annually (Relief Web. (2018). Displaced Population: 17.2 Million; Internally Displaced People (IDPs), Refugees and Third Country Nationals: 2.2 Million (NATO Hub 2018).

1.9.6. Demography

Population of Lake Chad Basin unevenly distributed because of the contrast in physical geography and climate. The south western part around Lake Chad is highly populated at the region to the southwest of Lake Chad along the Komadugu – Yobe basin in Nigeria, Cameroon, and Chad and along the Logone River in Cameroon and Chad, whereas the Northern part of the conventional basin is the dry Saharan zone, is sparsely populated (WorldAtlas 2017). The diversity of the ethnic groups reflect in the cultural background such as multifariousness of belief and faith, economic activity, culture and
language. The languages spoken by the riparian communities cover a broad variety of ethnolinguistic groups (Otitis, 1990). The ancient Islamized empires are mainly responsible for the present distribution of population in the basin, according to the "Transboundary diagnostic analysis", the riparian communities speak diverse languages and one standard language. The commonly articulated “Kanuri“. It is rooted to the religious background in connection with the colonial era: Check “Lake Chad -dx Multi-ethnic groups” diagram below. The Kanuri are the dominant ethnic group in the Nigerian state of Borno comprising around 30 million people (LCBC 2013, Pages 61-62). The population of Chad dwelling in the south is comprise of 12 ethnic groups, Sara is the largest (28%), they mostly involved in farming activities; the Buduma (fishers), the Arabs (12%), (herders), the Masa and the Moundang (sedentary livestock farmers) (LCBC 2013, Pages 61-62). The south of Niger and the north of Nigeria have greatly the same mixture of ethnic groups – the Fula and Hausas and the (Fulani or Fulbe), mostly Muslim. Kanuri are the powerful ethnic group in the Nigerian state of Borno (LCBC 2013, Pages 61-62). The Fula are the largest ethnic group from Cameroon who dwell in the South of the Lake, they grow millet and sorghum and rear goats, sheep and zebus and live alongside each other Muslims, Christians and Animists (LCBC 2013, Pages 61-62).

The demographic characteristics of this population reflect a young and growing population. An average of 45% of women are of child-bearing age,

Basin-wide average of about 53 years. The characteristics of the population demography in all basin countries are a young and growing population who are of high fertility rate of child-bearing age women estimated to be 45% In recent decades, the Life expectancy estimation had fluctuated but between 1960 - 2014 has increased from an average of 37 years to 53 years respectively (LCBC 2013, Pages 61-62).
Figure 1.9: Lake Chad -dx Multi-ethnic: 30 million, 70 ethnic groups (Riparian Countries) Hausa, Fulani and Kanuri groups Mousgoun in Yaere

Ethnicity/race of Lake Chad: Sara 27.7%, Arab 12.3%, Mayo-Kebbi 11.5%, Kanem-Bornou 9%, Ouaddai 8.7%, Hadjarai 6.7%, Tandjile 6.5%, Gorane 6.3%, Fitri-Batha 4.7%, other 6.4%, unknown 0.3% (1993 census).
The data contains the latest estimated population of each administrative level 1 unit in the Lake Chad Basin. Estimation is based on input from UNFPA and the most recently available census for each country. The Unique Values is 78%

**1.9.7. Current Climate of Lake Chad**

Lake Chad Basin has a tropical climate which comprises four climate zones that are the same with the different type’s isohyets. (© 2010-2016 – LCBC). The basin lies in the Sahelian zone which is influence by the monsoon rain. The rainfall increases as its move toward the south from the north (less than 100 mm of rainfall in the north pool and 1, 500 mm yearly in the south pool. Lake Chad consists of two seasons: wet (rainy) and the dry season (© 2010-2016 – LCBC). The seasonality is responsible for the temperature difference and very significant as it decreases in the rainy season and increases in the dry period. The dry period usually lasts for 8 months which constantly reduces the rainfall period covering a few days. The various geographical regions have different rainfall variations determined by relative humidity at their altitude, which is influenced by the seasonal movement of
the Convergence Inter-tropical Belt (ZITC). Because of the movement of the ZITC, the location of the isohyets of each region can be relocated on 300 km close to the south or the north of the basin (© 2010-2016 – LCBC)

Figure 1.11: Climate Zone of Lake Chad Basin
(Source: © 2010-2016 The Commission of the Basin of Lake Chad)

Sahelo-Saharan regional environment is characterized by aridity and the erratic availability of water resources

1.10. Consequences of climate change

Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC has highlighted numerous consequences of climate change that have caused a great deal of security implications, so for the purpose of this report few potential natural consequences will be discussed and emphasis will be made on the dynamics of scarcity specifically, negative changes in the accessibility of resources – which causes complications to a community. Notably, climate-induced events, that bring a sudden menace to human lives by the continuous diminishing resource and accessibility like droughts causing desertification impacting on water and food insecurity. Also, we will dive into the impact of the climate-induced hazard on the live of the people of Lake Chad basin. Analysis of the pathways of the Causal Chain, following the Conceptual Framework.
1.10.1. Scarcity of resources

Climate change may have adverse security implications and this can cause negative feedback on the population. Homer-Dixon (1999) refer resource scarcity to low per capita availability of a renewable resource, such as freshwater.

Rising temperatures, variation in precipitation patterns, can cause the depletion of basic resources. For example, the AR4 gave a prediction that there will be a drop of 10–30% average river runoff and a decrease in the availability of water in dry regions at mid-latitudes and the dry tropics by 2050, these might probably raise the consumption of groundwater in some regions of the world which include Lake Chad, and cause potential consequences on aquifers by contamination or depletion, besides diminishing the supply of fresh water (Homer-Dixon (1999).

1.10.2. Water scarcity

In August 2019 IPCC declared that "even if the world reduces its population to seven billion by 2100, reduces inequalities, carries out effective land-use regulation, limits intensive consumption of resources and adopts environmentally-friendly technologies and lifestyles, the planet will still face water scarcity"(IPCC News on Water 2019 ). This was the conclusion of the report of the final draft of the Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystem. The IPCC projections assessments were based on five standard socio-economic pathways (SSP) which are: global population, distribution of income, consumption of resource and land in 2100 the planet will still face water scarcity even if there will be a reduction in the SSP. “What the report says is that water scarcity is now unavoidable across projections, even with extremely cautious management of population or resource,” a climate change specialist advised DTE. IPCC News on Water 2019). Lakes hold more than 90% of the Earth’s freshwater resources (Rast 2014).
WGI TAR Section 9.3.6 & WGII TAR Sections 4.3-4, 4.5.2, & 4.6 also predicted water shortage exacerbation and quality problems in many water-scarce areas of the world. In high confidence that freshwater quality would be degraded by higher water temperatures generally. The effects of climate changes on water scarcity, water quality, and the frequency and intensity of floods and droughts will intensify challenges for water and flood management. 10% in decrease of Water supply in 2050 which is climate change predictions comparing to 1% per yearly rise in CO2 emission.

Figure 1.12: Effects of climate change on water resource
Effects of climate change on water resource without climate policy interventions (Source: IPCC – Climate Change 2001)

1.10.3. Water Quality and Quantity

Environmental Protection Agency of U.S. (EPA. 2017) "describes water quality standards as the desired condition of a water body and how that condition will be protected or achieved" and approved by federal law. The global Water quality norms and guidelines provided by WHO is required to be the basis for regulation and standard-setting world-wide. This is to protect human health and aquatic life. The core elements of water quality standards include designated uses of a water body, criteria to protect designated uses, and antidegradation obligations to protect existing uses and high quality/high-value waters (EPA.2017).

