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Climate Change and the Political Economy of Fish Production in the Lake Chad Basin

Anthony Chinonso Ajah

Ph.D. Student, Department of Political Science,
University of Nigeria, Nsukka, Enugu State, Nigeria

Ukachi Clementia Uche

Senior Lecturer, Department of Horticulture and Landscape Technology,
Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria

Edinya Jatau Garba

Senior Lecturer, Department of Agriculture & Economics,
Federal University Wukari, Taraba State, Nigeria

Abstract:

The world is overwhelmingly confronted with the challenges of climate change and extreme poverty, both of which are on the rise globally with the increasing dependency on fossil fuel for energy. Among the implications is the high level of dryness, rise in sea level, desert encroachment, and among others. Even so, water bodies such as lake, ponds and tributaries are the most affected. This is evidenced with the rapid shrinkage of the Lake Chad (LC) which sustains over 30 million people across 4 countries. The fast disappearing of the sixth-largest inland water body in the world and the largest endorheic Basin in Africa which is of paramount importance as an agricultural heartland has resulted to food insecurity, hunger, and poverty in the Lake Chad Basin (LCB). Against this background, the paper examines the impact of climate change on fish production in the LC region. It creates a nexus between the shrinkage of the LC water body and the reduction in fish production in the LCB. Theoretically, the study anchored on social production and reproduction as a framework of analysis. Relying on the documentary method of data collection, the paper found that the rise in global temperature accounts for the rapid disappearance of the LC water from more than 25,000km² in the 1970s to less than 2500km² presently. The paper also found that due to this shrinkage, the region is experiencing a sharp decline in the output of fish production, and consequently, reduction in the income level and GDP of the fishing communities of the LCB. Based on these findings, the study recommended that the Lake Chad Basin Commission (LCBC) should initiate a program for an annual transfer of water from either River Congo or the Atlantic Ocean into the LC in order to save the endorheic freshwater lake from drying up.

Keywords: Climate change, lake chad basin, political economy, fish production, green house gases

1. Introduction

Climate change is a change in the usual weather found in a place. It could be a change in the annual rainfall, temperature, or general weather condition of a given place. Climate change can be caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, volcanic eruptions among others. Scientists have pinpointed human activities such as the emission of carbon dioxide from cars, industrial plants, burning of fossil fuel; gas, coal, and oil, as the major causes of atmospheric greenhouse gases (GHGs) which heat-up the earth's temperature (NASA, 2014). In short, the United Nation's Framework Convention on Climate Change (UNFCCC, 2015) report succinctly summed it thus:

Rising fossil fuel burning and land-use changes have emitted, and are continuing to emit, increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO₂), methane (CH₄) and nitrogen dioxide (N₂O), have caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, the heat that would normally be radiated back into space. This increase in heat has led to the greenhouse effect, resulting in climate change. The main characteristics of climate change are increases in average global temperature (global warming); changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers and reduced snow cover; and increases in ocean temperatures and ocean acidity, drying of ponds, lakes, and tributaries (UNFCCC, 2015: 11).

The impact of climatic change on agriculture is so severe and the developing countries, especially Africa are the most affected (Vicky, 2017). This is because, the African economy is predominantly agrarian rain-fed, fundamentally dependent on the vagaries of seasons, and due to their inability to cope with any natural variation in environmental condition as a result of poverty and low technological development, hence a low level of cropping dynamics and less

