Review paper

The Impact of Climate Change in Nigeria: A Review

ABSTRACT

Climate change has become a great challenge to our generation which its impacts affects every person all over the world. Nigeria as a developing country with a population of about 180 million is likely to be adversely impacted by climate change due to its vulnerability and low coping capability. Evidences have shown that climate change impacts on Nigeria arises from various climate change related causes experienced due to the increase in temperature, rainfall, sea level rise, impact on fresh water resources, extreme weather events, flooding, drought in the north and increased health risk. This study is a review of the potential impacts of the challenges of climate change on the various sectors of Nigerian Economy. The paper is a review of some existing research literatures, information, policies, and data on climate change in Nigeria and Africa. The finding for this paper indicates that many sectors of Nigerian economy appear to be directly vulnerable to the impacts of climate change such as agricultural sector, health, energy, etc. This generally affects the growth of economy. This review attempts to push the frontier of knowledge and impacts of climate change in Nigeria forward and thereby pushing back its realm of unknown and uncertainty by presenting the facts and findings rationally to the public and to also communicate the danger we face and offer solution. The impacts of climate changed highlighted here raise the need for more support in research and education awareness on the problem of climate change in Nigeria. This finding recommends some adaptation and mitigation measures to help tackle this problem.

Keywords: Climate Change; Impact; Nigeria; Mitigation and Adaptation.

1. Introduction

Climate change is an undeniable environmental threat of the 21st century which the world is currently experiencing and seeking measures to adapt and mitigate its impact. According to United Nations Framework Convention on Climate Change, climate change is defined as a change which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere over comparable time periods [1]. Climate change is already beginning to transform life on earth. Around the globe seasons are shifting, temperatures are increasing and sea levels are rising. Climate change affects the whole world though the poorest people who contribute least to the change are the ones who suffer the most. Scientific evidence shows that the net climate resulting from the change will largely be driven by atmospheric greenhouse gases.

The Germany Advisory Council on climate Change noted that climate change is a threat already having substantial impact on humans and natural ecosystem both in developed and developing countries but at varying degree [2]. For developed countries which are the major contributor to climate change, the impacts they face are less severe due to natural advantage, high adaptation techniques, and technologies, effective research proven policies, mechanized agricultural system and wealth status. The presence of these factors has enabled the developed countries to adapt and curtail the adverse impacts of climate change. But for the developing countries like Nigeria and many more, the impact is greatly felt due to the poor adaptation capacity, lack of technology etc.

Concern over the negative impact of climate change has strengthened fears that environmental degradation and demographic pressures will displace millions of people in Africa and create serious social upheaval. Most scientists studying the potential impact of climate change have predicted that Africa is likely to experience higher temperatures, rising sea levels, changing rainfall patterns and increased climate variability, all of which could affect much of its population [3]. The core challenge is that climate change threatens to overburden states and regions that are already fragile and conflict prone. It is important to recognize that the risks are not just of a humanitarian nature; they also include political and security risks that directly affect African governments in particular and the global community in general.

The negative impact of climate change affects many sectors of Nigerian economy which its impacts have been observed to cause a great significant reduction in agricultural productivity; it has also impacted the health sector which has caused increase in illness, morbidity and mortality rate. The energy sector has not also be left out because climate change has impacted the hydropower plants which are source of electricity for the country. Many other sectors like the transportation, tourism and manufacturing sectors have all been affected which in all generally affects the entire Nigerian economy and it's GDP.

This study compiles and summarizes the existing knowledge about observed and projected impacts of climate change on various sector of Nigerian economy. This study aims at the following:

- Identifying the perceived impacts of climate change in various sectors of Nigerian economy.

