THE 18th BASSEY ANDAH MEMORIAL LECTURE

THEME
THE NIGERIAN ENVIRONMENT: A THREATENED HERITAGE

TOPIC
THE PARALLAX AND PARADOX OF CLIMATE CHANGE: PLIGHT OF LOCAL COMMUNITIES

Delivered by

Professor Lawrence Ikechukwu Ezemonye, **fnes, fsesn**
National President, Nigerian Environmental Society (NES)
(**Professor of *Ecotoxicology and Environmental Forensic***)
Department of Animal and Environmental Biology
University of Benin, Benin City
Edo State, Nigeria

January 2017.

THE PARALLAX AND PARADOX OF CLIMATE CHANGE: PLIGHT OF LOCAL COMMUNITIES

Preamble

I am really humbled by the invitation to deliver the 18th BASSEY ANDAH MEMORIAL LECTURE. I want to start by thanking the chairman and Board of Directors of the Bassey Andah Foundation (BAF) for the privilege and honour accorded me to be the keynote speaker at this 18th Bassey Andah Memorial Lecture. I am aware that the Bassey Andah Memorial Lecture series in honour of a foremost African Anthropologist, Archaeologist and Humanist was inaugurated about seventeen years ago. It is not only deserving of a celebrated erudite scholar but a well-conceived index for posterity.

The theme of this lecture The Nigerian Environment: A Threatened Heritage is fully captured in my presentation today titled- The Parallax and Paradox of Climate Change: Plight of Local Communities. It lucidly encapsulates global climate change scenario in the Nigerian space, vulnerability of the Nigerian environment to climatic alterations and the plight of local communities in Nigeria. The paper further examines the Conference of Parties (COPs) and response to Climate Change. Finally, the lecture reviews mitigation strategies in Nigeria, the challenges in executing these strategies and proffers the way forward for the Nigerian State.

OUTLINE

1. **The Nigerian Space**
2. **Vulnerability of Nigeria to Climate Change**
3. **Drivers of Climate Change in Nigeria**
4. **Plight of Local Communities.**
5. **Conference of Parties (COPs) and Climate Response**
6. **Nigeria's Response to Climate Change**
7. **Climate Change Mitigation strategies in Nigeria**
8. **Challenges of Climate Change Mitigation**
9. **Way Forward**
10. **Conclusion**
11. **References**

1. THE NIGERIAN SPACE

The Nigerian environment is characterized by a combination of natural features that makes it highly fragile and uniquely susceptible to anthropogenic environmental perturbations. This is due to its peculiar geographical, geological and geomorphological setting. In ecological terms, Nigeria is a land of extremes and has remained continuously at risk for ages, with the recent phenomenon of global warming further accentuating the rate of environmental degradation (Butler, 2012). Nigeria, like most parts of the world, is experiencing not only regional warming but also the essential features of climate change (Ojekunle *et al.,* 2014).

Climate change is driven by both natural and anthropogenic factors. Natural factors include events like continental drift, volcanic eruptions, and earth drift. On the other hand, anthropogenic causes include various human activities associated with population growth, urbanization, gas flaring and agricultural activities, which have continuously elevated the emission of greenhouse gases at an alarming rate, altering the natural composition of atmospheric greenhouse gases.

The environmental integrity of local communities now demands our care more than ever before because every passing day presents daunting and devastating challenges to its very existence (Ezemonye, 2013). Knowledge of existing environmental degradations and climate change complications bedevilling humanity appears to far outstrip current pragmatic ability to ensure sustainability. Consequently, Nigeria and her local communities fall into the vulnerable and susceptible countries in the world battling with the parallax and paradox of climate change.

2. THE VULNERABILITY OF NIGERIA TO CLIMATE CHANGE.

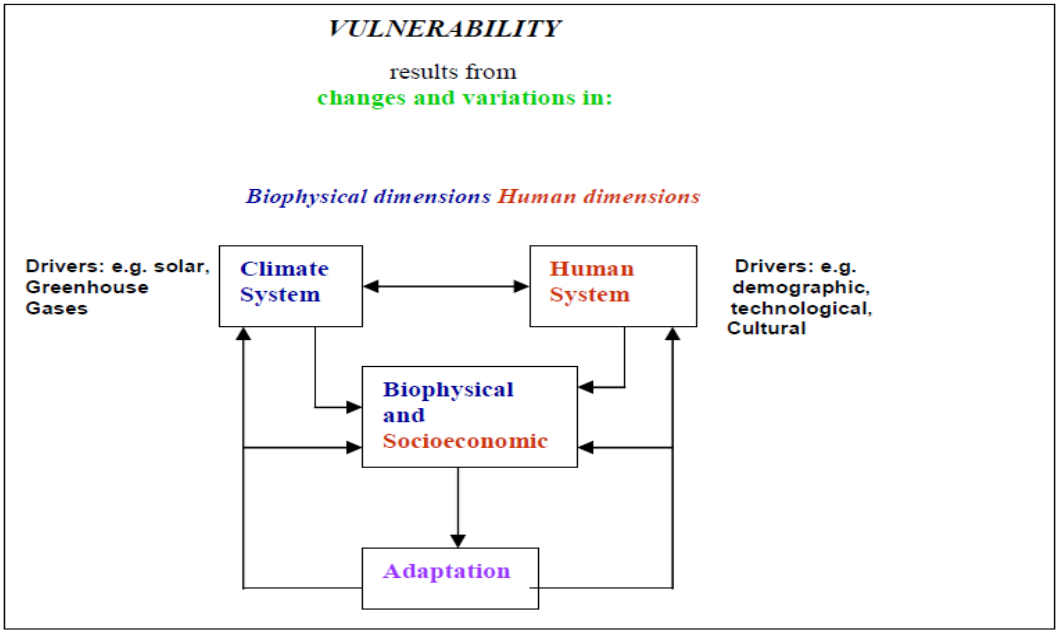
Nigeria is one of the few countries expected to be most affected by the impacts of climate change through sea level rise along her coastline, intensified desertification, erosion, flooding disasters and general land degradation. Environmental degradations and devastations associated with climate change are known to have wrecked rural livelihoods.

Incidentally, the country is among the vulnerable regions in the world exposed to climate change impacts (Adejuwon, 2008) and has a variety of ecosystems, ranging from mangroves, rainforest on the Atlantic coast in the south to the savannah in the north bordering the Sahara. According to Joiner *et al.,* (2012), Nigeria is highly susceptible to climate change in two primary locations: the Northern fringes particularly the Sahel and the Niger Delta regions. Other areas prone to climate change impacts include densely populated cities like Ibadan,

Lagos, Onitsha, Aba, Zaria, Bida, Ilorin and Jos. Vulnerability is hence magnified but not limited to the following interconnected factors;

a. Dependence on fossil fuel production and utilization.
b. Diverse tribal, religious and cultural groups.
c. High concentration of poverty especially in endemic regions.
d. Low literacy level and poor access to healthcare.
e. High dependence on natural resources and rain-dependent agriculture.
f. Limited technology for adaptation.

Nigeria's vulnerability will be in two ways; first, the resulting impacts of climate change and second, the impact of response measures. Changes in climate may alter Nigeria's major ecological zones such as agricultural ecosystems, freshwater and coastal resources, forests, and biodiversity are all susceptible to impacts from climate changes. Such impacts include increases in soil erosion, flooding, desertification, and salt-water intrusion



Source: Warrick (2000)

The implication is that the vulnerability of Nigeria to the effects of climate change depends not only on the magnitude of climatic stress, but also on the sensitivity and capacity of affected people to adapt to or cope with such stress (Madu, 2016). A number of conditions that accentuate vulnerability according to Ranger and Garbett-Shiels, (2012) are geographical in nature, remote location and paucity of socioeconomic infrastructure. Consequently, rural dwellers are especially affected by local conditions which amplify their vulnerability to climate change.

3. DRIVERS OF CLIMATE CHANGE IN NIGERIA

3.1 Population Growth and Urbanization

The current population of Nigeria is put at 187million, representing 20% of the entire population of Africa and 2.37% of the world's population (UN DATA, 2016). The population had therefore grown dramatically since the 1952/1953 census when it was 31.5 million (FRN, 2007). By 2050, Nigeria's population is projected to rise to 289 million (UN, 2002).

The recorded rise in Nigeria's population in an accelerating rate has led to a commensurate increase in anthropogenic activities. This, in turn, has distorted the natural balance by increasing the amount of heat trapping gases such as carbon dioxide and other greenhouse gases that induce global warming.

Apart from population growth, Nigeria has experienced increased urbanization over the last five decades. The rate of urbanization rose from 3.5% to 3.8% between 2010 and 2015 (World facts Book, 2016). This is made possible by the improved infrastructural platforms such as power, transportation, housing, communication, healthcare and enhanced geographical mobility (Odjugo, 2011). These infrastructural growth associated with urbanization has always been accompanied with environmental cost (Ezemonye, 1992).

A scene in Oshodi Lagos.