The dynamic nature of Lake Chad is constantly evolving due to temperatures and rainfall variations. Water crisis and related human insecurity are caused by climate and non-climate associated factors such as State fragility, displacement, and refugee population, violent conflict, and poor environmental problem-solving tendencies. (Relief Web. (2018). Water deficits and deprivation of livelihood have often forced people who are vulnerable into hazardous behaviors like the trading of drugs and tariffing of drugs and Some of the prominent cases recorded like the jihadist militants violent have claim lives in the southern pool area of lake chad basin over to 10,000, and this associated with deterioration of livelihoods and joblessness caused by environmental destruction and resources depletion (Ifabiyi, 2013).

Many terrorist groups/rebels are at a range of young people (Ohlsson 2003)

Freshwater scarcity is also one of the core causes of conflicts which is between farmers and pastoralists. The origin of most of the conflicts lies in the struggle for security of livelihoods between farmers and the herdsman

30
created by soil degradation and diminishing freshwater. Due to the complexity of the Conflicts nature, which include the scrambling for water resources coupled with the diversity in religion and faith, there is anticipation of increase of crisis in the future.

Transboundary water conflicts between the riparian nations (UCDP, 2008; Wallensteen and Margareta, Odada et al., 2006, 1999).

1.10.4. Irrigation

Over 60% of the basin population's livelihoods are based on Agriculture so, irrigated agriculture is the first water user. Groundwater is used more for irrigation particularly for dry-season irrigation of seasonal grazing ground. Presently, due to the shrinking of Lake Chad, the development of every new irrigation should be carefully studied. The lately prepared master plan for the Conventional Basin proposes should concentrate on future developments on small-scale projects.

The Chari-Logone Rivers, with 38.5 km3/year, supply about 95% of the total inflow into Lake Chad. The total inflow in recent times has varied between 7 km3/year (1984/85) and 54 km3/year (1955/56. This fluctuation contributed to the shrinking of Lake Chad in recent time.

Table 1.2: The FAO estimation of potential water volumes - LCB

<table>
<thead>
<tr>
<th>Region</th>
<th>Irrigation potential (ha)</th>
<th>Water requirement (km³/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudanian and western Sahelian zone:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Logone River system</td>
<td>100000</td>
<td>1.500</td>
</tr>
<tr>
<td>- Chari River system</td>
<td>400000</td>
<td>6.000</td>
</tr>
<tr>
<td>- Lake Chad</td>
<td>200000</td>
<td>3.000</td>
</tr>
<tr>
<td>Central and eastern Sahelian zone</td>
<td>135000</td>
<td>2.025</td>
</tr>
<tr>
<td>Total</td>
<td>835000</td>
<td>12.525</td>
</tr>
</tbody>
</table>
The FAO has estimated current and potential water volumes used for irrigation for each riparian country—Lake Chad and the Conventional Basin.

AR4 and other related investigations reported that the impacts of climate change on the environment vary remarkably across regions. Some of the regions, like Africa and the Lake Chad region are inclusive, with this the lower latitudes will suffer a great reduction in agricultural productions which will increase hunger in 2020.

1.10.5. Impact of Climate change on the lives of the populace in Lake Chad

The section will deal with the pathways that demonstrate the impact of Climate Change in the lives of the inhabitant of Lake Chad Basin through exploring the three stages (Early and Middle stage) – showing the analysis of the indirect relationship of Climate change and Conflict – in the cause and effect as far as the lifestyle and living standard of the Lake's people is concerned.

Lake Chad cut across nearly 8% of the continent of Africa and is inhabited by over 30 million people and Climate change has significantly influenced all aspects of their lives. A Causal Chain which traverses resource scarcity - social effects – instability and conflict. Causal chain analysis will be done showing it impact on the people as we go through all the stages of causality.
Causal pathways Early Stage

The Early stage is the first phase in the Causality pathways and has a direct link with Climate Change because it impacts directly on the natural resources which the resultant effect is the scarcity of resources. So this stage explored the link between Climate Change (CC) and Resource Scarcity - its impact on people’s lives in Lake Chad Basin for examples: food insecurity, lack of access to clean water and social inclusion - like deteriorating living standards - deprivation of basic amenities and lack of employment, etc. Drought is the predominate natural hazard caused by the climate change in Lake Chad. Other hazards like flood occurs not as frequent like drought. The three elements (natural resources) that are being affected the climate hazard are: Hydrology and Water resources, Biodiversity and Environment degradation. The disintegration of the resources fully started after the incessant drought occurrence during the pre-drought period from the 1970s. (“Please see Figure Historical dynamics of the shrinking Lake Chad Watershed in Chapter 1). Since then it’s growing rapidly causing a great deal on the people and society.

- Variability of Hydrology

Prolonged periods of water variability cause shifts in the ecosystems, potentially, weakening and reducing their capacity to sustain human populations. The causal chain is identified with the jeopardy of the goods and services which include both aquatic and terrestrial ecosystems, groundwater recharge and the consequences brought is scarcity and shortage of quality drinking water, and water for irrigation and other uses.

Inaccessibility to clean water: According to World Health Organization (WHO) and UN children’s relief organization UNICEF -Lake Chad is graded sixth on the list in the world as a nation with an urgent need for access to quality drinking water.
Further assessment by WHO is about 1 in 3 people lack access to clean drinking water - the water crisis has created a huge displacement of 1.3 million people and, 1.5 million children between the age range of 5 die from diseases associated with contaminated water like diarrhea and cholera for each year in the area in Lake Chad.

During the dry season when the temperature is constantly up to 45 degrees Celsius, the pumping process of water from the Wells and boreholes are also very difficult (UN News, 2015).

Lack of clean water is causing a devastation effect of health problems and diseases. The major health problems caused by contaminated water are diarrhea and cholera etc.

**Shortage of water for irrigation:** Global Security.org LCBC confirmed that between 1973 -1987 Irrigation water decreases four-times of the amount used in the previous 25 years which was caused by the diminished of water resources due to intensive evaporation and lack of rainfall (LCBC Global Security.org, 2019).

In 1980s the UN estimated the irrigation activities and development in term of the hectares of Agricultural land that should be irrigated, between 1983 and 1994, irrigation demand rise by 200%, out of the total Irrigation potential of over 1.16 million hectares of farm land that needed to be irrigated less than 115,000 hectares was actually irrigated. And About 16.53 km3 of water was still needed for the total irrigation of 1.16 million hectares.

This affects the Agricultural sector immensely as 90% of the farming activities in the Lake Chad are irrigated-fed and for the rain-fed crops are just for on scanty months of rainfall. UNEP/DEWA - Scientific Studies had it that lack of consistent irrigation affected the agricultural activities this caused a drop in food production - about 6.9 million people suffered food insecurity
and fish yield collapsed by 90% due to lack of water inundations (UNEP/DEWA - Scientific Studies, 2003).

- **Degeneration of Biodiversity**

  The biodiversity is destroyed in different ways. The Water fluctuations destabilize the ecosystems causing them to be vulnerable to invasive species and creating a total alteration in ecosystems, fragmenting the preservation of the biodiversity, and damaging mutual functionality fully.

  Over the last 40 years, Lake Chad Basin has suffered the largest decline in biodiversity and the drastic breakdown of ecosystems due to drought. (LCBC, 1990). In 1960s biodiversity provides: Food products, services for the healthy environment like clean air, freshwater, Timber and Fiber (LCBC Global Security.org) but presently there is great lost which is causing hungers and immigration.