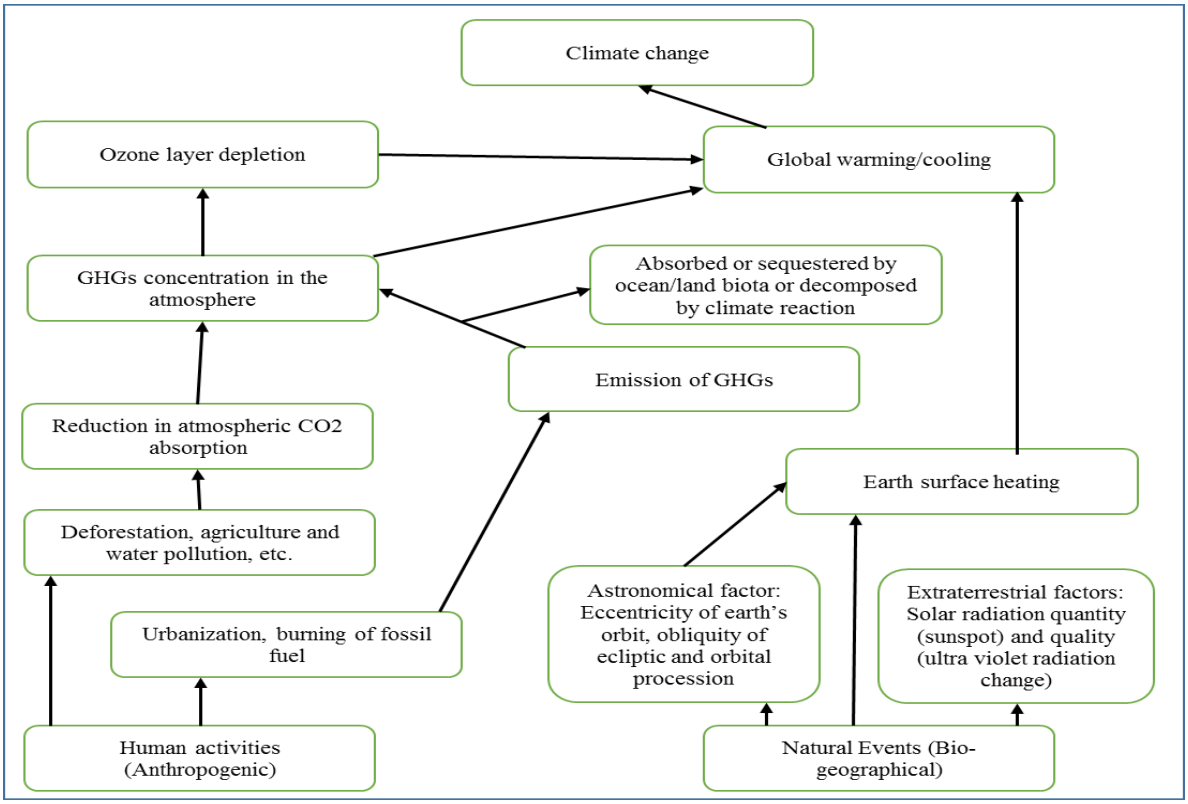
- To contribute to a better understanding of the possible economic and physical effects induced by climate change in various sectors of Nigerian economy.
- To create awareness and preparedness for climate change issues and to also suggest responsive adaptation measures to help offer solution.

The rest of this paper is organized as follows. Section 2 describes the causes of climate change on the global scene. Section 3 further explains the climate change situation in Africa. Section 4 discusses on the impact of climate change in Nigeria, which includes the agriculture, water, health, energy and other sectors of the economy. Section 5 concludes the study with some recommendation on mitigation and adaptation strategies.

2. Causes of Climate Change

Climate change is caused by two basic factors which include natural process (Bio geographical) and human activities which are also known as (Anthropogenic) (see Figure 1). The earth's climate can be affected by natural factors that are external to the climate system such as changes in volcanic activity, solar output and earth's orbit around the sun, these factors and its effects have relatively short term effects on climate.

Figure 1. Causal Factors of Climate Change



The Anthropogenic factor which are human activities that emit large amount of greenhouse gases into the atmosphere that depletes the ozone layer or activities that reduce the amount of carbon absorbed from the atmosphere. Human activities such as burning of fossil fuels, gas flaring, urbanization, agriculture and changes in land use like deforestation release greenhouse gases (GHG's into the atmosphere which increases the already existing concentration of these gases. The human factors have been proven to be responsible for the ongoing unequivocal climate change or global warming [4].