3.2. Transportation, Traffic and vehicular emission

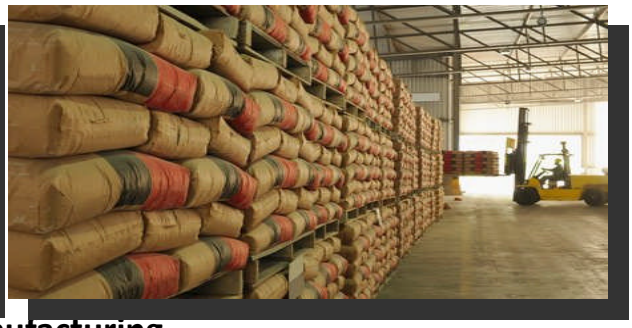
The process of burning fossil fuels to power cars, heavy duty vehicles and generators contributes greatly to the release of carbon dioxide and a variety of greenhouse gases into the atmosphere resulting in global warming and climate

change. The fleet of vehicles has steadily increased since independence in 1960 (ATPS 2013). Recent studies have shown that emission rate of CO_2 from average traffic volume in Minna, Bida and Suleja were 2956.8, 2803 and 3043 ppm respectively. These levels of CO_2 emissions were approximately eight times higher than internationally acceptable safe limit of 350ppmin (ATPS, 2013).


Vehicular Emissions in Nigeria

3.3. Emissions from cement manufacturing

It has been estimated that cement production contributes about 5% of global man made CO_2 emissions (Priyanka *et al.,* 2013). The typical gaseous emissions to air from cement production include NOx, SOx, CO, CO_2, H_2S, VOCs, dioxins, furans and particulate matters (Mishra and Siddiqui, 2014).

Cement Manufacturing

The main minerals used in the production of cement in Nigeria are limestone in some of the plants and marble in other plants (Okigbo, 2012). Nigeria produces over 25 million metric tonnes of cement annually (Osagie, 2011). Wilson and Law, (2007) stated that for every tonne of cement produced about half a tonne of carbon dioxide is released excluding the carbon dioxide released from the energy needed in the process. Emissions of Carbon dioxide take place during cement manufacturing due to decarbonisation of Calcium and Magnesium carbonate and burning of fossil fuels.

3.4. Deforestation and Land Degradation

Deforestation is a global threat, not only because it causes habitat fragmentation and loss of biodiversity, but it also degrades environmental

conditions and has an impact on global greenhouse gas emissions (GHG) by releasing CO_2 to the atmosphere. Forests are important sources of livelihoods to millions of people and contribute to national economic development of many countries. They provide critical ecosystem services and play a fundamental role in conservation of biodiversity.

Despite global acknowledgement of the importance of forests, recent data show that forest area has continued to shrink (Keenan *et al.,* 2015) as agricultural land continues to expand in 70% of countries. Unfortunately, Nigeria ranks 4th amongst the countries with the greatest net loss of forest area between 2010 and 2015 (FAO, 2015).

Rapid deforestation in Nigeria is clearly due to agricultural practices, commercial activities, overgrazing, uncontrolled exploitation of fuel woods, aggravated drought and industrial purposes (Agagu, 2009). Nigeria's 5% annual deforestation rate of natural forest means Nigeria loses about 350,000 to 400,000 hectares of land per year to deforestation. More worrisome is the fact that the country's forest cover is said to be less than 6%, way below the 26% recommended by FAO (FAO, 2015).

Deforestation

Land Degradation

Land degradation in recent times has become a matter of critical concern for Nigeria. Land degradation is a decline in the quality of the land over time which is usually caused by several anthropogenic activities (Imoke *et al.,* 2010). It also refers to the impairment of natural quality of soil component of any ecosystem, threatening its natural potentials.

It is primarily caused by deforestation, overgrazing, overexploitation for fuel wood, agricultural activities, increased flooding and industrialization (FAO, 1996). The fact that land degradation impacts world food security and the overall quality of the environment makes it of global concern (Imoke *et al.,* 2010).

3.5. Bush burning

Fire is clearly one of the most dominant forces affecting the Earth's land surface. Burning of forests in the tropics is of great concern (Dawson *et al.,*

2014). In Nigeria, bush burning contributes largely to the impact of climate change (Ogbo *et al.,* 2013). Slash and burn practice in agriculture and fire hunting is one of the major causes of desertification in Nigeria (Olugunju, 2015).

Owing to the low relative humidity in northern Nigeria coupled with very dry harmattan wind, there is always a high incidence of bush fires every dry season. Other regions of the country are also not spared from this scourge. There is need to prohibit the practice of bush burning and the release of greenhouse gases that result from the process. This could be achieved through clearing and raking of the grasses with the use of farm implements. Fire hunting is also a practice that should be totally discouraged.

Typical bush burning in Nigeria

3.6. Agriculture and chemical fertilisers

Climate change and agriculture are inextricably linked. Agriculture is both a cause and a victim of climate change (ITC, 2007). A significant portion of agriculture still depends fundamentally on the weather (rainfall, sunlight and other elements). However, agricultural practices also exacerbate climate change.

Reports by the Intergovernmental Panel on Climate Change (IPCC) puts the contribution of agriculture to greenhouse gas emissions at 13.5% (IPCC, 2004), and 32% if calculating both direct and indirect emissions from the food supply chain (land use, transportation, packaging and processing (Greenpeace, 2008). Prominent agricultural activities that significantly contribute to climate change include:

- Land conversion to agriculture: The conversion of forest into area suitable for agriculture has led to changes in the amount of sunlight reflected from the ground back into space (USGS, 2016). In Nigeria land conversion for agricultural practices in the Northern and Southern parts have reduced carbon sequestration.
- Nitrous oxide released from soils: Agriculture creates both direct and indirect emissions. Direct emissions come from fertilized agricultural soils and livestock manure (42%). Indirect emissions come from runoff and

leaching of fertilizers (25%). Agriculture creates 4.5 million tonnes of nitrous oxide per year globally (Ramachandran *et al.,* 2015).

- Livestock production: Livestock are responsible for over 18% of human-made greenhouse gas emissions (Steinfeld *et al.,* 2006). Nigeria has a thriving livestock subsector. Livestock production accounts for 5% of the total Gross Domestic Products (GDP) and between 17% and 20% of the GDP from agriculture (NBS, 2015). In a 2011 National Agricultural Sample Survey it was estimated that Nigeria had 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 28,000 camels. Methane from cattle and enteric fermentation (15-20% global production of methane) contribute largely to greenhouse gas emission. In 2010, enteric fermentation accounted for 43% of the total greenhouse gas emissions (Ripple *et al.,* 2014).

Livestock Production

Crop Production

Another agricultural activity that significantly contributes to climate change is chemical fertilizer production and application. Synthetic/chemical fertilizers as well as oil-based pesticides release Green House Gases (GHG) including carbon dioxide, nitrous oxide and methane into the air

.

3.7. Oil and Gas Activities

Paradoxically, oil and gas activities contribute a substantial quota to Nigeria's economy and environmental pollution. Oil production in the 1st and 2nd Quarter of 2016, stood at 2.11 and 1.69million barrels per day (mbpd), while as a share of the economy, the Oil sector contributed 10.29% and 8.26% to total real GDP (NBS, 2016). Despite these gains, the environmental pollution from oil and gas activities such as gas flaring, oil spillage and land degradation contribute substantially to climate change impact.

- Gas Flaring in Niger Delta

Gas flaring is a significant contributor to climate change by the emission of carbon dioxide; Global estimates also show that flaring of Nigeria's gas contributes significantly to the world's carbon dioxide emission (UNDP, 2006). Nigeria flares more gas than any other country in the world (Guardian newspaper, 2015). Close to 80% of the associated gas produced from Nigeria's oil fields are flared. Nigeria flares 17.2 billion m^3 of natural gas per year in the Niger Delta, which is equal to approximately one-quarter of the current power consumption of the African continent (Ajugwo, 2013). In the first half of 2016, Nigeria lost about $336.33 million as oil and gas companies operating in the country flared 112.11 billion Standard Cubic Feet (SCF) of gas between January and June 2016 (NNPC, 2016).

Gas flaring in Nigeria (Horizontal and Vertical).

- Oil Spillage

By global considerations, Nigeria has a high rate of oil spill with approximately a thousand spills every year (Kalejaye, 2015). Oil spills occur due to pipeline and tanker accidents (50%), sabotage (28%) and oil production operations (21%), with 1% of the spills being accounted for by inadequate or non-functional production equipment (Nwilo and Badejo, 2001).

Equipment malfunctioning, corrosion of aged pipelines, sabotage of oil installations by militants and oil thieves are the primary drivers of this phenomenon. Extensive exploration and production of petroleum in Nigeria's sedimentary basins especially in the Niger Delta area have opened up such areas to massive pollution.

The Niger Delta has suffered for decades from oil spills, which occur both on land and Offshore. Oil spills on land destroy crops and damage the quality and productivity of soil that communities use for farming. Oil in water damages fisheries activities and contaminates water that people use for drinking and other domestic purposes. The region is characterized by a prevalence of both old and new oil spills. Over 9,343 incidents occurred in the last ten years, according to official records (Kalejaye, 2015).

