A REVIEW OF SOCIO-ECONOMIC IMPACT OF CLIMATE CHANGE ON THE ENVIRONMENT IN BORNO STATE, NIGERIA

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ABSTRACT

Climate change is an adverse environmental phenomenon that is causing enormous concern all over the world. It refers to some anomalies in the climate system that is a result of human activities. These anomalies include increase in the concentration of GHGs, HFCs and CFCs in earth's atmosphere, which will ultimately lead to global warming. In fact, global warming has already begun, as earth's temperature has risen between 0.4 and 0.8°C in the last 100 years. Nigeria is recognized as being vulnerable to climate change because 70% of her population of about 200 million people are employed by agriculture that depends mainly of rain-fed system of production. It is also known that half of this population is considered to be poor. Borno state, located in the drier part of Nigeria is affected by climate change by way of decreased and poor rainfall distribution as well as high temperatures affecting agricultural production and human health all leading to food insecurity, poor health, high level of poverty and low economic development. Already out of the 27 Local Government Areas (LGA) of the state about two thirds of these LGAs have their populations displaced and entire communities are taking shelters as environmental refuges in IDP camps due to insecurity linked to environmental degradation. Climate change and global warming if left unchecked will cause adverse effects on livelihoods not only in Borno State but throughout Nigeria. The Local Government administrations need to rise up to the challenges posed by climate change to adapt to the changing climate to build a resilient community and economy through sustainable development.

INTRODUCTION

Climate change has been defined by the Inter government panel on climate change (IPCC) as any change in climate over time, whether due to natural variability or as a result of human activity. Climate change is an adverse environmental phenomenon that is causing enormous concern all over the world. It refers to some anomalies in the climate system that is a result of human activities. These anomalies include increase in the concentration of GHGs, HFCs and CFCs in earth's atmosphere, which will ultimately lead to global warming. In fact, global warming has already begun, as earth's temperature has risen between 0.4 and 0.8°C in the last 100 years.

Global warming is the term used to describe the gradual increase in the average temperature of earth's atmosphere and its oceans (Awosika*et al.,* 1992)a change that is permanently changing earth's climate forever (IPCC. 2005). Global warmingis caused by increase

in the emission of GHGs throughthe burning of fossil fuels (oils, natural gas and coal),burning of wood, wood products and solid wastes, raising of livestock and the decomposition of organic wastes in solid wastes landfills; combustion of solid wastes and fossil fuels in industrial and agricultural activities; bush burning; and deforestation. All these human (anthropogenic) activities contribute to alter the balance of the equilibrium between the natural GHGs (water vapour, carbon dioxide, methane and nitrous oxide) (water vapour, carbon dioxide, methane and nitrous oxide) and the man-made GHGs (Sulfur hexane fluoride-(SF), Hydro-fluorocarbons-(HFCs) and Perfluorocarbons (PFCs) in Earth's atmosphere thus promoting the warming of both the atmosphere and the oceans since they are heat-trapping gases.

The level of these GHGs has increased beyond natural level (NEST. 2004). There is a scientific consensus that the average temperature of Earth has risen between 0.4 and 0.8°C in the last 100 years (IPCC. 2005). The increased volume of carbon dioxide and other GHGs released from the burning of fossil fuels, deforestation, agriculture and other human activities are sources of global warming that have occurred in the last 50 years (IPCC. 2005).GHGs are good absorbers of heat radiation coming from Earth's surface acting like a blanket keeping it warmer than it would be. Enhanced GHGs effect however, is not natural as it acts to destabilize Earth's radiation balance due to anthropogenic destabilize Earth's radiation balance due to anthropogenic accumulation in Earth's atmosphere of radioactive GHGs especially tropospheric ozone and chlorofluorocarbons (CFCs) (Awosika*et al.,* 1992). It has been suggested that if the current trend of anthropogenic GHG emissions continue through 2030, Earth is likely to experience an average rise in temperature ranging from 1.5 to 4.5°C (Porter and Brown 1991).