According to the South African Confederation of Agriculture Union [5]. The main GHG's are Carbon dioxide, methane and nitrous oxide which account for 80%, 14% and 6% of the total GHG emission respectively. GHG's are good absorbers of heat radiation coming from earth's surface acting like a blanket over the atmosphere, keeping it warmer than it would be. It has been

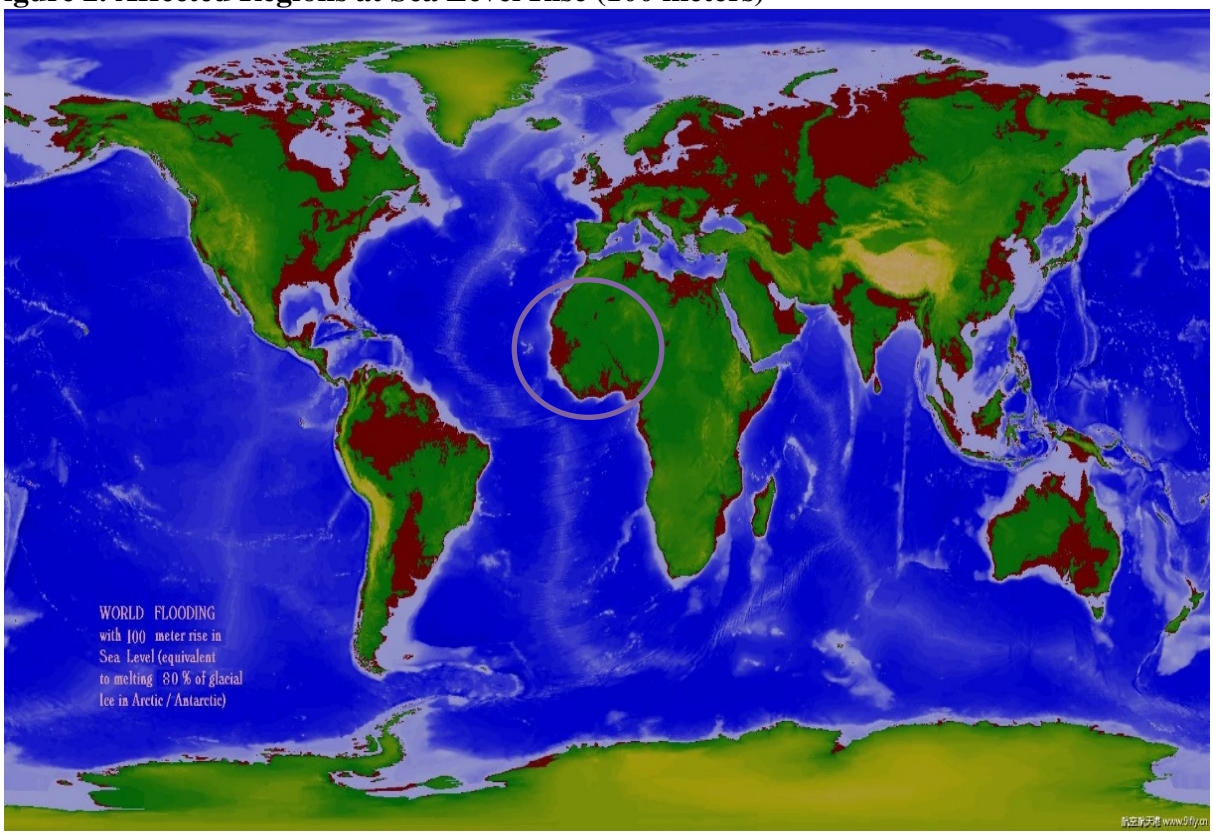
suggested that if the current trends of anthropogenic GHG emissions continue through 2030, earth is likely to experience an average rise in temperature ranging from 1.5°C to 4.5°C [6]. .It is well established that the activities of developed nations are mostly accountable for climate change, but developing nations are those suffering more due to inability to cope as a result of poverty and low technological development [7].

3. Climate Change in Africa

Climate change is already happening and small changes in average conditions such as sea levels, or temperature can result in large changes in frequency of extreme events so detrimental to our society. Nigeria is already experiencing adverse climate conditions with negative impacts on the welfare of the people. It is estimated that between 75 million and 250 million people in Africa may be exposed to increased stress due to climate change by 2022 [4]. The area suitable for agriculture, the length of growing seasons and yield potentials are expected to decrease due to climate change.

Climate change has been confirmed following release of the 4th IPCC Assessment report. Africa will be worst hit by the effects of climate change which Nigeria is part of it and this makes Nigeria vulnerable to the effects of climate change. Available evidences show that climate change will be global, likewise its impacts, but the biting effects will be felt more by the developing countries, especially those in Africa (Figure 2 & Figure 3) due to their low level of coping capabilities [8-9].