From 2007 to 2012, SPDC has been dealt with an average of 172 oil spills per year, slightly more than the 169 average for the 2006 to 2010 period. In 2011 there were 181 spills over 100kg (SPDC, 2011). Similarly, official records from the National Oil Spill Detection and Response Agency, NOSDRA, covering the period, 2006 and 2015, indicate that there were over 5,000 spillage sites from the over 9,000 spills (Kalejaye, 2015).

Fire from Oil spills in Nigeria.

4. PLIGHT OF NIGERIAN COMMUNITIES.

Local communities show varied susceptibility to observed impacts of climate change and high propensity of endangered heritage. Their capacity to adapt to climate change has been highly compromised, not only because of the magnitude of the impacts of climate change, but also because inadequate provision of adaptive measures.

It is generally recognized that natural-resource dependent communities particularly in Nigeria, are especially vulnerable to the effects of climate change and suffer disproportionate impacts (IPCC, 2007). Their intricate relationship with their environment is the very basis of their plight.

In Nigeria, the activities propelling climate change have destroyed rural livelihoods in the oil producing regions; desertification has wreaked havoc in the north; deforestation in the west; while gully erosion has ravaged the east in a menacing fashion.

The implication is that rural communities throughout Nigeria have become impoverished and particularly vulnerable to the impact of climate change. There has been an increase in weather-related disasters over the past four decades, and the trend continues to grow. Events like sea level rise, flooding, erosion, biodiversity loss, low rainfall, desertification and emerging diseases are some of the effects of climate change already manifest in Nigeria. The reoccurring plight of local communities includes but not limited to the following:

4.1. Desertification

In a desertification map, produced by the Food and Agriculture Organization (FAO), World Meteorological Organization (WMO) and U.N.E.S.C.O, about 15% of Nigeria land is being ravaged by desertification (Emodi, 2013). Almost one-fifth of the land area of Nigeria is fast becoming a desert. Sadly, 35 million people located in the eleven (11) frontline states of Northern Nigeria and in other parts of the country are currently threatened with food scarcity as a result of extreme weather conditions (Odiogor, 2010).

An estimated 350,000 ha of arable land used is for agriculture and other economic activities are lost annually to desert encroachment (Tercula, 2015). Population pressure results in overgrazing, overexploitation for fuel wood of marginal lands and aggravated drought due to global warming, has accelerated the rate of desertification.

The Sahara desert is ravaging beyond the arid zones of Nigeria giving rise to the recession of Lake Chad. Reports have shown that the Sahara Desert is moving southward at a rate of 0.6 km/year (Armstrong-Ogbonna and Onoh, 2015).

Medugu *et al.*, (2009), reported that the significant socio-economic impact of desert encroachment is the loss of farmlands, which is immediately followed by massive migration syndrome because of the loss of farms, thereby putting pressure on food production in the country. Desertification also contributes to loss of biological diversity, national disease burden, alters the geochemical composition of the soil, and contributes to water scarcity and reduced economic growth among other unfavourable impacts (Armstrong-Ogbonna and Onoh, 2015).

Desertification in Nigeria

4.2. Flooding

In 2010, the National Emergency Management Agency (NEMA) reported that over 250,000 Nigerians were displaced by flood disasters that ravaged many communities across the country (Ethan, 2015). Similarly, Nigeria was ranked highest alongside India amongst countries that had high rates of displacements, with over 2.1million people been displaced by devastating floods in the country since 2012 (Punch newspapers 2016).

Available records from the National Emergency Management Agency (NEMA) shows that 2012 floods in Nigeria affected 30 States in the country killed approximately 363 people and displaced over 2.3 million inhabitants (NEMA, 2013). It led to an economic loss amounting to N2.5 trillion. No fewer than 25 million Nigerians living in coastal communities of Niger, Benue, Sokoto, Katsina, Lagos, Ondo, Delta, Rivers, Akwa Ibom, Bayelsa and Cross River states were affected by the floods of 2012.

NEMA reported that floods in 2016 had more volume of water compared to 2012. A recent report of floods shows that less than a million people have so far been affected by floods in 2016, with less than a hundred (100) lives lost. Some specific cases of floods in Nigeria include; 14 June 2016 in Ebonyi State that left thousands displaced; 11 September 2015 floods which affected over 300,000 persons in Adamawa State after Dam Failure; Flood in Cross River destroyed no fewer than 4,070 houses and 13,147 farms between August and September 2016; In Niger State, farm lands in 24 communities as a result of flood that ravaged Mokwa Local Government Area of the state on September 19, 2016.

Other key flooding disasters in Nigeria include severe flooding in 3 separate incidents in Plateau, Kebbi, and Cross River states on 11 September 2013; Floods in Yobe, Nigeria, 21 August 2013 and Kano on 13 August 2013 which displaced about 500 people (Floodlist, 2016).

Flooding in Nigeria

4.3. Decline in Agricultural Productivity

Increased desertification, drought in the North, coupled with incessant flooding in the south has negatively impacted the agricultural sector, which is one of the most important economic sectors in Nigeria (Ekpoh, 2014). There have been reported cases of marked changes in variability in timing and amount of rainfall in several parts of Nigeria.

This implies that farmers experience loss in length of growing days as a result of rising temperatures, which also makes the storage of root crops and vegetables more difficult for those without access to the refrigerator (Ebele and Emodi, 2016).

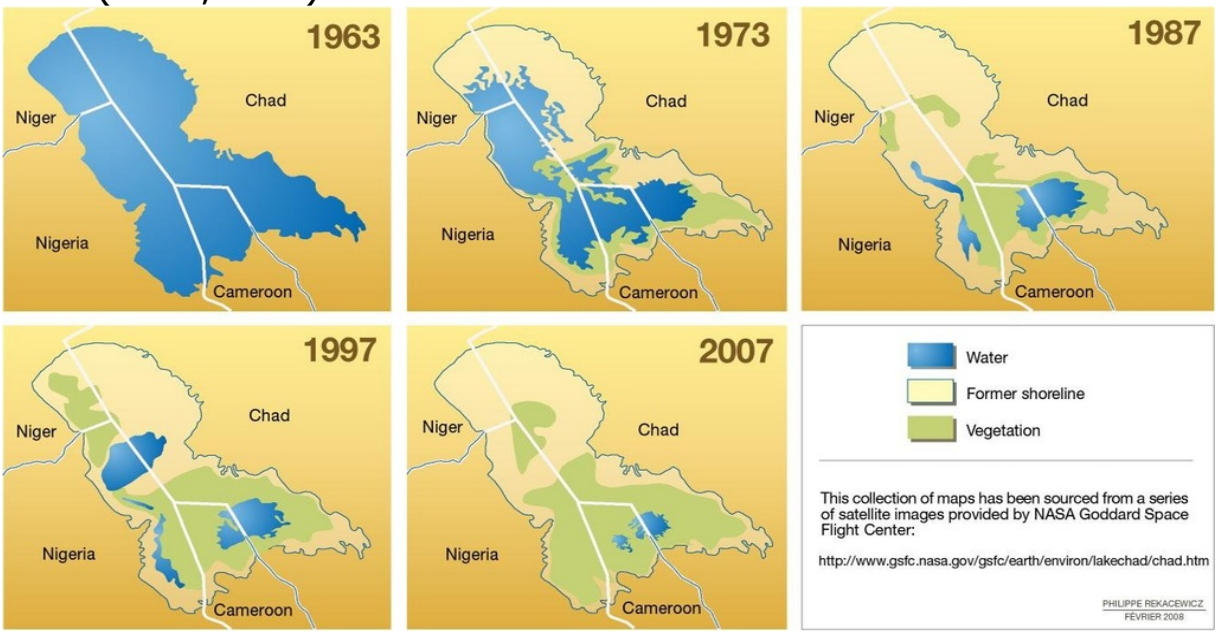
Water deficits have led to reduced crop and livestock production while farmers are now practicing shifting cultivation to suit the changes been observed in weather patterns (Usman and Dije, 2013). Another direct impact of climate change in agriculture in Nigeria is the reduction of arable lands as a result of sea incursion in coastal plains and desert encroachment in the North (Ebele and Emodi, 2016).

4.4. Effects on Water Resources

Climate change is having a multitude of immediate and long-term impacts on water resources in African countries including Nigeria. Reports have shown changes in hydrological seasons in Nigeria, longer dry spells, reduced rainfall, which will lead to reduced recharge capacity for lakes and rivers (Ekpoh, 2014). The current low levels of water in dams indicate the sensitivity of reservoirs storage to variations in runoff due to climate change and drought. Associated effects of climate change on water resources include:

- Irregular rainfall patterns: There is increasing variability in rainfall over Nigeria and particularly over the northern part of Nigeria due to climatic changes (NMetS). Studies have indicated a rapid shift in rainfall patterns in Nigeria, which could be attributed to changes in climate. More recently, Oguntunde *et al.,* (2011) reported that annual rainfall in Nigeria had been reduced to **50–350 mm** over 20% to 64% of the Nation's landscape. In another study, a comparison between monthly rainfalls received in two climatic periods in Nigeria shows rainfall reduction in all months except in August when there was a slight increase in the second climate period (Ogungbenro and Morakinyo, 2014).
  Disappearing lakes: A disturbing visible evidence of the impact of climate change in Nigeria can be found in the Lake Chad. The lake occupied 22,772 km^2 in June 1966, spanning the countries of Chad, Nigeria, Niger and Cameroon and bordering the Sahara desert (UNEP, 2008). The Chad basin is one of the most important agricultural heritage sites in the world, providing a lifeline to nearly 30 million people in surrounding countries (Salkida, 2012).