dependent on mechanization by the farmers have made adaptation to change in weather pattern a threat (Bello et al, 2012). In the worst-case scenario, the UNFCCC report (2007), predicted that billions of people, particularly those in developing countries will face shortages of water and food and greater risks to health and life as a result of climate change in the next 50 years. By 2030, up to 250 million people in Africa could be exposed to a greater risk of water stress and scarcity (UNFCCC, 2007). The trend of climate change: global warming, dryness, desert encroachment, shortage in annual rainfall has hampered the out-put of agricultural produce in West Africa. However, the worst affected is the fishing community in the LCB which depend on fishing and fishery product for sustainability. This is evidenced by the rapid shrinkage of the LC water body which supports millions of lives in the region (LCBC, 2014; Vicky, 2017; Uche et' al, 2016). Geographically, the Lake Chad is located between latitude 12° and 14° 20 north, and longitude 13° and 15° 20 east, in the centre of Africa, on the southern edge of the Sahara desert. In its original form and state, the LCB was about 2.5 million km², about 8 percent of the surface area of Africa, and was shared between Algeria, Cameroon, Chad, Central Africa Republic (CAR), Libya, Niger, Nigeria, and Sudan. It lies in the Sahelian zone of West-Central Africa shared by Chad, Niger, Nigeria, and Cameroon, (See fig. 1.1). It covers an approximated area of about 26,000 square kilometres with an ethnically diverse population of over 30 million people as of 2011, growing rapidly. The lake is of great geographical significance in West and Central Africa because of its cultural and socio-economic prominence as the regions agricultural heartland. According to the LCBC report 2014, the Lake was the world's sixth-largest inland water body and the largest endorheic (closed) drainage Basin in Africa (UNGP, 2004 cited in Ovie and Emma, 2010; Yunana1 et al, 2017, LCBC; 2014).

Figure 1: Map of the Lake Chad Basin

Source: <https://goo.gl/image/SRK6JL>

Unfortunately, the freshwater lake, which is the traditional source of livelihood for the LCB communities, is fast disappearing due to the adverse effect of climate change and desertification (Thomas, 2011). Studies have provided sufficient evidence that the fishery sector and water resources are more prone to variability in the climate, with effect on the aquatic ecosystem and the environment; such as changes in water salinity, water nutrient resulting in overall water quality, extinction of fisheries species, alteration of fisheries migration and breeding time, pressure on water availability, water pollution, acidification and so on (Burck, 2018; Frank, 2016; Babagana. 2008; Bello et al, 2012).

According to Ovie & Emma (2010), the natural resources in the LC are severely under threat from environmental, hydrological, and biophysical changes due to human-induced climate change. These scenarios have accounted for the drastic reduction of water in the LC, leading to loss of fishing water, agricultural land, and pastoral grounds; thus, causing severe implications for the LCB communities' source of livelihoods in terms of income generation, employment, food security, and environmental sustainability. With the depletion of water resources, flora, and fauna and agricultural products, the region has continued to experience famine-like condition, population drift, and humanitarian crisis. These conditions affect the gross domestic product (GDP), income level, and standard of living in the region (LCBC, 2014; Thomas, 2011; Burck 2018). This study tracks the rapid change in the size and dynamics of the LC and estimates the declining level of fish stocks produced in the LCB from the 1970s to date.

2. Literature

The debate on the effects of climate change on the developing nations in terms of food production, environmental sustainability and the GDP has occupied and continued to occupy a front row in the academic discourse. As such, various scholars and analysts have given their respective views and opinions on the trend (Dami et al, 2010; Soheila, 2010; Bahram, 2013; Gerald, 2008; Jawoo, 2012; Mark, 2008; Mandy, 2014; Gary, 2008). Due to the increasing rate of global temperature, the Lake Chad region has continued to experience rapid shrinkage. Climatic variation has further resulted in the reduction of annual rainfall, increase in dryness and heat, fast-growing arid environment, and the depletion of flora and fauna. This scenario has unsettled the majority of the population living in the Sahelian countries, especially rural farmers that depend mostly on subsistence farming and fishery for their survival (Diana, 2015; Emeka, 2008, UNFCCC, 2015). The risk of adverse effects on agriculture due to climate change, especially in semi-arid and sub-humid regions and in areas with more frequent and prolonged drought, may easily become life-threatening (IPCC, 2007). The UNFCCC, (2015) projected that by 2030, in some countries, especially among developing countries with little or no mechanization, yields from rain-fed agriculture could be reduced by up to 50 percent and agricultural production, including access to food, in many African countries might severely be compromised. According to Burton (2008), the expected rise of the surface

temperature of Earth will affect both freshwater fisheries and marine fisheries. The impacts are likely to include a shift in the production and composition of fish species, as ecosystems move geographically and change internally (ACPC, 2013).