  Loss of fish species, loss of forests and loss of wildlife stocks. Voice interview with a fisherman in 1990, he said “Before we could catch 20, 30 basins (of fish) a day, now to get five basins is very hard.”
In the 1960s, the Lake hosted about 135 species of fish and Fishermen captured 200,000 metric tons of fish every year and there were about 20,000 commercial fish sellers in Lake Chad Basin.

Voice Interview with a Lake’s dweller in 1990, he said “When we were young, fruits and vegetables grew wild, but now these plants just don’t grow anymore”.

Presently, plants species and canopy cover of trees has disappeared due to drought. Most of the animals go into extinction and others declining in population. (LCBC, 1990) 13 YEARS AGO (Reuters interviews the fishermen).

- Environment degradation

In recent years Agricultural production has declined drastically caused by degradation of the soil and loss of soil fertility due to drought and lack of enough water for irrigation as Lake Chad shrinks.

Agriculture is the main economic activity of approximately 80% of the population of Lake Chad and about 20% are into Agro-industrial production – textiles and tanneries. Basically, more than half of the population carves a living out of subsistence farming, herding, and fishing. The Agricultural activities include peanuts, cotton, millet, peanuts, rice, potatoes, sorghum, farm animal such as cattle, sheep, goats, camels.

Food scarcity

Lake Chad's agricultural productivity has fallen drastically, Food and Agriculture Organization of the United Nations (FAOUN) evaluated that about 35,000 tons of food production is lost every year which is creating great scarcity and the problem is intensified yearly as the rain get scanty.
In 2017 FAONU estimated that about 20 to 30 million people rely on Lake Chad and as the lake dries and desertification raises - malnutrition becomes more and more severe.

Figure 1.13: Causal Chain Analysis of Resource scarcity in LBC
**Suggested Solutions**

Lake Chad basin Commission (LCBC) should make huge afford to implement SDG N0 6: “Ensure access to water and sanitation for all” This should be done through the following ways:

Promotion of good health by providing and maintaining hygiene utensils and practices which is necessary for the prevention of diseases such as cholera, hepatitis, malaria, diarrhea, etc.

LCBC should carryout economic empowerment in an innovative way. There should be an integration of WASH activities which will grant opportunities to youth especially those who were kidnapped by Boko Haram with skills development and also the youth be taught how to build bio-sand filters, fix water points, make soap, and build latrines aiming at improving the water quality and sanitation in the Lake Chad region.

Promotion of health psychological theory. These involve the encouragement and support for households to involve in the chlorination of drinking water among the people of Lake to minimize the intake of contaminated water.

Irrigation Scheme - They should be an apt irrigation Scheme. Lake Chad Basin Commission (LCBC) should establish an irrigation Scheme for the regulation of the use of the Lake Chad's water including other natural resources. The irrigation scheme policies should oversee the interstate and local level. The four transboundary countries and the locals should adhere to and maintain the irrigation methods and plan that will help to manage the usage of the water in Lake.
CHAPTER 2. RESEARCH METHODOLOGY

2.1. Method of Research

Scientific research is about the methodical process applied to enables researchers to resolve the questions and provide answers to the problems defined in the report which is a very important chapter.

Therefore, the goal of this chapter is to describe the research methodology and the research procedure that was applied in achieving the objectives and aims of this thesis.

To investigate the link associated with climate change and violent conflict the framework of the causal pathways between climate change and conflict in Lake Chad basin was used, which was Customized based on academic literature in the field of environmental change and conflict.

The framework gives an integrated description of the relationship and the pathways between climate change and Lake Chad basin's conflict.

The Framework goes through three stages: ‘Early Stage’, ‘Middle Stage’ and ‘Conflict - Last stage’. (Ole Magnus, 2008).

Early Stage describes the causal link between Climate Change (CC) & Resource Scarcity – it is about the process of disintegration of the resources of Lake Chad after the incessant drought occurrence during the pre-drought period from the 1970s.

Middle Stage describes the Causal link between Resource Scarcity and Social Effect, which is the synthesis of the outcome of the resource scarcity which brought about instabilities and proceeded to Conflict in Lake Chad.
The last stage - The synergy of the three conflict types. This stage describes the linkage of the three stages - causing the conflict in Lake Chad.

2.4 Data Collection

In this research, the data collection process the open sources method - (secondary) and primary data through voice interview.

A limitation of the open-source method is that it depends on the data available. Not all historical data was gotten. The main datasets sources used in this thesis are from the generally acceptable sources - for example, data of climate change indicators are gathered mainly from sources in the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). Sources of Data concerning resources scarcity are mainly from the Database Query of the Food and Agricultural Organization of the United Nations (FAO) and the World Bank (World Development Indicators).

Table 2.1: Main and subgroups of variables

<table>
<thead>
<tr>
<th>Groups of variables</th>
<th>Sub-groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>Temperature change, precipitation change, drought</td>
</tr>
<tr>
<td>Resources Scarcity</td>
<td>water scarcity</td>
</tr>
<tr>
<td>Social effects</td>
<td>Political instability, economic instability, migration</td>
</tr>
<tr>
<td>Violent conflict</td>
<td>Water conflict, Farmers-Pastoral conflict, Boko haram conflict</td>
</tr>
</tbody>
</table>

Variable used for analysis in the research
The indicators are representative for the variables. (Refer to table in Appendix - A)

2.3. Scientific Data Analysis Process

This section involves the Analysis of Climate Change indicators and Conflict Drivers in Lake Chad basin (LCB). The purpose of this analysis process was to found the scientific evidence to prove the shrinking of Lake Chad basin caused by Climate Change and to shows the relationship between the shrinking of Lake Chad and the conflict occurrence.

Indicators:
Dataset of temperature change and rainfall change in Lake Chad basin;

Dataset of Changes in Lake Chad Water surface level;

Dataset of Sociopolitical violent conflict;

The indicators are representative for the variables.

Analyzing Tools: Using the excel tool, the analysis with the QGIS tool

Data Sources:

Water surface level time series to assist the shrinking of LCB) from Database for Hydrological Time Series over Inland Waters" (DAHITI) in German Geodetic Research Institute -University of Munchen World Bank Group).

Dataset of Climatic Research Unit (CRU) of University of East Anglia (UEA) (World Bank Group) Temperature change, rainfall change.
Using the excel function to make correlation co-efficient scatter plot. This analysis tool was used to show the relationship between the variables. And also to use some variable to the research hypothesis.
CHAPTER 3. RESULTS AND DISCUSSIONS

3.1. Temperature change

The definition of Climate Change as given by Intergovernmental Panel on Climate Change (IPCC) is “a shift in the condition of the climate which can be noticed (e.g., by using statistical tests) through the changes in the mean and/or the variation of its properties which persist for a long period - normally decades or more years”. “Climate change may be caused by natural internal processes or external forces, or through persistent anthropogenic alterations in the structure of the atmosphere or land usage”.

Fourth Assessment Report (AR4) IPCC presents a broad assessment of the physical science of climate change summarizing the climate variability into four elements:

Temperature change: the variation of average temperature in a long time - this rise in average temperatures on a global range is considered as ‘global warming’.

Precipitation change: variations in the precipitation pattern in a long time, this constitutes an overall increment or decrease in annual snow and rainfall.

Sea level rise: a rise in the sea level in a long time.

Extreme events: a shift in magnitude or number of severe weather events in a long time.

According to the IPCC heat - waves and higher precipitation is more prevalent across large areas of land, cold days, cold nights, and frosts are becoming less regular, while hot days and hot nights are increasing around different parts of the world (IPCC, AR4 2007).
The scope of this research is narrowed down to the issues and effect of climate change as far as violent conflict are concerned.

The climate change causes will not be discussed as it is beyond the scope of this research, sticking to the conceptual framework of the research.