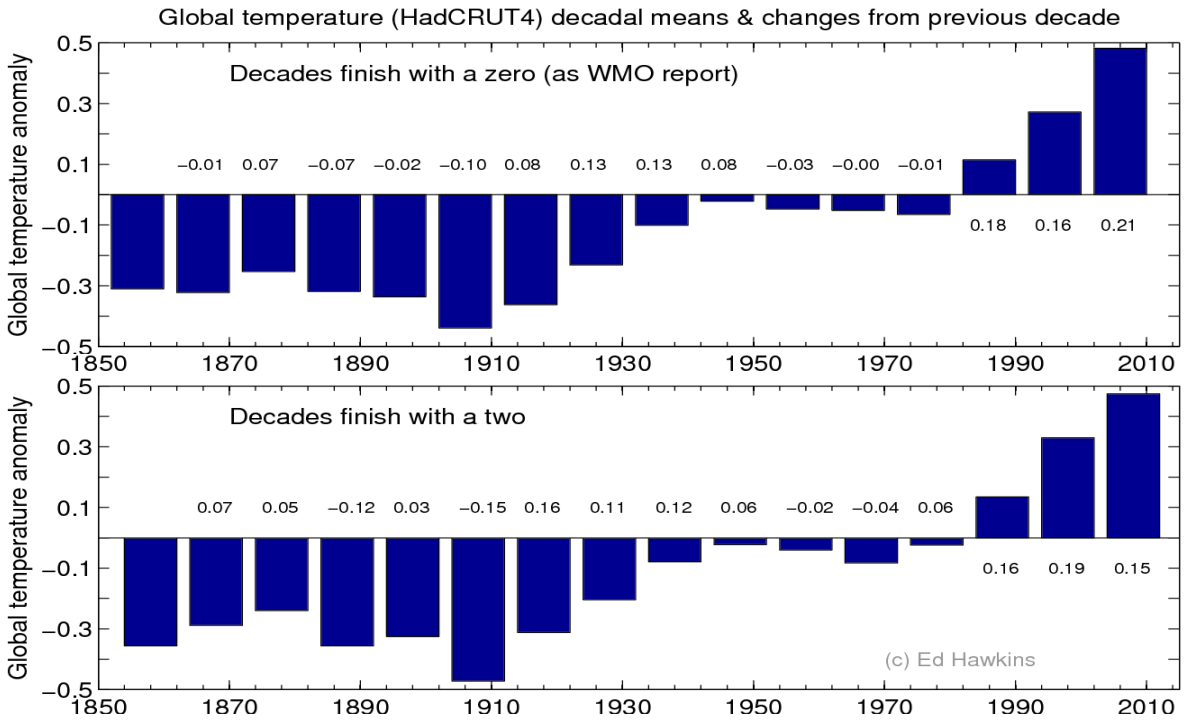
Figure 2. Affected Regions at Sea Level Rise (100 meters)



Source: Ref. [10]

Researches have shown that Nigeria is already plagued with ecological problems which have been linked to the ongoing climate change [11-12]. Recent evidence indicates that the world has already warmed by 0.8°C since the pre- industrial era and under a BAU scenario (Figure 3), global mean temperature could reach around 2°C by 2060 [13]. Climate change and global warming if left unchecked will cause adverse effects on livelihoods in Nigeria, such as crop production , livestock production, fisheries , forestry and pest harvest activities because the rainfall regimes and patterns will be altered , floods which devastate farmland will occur.

Figure 3. Global Temperature From 1850-2010



Source: Ref. [14]

Increase in temperature and humidity which increase pest and disease would occur and other natural disasters like floods, sea level rise and storm surges which will affect the livelihood of people and cause great havoc to life and properties. Indeed, in a few conflict- prone spots such as the Niger delta and the arid northeast, this sequence is probably playing out on a limited scale already.

