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Research Article

Poverty Induced Illegal Lumbering and Commercial Charcoal Production; Global Warming Implications in Kogi State Central Senatorial District, Nigeria.

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Abstract

That climate change is threat to humankind and that anthropogenic activities are the inducers at varying degree across the continents is mere re-echoing the reality on planet earth, Apart from the fossil fuels dependent activities that release scores of carbon into the atmosphere, forest degradation in all its forms do not only contribute to this pollutants, but it also undermine the ability of the natural system to fully sequestrate the millions of aero carbon released into the protective layers of the atmosphere. Studies also suggest that the agricultural sector is another most significant source of black carbon that induces climate change, while also being impacted negatively. This study examined the concept of climate change and the impacts of the illegal lumbers and charcoal producers that are major inducers within the study area. The levels of vulnerability to climatic impacts using climate data and remote sensing satellite Landsat TM imageries over a period of 20 years were carried out. The study review that between the year 2001 and 2014, there was a loss of about 99.95km^2 forest areas and from the year 2014 to 2024, the area has lost a total of 56.98km^2 forest areas due to illegal lumbering and commercial charcoal production, while the temperature over the same area is increasing .More so, most peasant and commercial farmers in this area and even the country at large are declining in output production, and therefore highly vulnerable to climate change impacts and food insecurity. It is therefore recommended that there should be inclusive policy formation in forest resources harvesting through local vanguards, periodic forest reserve auditing and employment of local technology in ecosystem conservatism.

Keywords : Adaptation and mitigation, Charcoal production, Climate change, Food security, and Vulnerability.

INTRODUCTION

The term Climate change has become a household word and even the scientific definition appear even milder, as its global impacts are frightening, disastrous, alarming and already threatening the continuous existing of human race. Direct atmospheric measurements made over the past 50 years have shown a steady increase in the atmospheric carbon dioxide (CO_2). In fact, should the projected climate change scientific evidence surges beyond a country's designed bearing capacity, then there will be environmental catastrophes that may be more difficult to manage and adapted to, (Robert et al., (2010). What appears destressing is the greater certainty that human activity warms the climate and that the rate of change is likely to be greater than any time in modern history (IPCC 2007, 2013). Greenhouse gases such as: Water vapour (H2O), Carbon dioxide (CO_2), Methane (CH_4), Ozone (O_3), Nitrous oxide (N_2O), and Halocarbons have continued to be used as substitutes for chlorofluorocarbons (CFCs) in refrigerant fluids, and CFCs from pre-Montreal Protocol usage as refrigerants and as aerosol-package propellants remain in the atmosphere (Forster et al., 2007). The poverty induced local charcoal production operators and small and medium scale entrepreneur lumbers (SMEL) in Sub-Saharan Africa tends to exacerbate the general ecological degradation in the continent (UNECA, 2023). More so, the agricultural sector happens to be one of the highly vulnerable anthropogenic activities that also aggravate the GHG while the impacts of climate change on irrigation agriculture infrastructure are also enormous in the face of unsustainable food security

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across the globe especially among the developing countries and Sub-Saharan countries. Hence the needs for such a paper like this as early warning source and the way forward.

RELATED LITERATURE

Concept of climate Change

The four related terms that tend to be amorphous in atmospheric discussion and deserving clarification are: 'Weather, Climate, Climate variability, and Climate change'. Weather is the atmospheric (temperature, humidity, precipitation, cloudiness and wind) condition of a place at a given point in time and in specific location. While Climate, is the average weather condition of a place over a long period (30 – 50 years) in a region. Climate variability refers to natural variation in climate that occurs over months to decades. El Niño, which changes temperature, rain and wind patterns in many regions over about 2 – 7 years, is a good example of natural climate variability, also called natural variability. But climate change is a deviation in the long-term known state of the atmosphere over multiple decades or longer. Scientists use statistical tests to determine the probability that changes in the climate are within the range of natural variability or by chance. For example, there is a less than 1% chance that the warming of the atmosphere since 1950 could be the result of natural climate variability. Climate change refers to significant, long-term changes in the global climate.