Climate change is a complicated process which is difficult to understand when the consequences and effect are not directly seen or felt. According to Hulme, “climate is a composed idea that takes […] sensual encounters and builds them into something more abstract.” (Hulme, M. (2009).

Thus, climate change is characterized by uncertainties therefore, scientific researchers use figures and data, graphs, images to explained climate variability and phenomena surrounding it. The climate system warning is indisputable, as is now apparent through investigations that show the increase in global mean temperatures, ocean, and air. The extensive melting of ice and snow is a notice portrayed the raised in the mean sea level globally.

Temperature is one of the main climate parameters which has the first product of climate changes with a tentacle that links to all other variables. The Third Assessment Report (TAR) proclaim that it evidence that is now accessible is considerably stronger based on the studies of the extensive increases temperature.

Berkeley Earth- California - based scientific community predicts that the near-future climate may amplify if the energies driving global warming persist at their present rate, this assumption was due to analysis of the overall temperature trend since 1980 which is +0.19 °C/decade (+0.34 °F/decade). From the 1850-1900 pre-industrial climate the temperatures were more than 1 °C (1.8 °F) above the average temperature (Berkeley Earth, 2020).
Climate Trends and Projection IPCC

IPCC reviewed as shown Figure 2 reveals that the temperature and precipitation trends in Africa over the past 30 years had fluctuated greatly and had a tremendous impact on the socio-economic development of the its states because majority of activities are agriculturally based (Serageldin, 1995).

According to the temperature projection by 2050 of IPCC Box 2-3. Climate Scenarios of African Climate Trend.

The prediction warmed that the will be temperature increase across the Sahara and semi-arid region of southern Africa which the regions include Lake Chad Basin as far as it geographical location is concerned (Hernes et al., 1995; Ringius et al., 1996) and also, the land areas may warm by as much as $1.6^\circ C$ response to the increment in temperature dry seasons will prolong over the subcontinent.

In the past 50 years, the Sahel and West Africa have undergone an increase in the near-surface temperatures. And since 1960, Chad has experienced an increased by $0.7^\circ C$ of its Mean temperatures annually, $0.36^\circ C$ per each decade and the highest degree of the increase that happened in the wet season during the months of July-September. From 1901-2016 its Mean annual temperature is $26.9^\circ C$ “Please see Figure 4.1” (World Bank group (WBG) 2020).

3.2. Analysis and Results

Changes in temperature have a direct extreme impact on crop production which also impacts on resource security. Food and water insecurity causing instability in the livelihood which always result to conflict.

According to IPCC report on 2018. Direct and indirect climate extremes which include continuous increasing temperature, drought, and heat stress etc. have detrimental effects on cropping systems (IPCC Global...
Warming of 1.5 °C Report, 2018). Climate Change had already affected crop suitability, resulting in changes in the agricultural crop production levels in many regions of the world in which Lake Chad region is inclusive.

In the case of Lake Chad about 2.4 million people are affected because of repeated droughts due to high evaporation caused by high temperature, this had impacted on agricultural production tremendously and also speeded up desertification in the northern part of the Chad, causing agro-pastoral areas to decrease and livestock grazing areas to shift further South. This had contributed to numerous farmer-pastoral conflict over grazing land around the South pool over the years. The high frequency of the conflict was prominent from 1990s across 2000 and the findings from temperature change analysis it is clear that the temperature starting rising so high in 1990s across 2000 (refer to table) this is a prove that there is a relationship between the frequency of the conflict and the rise in temperature in 1990s across 2000.

![Temperature](image)

Figure 3.1: The graph shows the change in the temperature from 1991 to 2016

The trend line shows increasing temperature. The highest point of temperature recorded was in 2010 with average of about 29.4 degree Celsius high from its lowest point of average 28.3 degree Celsius in 2008.
From Figure 4.1 further analysis done on the highest and lowest temperature recorded years (2008 and 2010) in other to examine if any unique event relating to conflict happen and also if there are any relationships between those years with the Lake Chad water level.

![Chart Title](image)

Figure 3.2: The graphs shows the annual average temperature in Lake Chad 1991 – 2016

The graph shows the (blue line) Average temperature between 1991 – 2016. And highest and lowest temperature 2010 (pink line) and 2008 (grey line) respectively between 1991 – 2016

**Findings**

Findings from the analysis of the Lake Chad Surface water level (figure 3.3 above) 2010 recorded the year of the lowest Surface water level between 1991 – 2016. Between September 2009 and May 2010 shows a drastic decline in the surface water level. From this findings the conclusion is that high temperature cause increase rate of evaporation of Lake Chad Surface water level that is why there is a decrease in water level.
3.3. Precipitation change

The rain gradient in Lake Chad Basin follows the three main climatic zones in the Chad Republic. The northern part of Chad in the arid Saharan Desert, Sub-tropical, semi-arid Sahel region in central Chad, The rainfall declines from the south to the north (less than 100 mm of rainfall in the north of Chad, Libya and Algeria– to 1, 500 mm per year in the south of the basin. Southern Chad experiences a rainy season between May-October with rainfall totals between 150-300 mm per month. Average annual temperatures are highest during this season, ranging between 27-29°C (World Bank group (WBG) 2020). Central Chad experiences a shorter rainy season that lasts from June-September and receives around 50-150 mm of rainfall per month. Seasonal temperatures vary considerably with temperatures ranging from 20-27°C in the winter and between 27-35°C in the summer. Northern Chad extends into the Sahara Desert and receives very little annual rainfall with seasonal temperature variations similar to that of the central region. The dry season lasts between November-March and very little to no precipitation falls during this season.

Figure 3.3: Rainfall Changes between 1900 – 2000 in Lake Chad

IPCC final draft of the Special Report on 2019 August declared that “The dryland population will continue to be vulnerable to water stress,
drought intensity, and habitat degradation and it is projected to effect the livelihood of about 178 million people by 2050 at 1.5°C warming, increasing to 220 mln people at 2°C warming, and 270 mln people at 3°C warming”.

The climate marker in Lake Chad is drought and water scarcity. Years of critical droughts were between the 1970s - 1980s which led to the lake drying up of larger portion of the Lake water - from 25,000 in the 60s to 2,000 km² in the 90s.

![Drought severity map](https://crudata.uea.ac.uk/cru/data/drought/)

Figure 3.4: Climatic Research Unit (CRI) Drought indices (Self-calibrating Palmer Drought Severity Index (scPDSI))
https://crudata.uea.ac.uk/cru/data/drought/
The Figure shows the years of major drought with the Shrinking of the Lake from the 1970 – 2000s. As the rainfall reduces the LC surface water reduces too. The population increase across the year.

3.4. Consequences of Climate Change and Effects

From the conceptual framework, deals with the Causal Chain Analysis (the Middle and last stage). It is shown from the framework that the outcomes of climate change can result in social impacts such as unstable situations politically, economically, and cause immigration. So, this section will discuss about the cause and consequences on Social and economic welfare of the populace of the lake by the analysis of the connection between the results of climate change (resource depletion) and social effects looking at the negative or positive feedbacks.

In section 3.2 of the report - the first research question was spitted in to sub-headings and this section should try to answer the RQS1:

**Does scarcity of resources lead to socio- economic and political instability in Lake Chad?**
3.5. Political instability

According to the political theories of Max Weber, political stability depends on the government's legitimate use of physical force. If the government cannot ensure the basic services it provides to his citizens, such as security and the possibility of procuring food and shelter, it loses the power to enforce laws and political instability ensues. Political instability is associated with the concept of a failed state. (Max Weber Reference.com, 2020).