Bello (2012) and Babagana (2002) agreed that Change in climate and consequent global warming are posing threats to food security in many developing nations including Nigeria because of the climate-dependent nature of agricultural systems and lack of coping capabilities. They warn that the rising change in weather variation will continue to hurt the economy and survival of the low-income nations. Corresponding this view, Wahab (2012) observes that land degradation, desert encroachment, drying up of surface waters, coastal inundations, and shift in cultivated crops over time remain a major threat to food security in Nigeria. The freshwater ecosystem is particularly threatened by climate change and global warming which have resulted in increased pressure on water resources. Consequently, this has led to a significant loss in the aquatic species (Uche et al, 2016; Mariama, 2017). The LC has continued to shrink; from 1963 to 2013, it has lost over 90% of its water mass, reducing from 25,000 km square to less than 2500km square (Hancock, 2007). Once the third-largest freshwater lake in the world now covers much less than one-tenth of its original body mass. The continuous reduction in the size and shape of LC has negative socio-economic impacts on the local communities that depend on it for their livelihood (Nebesum, 2016; United Nations, Food, and Agricultural Organization, 2007).

3. Methodology

In observing the continuous change in the size of the LC and the quantity of fish production over the years, this paper adopted the Time Series Research Design (TSRD). The study specified the dependent variable and then tried to identify the reason for its occurrence. The TSRD analysis of independent variable (X) and dependent variable (Y) is based on adjoining variation, i.e., if (X) occurs, there is likelihood that (Y) will follow. By application, (X) variable which is 'Climate Change', influences, and will continue to dictate the behavior of the (Y) variable 'Fish Production'. Some of the major indicators of the variable (X): shrinkage of lakes, dryness, and so on, have adversely shown a causal effect on the variable (Y) which resultantly cause a decrease in the quantity of fish produced in the region. Also, data for the study was collected through secondary means available on journal articles, conference papers, official documents, seminar papers, published and unpublished materials as well as other documents that are relevant to the study.

3.1. Theoretical Application

Furthermore, the paper employed the Social Production and Reproduction Theory (SPRT) in explaining climate change and the political economy of fish production in the Lake Chad Basin. Social production and reproduction are associated with Marx's socio-economic system which studies the impact of economic activities on social processes. Ogban-Iyam (2005) noted that the fundamental concern of human beings is survival. And for man to survive, he must have a means of livelihood. He must produce and reproduce human needs, including mankind; these are unequivocal to his sustainability and continuous existence. Therefore, every social process tends to be a full or partial social production and reproduction of tangibles and intangibles such as food, shelter, clothing, medicine, pain, pleasure, etc., which revolve around life process and varies in importance to various people at various points in time (Ogban-Iyam, 2005).

The social production and reproduction of material wealth and the overall economy of the LC region is purely agrarian and relied heavily on the fishery. The agrarian communities of the LCB massively engage in fishing as the dominant occupation of individuals and families, and production is essential for direct consumption and subsistence, with few commercial fishery sectors. Fish and fisheries provide the commonest and cheapest source of protein for a population of 30 million people and above, with over 200,000 people directly involved in the sector and 10 million others supported by it (LCB, 2014).

Unfortunately, the social production and reproduction of basic human needs in the LCB are constantly under threat by global warming. The climatic variability; changes in cloud cover and precipitation particularly over land; decrease in annual rainfall, drying of ponds, lakes, and tributaries, have all affected the volume and quantity of not only fish production, but overall agricultural activities in the LCB. This man-made disaster has negated the traditional means of production, which are agriculture; fishing, farming, and livestock production, all of which largely depends on the availability of water resources.