Sadly, current report show that the Lake Chad has contracted by a massive 95% between 1963 and 2001, with current data putting the surface area of the lake at 2500 km^2 (cblt.org). However, recent World Bank group reports a surface area of 1350 km^2. The main reason for the decrease in the size of the lake since the 1960s is attributed to human water use, and shifting climate patterns (UNEP, 2008).



Disappearing Lake Chad (UNEP, 2008)

- Energy (Power Production and Distribution): Reduced rainfall one of the footprints of climate change has led to a huge drop in the volume of water needed for efficient power generation. With four functioning hydroelectric power dams namely; Kainji Power Station, Jebba Power Station, Shiroro Power Station and Zamfara Power Station, Nigeria relies on adequate rainfall for sufficient power generation. Therefore a drop in rainfall volume greatly impacts power generation.

  In 2014, low rainfall in Kainji and Jebba areas resulted in low flows and reduced power generation by Kainji and Kabba dams (NiMet, 2014). In 2016, electricity supply was worsened in many parts of the nation as generation, dropped from over 5,000mw to 4,150.64mw, due to low rainfall, that resulted in a drop in water supply for hydro-power generation (http://www.nigeriaelectricityhub.com/, 2016).

4.5. Source of livelihood

According to the International Centre for Development Oriented Research in Agriculture (ICRA, 2012), a livelihood (making a living) is largely about generating income. A comprehensive definition by Carney (1998), shows that "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. Nigeria is blessed

with a composition of individual with diverse livelihoods. In the rural communities, means of livelihood includes but is not limited to the following; crop production, fishing, livestock production, transportation, civil service, construction, fashion designing, Furniture / Carpentry, and lots more (Obi and Njoku, 2014).

Climate change impacts have a significant impact on livelihood especially in rural communities. The IPCC Working Group II 2001, reports that "Populations are highly variable in their endowments [of different capitals] and the developing countries, particularly the least developed countries have lesser capacity to adapt and are more vulnerable to climate change damages, just as they are more vulnerable to other stresses. This condition is most extreme among the poorest people".

Some means of Livelihood in Nigeria

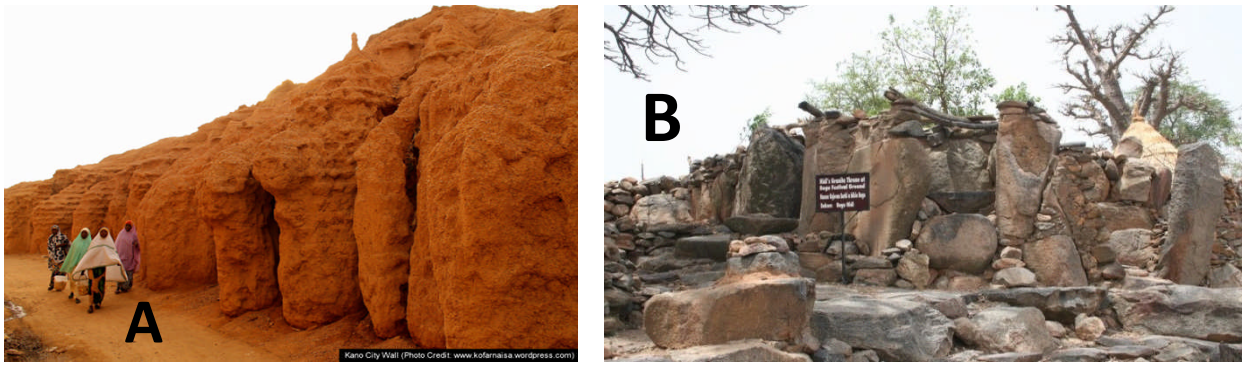
Climate change impacts have affected the livelihood of Nigerians in vulnerable regions. It threatens the capacity of community people to provide for their own livelihoods and also destroy or reduce the quality of the local natural resource base upon which current livelihoods depend. Some notable ways include the following:

- Rise in sea levels has led to flooding in several parts of the country and attendant displacement. Apart from displacements, there is huge reduction in natural resources (fisheries, mangroves and wetlands) that are essential to the current livelihood patterns of many poor communities. (IISD, 2003).
- Changes in temperature and rainfall patterns in Nigeria directly affect crop yields and have produced changes to ecosystem distributions and species ranges. This in turn affects the livelihoods of many people who depend on these resources (IISD, 2003).
- Changing climate patterns and extreme weather events have also impacted new livelihood like tourism. The impact is mostly felt in communities without social, political and financial power to attract protection after such events.

- Climate related health issues also strains means of livelihood in that, they pose a double jeopardy for poor people's livelihoods: the contribution of key productive members of the household is lost and the cost of health care is expensive and time consuming.
- Pests and crop diseases migrate in response to climate variations and potentially pose a threat to crop and livestock production.

4.6. Destruction of cultural heritage

Nigeria is blessed with ten (10) outstanding cultural, natural and significant heritage sites, which are listed among The UNESCO Heritage Sites (Leadership.ng). These sites exist nowhere else in the world and have become a great interest to visitors and Nigerians. Some of these sites include: Sukur Cultural Landscape, Adamawa State, Osun-Osogbo Sacred Grove, Osun State, Oban Hills, Cross River State, Ancient Kano City Walls, Kano State and Gashaka-Gumpti National Park, Taraba State etc. Sadly, most of these sites have come under the direct or indirect impact of climate change ranging from insecurity (insurgency), massive deforestation and other extreme weather conditions.



Some Notable sites of Cultural Heritage a) Kano City Walls b) Sukur Adamawa.

4.7. Climate Change related Health Issues

In 2015, the World Health Organization in its Climate and Health Country Profile reported that Climate change is threatening to worsen health problems in Nigeria. The problem of increased temperatures, intense heat waves, extreme rainfall, and floods intensifies existing challenges of communicable diseases, prevalence of cholera, meningitis, malaria, and pneumonia (Omoruyi and Onafalujo, 2012; WHO, 2015).

Changes in climate will naturally lead to changes in types of vectors, patterns infections and the manner which we originally know them. There would be an easy spread of insect-borne diseases such as malaria and dengue fever due to rising temperatures (Binitie, 2016).

Climate Related illness a) Cholera outbreak b) Meningities

The Nigerian Meteorological Agency (NIMET) has predicted a further increase in heat waves and high humidity (NIMET, 2016). Increased heat can cause heat stress, profuse sweating, and possible spinal meningitis/stroke, skin rashes, skin cancer, heat exhaustion and respiratory diseases. Recently, in 2016, over 20 children were killed by measles in Eti-Osa area of Lagos State. Measles is caused by serious heat and high humidity temperature in the atmosphere (NIMET, 2016).

4.8. Displacements and conflicts

Climate-related disasters have led to significant socio-environmental issues in Nigeria such as environmental refugees (Omoruyi and Onafalujo, 2012). Notable among these socio-environmental issues is displacement and conflicts. Nigeria is responsible for over 30% of all conflict-related internal displacement in Africa, with 737,000 people internally displaced (IDCM, 2016).

The increase in environmental degradation caused by irregular rainfall regimes, recurrent droughts, pollution, exacerbated by the combined effects of natural population growth has led to the displacement of millions of Nigerians from their homes and triggered violence in several hotspots within the country.

There has also been displacement of persons in northern Nigeria as a result of the impacts of climate change. The advent of drought, desertification, loss of arable lands, drying up of Lake Chad and a steady decline in food production has had a negative impact, directly or indirectly on over 70 million Nigerians in 11 frontline states (Odiogor, 2010). The massive drying up of Lake Chad to about 2500km^2 has resulted in the displacement of over 5 million people living in that region. These displaced persons migrate to urban areas/ towns, creating a huge competition for limited natural resources and overpopulation (Acted.org).

Internally Displaced persons in Nigeria

There is also the rise of insurgency in the north and militancy in the Nigeria Delta, because of the loss of livelihood and destruction of habitats. This has led to loss of employment opportunities for fishermen, farmers, and herders whose livelihood depended on natural resources (Acted.org).

Migrating headsmen in Nigeria

4.9. Land Grabbing and Food Insecurity

There is a connection between Climate Change and land grabbing. Sophia, (2013) reported that fears over Climate Change mostly influence the current wave of land grabbing. Primary drivers of land grabbing i.e. food security, energy, and private investments are connected to agriculture, which is also a major contributor to Climate Change.