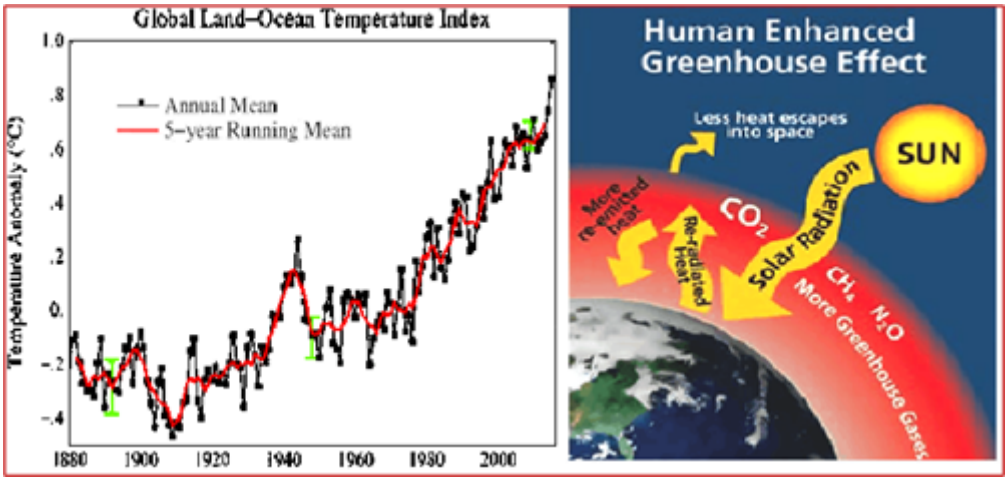
The global climate is the connected system of sun, earth and oceans, wind, rain and snow, forests, deserts and savannah, and every human activity. But the global climate is more than the mere "average" of the climates of specific places. A description of the global climate includes how, for instance, the rising temperature of the Pacific feeds cyclone which blow harder landwards, drop more rain and cause more damage, but also modify global ocean currents that melt Antarctica ice cap which causes sea level rise that often leads to tsunami. It is this systemic connectedness that makes global climate change so challenging and so complicated.

The Concept of Global Warming

There seem to be three school of thought on global warming: (1) that global warming is not occurring and neither is there climate change; (2) that the observed global warming and climate change are natural cyclic events, and unrelated to human activity; and (3) that global warming is primarily as a result of human activity and that climate change is also the result of human activity.

The claim that nothing is happening is very hard to defend in the face of masses of visual, land-based and satellite-based data that clearly shows rising average sea and land temperatures and shrinking ice masses. Global warming is the continuous slow increase in the average temperature of the earth's atmosphere because of the increase trapping of the radiated energy (heat) emitted by the earth from the incoming sun radiant energy. The re-radiated and emitted heat does not get to the outer space. The excess greenhouse gas because of anthropogenic activities now trapped more than required surface temperature for the emergence of life forms including humans, (see **figure 1 and 2**).

Figure 1 and 2. Global land-ocean temperature index and Greenhouse effect.



(**Source:** NASA and: Center for Climate and Energy Solutions)

Heat is energy that is added to the global climate systems that are interconnected trigger changes of different degrees in the spheres. The global ocean that is heated up, causes much water to evaporate into the clouds in conjunction with devastating storms like cyclone, hurricanes and typhoons. More so, a warmer atmosphere makes glaciers and mountain snowpacks, the Polar ice cap, and the great ice shield jutting off Antarctica to melt thereby raising sea levels across the world (Velicogna et al 2020).

Scientific Evidence of Climate Change

Scientists attribute the current global warming trend to the overuse of fossil fuels energy that releases into the atmosphere scores of carbons that were sequestered (buried) millions of years ago (see **Fig 3**). Natural sources of GHGs and black carbon include forest fires, savannah fires and volcanoes. New studies suggest that agriculture is the largest contributor of particulate emissions in the US and other developed agricultural countries driven by the desire to expand cultivated areas for food security. According to NASA(2023), the wet-gets-wetter, dry-gets-drier hypothesis through a study across five continents from 2002 to 2021, revealed a continuous pluvial event that began in 2015 in the tropics that causes drought in Brazil that led to empty reservoirs and water rationing across some cities, while Lake Victoria's water level in Africa rose by about 3 feet resulting to severe flooding activities.