The Intergovernmental Panel on Climate Change (IPCC) and major scientific organizations of industrialized countries have concluded that the increase in global temperature since the middle of twentieth century has been due mainly to human induced (anthropogenic) greenhouse gases concentration via the greenhouse effect; while the warming effect of natural phenomenon such as solar variation contributed a small warming effect from preindustrial times to 1950, and from then a reverse cooling effect. The United Nations Framework on Climate Change (UNFCC) uses the term "Climate Change" for human induced change while the term "Climate Variability" is used for changes due to External Forcing. External forcing is climate change caused by change in the global energy balance owing to fluctuations in the Earth's orbit, ocean circulation and atmospheric composition.

The Green house Effect is the process by which radiative energy leaving the planet surface is absorbed by some atmospheric gases, called **greenhouse gases (GHG)**. The Sun is Earth's only external form of heat. It emits solar radiation mainly in the form of shortwave visible and ultraviolet (UV) energy. As this radiation travels toward the Earth, about 25% of the radiated energy is absorbed by the atmosphere and about 25% is reflected by the clouds and other gases back into space. The remaining radiation travels unimpeded to the Earth and heats its surface. The atmosphere acts like the glass in a glass greenhouse, allowing much of the shortwave solar radiation to travel through unimpeded, but trapping a lot of the long wave heat energy trying to escape back to space. The greenhouse gases transfer the energy to the surface and lower atmosphere and it is reradiated in all directions, including down towards the Earth's surface. This process makes the temperature rise in the atmosphere just as it does in the artificial greenhouse (Idowu, 2011).

In their natural state of occurrence the Earth's greenhouse gases do not constitute any danger to the environment. The Earth's natural greenhouse effect transfers energy to the Earth's surface and lower atmosphere; so that the temperature there is higher than it would have been if direct heating by solar radiation were the only warming mechanism (Idowu, 2011). This process has a warming effect of about 33°C, without which the Earth will be uninhabitable. The major natural greenhouse gases are: water vapour which causes 36%-70% of greenhouse effect; carbon dioxide, CO_2, 9%-26%; methane CH4 4%-9% and ozone with 3%-7%.

Scientists have shown that the main cause of global warming and climate change is the continued increase in the level of CO_2 as a result of emissions from fossil fuel combustion, deforestation and cement manufacture which are the major causes of CO_2. Fossil fuel combustion and deforestation produce the most significant CO_2 than cement production which is fingered as third largest producer of CO_2. The global CO_2 level will continue to rise due to continued burning of fossil fuel and land-use changes, especially deforestation. The rate of increase will however depend on economic, sociological and natural developments.

2.0 Climate Change and its socio-economic impacts inBorno State

2.1 Impacts for Agriculture and Food Security

Although all the main sectors of the State's economy will be impacted by climate change, the agriculture, forestry and livestock sectors are particularly vulnerable to climate change (Gwary, 2018). In general, climate change is driving aridity and desertification in the State, as well as increasing flash flooding and erosion. Flooding and erosion lead to crop failure by removing topsoil and washing away or submerging crops. In addition, global warming-induced increase in temperature have significant impact on crop productivity. The impacts of changing climatic conditions that are contributing to significant loss of livelihoods in the desertification frontline States of Nigeria including Borno State are:

* decreased rainfall, increased temperature and evaporation
* more frequent drought spells leading to source water shortage;
* changes in the onset of the rainy season changing planting dates and the length of the growing season of annual crops
* increased fungal outbreaks and insect pests due to changes in temperature and humidity
* decrease in the available areas that can be cultivated and decline in yields
* increased risk of food shortage and famine
* increased potential of malaria transmission and the related reduction in available labour to work on farms
* increased movement of pastoralists to more humid southern areas in search of fodder and water
* lower quality and quantity of grazing lands
* increased desertification of arable lands
* increased rural to urban migration leading to a reduction of available farm labour; and loss of soil fertility.