Various agricultural practices have led to deforestation and release of greenhouse gases. Aside from these factors, there is an increasing amount of evidence that suggest that climate change is also caused by the industrial food system itself and the corporate quest for profits that drives its expansion, thus

creating an inextricable link between land grabbing and climate change (GRAIN 2016).

Globally, land grabbing has become a growing concern, with foreign interests seeking or securing between 37 million and 49 million acres of farmland between 2006 and the middle of 2009 (Buying Farmland Abroad, 2009).

Land grabbing is driven by several factors, some of which include:

- Fear of Food Insecurity: The fear of food insecurity occasioned by the 2007-08 global food crisis which led to an unprecedented hike in food prices is still one of the primary drivers of land grabbing (Cotula *et al.,* 2009).
- Energy and Manufacturing: A surging demand for agrofuels (biofuel and biodiesel), new sources of raw materials for manufacturing goods is also driving land purchases. The production of Biofuel has been central to the land grabbing phenomenon (Odoemene, 2015). To mitigate climate change, the use of greener fuel has been on the increase which will lead to the acquisition of cheap lands in developing countries notably pioneered by the Global West.
- Private Investments: After the 2008 financial crisis, food corporations, financial investors and other global institutions in a quest for more profit and in an attempt to switch from "hard" to the "soft" commodities market turned their attention to profits of investment opportunities presented by cheap and "available" farmlands in the developing world (Odoemene, 2015). This scenario has significantly fuel land grabbing in Nigeria.

Farmers protesting land grabs in Nigeria

Sadly, the people suffering the brunt of this are small-scale farmers, pastoralists, and Indigenous communities, who are displaced by multinational corporations and financial investors scrambling for arable lands and water resources (GRIAN, 2016).

5. STRATEGIES AND RESPONSE TO CLIMATE CHANGE

5.1 Conference of Parties

Conference of the Parties (COP) serves as a governing body for the United Nations Framework Convention on Climate Change (UNFCCC). It is the "supreme decision-making body of the Convention" and is currently composed of 197 countries, including Nigeria.

At the Rio Earth Summit in 1992, the UNFCCC was adopted, and it came into effect on March 21, 1994. This summit began the first international response to climate change. This Convention set out a framework for action aimed at stabilizing atmospheric concentrations of greenhouse gasses (GHGs) to avoid "dangerous anthropogenic interference with the climate system."(UNFCCC, 1992).

The primary objectives of the annual conference of parties is to review the Convention's implementation and any other legal instruments that the COP adopts and take decisions necessary to promote the efficient implementation of the Convention, including institutional and administrative arrangements (UNFCCC).

5.2. ROAD TO COP 21

1988- The first intergovernmental panel on climate change (IPCC) was set up with its focus more on the science of climate change. IPCC was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to prepare, based on available scientific information, assessments on all aspects of climate change and its impacts, with a view of formulating realistic response strategies.

1990- IPCC released its first assessment report in 1990. The scientific evidence brought up by this report underlined the importance of climate change as a challenge requiring international cooperation. This led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC).

1991- An Intergovernmental Negotiating Committee (INC) was convened to conduct these negotiations.

1992- The INC adopted UNFCCC recommendations. At the Earth Summit in Rio, the UNFCCC was opened for signature along with its sister Rio Conventions, United Nations Convention on Biological Diversity (UNCBD) and United Nations Convention to Combat Desertification (UNCCD). The Convention was adopted on 9 May 1992 and opened for signature at the UN Conference on Environment and Development in Rio de Janeiro, Brazil (UNFCCC).

1994- After receiving the necessary 50 ratifications the UNFCCC finally entered into force on 21 March 1994. The Convention had 186 member states (UNFCCC).

1995- The first Conference of the Parties (COP 1) took place in March/April in Berlin. This round of negotiations was aimed at strengthening the commitments of Annex I Parties. IPCC released its second assessment report, which provided relevant material drawn on by negotiators in the run-up to the adoption of the Kyoto Protocol in 1997 (UNFCCC).

1996- The UNFCCC Secretariat was set up to support actions under the Convention.

1997- Further negotiations resulted in the adoption of the Kyoto Protocol at COP 3 (Kyoto, December 1997). The Kyoto Protocol was a legally binding agreement adopted in 1995 by the COP. It specifically aimed at developed countries; it held them to be specific carbon emission reduction targets within specific time periods. The first commitment period lasted from 2008-2012. The second one began on Jan. 1, 2013, and was set to end in 2020 (Ulrich and Macpherson, 2016). The Kyoto Protocol, however, left many of its operational details unresolved and referred these to the COP and subsidiary bodies for further negotiation. The Kyoto Protocol was signed by 84 Parties, and has received some 39 ratifications (UNFCCC).

1998-Parties adopted the so-called "Buenos Aires Plan of Action," at COP 4 (Buenos Aires, November 1998), setting out a program of work to advance the implementation of the Convention and to flesh out the operational details of the Kyoto Protocol (UNFCCC).

2000- At COP 6 in Hague in 2000, a consensus was reached on the Bonn agreement. Work was also completed on a number of detailed decisions based on the Bonn Agreements, including capacity-building for developing countries and countries with economies in transition (UNFCCC).

2001- IPCC's releases its Third Assessment Report. At COP 7 in Marrakesh, parties agreed on a package deal, with key features including rules for ensuring compliance with commitments, consideration of Land use, land-use change and forestry (LULUCF) Principles in reporting of such data and limited banking of units generated by sinks under the Clean Development Mechanism (CDM) (the extent to which carbon dioxide absorbed by carbon sinks can be counted towards the Kyoto targets), alongside establishing a technology transfer framework (UNFCCC).

2005- Entry into force of the Kyoto Protocol. The first Meeting of the Parties to the Kyoto Protocol (MOP 1) took place in Montreal. In accordance with Kyoto Protocol requirements, Parties launched negotiations on the next phase of the

KP under the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).

2007- IPCC's Fourth Assessment Report released. Climate science entered into popular consciousness. At COP13, Parties agreed on the Bali Road Map, as a two-year process towards a strengthened international climate change agreement. It included the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.

2009- Copenhagen Accord was drafted at COP15 in Copenhagen which resulted in an agreement on the long-term goal of limiting the global average temperature to no more than 2^0C, subject to a review in 2015. A number of developing countries agreed to communicate their efforts to limit greenhouse gas emissions every two years (UNFCCC).

2010- Cancun Agreements was drafted at COP16. Parties agreed to: commit to a maximum temperature rise of 2℃; make fully operational by 2012 a technology mechanism to boost the development and spread of new climate-friendly technologies; establish a Green Climate Fund to provide financing for action in developing countries via thematic funding windows.

2011- The Durban Platform for Enhanced Action was drafted and accepted by the COP, at COP17. Parties decided to adopt a universal climate agreement by 2015, with work beginning under a new group called the Ad Hoc working Group on the Durban Platform for Enhanced Action (ADP). Parties also agreed to a second commitment period of the Kyoto Protocol from 1 January 2013. A significantly advanced framework for the reporting of emission reductions for both developed and developing countries was also agreed, taking into consideration the principle of common but differentiated responsibilities (UNFCCC).

2012- COP 18 also saw the launch of a second commitment period under the Kyoto Protocol, from 1 January 2013 to 31 December 2020, with the adoption of the Doha Amendment to the Kyoto Protocol (UNFCCC).

2015– COP 21: The Paris Agreement.

At the Conference of the Parties (COP) 21 in December 2015 in Paris, an international agreement was reached which is widely seen as a milestone in the global endeavour to respond to climate change. The Paris deal is the world's first comprehensive climate agreement (CBS News, 2015).

The agreement covers the main cornerstones of international climate action:

- Mitigation, i.e. the reduction of greenhouse gas emissions and the enhancement of sinks for greenhouse gases.
- Adaptation, i.e. the adjustment of natural and human systems in response to climate change.
- Averting, minimizing and addressing loss and damage associated with the effects of climate change.

In an attempt to encourage greater level of participation by parties, the ADP devised a radical new method, by asking all member Parties to create voluntary emission reduction targets that are not only achievable, but also reflect the basic policies and priorities of the UNFCCC. This strategy gave rise to the Intended Nationally Determined Contributions (UNFCCC).

Nigeria formally signing the COP 21 agreement

5.3. Critique of the COP 21 Paris Agreements

Despite getting 195 world leaders to sign up to a global warming target of between 1.5°C to 2°C and pledge actions to cut carbon emissions, critics say the deal is flawed and actions agreed are far too weak to get anywhere close to that target.

- The pledges countries have made to cut their carbon emissions are not sufficiently binding to ensure they are met, while the Paris Agreement will not force them to "rachet" them up as often as they need to (Bawden 2016)
- Of even greater concern, is the lack of dramatic immediate action that was agreed to tackle global warming. The Paris Agreement only comes into force in 2020 – by which point huge amounts of additional CO_2 will have been pumped into the atmosphere.