Figure 3. Industrial gas emission into the atmosphere.



Source: Google Earth.

Infact, in the words of President von der Leyen and President Michel "*Humanity has waged war against nature: we must stop. Planet Earth is our one and only home*. We must cap global warming at 1.5C". It is in line with this fact that made COP29, held in Baku, Azerbaijan to agreed on a new collective quantified goal (NCQG) for climate finance, aiming for at least $300 billion annually by 2035, with developed countries leading the mobilization of these funds, and also finalized the rules for carbon markets under the Paris Agreement in line with SDGs Goal 13 "Take urgent action to combat climate change and its impacts" Every person, in every community across the globe is impacted in one form or the other by climate change and if left unchecked, it will undo a lot of the development progress made over the past decades including intensive conflicts over resources and forced migration. Currently, planet earth is already about 1.2°C warmer than it was in the late 1800s amidst continuous soaring emissions. To keep the global target of not more than 1.5°C, greenhouse gas emissions must be cut by almost half by 2030 compared to 2019. The summary of the globally accepted scientific evidence is as listed below:

i. Increase warming of the earth and ocean surface temperature at a rate of about 0.13° C per decade since 1957.
ii. Significant changes in the hydrologic cycle with some areas experiencing severe and long-term drought, while others experience increased annual precipitation flash flood.
iii. Declining glaciers and snowpack in area, volume and mass across the globe, nearly all glaciers are decreasing impacting billion of people.
iv. Episodes of sea level rise because of melting glaciers and snowpack also contribute to rising seas (see **Fig 4**).
v. Ocean acidification resulting from the absorption of about 25% of emitted CO2 from the atmosphere.

Figure 4. Worsening Drought, tornado, and Tsunami episodes.



Climate Financing of the COP29 and the Polluters Pay Dilemma

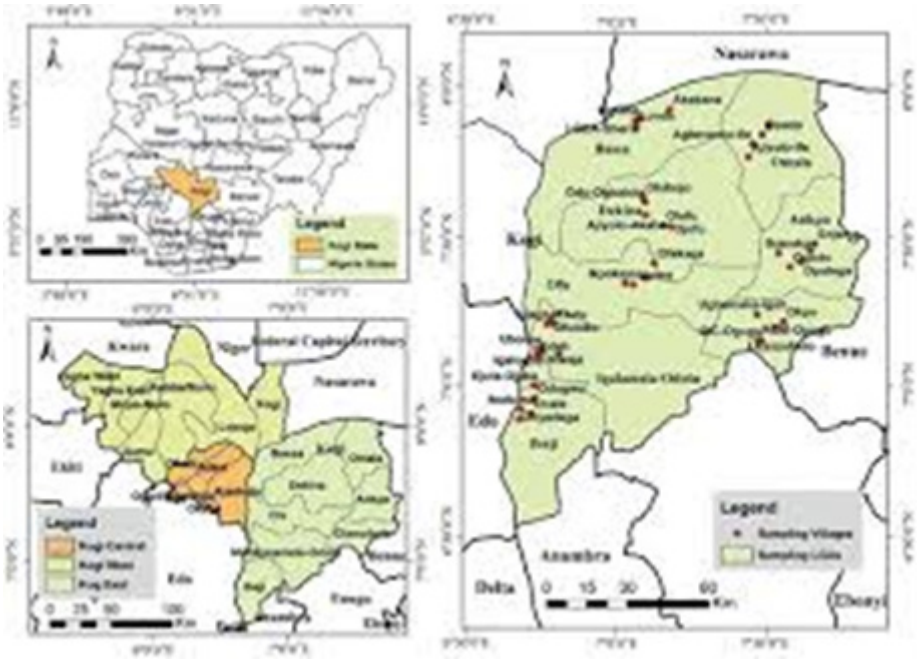
Observably, much progress has been made toward climate change impact adaptation and mitigation through COP27 in Sharm El-Sheikh and COP28 in Dubai in pledges to the Fund for Responding to Loss and Damage (FRLD) which currently cover only 0.1% of the total $587 billion in climate-related damages (UNFCCC, 2023). But sub-Saharan Africa countries are projected to needing about $168 billion by 2030 alone, while the adaptation finance currently sits at a gap of around $194-$366 billion per year. The question that may arise is 'where Nigeria's effort amidst the national insecurity and politicking of every sector of their policy implementation including the climate change adaptation programmes'. The COP29 presidency has however called on all actors to scale up climate finance for developing countries to at least $1.3 trillion per year by 2035 since they need more of adaptation to climate change effects than mitigation. Although there is the difficulty of defining and tracking progress in enhancing adaptive capacities and resilience, biodiversity protection in most of these developing countries where signing of UN agreements are more of lip-service as evidence in Nigeria. Unfortunately, even with the New Collective Quantified Goal (NCQG), the decisions made at COP29 seem to lack enforceable mechanisms to make polluters pay as emphasized by the African Group of Negotiators (AGN) at the summit (UNEP 2023).The current political systems in many African countries seem to give immunity to environmental polluters in line with the maxim that states 'power corrupt, and absolute-power corrupt absolutely'. In countries like Nigeria, environmental justice is mere theoretical as political affiliates defines what is just and for who. Hence the grave levels of ecological degradation that include illegal lumbering and charcoal production in the study area and the need for studies like this.