Global warming has caused unpredictable and extreme weather events that increasingly affect crop growth, availability of soil water, and floods production (IPCC, 2015; Bello et al., 2012). The effect of global warming on water resources in the LC region cannot be overemphasized, thousands of aquatic species have died as a result of drought, famine, excessive heat, and decline in rainfall. Global warming has caused uncontrollable drying of fish habitat ecology, pollution, and contamination of freshwaters in the region. It has also altered the fish migration and reproduction process, thereby reducing the population and growth of aquatic resources (FAO, 2015).

3.2. Climate Change and Water Resources

Both natural and biological processes can cause a change in weather variation but scientists have identified human activities like GHGs emission as the major cause of climate change. The US environmental protection agency (EPA, 2017) investigation shows that:

"Since the Industrial Revolution began; human activities have contributed significantly to climate change by adding CO₂ and other heat-trapping gases to the atmosphere. These greenhouse gas emissions have increased the green house effect and caused the Earth's surface temperature to rise" (EPA, 2017: 4).

Also, the United Nations Framework Convention on Climate Change (UNFCCC, 2015) reports that the rising fossil fuel burning and land-use changes have emitted, and are continuing to emit, increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO₂), methane (CH₄) and nitrogen dioxide

(N₂O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere; heat that would normally be radiated back into space.

Figure 2
Source: Google Image

Figure 3 above shows the massive emission of carbon mono-oxide greenhouse gas by heavy industry, which experts have identified as the major cause of climate change (Stuart, 2013).

Climate change affects water resources through its impact on the quantity, variability, timing, form, and intensity of precipitation. Another effect of climate change that impacts water resources includes evaporation rates, shorter rainfall seasons, increased water temperatures, and decreased water quality in both inland and coastal areas. An increased evaporation rate reduces water supplies in many regions with the worst period occurring in the summer, causing decreased soil moisture levels and severe agricultural drought (Mariama, 2017). The agricultural sector especially the fishery sector is particularly vulnerable, as evidenced by severe droughts, rapid shrinkage of lakes, and inland freshwater, causing the crisis in water resources, and devastating impact on the political economy of the affected regions. Such droughts, shrinkages, and the disappearance of ponds, and tributaries also impose costs in terms of prices and the availability of certain species of fish products (LCBC, 2014; UNFCCC, 2015; Richard et al., 2008; Ovie & Emma, 2010).

3.3. Responding to Climate Change: the Lake Chad

Akegbejo (2009) concludes that the impacts of climate change will be more severe and devastating in tropical regions because developing countries are generally considered more vulnerable to the effects of climate change than the developed world. This is attributed to the low capacity of adaptation and mitigation in those areas (UNFCCC, 2015). Fisheries and aquaculture are threatened by changes in the earth's atmosphere and ocean, such as increasing global surface temperature, rising sea levels, increases in incident ultraviolet radiation, irregular changes in average annual precipitation, and increases in the variability and intensity of extreme weather (IPCC, 2007).

The present-day lake is the remnant of a much larger inland lake, about 400,000 sq. km at its largest around the year 4000 BC. It has shrunk in summer and expanded thereafter, but have to keep shrinking since the great drought of the 1970s (Jacob, 2010). When the Europeans first surveyed the lake in 1832, it was still one of the largest freshwater lakes in the world. But in 1908 and 1984, it almost dried out. By the 1960s, it recovered and covered a surface area of about 26,000 square km, making it the fourth-largest lake in Africa. By 2000 however, it had shrunk to a mere 1,500 square km, with an average depth of no more than 1, 5 meters. A BBC report dated January 15, 2007, stated its present size as 500 square km and even predicted it could disappear in the next two decades (Jacobs, 2010). In the 1960s, LC was about 25,000Km² in surface area, but after the great drought of the early 1970s, it has been fluctuating between 2,000 and 1,500Km², depending on annual rainfall (Eboh, 2018). Also, Hydrological observation for over 3 decades reveals that the volume of water stored in the lake decreased from 40-100 10⁹m³ in 1962 to 7-72 10⁹m³ in 2005 (Yunana, 2017). Fig. 1.3 below demonstrated the sequential and systematic reduction in the body mass of LC since 1960. However, in 1997, the lake showed a little sign of recovery but has since shrunk even more.