5.4. Loss and Damage in the Paris agreement

Loss and damage was arguably one of the most debated topics at the Paris climate talks, and it was only added to the agreement as proceedings came to a close. According to the UNFCCC, "loss and damage involves the development of approaches to address the effects of such events on the most vulnerable developing countries, who are recognized as bearing disproportionate costs from climate change, having both contributed the least to the problem and the least capacity to manage its negative impacts" (UNFCCC).

The issue of loss and damage wasn't on the agenda at UNFCCC negotiations until 2007, when the Bali Action Plan called for action on 'disaster risk reduction strategies and other means to address loss and damage in developing countries particularly vulnerable to the adverse effects of climate change (In Particular Small Island and developed countries).

These countries pushed strongly for the Paris Agreement to recognize loss and damage as a separate pillar of climate action – in addition to mitigation and adaptation – and create appropriate institutional and financial arrangement and provide consistent financing (UNFCCC).

The concept springs from the reality that there are some climate change impacts that cannot be adapted to. Loss and damage of this kind can arise from extreme weather events, extinction of species that result from ecosystem shifts, the loss of arable land to desertification, or the complete disappearance of low-lying island nations. Impacts like these are so severe that they leave in their wake permanent or significantly damaging effects.

The loss and damage article of the agreement calls on countries to cooperate to enhance understanding, action and support in areas such as early warning systems, disaster preparedness, risk assessment and management, and insurance. (Mogelgaard and McGray, 2015).

In the Paris agreement, the concept of loss and damage was integrated as an independent third pillar of the climate regime. It does so through dedicating a full article (Article 8) to loss and damage and integrating the Warsaw International Mechanism into the long-term cooperative structure of the climate regime, cementing its role beyond 2016 and linking it to the institutional architecture of the Paris Agreement (www.climatefocus.com).

6. Nigeria's Response to Climate Change

Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004. In 2003 and 2014, Nigeria

submitted its First National Communication (FNC) and a Second National Communication respectively.

It is important to note that Nigeria has hosted a number of Clean Development Mechanism projects as well as projects financed by the Adaptation Fund. In September 2012, the Federal Executive Council approved the Nigeria Climate Change Policy Response and Strategy.

To ensure an effective national response to the significant and multi-facetted impacts of climate change, Nigeria has adopted a comprehensive strategy, as well as a number of specific policies. The strategic goal of the Nigeria Climate Change Policy Response and Strategy is to foster low-carbon, high growth economic development and build a climate resilient society through the attainment of the following objectives:

- Implement mitigation measures that will promote low carbon as well as sustainable and high economic growth;
- Enhance national capacity to adapt to climate change;
- Raise climate change related science, technology and R&D to a new level that will enable the country to better participate in international scientific and technological cooperation on climate change;
- Significantly increase public awareness and involve private sector participation in addressing the challenges of climate change;
- Strengthen national institutions and mechanisms (policy, legislative and economic) to establish a suitable and functional framework for climate change governance.

6.1. Climate Change Adaptation

Nigeria's response to climate change has focused on increasing resilience and managing the unavoidable impacts. Adaptation to climate change requires development of strong adaptive capacities, including provision of tools, technologies and/or information, raising awareness of adaptation options, educating society, professionals on climate change through education, research and community engagements.

The National Adaptation Strategy and Plan of Action for Climate Change Nigeria (NASPA-CCN) describe adaptation priorities, bringing together existing initiatives and priorities for future action. The goal is to take action to adapt to climate change by reducing vulnerability to climate change impacts and increasing the resilience and sustainable wellbeing of all Nigerians; and to reduce or minimize risks by improving adaptive capacity, leveraging new opportunities, and facilitating collaboration inside Nigeria and with the global community.

7. Climate Change Mitigation Strategies

Climate change mitigation is any action taken to permanently eliminate or reduce the long-term risk and hazards of climate change to human life and property (Diara and Christian 2013). In Nigeria, Mitigation and adaptation are both necessary to alleviate the impacts of a changing global climate on our indigenous communities and national economy (Ijeoma, 2012).

- At the core of most mitigation programmes is the reduction of greenhouse emission through improved energy efficiency performance, environmentally sustainable lifestyles and reduction of greenhouse gases emission (Olaniyan, 2016).
- Reducing the rate of deforestation and increasing forestation and afforestation efforts across the country especially at areas worst hit by desertification and sea encroachment. An example is the Great Green Wall of the Sahara and the Sahel Initiative which runs across eleven frontline States of Adamawa, Bauchi, Gombe, Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, Yobe and Borno. It will cover 43 LGAs in the frontline states to be covered to rehabilitate 225,000 Ha of lands. Deforestation can also be reduced by encouraging integrated and mechanised farming while encouraging smarter cooking methods (Olaniyan, 2016).
- Improve climate forecasting capacity
- Modify agricultural practices to reduce emissions of greenhouse gases.
- Involve local actors and stakeholders in environmental management and bringing local and indigenous communities into climate change discus (Salami, 2010). There is the need to mainstream climate change and mitigation efforts into national, regional and state development plans. This would provide an important intersection between development and climate change adaptation and remediation.

8. Challenges of Climate Change Mitigation in Nigeria

8.1. Legal and Regulatory Framework

The lack of a legal and regulatory framework for mitigating and dealing with climate change issues is a big challenge in Nigeria (Idrisu, 2015). Although there is a bill creating the national climate change commission charged with the responsibility of coordinating the response to climate change, the commission is non-existent.

The bill signifies Nigeria's commitment to the implementation of the rules, institutions and procedures governing the national and international regimes on climate change as outlined in the UNFCCC, Kyoto Protocol and Marrakesh Accords (http://www.yusufali.net). Ogbo *et al.,* 2013, reported the

underdeveloped nature of polices frameworks geared towards aligning human development and Climate change.
Despite the existence of several institutions at the national level, like NESERA, SCCU in the Federal Ministry of Environment, NIMET and the Climate Centre in Minna, the country's institutional capacity to respond effectively to climate change is weak. This is because there is no formal institutional structure at state and local government levels to address climate change.

8.2. Mono Product Economy

Nigeria's effort to mitigate climate change and become a low carbon society is significantly hampered by the fact that its economy is highly dependent on fossil fuel (Salami, 2010).

8.3 Infrastructure

The recent and continuous increase in Nigeria's population is expected to put pressure on existing infrastructure. There is a direct link between population growth and climate change. The combination of these factors has made communities vulnerable to frequently occurring effects (Idrisu, 2015).

8.4. Expertise and Knowledge base

Another major challenge in climate change mitigation in Nigeria is the dearth of technical expertise to execute mitigation or adaptation strategies (Idrisu, 2015). There are very few people with proven competencies in the Unit and agencies saddled with climate change adaption programme, while facilities available in these institutions remain inadequate (Ogbo *et al.,* 2013).

8.5. Awareness

There is still a great level of ignorance on issues surrounding climate change including its causes and mitigation strategies. Numerous Indigenous communities in Nigeria still view climate change as a strange concept. This scenario significantly hinders mitigation strategies (Ogbo *et al.,* 2013; Idrisu, 2015).

8.6. Poverty and Finance

The implementation of adaptation strategies for climate change is usually capital intensive, out of the reach of people in rural communities. Furthermore, there is a minimal investment of the Nigerian government in renewable programmes or processes that ensure environmental sustainably (Onu and Ikehi, 2015).

9 WAY FORWARD

The vulnerability index of Nigeria to climate change impacts is critical and urgent steps must be taken to reduce its vulnerability and build its resilient adaptive capacity. To deal with the adverse impact of climate change in the Nigeria some steps and strategies are recommended herewith. These measures are centred on mitigation and adaptation (Culled from Olaniyi *et al.,* 2014; Emodi and Ebele, 2016 and Ezemonye, 2016).

- Oil spills and gas flaring in the coastal regions should be checked to help enhance carbon sink.
- Research into alternative energy sources and energy democracy should be encouraged.
- Introduction of a regulated urban mass transit would definitely reduce the intensity of traffic on the roads; hence reduce the emissions from vehicles that would have been on the road.
- Concerted efforts towards biodiversity conservation should be amplified by strengthening protected areas system (aquatic and terrestrial).
- Aquatic and Terrestrial ecosystems that act as carbon sink reservoir to greenhouse gases should be protected and sustained by reducing bushing burning and encourage afforestation
- Improved agricultural systems should be strengthened with the use of climate forecasting to reduce production risk.
- Climate change predictions and vulnerability assessments should be incorporated into national and local Protected Area and land use management policies
- Research on crops that are resistant to drought and heat should be increased.
- Continuous training of public health professionals for increased health impacts and emerging diseases.
- The Federal Ministry of Environment should check erosion problem by the construction of dikes and storm surge barriers against projected sea level rise.
- Developing and building actions plans for urban and rural area development for proper settlement so as to reduce the vulnerability to Climate Change in the environment.
- Commissioning an extensive study for an up- to- date Greenhouse gas (GHG) inventory, projection and mitigation strategies.

- International cooperation to support the implementation of adaptation Actions should be vigorously pursued.
- Use of modelling tools for assessing climate change impacts to biodiversity, including regional climate models, vegetation models, and species bioclimatic envelope models.