The Intergovernmental Panel on Climate Change (IPCC) declared that ‘The potential implications of changes in the climate and conflict is top on the list in the international political agenda’ (Climate &Conflict, IPCC). In the previous years, the Lake Chad region is characterized as been insecure, because of the insurgency of the rebels - Boko Haram, this has claim the peace and security of the Lake (Darby, M. (2018). Climate change is confirmed as a threat to security and pictured as a threat multiplier - causing food, water, and livelihood vulnerability, spurring heightened migration, and excavating political instability.

Worldwide Governance Indicators (WGI) concluded that the average quality of governance around the world has not improved much over the past decade (1998-2008) though some regions have made extraordinary advancements in their governance, African countries including Lake Chad are still in the back stage. Quality governance is the one that can efficiently formulate and implement sound policies that will reflect in the economic and social statue of the state (World Bank 2009 – WGI PRESS RELEASE). Max Weber also added that if the government cannot ensure the basic services for his citizens, such as security and food and shelter, it misses the capability of implementing laws that bring about a lot of political uncertainty. The political imbalance is related with the notion of a failed state. (Max Weber Reference.com, 2020).
WGI confirmed that better governance helps in the fight against poverty and improves living standards. (World Bank 2009 - PRESS RELEASE WGI).

The WGI measure five broad Indicators to measure a quality governance of a country:

- Voice and Accountability:
- Political Stability and Absence of Violence:
- Government Effectiveness:
- Regulatory Quality:

In Chapter 3 session 3.6 it was discovered that the governing body of LCBC have a lot of setback and challenges as a result of ineffectiveness of the governance which brought political stability and violence in Chad. Lack of good water management policies. Lack of cooperation and motivation among the riparian countries etc.

The member states did not adhere to its convention which legally bind them. LCBC Read more in section 3.6 of Chapter 3 in the report.

The LCBC is weakened by political and financial issues and suffers a lack of effective institutional capacity and technical knowledge to tackle transboundary aquifers challenges. For these reasons, LCBC is often bypassed, even when problems fall under its mandate.

There was an absence of structural and regional organizational settings for basin till the 1990s when LCBC started playing a security role over its Member states. This was after the surge of Boko Haram outside Nigeria to Lake Chad. LCBC formed a political forum that is used as a platform to regulate and recognize basic security hurdles that LCBC is confronted with.
A group to organize shared services authorized by the AU and with international funding (ecdpm, 2016).

3.6. Socio-economic instability

Drought and food insecurity helped create the socio-economic conditions that led to the emergence of Boko Haram and the violent insurgency in the North East of the country” (CCER, 2014). The social effect associated with the consequences of climate change that can create violent conflict economic instability. Food, freshwater, and soil insecurity influence the livelihood directly. This can cause poverty at the individual as well as the national level. Poverty (typically measured as low per capita income) has long been considered a major cause of civil war (Collier et al., 2003). About 30 million people livelihoods depend on the Lake Chad Basin.

The agricultural activities are mainly rain-fed mostly in the south pool. But, water demand for irrigation has drastically increased in the last thirty years. For example, between 1983 and 1994, irrigation demand has risen by 200%, leading to overexploitation of water resources. Irregular precipitations and the low efficiency of irrigation systems is the primary cause of it. Loss of livelihood in agricultural societies increases the pool of potential rebel recruits, resulting in a higher conflict risk. "Poor economic accomplishment means an increasing ‘ingenuity gap’ between the developed and the developing world, whereby the latter has less to spend on adaptive buffers against more extreme weather-related events, such as more resilient infrastructure, irrigation systems, and desalinization plants for freshwater production (Homer-Dixon, 1999)". They can be found in reappearing economic crises, reforms and weak governance in the region, linked with increasing inequality and confusion at corruption amidst the ruling elite. These helped to set the stage for strengthening religious fundamentalism and the rise of the armed opposition group.

Sahel is very vulnerable to a warming world and also Lake Chad as its falls under Sahel climate. UN reported that the world temperature will
increase of up to 3 to 5 °C by 2050. This will cause alterations in seasonal agricultural activities - the span and timing of season will be affected, which influences the yield of crops.

Nearly 33 million people in the Sahel fall under the label of food vulnerability. The UN Food and Agriculture Organization (FAO) reports that a decline in the growth of grain and food products shows that herdsmen will be migrating in search of fertile lands at random periods, and this can be that the cattlemen arrive too early or hang on longer than usual which can promote violence among two groups.

There had been many previous investigations of Lake Chad Basin water resources and hydrology cycle conducted by international bodies such as ORSTOM, the UNESCO "Study of Water Resources in the Chad Basin" (1970), the FAO "Survey of the Water Resources of the Chad Basin for development Purposes" (1972), the UNDP's "Lake Chad Basin Development Study" (DRN 1979), and many others.

**Social Impact - Loss of economic activities**

The main direct socio-economic consequences of the variability of hydrology and Water resources are related to the failure of agriculture, fisheries and livestock as the local economic activities of the people Lake Chad are fishing, agriculture, and pastoralism. The decreasing availability of water reduces the yield of these goods and services such as lost of livelihood, lack of alterative livelihood, lack of economic development activities and lack of Job opportunity

**Migration**

According to -World Health Organization (WHO) the crisis of lack of access to clean drinking water has caused massive displacement of about 1.3 million people in Lake Chad.
According to Mr. Boukar (Agricultural engineers in Lake Chad) in a voice interview “he says, “more and more men are migrating in quest of jobs in nearby countries” as the Lake continue to disappear.

Over 2.6 million people are currently displaced across Lake Chad Basin. While Boko Haram insurgents have changed tactics and continue to terrorize people of the basin. It has not only affects the economy by the blockage of major trade routes but also caused movement and trafficking, drastic displacement of the communities. People are continuously on the move.

3.7. Result - Causal Chain Analysis

The International News 2017 the UN Security Council gave a verdict on the Lake Chad region - outlining their concern about the interplay of factors driving the crisis and calling for better collaboration amongst UN armed to deal with the condition. And Adelphi pointing in his report "Insurgency, Terrorism and Organized Crime in a Warming World" “The complex risks arising from climate change, fragility and conflict can add to the increase and growth of terrorist groups, like the Boko Haram and Islamic State (IS)”. 

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Figure 3.6: Causal Chain Analysis of social effect and Conflict

(Source: Janani Vivekananda, ECDPM Great Insights magazine, autumn 2019, Volume 8, Issue 4)

Causal Chain Analysis - showing the social effect and conflict in Lake’s Community.
The EU’s 2016 Global Strategy states that “Climate change and environmental degradation exacerbate potential conflict, in light of their impact on desertification, land degradation, and water and food scarcity”. The Strategy considers climate change to be “a threat multiplier that catalyzes water and food scarcity, pandemics and displacement in its statements on 2017 about climate risk - the emphasis is on translating the high level potential conflict climate risk problems into effective policy. The policymakers governing bodies have to concentrate more on the security, stability, and migration. Tension remains but increased multilateral cooperation on poverty and climate change lessens the risk of instability (EU, 2017).

Lake Chad political instability arises from several issues, including widespread corruption, weak government institutions, high migration from North pool to South Pool of the Lake due to desertification terrorism, has successfully exploited the political vacuum Tension remains but increased multilateral cooperation on poverty and climate change lessens the risk of instability.

Climate change and desiccation of Lake Chad itself may not be perceived as a root of conflict in the Lake Chad. But, the local population facing a declining living condition, vulnerability and the limited capacity for adaptation to new conditions constitute a suitable condition for armed movements to emerge since unemployed youth became more reluctant to be recruited by this organization to improve their living standards.