Figure 3
Source: Google Image Cited In Babagana, (2002)

3.4. Fish Production in the Lake Chad

Speaking on-behalf of Nigeria in a two-day workshop organized by the United Nation Food and Agricultural Organization in collaboration with the Lake Chad Basin Commission on the impact of climate change on the Lake Chad fishery communities, November 18-20, 2011, Mr Ahmed Muhammed noted that the Lake Chad supports the largest freshwater fishery in Nigeria, with an annual catch of over 50,000 tons, amounting to more than 60million dollars in the past decades. The fishery also employs 2million people, either on a part-time or full-time basis. Similarly, the representative of Cameroon MrDjonwe Gaston reported that Fishery is of great importance in the five main catchment areas of Cameroon, which support a fishery industry valued at US\$ 180 million. Messrs. Minde Ngakoungong and Awoto

Yacoub in their national presentation on behalf of Chad noted that the total fish production of Chad is estimated at 61,000 tons in 2003, which contributed 4.5% of the gross domestic product (GDP) of the country. The Nigerien representatives Abdou Mahaman and Achirou Elhadj also stressed the national importance of fresh inland water fish production from the Lake Chad, they conclude that national fish production in Niger is estimated at 58600 tons annually, 43700 of which comes from the Lake Chad basin (FAO/Lake Chad Basin Commission Workshop 18–20 November 2011: 4-5)

However, the continuous increase in global surface temperature around the LC has led to a sharp decline in the productive capacity and cycles of aquatic species and shortage production output of fish (Yunana et al, 2017). The LC region has experienced a decrease in production by more than 50 percent, from 140,000 tons in 1966 to 70,000 tons in the 1980s, and to less than 50,000 tonnes in 2012. Recent annual harvests are placed at 50,000 to 60,000 tonnes. Fish harvest has declined from catches of 220,000 tons in 1974 after the great drought to less than 100,000 per annum today. Fish and fishery products are of great importance to the LCB communities because, fish is the most common and cheapest source of protein and provides benefits and services for poverty alleviation, food security, and contributions to the national and regional economies. In short, annual fish production from the Lake Worth over US\$ 60 million on average, with over 200 000 people directly involved in fishing, and 10 million others supported by the sector (FAO/Lake Chad Basin Commission Workshop 18–20 November 2011: 5-7) table 1.1 show the trend of fish production since 1970 through the great drought of 1971-1973, to the present production output of fish stocks in the region.

Figure 4: Fish Production in the LCB Since 1970

Source; data generated from FAO <http://www.fao.org/3/a-i3037e.pdf>

Figure 4 indicates a steady decrease in fish production in the LCB. The impact of climate change on the fishery sector of LCB cannot be overemphasized. A report by Mustapha Muhammad, Special Correspondent, Daily Trust, dated Jan 23, 2010, revealed the feelings of selected fishermen in the region on the impact of climate change on the fishery sector. According to the report, Guru Garba Bundaram when interviewed recalled that years back, "Our catch those days are too big for one person to lift. We even had to invite other fishermen to help, but unfortunately, those days are no longer with us, he lamented" (Mustapha Muhammad, Daily Trust, 23 January 2010).