10. CONCLUSION

In this lecture I have tried to emulate the scholarly ethos of Bassey Andah of blessed memory by presenting various positions, deduced from multifarious perspectives of climate change on the plight of the local communities and their endangered heritage. It is my humble submission that veritable and pivotal strategies advocated in the lecture must be engaged to protect the fragile Nigerian environment. Res judicata.

Thank You.

REFERENCES

Acted.org. In the Lake Chad basin, populations are trapped between climate change and insecurity. December 17, 2015. http://www.acted.org/en/lake-chad-basin-populations-are-trapped-between-climate-change-and-insecurity

Adakayi PE (2012). An assessment of the rainfall and temperature variations in parts of Northern Nigeria. PhD thesis. University of Jos.

Adejuwon, J.O. 2008. Vulnerability in Nigeria, a national level assessment. In N. Leary, C. Conde, J. Kulkarni, A. Nyong and J. Pulhin, eds., Climate Change and Vulnerability. Earthscan, London, UK.

African Technology Policy Studies Network, (ATPS) (2013): Vehicular Carbon Emissions Concentration Level in Minna, Nigeria the Environmental Cum Climate Change Implication [Okelola Olumayokun Francis, Okhimamhe Apollonia], ATPS WORKING PAPER No. 71

Agagu, O.K (2009). Threats to the Nigerian Environment: A call for positive action. A Lecture delivered at the 7th Chief S.L Edu Memorial Lecture, Nigerian Conservation Foundation (NCF), Lagos

Ajugwo, A. O. (2013). Negative Effects of Gas Flaring: The Nigerian Experience. Journal of Environment Pollution and Human Health, 1(1), 6-8.

Ann Ogbo, Ndubuisi Ebele Lauretta and Wilfred Ukpere 2013. Risk Management and Challenges of Climate Change in Nigeria. J Hum Ecol, 4 1(3): 22 1-235.

Armstrong-Ogbonna Augustina and Innocent Onoh (2015). Encroaching desert fuels conflict in northern Nigeria. https://climate.earthjournalism.net/2015/12/11/encroaching-desert-fuels-conflict-in-northern-nigeria/

Bawden Tom (2016). COP21: Paris deal far too weak to prevent devastating climate change, academics warn. Environment Editor. Friday 8 January 2016. http://www.independent.co.uk/environment/climate-change/cop21-paris-deal-far-too-weak-to-prevent-devastating-climate-change-academics-warn-a6803096.html

Binitie Alero (2016), Nigeria: Climate Change Fuels Spread of Diseases in Nigeria. The Guardian Newspapers. 25 February 2016. http://allafrica.com/stories/201602250369.html.

Butler. Rhett, A. (2012). Concequences of Deforestation. www.rainforest.mongaby.com.

Buying farmland abroad: outsourcing's third wave (May 23, 2009) The Economist.

Carney, D. (1998). Sustainable rural livelihoods: what contribution can we make? Conference proceedings of the International Development's National Resources advisers' conference, July 1998pp428

cblt.org. The Lake Chad Basin Commission. http://cblt.org/en.

Coe M.T. and Foley J.A. (2001). Human and natural impacts on the water resources of the Lake Chad basin. *Journal of Geophysical Research (Atmospheres*) 106: 3349-3356.

Cotula L, Vermeulen S, Leonard R, Keeley J. Land grab or development opportunity? Agricultural investment and international land deals in Africa. Rome/London, UN (FAO) / (IFAD) /(IIED) 2009. http://www.iied.org/pubs/display.php?o=12561IIED.

Daily Trust (2015). Nigeria: 185 Flights Delayed, 130 Others Cancelled Over Bad Weather. http://allafrica.com/stories/201501080757.html.

Diara C.D. Benjamin and Christian Nche George (2013). Theology of Climate Change Mitigation and Adaptation: The Place of the Church. Academic Journal of Interdisciplinary Studies. Vol 2, No 13.

Ebele Nebedum Ekene and Emodi Nnaemeka Vincent (2016). Climate Change and Its Impact in Nigerian Economy. J*ournal of Scientific Research & Reports 10(6): 1-13, 2016;*

Ekpoh Imeh Jackson (2014). Slow Response to Climate Change in Nigeria: the Need for Urgent and comprehensive action. *Studies in social sciences and humanities* Vol 1(1): 19-29.

Emodi EE (2013). Drought and Dsertification as they affect Nigerian. Environment. Journal of environmental management and safety. 4(1): 45-54

Ethan Saul (2015). Impact of climate change on agriculture and food security in Nigeria: challenges and adaptation. Global Advanced Research Journal of Medicinal Plant (GARJMP) Vol. 3(1) pp. 001-009, February 2015.

Ezemonye L.I.N. (1992). Heavy metals concentration of water, sediment and fish fauna of Warri River and its tributaries. Ph.D. Thesis. University of Benin. Benin City.

Ezemonye, L.I.N. (2013). Effects of Human Activities on Climate Change". Being a paper presented at the AEBSA Week, University of Benin, Benin City.

Ezemonye L.I.N. (2016). Protection of biological diversity of the ecosystems, habitat and biomes from global warming being a paper presented at a three day conference with the theme, National Conference on Energy and Environment held at the National Centre for Energy and Environment, Energy Commission of Nigeria, University of Benin. 30 November to 2nd December, 2016.

FAO (1996). Our Land Our Future. Rome and Nairobi, Food and Agriculture Organization and United Nations Environment Programme.

FAO, 2015. Global Forest Resources Assessment 2015. FAO Forestry Paper No. 1//.UN Food and Agriculture Organization, Rome.

Federal Republic of Nigeria (FRN) (2007). Official Gazette on the breakdown of the National and State Provisional Totals 2006 census, S.I No. 23 of 2007, 94 (24), Lagos.

Floodlist 2016. Nigeria Floods and Flooding. http://floodlist.com/tag/nigeria.

Greenpeace (2008). "Cool Farming: Climate Impacts of Agriculture and Mitigation Potential." http://www.greenpeace.org/international/press/reports/cool-farming-full-report (accessed 26th Dec 2016).

GRIAN, (2016). The global farmland grab in 2016: how big, how bad? https://www.grain.org/article/entries/5492-the-global-farmland-grab-in-2016-how-big-how-bad.

Guardian newspaper, (2015). Nigeria burns off $5 billion resources yearly from gas flaring. By Roseline Okere 06 November 2015. http://guardian.ng/features/weekend/nigeria-burns-off-5-billion-resources-yearly-from-gas-flaring.

http://www.climatefocus.com/ Loss and Damage In the Paris Agreement Climate Focus Client Brief on the Paris Agreement IV. www.climatefocus.com.

http://www.nigeriaelectricityhub.com/

Ibimilua, A.F. (2013). Biodiversity-Ecosystem Management and Sustainable Development in Ekiti State, Nigeria. British Journal of Humanities and Social Sciences. 9(1): 35-44.

IISD. (2003). Livelihoods and Climate Change, Paper No. 12, Unigraphics, Winnipeg.

Ijeoma, Stanley (2012). Nigeria and Climate Change Adaptation. International Society of Sustainability. Professionals Insight, 1-6.

Imoke, Eni, D., Upla,J. Ibu, Oko, C. Omonya, Obiefuna, J.N and Njar, G.N. (2010). Effects of land degradation on soil productivity in Calabar south local government area, Nigeria. European Journal of Social Sciences (18) 166-170.

Intergovernmental Panel on Climate Change (2007). From Climate Change 2007: Chapter 8 "Agriculture.": www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter8.pdf (accessed December 11, 2016).

Intergovernmental Panel on Climate Change (IPCC) (2001). Impact, Adaptation and Vulnerability. Contribution of Working Group II of the Intergovernmental Panel on Climate Change (Third Assessment Report). London: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC) (2007). Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change (Third Assessment Report). London: Cambridge University Press

International Trade Center (ITC) (2007). Organic Farming and Climate Change.www.intracenorg/Organics/documents/Organic_Farming_and_Ciimate_Change.pdf.

Joiner Emily, Derell Kennedo, and Jesse Sampson (2012). Climate Change and African Political Stability (CCAPS). A student working paper no. 4 for the Robert S. Strauss Center for International Security and Law.

Kalejaye Kunle (2015). Nigeria records 9,343 oil spill incidents in 10 years. Sweet Crude Reports.

Keenan, R., Reams, G., Freitas, J., Lindquist, E., Achard, F., Grainger, A., (2015). Dynamics of global forest area: results from the 2015 Global Forest Resources Assessment. Forest Ecology and Management. 352, 9–20.

Leadership.ng. Nigeria's Top 10 Heritage Sites by Chika Okeke. May 27, 2016. Assessed on 30th December 2016.

Madu A. Ignatius (2016). Rurality and climate change vulnerability in Nigeria: Assessment towards evidence based even rural development policy. Being a paper presented at the 2016 Berlin Conference on Global Environmental Change Held from 23-24 May 2016 at Freie Universität Berlin.