4. Impacts of Climate Change in Nigeria

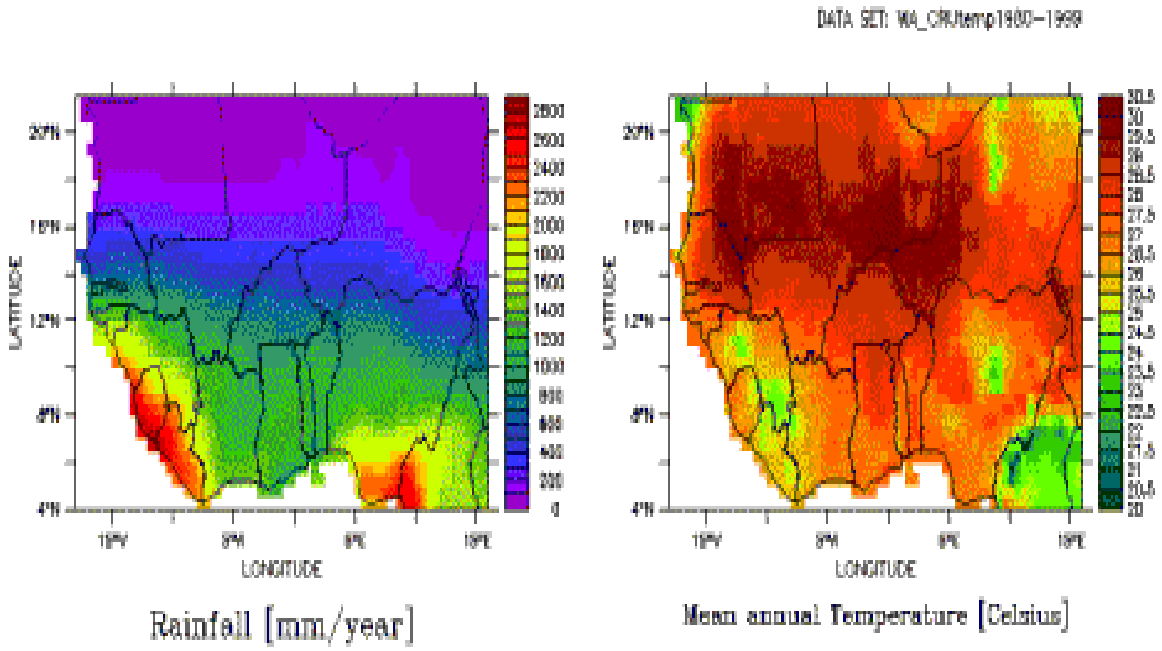
Climate change is indeed a great challenge facing man's existence on earth in this present dispensation. The impacts of climate change are being felt by both developed and developing countries. Many sectors of Nigeria's economy appear to be directly vulnerable to the impacts of

climate change. These impacts are currently been experienced on agricultural production, health, biodiversity, social, economic, manufacturing and energy sector, etc.

4.1 Impacts on Agriculture in Nigeria

The concern with climate change is heightened given the linkage of the agricultural sector to poverty. It is anticipated that adverse impacts on the agricultural sector will exacerbate the incidence of rural poverty. Climate change has the potential to affect African agriculture in a range of ways leading to an overall reduction of between 2 and 7% of GDP in 2100 in the Sahara and 2 to 4% in Western Africa as shown in Figure 4 [12]. Over 80% of Nigeria's population depends on rain-fed agriculture and fishing as their primary occupation leading to a high risk of food production system being adversely affected by the variability in timing and amount of rainfall.

Figure 4. Percentage Change in Annual Rainfall and Temperature 1980-1999



Source: Ref. [13]

Crops occupy nearly 94% of the agricultural sector in Nigeria and some areas are already experiencing a loss in length of growing days by 20% [15]. Growth rates of maize, guinea corn, millet and rice are depressed by rises in temperature. Warming trends also make the storage of root crops and vegetables more difficult for those without access to refrigerators. Agriculture in Nigeria will be adversely impacted by increasing variably in terms of timing and amount of rainfall. Water deficits may also depress crops and livestock production and hence, food supply necessitating imports [16].

As noted by Ref [17], climate change has caused a shift in crop cultivated in northern Nigeria. The preferred crops the farmers cultivated were guinea corn followed by groundnut and maize, but due to increasing temperature and decreasing rainfall amount and direction occasioned by climate change, the farmers as a means of adaptation in 2007 shifted to the production of millet followed by maize and beans. Another major problem of agriculture in Nigeria due climate change is the reduction of arable lands. While the sea incursion is reducing the arable lands of the coastal plains, the desert encroachment with its associated sand dunes is depriving farmers of their agricultural farmlands and grazing lands.

During the worst of the drought in the 1970's and 1980s, close to one million livestock were lost, affecting meat and dairy supply throughout the country [18]. High temperatures have hindered livestock (sheep, goat, cattle, poultry and piggery) production through retarded cycles, reduced meat and milk outputs, as well as their grazing lands. Livestock mortalities (stock losses) increased in poultry, piggery and rodentary production systems to the level of at least 15% per annum. Animal production as well is affected by increase in disease and pest (Including PPR, food rot, mange etc.) under the influence of climate change impacts that cut investment profits in livestock production system by more than 20% per annum [19].