Also, in his contributing paper, MrOvie of the Nigeria National Institute for Freshwater Fish Research (NIFFR), laments that many species of fish are going into extinction in the LC water, and those that are available are drastically reducing in their number. For instance, the Celestes species has significantly reduced in population due to the disruption of the life cycle and migration time of the specie hindering effective breeding and reproduction of fishes. Furthermore, the constrained access to conducive spawning ground, resulting from ecological changes, reduction of water volume, and precipitation have caused the increased anoxic condition, water alkalinity, and the concentration effect of eutrophication. Even as some species like clarias catfish, cichlids, and heterotis have survived through natural selection due to their fast breeding attributes, there has been a continuous decrease in species diversity over the past years (FAO/Lake Chad Basin Commission Workshop 18–20 November 2011)

3.5. Inland Fisheries and rural livelihood in the Lake Chad Basin

The Lake Chad river-line channels have always played a tremendous role in the survival, sustainability, and GDP of hundreds of thousands living in the region. Bene et al., (2003) contends that fishing constitutes the major economic activity of rural communities because of its natural open access and as the last resort to the common man. Similarly, Thomas (2001) also noted that despite being an important route for trans-Sahara trade, fishing activities is the major contribution of the LC to the region and a fundamental element of the livelihood of several millions of people. Fishery is the key to the socio-economic stability of the region. Fishing and fishery activities contribute significantly to the GDP and internally generated revenue of the region. However, following the effects of climatic variation and global warming, the economy of the LCB is severely under great danger. This scenario has raised the poverty level as fishermen record less and less fish catch from the lake (Neiland et al, 2001; LCBC, 2014; FAO, 2012).

Mustapha, (2010) reports that farmers and fishermen in the LCB are facing a difficult time due to a dwindling source of income, poverty is seen at homes. The shrinking of the lake has not only affected the teeming population that depends on the water, but it has also led to poverty and chaos among fishermen because they have to scramble for the scarce fishes in LC. According to the report, about 30 trucks of dried fish usually found its way in the 1990s and early

2000s from the LC to Baga market in Maiduguri on daily basis, but today, they are less than five trucks (Mustapha Muhammad, Daily Trust, 23 January 2010).

4. Findings

Based on shreds of evidence presented above, the study made the following findings:

- That the increase in global temperature has continued to shrink the LC water, thereby, altering fish breed and reproduction.
- The shrinkage of the LC has caused depletion in fish species and population, which have massively contributed to the decrease in the output of fish production and inflation of the price of fish stock.
- The decrease in fish population and daily catches have caused unemployment, hunger, and poverty in the region. The region is suffering from food insecurity, acute malnutrition, and humanitarian crisis orchestrated by both human and environmental factors.
- The LCBC has not adequately addressed the challenges posed by climate change in the region.
- Finally, the study discovered that all these puts together have continued to threaten the very survival and economic lives of a population of more than 30 million people in the region.

5. Conclusion

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

Generally, the effects of climate change have been so devastating on the developing south, which remains vulnerable without the adequate capability for adaptation. This is the case of Lake Chad region whose means of production have been truncated. Evidence abounds that the fishery sector has been hit by the increase in the earth's temperature, leading to a drastic reduction in fish production which contributes massively to the GDP of over 30 million people. The reduction in the quantity of fish caught has caused a stir, poverty, and unemployment in the region. More worrisome is that the LCBC has not done much to arrest the situation.

6. Recommendation

On the strength of our findings, the study recommends the following strategies:

- The Lake Chad Basin Commission (LCBC) should consider transferring water from either River Congo or Atlantic oceans into the Lake Chad to save the shallow river from drying up.
- The LCBC should adopt a more pragmatic ecological sustainability strategy that can help reproduce the already depleted aquatic population in Lake Chad through proper adaptation.
- Mitigation should be enforced and the resolution of the 2015 Paris agreement on Climate change must be implemented by all parties. The government should drive the socio-economic sectors through the policy of adaptation by reducing the vulnerability of social and biological systems to relatively sudden change and thus offset the effects of global warming.
- The government should improve the infrastructural development, human capital indices, humanitarian needs, and the welfare of the people in the Lake Chad region to enable them to survive the devastating impact of climate change.

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