The livestock sub-sector will also be affected by climate change and other environmental hazards within the regions. The climate change hazards affecting livestock production include late onset of rainy season, higher than normal temperatures, flooding, salt water intrusion and windstorms. Late onset of the rainy season causes a lack of available water for livestock

and reduces forage availability. Higher than normal temperatures leads to poor livestock health which reduces the market value of affected livestock thereby reducing farmers' income. Flooding leads to loss of livestock, destruction of livestock enclosures and outbreak of diseases. In general, the livestock sub-sector is vulnerable to climate change hazards because of the low adaptive capacity of livestock farmers to its impacts (BNRCC, 2011).

2.2 Impacts for Water Resources

The water sector in Borno and the arid & semi-arid region in Nigeria is one major area that is and will be impacted by climatic change and therefore a major focus to make the region climate resilient is a great necessity. With projected average temperatures showing rising trends, the impacts of climate change in the water sector are likely to be more severe in the future. The arid and semi-arid belt of Nigeria could become a water stress region by the middle of the century.

Although the exact trend remains unclear, there is evidence that many parts of the arid and semi-arid areas of Nigeria region to which Borno State belongs are already experiencing a climate-induced decrease in water availability. The rapid shrinking of Lake Chad from about 45,000 km^2 in 1960 to less than 3,000 km^2 in 2007 is attributed mainly to changes in the climatic conditions over the region towards increasing aridity. In addition, many freshwater aquifers, particularly in Borno State, are already stressed from over-extraction and face the risk of total depletion. This does not only reduces available water resources and borehole yields but can result in other serious and potentially costly side effects including saline intrusion and subsidence.

2.3 Impacts for Environmental degradation

Environmental degradation is the deterioration of the environment through depletion of resources such as air, water, and soil, the destruction of ecosystems and the extinction of wildlife (Wikipedia). When the environment becomes less valuable or damaged, environmental degradation is said to occur. There are many forms of environmental degradation. When habitats are destroyed, biodiversity is lost, or natural resources are depleted, the environment is hurt. Environmental degradation can occur naturally, or through human processes. The largest areas of concern at present in Borno State are the loss of forest, loss of soil through erosion, air pollution and dust particles, and the destruction of the biodiversity. Even in remote areas, the effects of land degradation are obvious. In some areas, the natural environment has been exposed bare due to unsustainable deforestation. In other places, major disasters of sand dunes have ruined the local environment and buried farmlands and communities. Table 1 shows the extent of land degradation in the State.

Table 1: Extent of Area (ha) of Terrestrial Biomes and Degradation in Semi-Arid Zone of Borno State.

COED Class	Borno State			
	Total Degraded Area	Degraded Area within 25 years (1990 – 2015)	Average Degraded Area Per Annum	Percentage proportion of Total Degraded Area per State
Area Under Cultivation	3171542	488335	19533.4	43.91311
Area Under Desert Enchroachment	2889646	81138.8	3245.55	40.00998
Dam Siltation	2614.58	70.11	2.804	0.036201
Deforested Area	2638.8	1636.27	62.451	0.036537
Eroded Areas Especially Gullies	250360.1	28188.3	1127.53	3.466481
Forested Area	119644.7	351774.5	14070.98	1.656598
Irrigation Project	79163.73	2954.77	118.191	1.096099
Perennial/Seasonally Flooded Arable Lands	620697	265928	10637.12	8.594158
River Bed Siltation	5571.01	1264.16	50.567	0.077136
Rock Outcrop	45529.84	243.898	9.756	0.630405
Urban Growth	31879.23	14650.1	586.005	0.441399
Water Body	3026.286	2624.463	105.699	0.041902
Total	7222313			100

Source: World Bank Survey Report on Degraded lands in Arid and semi-arid of Nigeria 2018

2.4 Impacts for Health

Climate change could negatively impact human health in Borno State. The high mortality due to the incidence of Cholera in Internally Displaced People's (IDP) Camps reported in the State in 2018 can be related to increasing temperature as predicted for the region accompanied by poor sanitation accentuated by lack of water. Changes in temperature and precipitation have great implications on human health in the area of injury, illness, morbidity and mortality. Extreme weather induced flooding 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, malaria and incidence of diarrheal disease.