Available evidence has shown that the coastal regions will be hit as climate change upsets ocean currents and fisheries [20]. Major changes on fish spawning patterns have already been observed. In the coastal zone, the loss of mangroves as sea level rises will have serious repercussions for fishing as mangroves acts as a sanctuary for young fish to mature [21]. According to Ref [22], since 2001 till date , the fishing activities in the various Eco zones of the Nigerian coastal regions has drastically reduced due to the present rise in sea level and heavy rainfall and this has caused a great decline in the fish production business in these areas.

Also other effects are flooding of fish ponds especially those sited in wetlands and farmlands nationwide. Increases in the severity of storms will threaten fishing vessels and crew thereby affecting the fish farmers on board. The viability of inland fisheries is threatened by increased salinity and shrinking rivers and lakes [20]. Also, Gwary in his work indicates that what is left of Lake Chad is not more than 36% of which mostly was attributed to climate change (Lower rainfall and drought) [23].

4.2 Climate Change Impact on Water Resources, Wetlands and Fresh water ecology

Climate change will affect the nature and characteristics of freshwater resources on which Nigeria depends on for its freshwater. Changes in weather and climate have been known to profoundly influence water resources, a factor that increases the vulnerability of human to infection. The impacts will vary between eco-zones exacerbating problems of too much water (flood) to little water (droughts) and reduced water quality , salt water intrusion, sea level rise, drying, poor water quality in surface and ground water system.

The UN Food and Agriculture Organization rates Nigeria’s water use and conservation practices “poor” by international and African standards, and only 8 percent of homes nationwide have

treated pipe-born water [24]. Many countries in Africa live under water stress, defined as those using more than 20 percent of their renewable water resources [3]. About 25 % of the contemporary African population experience water stress, while 69% live under conditions of relative water abundance [25]. But abundance does not necessarily mean availability. In Ref [22] research findings, various parts of the southern part of Nigeria showed many adverse effect of climate change on the people of the coastal regions. In Akwa Ibom state, Ikot Ibom Itam community experienced heavy rainfalls which lead to the disappearance of about four local streams, flooding of many homes and heavy erosion damages.

It has been estimated that a rise in sea level by up to 59cm will see several of Nigerian coastal states being submerged in water and floods [25]. Such events will no doubt, disrupt the life and activities of the inhabitants as well wreak great havoc on the ecological balance [27].

UNEP alerts that globally, wetlands have been reduced by 56% [28]. It is estimated that one third of all endangered species are dependent on wetlands [29]. Nigeria is richly endowed with abundant wetlands ecosystem the majority of which are found in the Niger, Benue and Chad basin. Wetlands represent 2.6% of the country's area of about 923,768 Km.

In Nigeria, inundation is the primary threat for at least 96% of the land at risk [30]. With a 1-m rise in sea level, up to 600 km^2 of land would be at risk. This area includes parts of Lagos and other smaller towns along the coast. The periodic overflow of the Atlantic across the Bar beach bank is an indication of a phenomenon that may accelerate as climate change intensifies and the seal level rise even further. The Niger delta is one of the most important wetlands in Nigeria, the largest in Africa and third largest in the world.

The southern ecological zone of Nigeria is largely known for high rainfall is currently confronted by irregularity in the rainfall pattern, while Guinea savannah is experiencing gradually increasing temperature. The Northern zone takes the threat of desert encroachment at a very fast rate per year occasioned by fast reduction in the amount of surface water, flora and fauna resources on land [31-32]. There is evidence that climate variability and change has affected Nigeria's water and wetland resources. Several large river and lake system have suffered marked reduction in flow rate and in the length of their networks in response to reduced rainfall and higher evaporation e.g. Sokoto river system in North West Nigeria. Since the mid-sixties (40) years rainfall has decreased by about 15 to 20 % in average over west Africa and run off have decreased by about 30 to 50% or more over most rivers [33].