Therefore, this supports the evidence that climate change itself does not create conflict, but the lack of active governments that are not able to deal with environmental issues may lead to conflict (e.g., Barnett & Adger 2007; Salehyan 2008; Cook & Bakker 2012). And this partly answer the RQS1:

Does scarcity of resources lead to socio-economic and political instability in Lake Chad?

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And the hypothesis of the report:

Is Climate change a threat Multiplier

3.8. Climate change-induced social effect and violent conflict

International humanitarian law classified armed conflicts in two categories: International armed conflicts and non-international armed conflicts, "International armed conflicts opposing two or more State, Non-international armed conflicts, between governmental forces and non-governmental armed groups, or between such groups only". The Geneva Conventions of 1949 states that: "In addition to the provisions which shall be implemented in peacetime, the present Convention shall apply to all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties, even if the state of war is not recognized by one of them. The Convention shall also apply to all cases of partial or total occupation of the territory of a High Contracting Party, even if the said occupation meets with no armed resistance".

Hsiang et al (2013). For each one standard deviation (1σ) change in climate toward warmer temperatures or more extreme rainfall, median estimates indicate that the frequency of interpersonal violence rises 4% and the frequency of intergroup conflict rises 14%.
Figure 3.7: Lake Chad Basin Conflict Events and Fatalities

(Source: Creative Commons Attribution-Share Alike 3.0 License)

This dataset contains information about conflict events in the Lake Chad basin crisis region as compiled by ACLED - data source ACLED & UNFPA 2020. CLED is the highest quality and most widely used real-time data and analysis source on political violence and protest around the world. Practitioners, researchers, journalists, and governments depend on ACLED for the latest reliable information on current conflict and disorder patterns.
Figure 3.8: Map showing expansion of terrorist group the nations.

Showing expansion of terrorist group across Nigeria to the neighboring nations Boko Harm violence escalated dramatically in 2014 and 2015 with 10,849 death rate and many displaced.
Figure 3.9: Frequency of conflict and seasons

The graph showing the number of conflicts in the different month between 2016 and 2017. The month with the highest conflict occurrence are the month of dry season while the month with less or no conflict are month in the wet season. This is one the proof to show that climate change triggers conflict. Relationship in the seasonality and conflict. Availability of precipitation from lessen the risk of conflict. 29 April 2017, Adelphi publish a report illustrating the fact that the vicious cycle of violence, conflict, and fragility are exacerbated by the impacts of climate change and Lake Chad is viewed as the most typical case study in the world. The most vicious cycle of violence group so far is Boko Haram.

**Lake Chad surface water analysis**

The purpose of this analysis is to find the Scientific evidence that shows the relationship between the drying of Lake Chad basin and climate Change with conflict.
Figure 3.10: This graph shows changes in Lake Chad’s water surface level

The volume of Lake Chad basin from 1992 to 2020 about 27 years ago.

The purpose of the analysis is main to prove the scientific evidence of the shrinking of Lake Chad:

1. The graph shows the altitude of the water volume across the years and seasons. This confirms that the water level storage is always very unstable, with a very high level of fluctuation in the volume in the water surface. The unstableness in the surface water is partly the evidence that shows the drying of the lake water.

2. The trend line shows a gradual increase in the water volume between 1990-2000 - and maintains a constant volume between 2000-2010 showing gradual increase between 2010 and 2020 again.

3. The graph shows a regular rising and falling pattern in the water volume showing different periods where the water level rises consecutively and falls again in phrases.

4. The wet and dry seasons.
Figure 3.11: Water level phases of Lake Chad Basin from 1992 - 2020).

The graph highlights the water level phases of the Lake Chad Basin from 1992-2020. It shows the maximum (Annual max.), minimum (min), and average water level.

**Findings:** Lake Chad surface water storage holds about 20% of its total water. This part of the lake water serves a very important purpose as livelihoods including fish farming, livestock, and domestic uses are carried out. The basin water surface is highly relevant to the inhabitants around the lake. 60% of groundwater of the lake is extracted via boreholes. My observation is during the wet season the risk of conflict over scrambling for water supplies or scarcity become less because the agricultural activities will be rain fed due to the precipitation less water extraction for irrigation (farming), livestock, and domestic use and promoting fishing farming growth well, thus less resources scarcity (water and food). Livelihoods are concerned more stable as compared with the dry seasons. More green land for cattle grazing reducing the mass movement of pastoralist in search of green land for gazing which is the major cause of Farmers-pastoralists conflict.
Farmers-Pastoralists Conflicts (Major Conflict events)

The farmer-pastoralists conflict occurs due to scarcity of freshwater, this is because of the high migration of the pastoralists and the farmers to the south pool for greener pasture which causes increases in demand for resources. The lack of proper management (policies and rule of laws by the institutions) are what is increasing the conflict risk. (Obioha, 2005). In northern Nigeria, the main causes of conflicts are raced to struggle of livelihoods security between the pastoralists and farmers which is as a result of the decrease of freshwater and the Greenland areas. Scrambling for access to resources and the differences in religion are the genesis of the crisis. Climate change intensifies freshwater scarcity.

The changes in the climate, in turn, influence the rain patterns and constrain the farmers and pastoralists' rhythm of agricultural activities. (Obioha, 2005).
CHAPTER 4. PROPOSAL OF SOLUTIONS AND
RECOMMENDATION TO REDUCE OR END THE VIOLENT
CONFLICT IN LAKE CHAD

4.1. Introduction

This chapter aims at proposing ways to minimize or end the violent conflict in Lake Chad. The proposed solutions are based on the results of the analysis of Lake Chad's Case study. There are categorized into three sessions, including- the Short-term, the middle-term, and the long-term solutions.

SHORT-TERM SOLUTIONS

This entails LCBC stopping the conflict immediately and this should be done through negotiations and implementation of activities that will bring peaceful co-existence among the Lake Chad inhabitants. The Short-term solutions should be the first actions to be taken in the process of resolving or reducing the conflict in Lake Chad and they should be executed as soon as possible – between a span of 1 to 2 years. Nothing can be accomplished in a chaos and crisis environment, so the Short-term solutions are the stepping stone in the conflict settlement. The Short-term solutions should include:

- **Negotiations:** It is a powerful tool in conflict settlement. The past Lessons shows that the administration of the United States fails due to the policy of non-negotiation with rebels. (Interview Voice): 2015, Nigeria news. This is why negotiations should the first tool to be apply.

  The negotiations actions should include:

  (i) The government should set up a platform for dialogue between the leaders of the herdsmen and farmers associations, including other stakeholders -like traditional authorities, interest groups, and the civil community.

  (ii) The dialogue should include acknowledgment of the difficulties and grievances of both parties (herdsmen and farmers) and addressing them.
(iii) They should be laws and norms that should prohibit any further conflict instigating factors for both parties (pastoralists and farmers) and allow both parties to know their limits and bounds and penalties for violation. These laws and norms should be unanimously accepted by all parties and panels in the dialogue forum.

- **Poverty alleviation schemes**: LCBC governing body should negotiate with the terrorist groups- and this should involve given incentives to the victims who were recruited by the terrorist group due to loss of livelihoods. The incentives can be informed of given loans to enable small-scale businesses establishments especially by the vulnerable victims.

- **Empowerment programs**: LCBC governing body should sponsor educational programs and seminars, lectures that will create a platform where skills and talents will be developed and used for the betterment of the individuals and the societies, this will prevent situations of jobless, idleness, hunger, sadness among the inhabitants of Lake Chad, which are the ingredient that generates conflict and violent. This will go a long way in preventing –the long time adage that says "Hunger man is a hunger man" and, "An idle man is the devil workshop"

- **Employment Opportunities**: Government should co-operate with other institutions, organizations, and large-scale business organizations etc. to Create jobs employment opportunities for mass recruitment of jobless people in the Lake Chad.