2.5 Impacts for Energy

Despite the state's disposition to different sources of energy including fossil fuel and renewable energy, most inhabitants of the state use fuel wood for their domestic and sometimes industrial uses. This has placed high demand on the fragile forest in the region. The consequences of this is the land and vegetation degradation and poor environments that have accelerated desertification in the northern part of the state. In the southern part of the state, unsustainable logging are exposing land to water erosion and leaving land that can no longer support food production.

2.6 Impacts for Security

Over the past ten years, both our understanding and awareness of the links between climate change and security have increased tremendously. Today the United Nation, the European Union, the G7 countries and an increasing number of states have classified climate change as a threat to global and/or national security. The increasing impacts of climate change do not automatically lead to more fragility and conflict. Rather, climate change acts as a threat multiplier. It interacts and converges with other existing risks and pressures in a given context and can increase the likelihood of fragility or violent conflict. There is deeply related to a process of increased competition over resources (Conroy, 2014). Climate change and natural hazards reinforce existing vulnerabilities, lead to greater water and food insecurity, and modify the availability of natural resources. These impacts increase migratory pressure, and give rise to greater competition for resources, growing tensions, and levels of conflict (United Nations Environment Programme, 2011). Studies have shown that in Sub-Saharan Africa, a proportional reduction of 5% in rainfall compared to the previous year increased the likelihood of conflict the following year by 50% Climate change and drought and desertification will intensify resource scarcity for everyone, and deplete the natural capital (Conroy, 2014).

There is a rising concern that climate change may lead to new class of environmental refugees due to the ability of climate change to destablize communities living in areas that have been subjected to uncontrolled depletion of natural resources resulting in land degradation. In particular, the current situation in the Lake Chad region of the north-eastern part of the country provides a good empirical evidence of apparent linkage between climate change, migration, conflicts and insecurity (Fasona and Omojola, 2005; Onuoha, 2008), but in a rather non-linear and complex manner.

Freshwater shortage in the Lake Chad Basin, due to rapid shrinking of the lake in recent years, has had severe economic impacts on the fisheries, flood recessional agriculture, livestock rearing and other wetland industries in the region. For example, it led to the failure of the overly ambitious South Chad Irrigation Project aimed at irrigating 67,000 ha to produce rice, wheat and cotton. Over US$400 million worth of agricultural investments were lost, and by 1984 the project disintegrated, leaving about 60,000 people with no secured means of livelihoods (Oladipo, 1993). Consequently, there has been severe food insecurity in the region and a proliferation of diseases. There has also been significant migration from the north of

the Basin as "environmental refugees" have fled drought, increasing the pressure on natural resources and inciting social tensions, that is ball rolling into severe national insecurity of the region (Oladipo 2012, 2018). In the Chad Basin area, responses to climatic shifts create shortages of resources such as land and water. Shortages are followed by negative secondary impacts, such as more sickness, hunger, and joblessness. Poor responses to these, in turn, open the door to conflict. For example, many of the abandoned settlements in the Lake Chad basin are now homes to Boko Haram terrorism. In other parts of Borno State, land and water sources degradation due, partially to climate change is contributing to low crop yields and accelerating farmer herdsmen clashes and social unrest.

2.7 Impacts for Political stability

Negligence and a failure to tackle the issue of climate change by successive governments have also contributed to the rise of insurgency groups across the country. Against this backdrop, if appropriate, preventive action is not taken and adaptation measures are not implemented in time, the results could be catastrophic.

Borno state has never in its history encountered massive insecurity until the year 2002. In fact locals popularly call it the Home of Peace before Boko Haram started clashing with the army and government officials. By the year 2006 the group was fully armed and was killing innocent civilians in multitudes. This caused a great displacement in the rural communities around the state, as the daily lost of lives became unbearable and people had to flee from their villages to stay alive. According to Sani, 'the main target of the group is to take over the city of Maiduguri as half of the population forcefully flee their homes for safety. This crisis has made farming in the rural communities impossible.