4.3 Impact of Climate Change on Health Sector in Nigeria

Climate change could negatively impact human health in developing country like Nigeria. Climate change affects human health directly or indirectly in many ways. Changes in temperature, precipitation, rising sea levels, increasing frequencies have great implications on human health in the area of injury, illness, morbidity and mortality. During rainy seasons, there is a rise in the sea ocean levels as a result of global warming. Hence flooding may result which is likely to increase the vulnerability of the poor to malaria, typhoid, cholera and pneumonia. Also temperature and rainfall dynamics may increase the distribution of disease vectors such as dengue, malaria and incidence of diarrheal disease [34].

The Guardian Newspaper of 30th march 2010 reported that within one week in the early of 2009 over 209 people were killed by meningitis in Nigeria and Niger republic [35]. According to [36] climate change will increase threats to human health thereby affecting their productivity. Already

a study by the World health Organization shows that climate change is the cause of 150,000 deaths every year [2]. Heavy rainfall events can also carry terrestrial micro-biological agents into drinking water sources which eventually lead to outbreak of Cryptosporidiosis, giardiasis, amoebiasis, typhoid and other infections [37-38].

Recent evidence showed that typhoid is mostly triggered in high temperature and increased humidity which are proof of climate change. A large part of Nigeria's economy is dependent on natural resources that are vulnerable to climate impacts. When resources are affected, the health of Nigerians can also be affected.

4.4 Impact of Climate change on Energy Generation and Supply in Nigeria

Energy services are necessary inputs for every nation's development and growth. As stated by [39] the fuel driving the engine of growth and sustainability development is a nation's access to reliable and adequate energy. No economy can sufficiently thrive without adequate access to clean reliable and adequate energy. The supply of energy entails the generation, transmission and distribution of energy, notably electricity.

Nigeria has an abundant supply of energy sources as it's endowed with thermal, hydro, solar, oil resources and yet still described as an energy poor country [40]. Nigeria as a country is highly vulnerable to the impact of climate change because its economy is mainly dependent on income generated from the production, processing, export and/or consumption of fossil fuels and associated energy-intensive products [41].

The US Department of energy asserts that changing climate trends which are expected to continue can restrict supply of secure, sustainable and affordable energy which is critical to the nation's economic growth. Energy services and resources in Nigeria will be increasingly be

affected by climate change in trends, increasing variability, greater extremes and large inter-annual variations in climate parameters in some regions. Climate change is also expected to negatively impact the already limited electrical power supply through impacts on hydroelectric and thermal generation coupled with service interruptions is also expected to result from damage to transmission lines and substation equipment impacted by sea level rise, flash floods and other extreme weather events [42].

BNRCC report asserted that hydropower generation is the energy source most likely to be affected by climate as it is sensitive to the amount of, timing and geographical pattern of precipitation as well as temperature. The report also stated that a reduced flow in river and higher temperature reduces the capability of thermal electric generation as higher temperature also reduces transmission capacity. Also excessive drought will lead to higher evapotranspiration that adversely affects water volume thereby reducing hydroelectricity capacity [22].

The ability of the kanji Dam hydropower project to perform as designed has been greatly hampered by the drought which has ravaged most of the West African countries bordering on Sahara for the past three years. The effect of this drought on the power plants has led to a drastic reduction in the expected power supply from Kanji Dam [43].

4.5 Impact of Climate Change to other Various Sectors

Man other sectors will be affected by the extreme weather pattern due to change in climate change that may lead to sea level rise, drought, floods etc. and transport sector, tourism, energy and utility will be among most the worst hit as they are directly affected. . Tourism especially the beach based tourism will be negatively affected, the beaches and lagoons will be taken over by water due to sea level rise as in the case of Lagos bar beach and Lekki Island [44].

Nigeria's transport systems will not escape the effects of global warming and climate change. For example, higher sea level rise may require costly changes to other ports and coastal roads and railways as the current means of communications along the coast may be covered by the intruding sea water or washed away by erosion. Changes in lake and river levels would also affect inland navigation [41].

Manufacturing sector will suffer losses from reduced potentials to reduce output requiring agricultural produce as inputs. Sea level rise may lead to flooding which can destroy transportation and other infrastructure as well plants and industrial layouts that can hamper productivity and efficiency in the sector [43]. Extreme weather events around the coastal region will threaten rise in the Niger delta [42].

Climate change impact has caused the Nigerian Government a huge sum of expenditure. The Federal Government has disbursed N3bn from the Ecological fund in the last two years. A breakdown of the figures indicated that N2.3bn was disbursed for erosion, flood and pollution control [45]. Also a huge amount of funds is been spent by the government in the treatment and resettlement of victims of increasing environmental disaster linked with climate change.