Medugu NI (2009). Nigeria and the advancing Desert. Environmental Synergy World Press.com

Mishra Shraddha and Siddiqui Nehal Anwar (2014). A Review On Environmental and Health Impacts Of Cement Manufacturing Emissions.

Mishra, S., Siddiqui, N.A (2014). Review on Environmental and Health Impacts of Cement Manufacturing Emissions. nternational Journal of Geology, Agriculture and Environmental Sciences 2 (3): 26-31

Mogelgaard Kathleen and McGray Heather (2015). When Adaptation Is Not Enough: Paris Agreement Recognizes "Loss and Damage". December 24, 2015. http://www.wri.org/blog/2015/12/when-adaptation-not-enough-paris-agreement-recognizes.

National Bureau of Statistics (2015). Nigerian Gross Domestic Product Report, Quarter One. http://www.nigerianstat.gov.ng/pdfuploads/GDP_Q1_2015_old.pdf

Ndoke, P. N. Akpan, U.G., and Kato, M. E. (2006), Contributions of Vehicular Traffic to Carbon Dioxide Emissions in Kaduna and Abuja, Northern Nigeria. Leonardo Electronic Journal of Practices and Technologies (online). http://lejpt.academicdirect.org/A09/081_090.htm (Accessed on August 15, 2012)

Nigerian Meteorological Agency (NIMET). (2014). Seasonal Rainfall Prediction for 2014. http://www.nimet.gov.ng/publication/seasonal-rainfall-prediction-2014.

Nigerian Meteorological Agency (NIMET). (2016). Seasonal Rainfall Prediction for 2016. http://www.nimet.gov.ng/publication/seasonal-rainfall-prediction-2016.

Nwafor JC (2006). Environmental Impact Assessment for sustainable Development. Enugu. EDPCA Publishers

Nwilo, P. C., & Badejo, O. T. (2006). Impacts and management of oil spill pollution along the Nigerian coastal areas. Administering Marine Spaces: International Issues, 119.

Obi Ifeanyi C.C and Njoku Matthews, E.C (2014). Socio-Economic Factors Affecting Choice Of Livelihood Activities Among Rural Dwellers In Southeast Nigeria. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). Vol 7(4) 52-56

Odiogor H (2010). Special Report on Desertification in Nigeria: The Sun heats our land. The Vanguard May 3rd (Assessed 30th December 2016).

Odjugo, P. A. O. (2011) "Climate Change and Global Warming: The Nigerian Perspective" Journal of Sustainable Development and Environmental Protection. Vol. 1(16): 6-17

Odoemene Akachi (2015). Climate change, Food (In)security and the Land Grab Syndrome in Africa. Brown University, Providence, (USA).

Ogungbenro, S. B., & Morakinyo, T. E. (2014). Rainfall distribution and change detection across climatic zones in Nigeria. Weather and Climate Extremes, 5–6, 1–6. http://dx.doi.org/10.1016/j.wace.2014.10.002

Oguntunde P.G., Abiodun B.J., Lischeid G. (2011). Rainfall Trends in Nigeria.

Ojekunle Z.O., Oyebamji F.F., Olatunde K.A., Amujo B.T., Ojekunle V.O. & Sangowusi O.R (2014). Global Climatic Change in Nigeria: A Reality or Mirage. *Global Journal of Human Social Science* Vol 14: 6 1.0.

Okhimamhe, A. A.and Okelola, O.F 2013. Assessment Of Carbon Dioxide Emission At Road Junctions In The Southeast Of Niger State, Nigeria. Alam Cipta Vol 6 (2): 59-71.

Okoli Josephine Nwanneka and Amaechi Comfort Ifeakor (2014). An Overview of Climate Change and Food Security: Adaptation Strategies and Mitigation Measures in Nigeria. Journal of Education and Practice. Vol.5, No.32, 2014.

Olagunju, T.E (2015). Drought, desertification and the Nigerian environment: A review. Journal of Ecology and the Natural Environment. 7(7): 196-209,DOI: 10.5897/JENE2015.0523.

Olaniyi O.A., Funmilayo O.A., Olutimehin I.O., (2014). Review of Climate Change and Its Effect on Nigeria Ecosystem. International Journal of Environment and Pollution Research. Vol.2,No.3, pp.70-81, December 2014

Olufemi Fatile Jacob and Adejobi O. Samson (2012). Climate Change, Environment and Conflicts in Nigeria. British Journal of Arts and Social Sciences. ISSN: 2046-9578, Vol.6 No.1 (2012).

Omoruyi Eke Patrick and Onafalujo Akinwumi Kunle (2012). Effects of Climate Change on Health Risks in Nigeria. *Asian Journal of Business and Management Sciences.* Vol. (1)1 [204-215].

Osagie C. 2011, Boosting Nigeria's cement manufacturing. This day newspaper of 1st February 2011 p 40.

Osagie C. 2011, Boosting Nigeria's cement manufacturing. Thisday newspaper of 1st February 2011 p 40.

Priyanka A. Jadhav and Dilip K. Kulkarni (2013). Effect of replacement of natural sand by manufactured sand on properties of cement mortar. *International Journal of Computational Science and Engineering*. IJCSE, vol.3, no.3

Punch Newspapers (2016) Floods displaced over 2.1million Nigerians, by Olalekan Adetayo. November 15, 2016

Rai Priyanka, Mishra RM and Parihar Sarita, Quantifying the Cement Air Pollution related Human Health diseases in Maihar city, MP, India, 2013

Ramachandran S, P.L. da Silva Dias, S.C. Wofsy and X. Zhang. Couplings Between Changes in the Climate System and Biogeochemistry. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007

Ranger, N. and Garbett-Shiels, S.-L. (2012) Accounting for a Changing and Uncertain Climate in Planning and Policymaking Today: lessons for least developed countries. Climate and Development.

Ripple, W. J., Smith, P., Haberl, H., Montzka, S. A., McAlpine, C., & Boucher, D. H. (2014). Ruminants, climate change and climate policy. Nature Climate Change, 4, 2-5.

Salami Abayomi (2010). Climate Change Mitigation and Adaptation Options: The Nigeria Experience.

Salkida Ahmad (2012). Africa's vanishing Lake Chad; Action needed to counter an "ecological catastrophe. April 2012. http://www.un.org/africarenewal/magazine/april-2012/africa%E2%80%99s-vanishing-lake-chad

Sophia Murphy (2013). Land Grabs and Fragile Food Systems: The Role of Globalization. The Institute for Agriculture and Trade Policy. Published February 2013. http://www.iatp.org/files/2013_02_14_LandGrabsFoodSystem_SM_0.pdf.

Tercula I (2015). Desertification: Water Scarcity hits Sokoto Farmers. Sunday, 09 February. www.sundaytrust

The Internal Displacement Monitoring Centre (IDMC) (2016). Africa report on internal displacement. The Internal Displacement Monitoring Centre (IDMC). http://www.internal-displacement.org/assets/publications/2016/2016-Africa-Report/20161209-IDMC-Africa-report-web-en.pdf.

Ulrich Emily and Macpherson Martina (2016). The Climate Change Challenge – From COP 21 to COP 22. https://www.spglobal.com/our-insights/The-Climate-Change-Challenge--From-COP-21-to-COP-22.html.

United Nations (2002). World Population Prospects: The 2001 Revision. Data Tables and Highlights. United Nations. Department of Economic and Social Affairs. Population Division. New York.

United Nations DATA (2016). Country Profile: Nigeria. United Nations Statistics Division. http://data.un.org/CountryProfile.aspx?crName=NIGERIA

United Nations Environment Programme (UNEP) (2008). Lake Chad: almost gone. http://www.unep.org/dewa/vitalwater/article116.html

United Nations Framework Convention on Climate Change (UNFCCC). A Brief Overview of Decisions. http://unfccc.int/documentation/decisions/items/2964.php.

United States Geological Survey (USGS) How does land-use change affect climate change? URL: www2.usgs.gov/faq/node/5601 Accessed 27th December 2016.

Usman Y. Dutse and Dje B. Ibrahim (2013). Potential Challenges of Climate Change to Nigerian Economy. IOSR Journal of Environmental Sciences, Toxicology and Food Technology . Vol 6 (1) 7-12.

Warrick,R.(2000): Strategies for Vulnerability and Adaptation Assessment in the Context of National Communications paper presented at the 2nd AOSIS Workshop on Climate Change Negotiations 31 July to 3 August 2000 Apia, Samoa

Wilson J. and Law S. (2007). Global Warming. Magpie Books London. p18.

World Facts Book (2016), US Bureau of Statistics quoted by Wikipedia, AMPS 2016).http://mediaperspectives.ng/nmag/analyze/?sector=nigeria&data_title=Urbanization+%7C+Nigeria+Urban+Population+Trend

World Health Organization (WHO), (2015). WHO warns climate change to threaten human health in Nigeria. WHO Regional Office for Africa. http://www.afro.who.int/en/nigeria/pressmaterials/item/8168whowarnsclimatechangetothreatenhumanhealthinnigeria.html.