3.0 Borno State's Vulnerability to Climate Change

All aspects of State's development are vulnerable to climate change. It natural capital (land, forests, landscapes, water, and fisheries) and physical capital (cities, infrastructure, and other kinds of produced capital), as well as its human capital are highly susceptible to the impact of climate change. The economy and other sectors of development are very vulnerable to climate change. Climate change affects the ability of natural capital, which is the main source of income and livelihoods for the majority of the State indigenes, to deliver its wide range of products and services (including food, fodder, timber, and the regulation of water cycles), some of them vital.

4.0 Response to Global Warming and Climate change

The recent 2018 IPCC special report on the impacts of global warming of 1.5^{o}C above pre-industrial levels clearly indicates that global warming is likely to reach 1.5^{o}C between 2030 and 2052, with its adverse negative consequences. According to the report, to limit the risks from the global warming of 1.5^{o}C in the context of sustainable development and poverty reduction implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes. It also requires that current global GHG reduction pledges through the NDCs should be increased to further minimise human contributions to global warming. Knowing to manage the territory, protect the environment and evaluate the cultural heritage. The available options are: mitigation to reduce further emissions; adaptation to reduce the impact of global warming on the environment and human life.

4.1 Mitigation

This means that the measures must be taken by various nations to reduce rate and magnitude of global climate change caused by human activities. According to IPCC, the mitigation options includes reduction in burning of fossil

fuels and reduction of greenhouse gases and soot from the energy sector; reduction of deforestation; increase in reforestation and afforestation; modification of agricultural practices to reduce emissions of greenhouse gases and build up soil carbon. Other mitigation options include: geo-engineering to reverse the effect of global warming by creating cooling effects which will offset greenhouse heating; and conceiving the development of technology to clean the greenhouse gases from the atmosphere. It has been estimated that at present the cost and benefit of mitigating global warming are approximately the same. In general, the IPCC concludes, without mitigation global warming will reach a point where it will be impossible for some natural systems such as ecosystem to cope and therefore may go into extinction. As for humans the cost of adaptation will be so prohibitive that many will not cope. It is therefore essential to do a little of mitigation and a little of adaptation.

4.2 Adaptation

Adaptation means that we should take measures to reduce the adverse impact of global warming on human life and the environment. Some of the options that are available include: changing the cropping patterns; stopping further development on wetlands, flood plains, and close to sea level; developing crops that are resistant to drought, heat and salt; strengthening public health and environmental engineering defense against diseases; designing and building new water projects for flood control and drought management; construction of dykes and storm surge barrier against sea level rise (Holdren, 2010).

4.3 Climate change and Sustainable Local Government Development

4.3.1 Sustainable Development

During the last four decades rapid economic growth has lifted many countries out of poverty, but has been accompanied by depletion of natural resources and deterioration in environmental quality. This immediately called for a serious environmental conservation and sustainable development. In 1984, the UN General Assembly appointed the World Commission on Environment and Development (WCED) to propose long-term strategies for achieving sustainable development by the year 2000 and beyond. The work of WCED culminated in the Brundtland Commission's report, “Our common Future” in 1987 (WCED, 1987). The report defined sustainable development as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*(WCED, 1987).

The report has stimulated renewed discussion of development with emphasis on sustainability leading to the first Rio Earth Conference of 1992, and also a lot of debate on the concept and its practice. Presently there are about three broad approaches to sustainability: economic, biophysical and socio-cultural as shown in figure 1.