Today 80% of all the government revenue and 97% of Nigerian foreign exchange come from Niger delta oil. Some hydrological modeling estimates that a 3 feet sea level rise could put nearly all the Delta's onshore oil fields under water [46] .The DFID study concluded that without a strong adaptive and mitigation response climate change would cost the country between 6 % and 30 % of its GDP by 2050, worth between $100billion and $460 billion [47].

5. Conclusion

Evidences from its negative impacts of climate change which has been observed from increase in temperature, rainfall, sea level rise, desertification, drought, flooding, and low agricultural productivity etc., which Nigeria is currently facing, proves that climate change is indeed a reality. Particular threats are posed to Nigeria's competitiveness in agriculture from changes to rainfall patterns in the north resulting in increased desertification and flooding, and to economic activity in Lagos, Nigeria's commercial hub, which has recently been identified among the 21 cities most likely to be affected by rising sea levels.

From the findings of this study which have highlighted the various negative impacts of climate change in various sectors of Nigerian's economy. It is therefore very paramount that the nation should take proactive measures in her response to this issue. The government and the people of Nigeria should take up the challenge and seek cooperation and collaboration with international agencies in other to create opportunities for technology and skill transfer to foster better adaptation and mitigation measures. This study therefore recommends the need for further research on this issue of climate change in other sectors so that it can proper adaptive and mitigation measures can be developed and applied on time.

5.1 Recommendations

Nigeria is highly vulnerable to the impacts of climate change and must, therefore as a matter of urgency take steps to reduce its vulnerability, build its resilience and build its adaptive capacity. so therefore In order to deal with the adverse impact of change on the Nigerian economy and society, certain adaptation and mitigation strategies have to be employed so as to take appropriate actions to prevent or minimize the damages they can cause to the developing

340 economy of Nigeria and livelihood of the people. The following suggestions were made as
341 follows;

342 • Adopting improved agricultural systems for both crops and livestock
343 For example, diversify livestock and improve range management; increase access to
344 drought resistant crops and livestock feeds; adopt better soil management practices; and
345 provide early warning/meteorological forecasts and related information.
346 • Increasing use of climate forecasting to reduce production risk.
347 • The Federal Government and its agencies should review natural agricultural policies and
348 related programmes so as to encourage and support development initiatives which can
349 introduce newly advanced and proven strategies which will help agricultural production.
350 • The agricultural and Research institution should commence research into crops that are
351 resistant to drought and heat.
352 • The River basin Authority should commence design and construction of new water
353 projects for drought management and irrigation farming.
354 • The Federal Ministry of Environment should check erosion problem by construction of
355 dykes and storm surge barriers against sea level, also development on wetlands, flood
356 plains and area close to sea level, especially by the poor who are most vulnerable to
357 disasters should be stopped.
358 • Quality health information and robust enlightenment campaigns will help people adapt
359 before any disaster. Campaigns on preventive and defensive medical practices should be
360 taken to the grass roots in local areas and with their local dialects.
361 • Undertaking research to better understand impacts of climate change on human in respect
362 to Nigeria health sector and status.

- Reinforcing programmes to advocate and promote the relevance of environmental sanitation and waste management facilities so as to reduce exposure and vulnerability of the society and also improving climate –sensitive disease surveillance and control.
- Developing and building actions plans for urban and rural area development for proper settlement so as to reduce vulnerability of the environment.
- Relocation of settlers in areas vulnerable to sea level rise and flooding, protection of exiting natural barriers, building of sea walls and dune reinforcement.
- Encouraging the use of low cost solar energy cookers instead of wood burning devices which cause deforestation.
- Terrestrial and marine ecosystems that act as carbon sink reservoir to greenhouse gases should be protected and sustained by reducing bushing burning and encourage afforestation, also enforcing laws and penalties on bush burning which destroys fresh grasses for animal grazing.
- Oil spillage and gas flaring in the coastal regions should be checked to help enhance carbon sink and depletion of the ozone layers.
- The use of renewable energy sources such as fuel cells that convert hydrogen fuel directly into electricity without first burning it to produce heat as well as small photovoltaic cells should be encouraged.
- Realignment/ relocation, designing of standards and planning for roads, rail and other infrastructure to cope with warming and drainage effects.

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