- **Agricultural Adaptation to Climate Change**: The Government institution of Agriculture should improve, teach, and encourage the farmers into applying practical adaptation measures and best farming practices like cultivating more of drought-resistant crops to meet the severe condition of climate. The improvement of the traditional farming practices should include:
(i) Recession cropping, in the moist soil accompanying the main harvest at the end of the rainy season.

(ii) Weak or lost rain-fed yields of sorghum and rice should be supplemented by Berbéré sorghum that is more resistant to drought and can grow from the surplus soil moisture.

(iii) New species with short growing cycles facilitate a second harvest before the onset of the dry season during which irrigation is needed to assure the success of horticultural activities.

MIDDLE-TERM SOLUTIONS

Middle-term solutions are separated into two sections - Technical solutions and Political Solutions. Technical solutions should be pilot projects that need funding assistance by the international bodies like World Bank, UN etc. and should be executed within 5 to 10 years.

- **Technical solutions** – These are sets of solutions focus on:

  (i) Evaporation reduction - Lake Chad basin water surface evaporation losses should be minimized by the use of chemical films - Fatty alcohols - (Cetyl and Stearyl - alcohol carbon compound (IJCIE, 2013). Many experiences from past researchers had shown that Cetyl and Stearyl substances when sprayed across water’s bodies can lessen evaporation drastically without been harmful to the aquatic organism.

  (ii) Restoration ecosystem: Lake Chad water and ecosystem could be restore through Inter-Basin Water Transfer using solar power technologies. These require pumping water from the Ubangi River by gravity through canals – pumping about 1000 m3 of water in a second to Lake Chad- consuming only 0.5 to 07 of the Ubangi River water. Without affecting aquatic animals.
These will add about 3000 square kilometers of Lake Chad surface water yearly, in consideration of the quantity of water drawn for irrigation purposes (LCBC project visions, 2018).

- **Political Solutions**

(i) LCBC must be strengthened and empowered and which could be achieved through Cooperative management – all stakeholders (ministers of water, environment, and agriculture, etc.) in all the levels including National, Regional, and Local levels and institutions should agree to work together unanimously.

(ii) Making and coordination of policies that have to do with the sustainable management and use of Lake resources- especially (water and land).

(iii) Impacting education of technical knowledge concerning adaptation for the benefit of both the farmers and pastoralists. These could be achieved through conducting seminars, lectures, etc.

(iv) The corporation with the international bodies, expertise for the purpose of consultation and funding and implementation of pilot development projects (UNDP, World Bank, etc.) projects like – Reforestation of vegetation cover, restoration of Lake Chad ecosystems around the lake chad basin

**LONG-TERM SOLUTIONS**

These sets of solutions are the general solution for climate change- which includes the Paris agreement (UNFCCC) - to keep the average temperature below 2 °C globally- as in the pre-industrial era and slow down the rise to 1.5. These involve all countries including the riparian countries of Lake Chad Basin making plans and decisions to reduce the emissions of greenhouse-gas through mitigation and adaptation (UN (2015).

**4.2. The synergy of Climate Change Adaptation, Mitigation and, Sustainable Development**
Climate Change Adaptation, Mitigation and, Sustainable Development could bring about Conflict reduction in Lake Chad Basin. From the research, we can see that LCBC’s political status and institutions are so weak (“Please see section” – Administrative Structure) partly due to the absence of the SDGs implementation.

Lake Chad conflict situation needs the application of Goals 16 (peace, justice, and strong institutions) and Goal 1 (no poverty), Goals 2 (zero hunger). There are highly recommended in other to reduce Lake Chad conflicts. Therefore the establishment and the implementations of goods laws and policies are needed as far as peace, justice, and strong institutions are concerned.

The above result concerning - tracing the pathways between climate change and Lake Chad basin's conflict using the framework should be noticed. The “cause and effects” of the three conflicts - Water, Farmers-Pastoralists Conflicts and the Boko haram insurgency (refer to Framework – Climate Change Pathways to Conflict above). How the three conflicts are linked - which show a clear explanation of the relationship of climate change and conflict (“Please see the section” – Causal Chain Analysis of Lake Chad scenario in Chapter 4).

4.3. Recommendations

The nature of the Lake Chad conflict situation is very complicated, and to attain a long-lasting conflict-free environment the settlement process should be done systemically, consecutively, logically, and innovatively.

Many solutions have been proposed, but the recommendation is that the short-term solutions should be applied first because these are mainly to stop or reduce the conflict immediately in Lake Chad.
Nothing can be accomplished in a chaos and crisis environment, so the Short-term solutions are the stepping stone in the conflict settlement process. And to maintain a long-lasting peaceful and progressive nation- the LCBC should follow-up with the Mid-term and the long-term solutions immediately the short-term solutions are successfully implemented.
CHAPTER 5. CONCLUSIONS

In this thesis, the link between climate change and violent conflict has been examined. And the research question and hypothesis were analyzed and answered.

In conclusion, the fact that climate change does not cause conflict directly, but cause conflict indirectly is confirmed through the three stages of the causal pathways analysis of Lake Chad study.

The pathways of causality which are -The Resource Scarcity (Early Stage), Social Effect (Middle Stage) and the Conflict - Last stage. The summary of the analysis are follows:

The Causal pathways Early Stage – explored the link between Climate Change (CC) & Resource Scarcity (Early Stage) in Lake Chad Basin.

This stage shows the process of disintegration of the resources of Lake Chad after the incessant drought occurrence during the pre-drought period from the 1970s. (Please see: Chronological Landmark Dates -Lake Chad Watershed above). The biodiversity, freshwater and soil declined drastically given rise to scarcity. This gave an answer to the second research question of the thesis “What are the main indicators of climate change and how do they impact on resource scarcity”.

Causal pathways between Resource Scarcity and Social Effect - (Middle Stage)

This stage shows the synthesis of the outcome of resources scarcity – This implies that resources scarcity are directly link to instability-socioeconomic and political instability. The migration of large number of people (mostly herdsmen) from the North to the South pool of the Lake Chad to secure their livelihood which was due to scarcity of fresh water and Greenland for cattle grazing.
Causal pathways from Social Effect to conflict - the last stage-

This is the last stage conflict resulting from instability- socioeconomic and political instability. The analytical diagram below shows the synergy of the three conflict types in Lake Chad.

The Boko Haram conflict escalated drastically due to high recruitment of helpless victims who lose their livelihoods as a result of drought. This answer the hypothesis – “Is climate change threat multiplier?”

In conclusion, we have seen that climate change does not cause conflict directly, but cause conflict indirectly- this fact is confirm through the three stages of the causal pathways as narrated above in (Figure 5.1 Figure 5.2 Figure 5.3.).

From the researches it was reveals that the world statistical data of violent conflict is rising and the regions with the highest figures of recorded conflicts events are regions with the highest climate change vulnerability index. Among the top five regions on the list are the developing countries which Lake Chad region is inclusive (UN –OCHA - 2017). Among other general facts and findings concerning Conflict and Climate Change (CC) are:

The most vulnerable regions to climate change are most conflict-oriented (IPCC climate science, 2018);

A drought crisis country always crash down to conflict if the economy is Agriculture based under weak Institutions (poor policies) and poverty (Report by WWF) Syria, Lake Chad etc. ” Barack Obama said in 2015, “drought and crop failures and high food prices Help to multiply conflict during the early unrest in Syria.