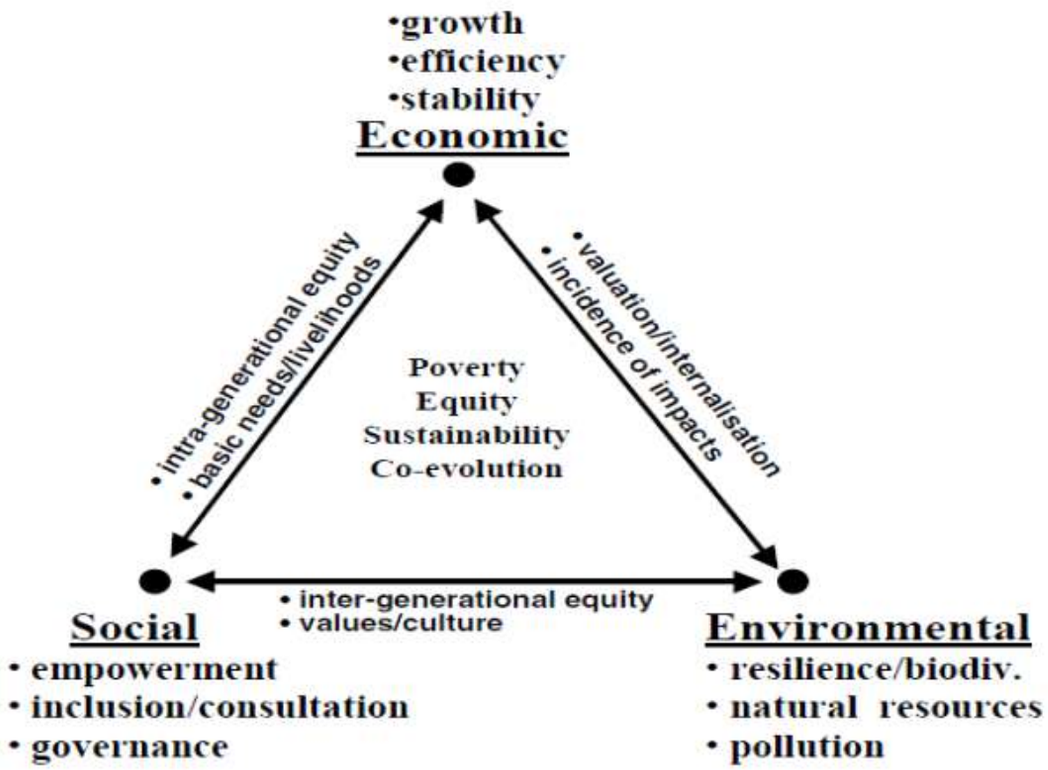

Figure 1: Dimensions of Sustainable Development

The economist's approach to sustainability recognizes that the measurement of a country's base of assets be broadened to include natural capital, in addition to human-made capital. The challenge of economist's approach to sustainability is to expand the analysis of resource values to consider the function and value of ecological systems, making greater use of ecological information, and to extend economic theory and analysis to incorporate the implications of biophysical resource limits.

The ecological approach therefore conceives the environment as a global life-support system of "ecosystem" within which living organisms interact with the physical elements. Economic activity that implores unsustainable levels of stress on the natural environment may generate negative feedback effects.

The socio-cultural approach recognizes the centrality of the social action and their institutions in sustainable development. Sustainability must be "socially constructed" to take cognizance of the fact that the environment is at risk not from extra-terrestrial enemies, but from human beings including both local and distant resource users.

Sustainable development (SD) contains two key concepts around which balance must be sought and attempt to reconcile various approaches be made: "needs" among the world's population; limitations associated with current states of technology and social organization

and their relationship to the capacity of the ecosphere to satisfy present and future demands. SD emphasizes that environmental stresses are linked to patterns of economic development, requiring that economics and ecology be integrated in decision making processes both to protect the ecosystem and promote development. In this discussion SDG 12: Take urgent action to combat climate change and its impacts and SDG 15: To sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss both become relevant.

5.0 Conclusion and recommendations

In conclusion, the paper defined climate change and discussed it general implications and specific impacts in Borno State and the semi-arid region of Nigeria. The paper suggested the three responses to climate change applicable not only Borno state but to all regions and countries affected by climate change. These include mitigation and adaptation both under a sustainable path of development commonly referred to as green economy. There is a need to implement sustained programme of afforestation in Borno state, reduction of deforestation and modification of agricultural practices to reduce emissions of greenhouse gases and build up soil carbon.There is an urgent need to curtail insecurity issues and bring an end to the decade long insecurity caused by Boko Haram insurgent in the north east. There is a need to take measures to reduce the adverse impact of global warming on human life and the environment. This measures include changing the cropping patterns; stopping further development on wetlands, flood plains, and close to sea level; developing crops that are resistant to drought, heat and salt; strengthening public health and environmental engineering defense against diseases; designing and building new water projects for flood control and drought management

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