According to World Bank data (2015) – more than 50% economy of some developing countries including Lake Chad Basin is agriculture-based, and have food insecurity score below 50%. Highest concentration citizens
under poverty with poor living standard but there are the lowest C02 emitters in the world. Drought is one of the most devastating natural hazards in the world.

“According to Report by WWF - 55 million people are affected by drought crises every year, across the world. (Posted on 25 August 2019)”.

With the above facts - the analysis of the causal pathway of climate change and violent conflict was done based on one of the regions with the attribute of all the above facts - Lake Chad basin case study.

5.1. Limitations of the Research

Every research has a limitation and so does this research:

There is a problem of inadequate data collection. Due to the current global pandemic, I could not travel to my research location for field research and investigations due to the restriction of movement and social distance. So the research’s limitation is that it depends on the data available and most of the historical data were limited.

5.2. Recommendations for future study

In my research, going through the causal pathways to conflict I discovered that the most important element to prevent or intervene this deadly causality pathways immediately is in the middle stage of the pathways - the social effect and the 'changes' - instability in the political and social aspect which is very important in conflict reduction or prevention.

So the future research should focus on - the role of the government in bringing about stability and peace in the face of pre-crisis and pre-crisis (stage between the Middle and Last -Conflict stage (resource scarcity and instability). Since Climate change has become a crisis of our time, the government should know how to manage climate change and conflict drivers for a peaceful nation.
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## APPENDIX – A: MAIN AND SUBGROUPS OF VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Element</th>
<th>Indicator</th>
<th>Description</th>
<th>Source</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate Change</strong></td>
<td>Temperature Change</td>
<td>Temperature anomaly</td>
<td>Average Monthly temperature changes in Lake Chad</td>
<td>World Bank Group. Climatic Research Unit (CRU) of University of East Anglia (UEA).</td>
<td><strong>Climate Change</strong></td>
</tr>
<tr>
<td><strong>Precipitation Change</strong></td>
<td>Rainfall</td>
<td>Average Monthly rainfall changes in Lake Chad</td>
<td>World Bank Group. Climatic Research Unit (CRU) of University of East Anglia (UEA).</td>
<td><strong>Precipitation Change</strong></td>
<td></td>
</tr>
<tr>
<td>Social effects</td>
<td>Political Instability</td>
<td>Political stability and absence of violence</td>
<td>World Bank Group. Climatic Research Unit (CRU) of University of East Anglia (UEA)</td>
<td>Social effects</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Rule of law</td>
<td>The quality of public services, the quality of the civil service and the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The indicators are representative for the variables. (Refer to table in Appendix - A) (source: extracted from UEA-World Bank Group, 2018)
<table>
<thead>
<tr>
<th>Riparian Countries</th>
<th>Religion</th>
<th>Ethnic group</th>
<th>Language</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>Muslims and non-Muslims- (Christianity, atheist, agnostic,)</td>
<td>Sara - (Mbay, Kaba, Gulay, Dai, Ngambay) Buduma Arabs Masa Moundang</td>
<td>Nilo-Saharan, Arabic</td>
<td>Fishing Pastoral farming sedentary-livestock-farmers Cotton, cassava, and millet.</td>
</tr>
<tr>
<td>Niger</td>
<td>Muslim(Majority)</td>
<td>Hausas Fula</td>
<td>Fulfulde</td>
<td>Fishing Pastoral farming</td>
</tr>
<tr>
<td>Cameroon</td>
<td>Muslims, Christians Animists</td>
<td>Fula(Majority) Arabs Kotoko Masa, and Sara</td>
<td>Fulfulde</td>
<td>Fishing, grow millet and sorghum goats, sheep, and Zebus</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Muslims</td>
<td>Hausas and Fulani</td>
<td>Kanuri Fulfulde</td>
<td>Fishing, Pastoral farming</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>

Source: © 2010-2016 the Commission of the Basin of Lake Chad
## APPENDIX C: WATER SCARCITY CONFLICT

<table>
<thead>
<tr>
<th>Period</th>
<th>Nature</th>
<th>Casualties</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>Conflict between Cameroon and Nigeria due to the possession of water resources in the south pool of the lake basin</td>
<td></td>
<td>(Odada <em>et al.</em>, 2006).</td>
</tr>
<tr>
<td>1983</td>
<td>Interstate violent conflict Chad and Nigeria over water basin</td>
<td>About 100 fatalities cases</td>
<td>(Margareta and Wallensteen 1999).</td>
</tr>
<tr>
<td>late 1980s</td>
<td>The conflict between the Republic of Niger and Nigeria over water disparity and control at the Komadugu-Yobe River inflow in the lake basin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>Nigeria(disputes between upstream ) and Niger (downstream) populations over control over waters from the Tiga and Challawa gorge dams in the Lake Chad southern-western.</td>
<td></td>
<td>(Odada <em>et al.</em>, 2006).</td>
</tr>
</tbody>
</table>
Since 2005 | Struggles and fights for the use of water in southern pool. (violent jihadist militants) | Ifabiyi, 2013.
---|---|---
2005 | Fulani herdsmen and farmers dispute over grazing land. | Dozens of people were killed
2012 | Fulani herdsmen and farmers |
## APPENDIX D: FARMERS PASTORALISTS CONFLICTS
### (MAJOR CONFLICT EVENTS)

<table>
<thead>
<tr>
<th>Years</th>
<th>Nature of Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2012</td>
<td>A clash between farmers and herders in Gwer West area in Benue State left five people dead and many others displaced</td>
</tr>
<tr>
<td>April 2012</td>
<td>April 2012 one person was killed and several others were injured in a Fulani-Hausa Clash in Sokoto.</td>
</tr>
<tr>
<td>March 2012</td>
<td>Sixteen people were reported killed in a clash between Tiv farmers and Fulani herdsmen in Kadarko community, Giza Local Council of Nasarawa State. About 5,000 residents fled the community to safer areas in nearby towns.</td>
</tr>
<tr>
<td>March 2012</td>
<td>Conflict between Fulani pastoralists and sedentary farmers in Gwer West Local Government Area of Benue State left over 30 people dead.</td>
</tr>
<tr>
<td>November 2011</td>
<td>Fulani/ farmers clash in Kirikasamma Local Government area of Borno State left one person was killed and over 17 people from the farmers’ side seriously injured. The clash was triggered when farmers in the area</td>
</tr>
</tbody>
</table>
took measures to protect the perennial destruction of their yet-to-be-harvested farm produce and incessant attacks on them by the Fulani pastoralists.

Conflicts between farmers and Fulani pastoralists in Benue State, left two soldiers, some 50 men, women, and children dead.

### March 2010

Fulani herdsmen invaded three villages of Dogo Na Hauwa, Ratsat and Jeji in Jos South Local Government Area of Plateau State killing many people including mostly children and women in a barbaric manner.

### December 2009

32 people were killed, scores of houses burned, and several farms destroyed following clashes between pastoralists and farmers in Nassarawa State.

About 700 pastoralists were expelled from Borno State and another 2,000 from Plateau State after attacks on local farmers.

### February 2005

Dozens of people were killed in Adamawa state when Fulani herdsmen alleged to come from Chad
and Niger attacked farming communities in a dispute over grazing land.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2004</td>
<td>49 farmers were killed as they flee nomad attacks by Nomads in the farming town of Yelwa, Plateau State.</td>
</tr>
<tr>
<td>May 2003</td>
<td>Cattle herders attacked and burned 34 farming villages in Adamawa and Gombe States resulting in 63 dead and over 500 injured. The attackers, thought to be nomadic herdsmen from neighboring Chad, attacked the rural town.</td>
</tr>
</tbody>
</table>