RESEARCH METHODOLOGY

Study location

Geographically, Kogi State Central Senatorial District that comprises of Adavi LGA, Okehi LGA, Ogori Magongo, Ajaokuta LGA and Okene LGA is located in the north central region of Nigeria, bordered to the west by the states of Ekiti and Kwara, to the north by the Federal Capital Territory, to the northeast by Nasarawa State, to the northwest by Niger State, to the southwest by the states of Edo and Ondo, to the southeast by the states of Anambra and Enugu, and to the east by Benue State. The state capital Lokoja is known as the The Confluence State and it lies on coordinates 7°30'N and 6°42'E with a total land area of 29,833 km2 (11,519 sq mi) (see **Fig. 5**) .

Figure 5. The study location.



Source: Adapted from Google map.

Climatically, the state has an annual rainfall total of between 1,100mm and 1,300mm, and the rainy season lasts from April to October each year while the dry season is between November and March. The dry season is very dusty and cold (called hamartan) as a result of the north-easterly winds through the Sahara Desert.

Data collection

This study employed both direct participatory field survey data collection on lumbering and charcoal production in the study area, and remote sensing satellite data acquisition in analysing the impact of deforestation in Kogi Central. A survey of twenty-one timber sheds, and five charcoal deports were surveyed in the area, while the level of vulnerability to climatic impacts using NIMET climate data and remote sensing satellite Landsat TM imageries over a period of 20 years (2001 and 2024) were used. In analysing the land use land cover change for deforestation impact, ArcGIS 10.0 was employed in carrying out the digital analysis.

Data analysis and discussions

Lumbering which is the process of harvesting and processing trees for wood-based construction are now being carried out indiscriminately by harvesting immature soft and hard woods as a major cause of deforestation. In Nigeria, the major tree species of export and local interest includes Mahogany (Khaya senegalensis), Obeche (Triplochiton scleroxylon), Afara (Terminalia superba), Abura (Mitragyna ciliate), Iroko (Milicia excelsa), Teak (Tectona grandis) (ITTO, 2006). In terms of hardness and durability, the yellow tree species locally called *Ironwood* is the target of loggers in Kogi central and the nation at large (Awe et al 2019; Famuyide et al 2012). Based on the field survey carried out, the list of tree species in **table 1** are near extinct due the illegal loggers' activities , thereby calling for urgent drastic national environmental protection policy implementation.

Table 1. Endangered Tree Species in Kogi State.

S/N	Scientific Botanical Name	Local name
1	*Ceiba petandra*	Araba
2	*Milicia excels*	Iroko
3	Mitragynia ciliate	Abura
4	Nuclea diderrichii	Opepe
5	Cordia millenni	Omo
6	Chrysophyllum delevayi	Osan
7	Arogeissus leocarpus	Ayin
8	Triplochiton scleroxylon	Arere
9	Khaya senegalensis (Mahogany)	Awo
10	Terminalia superb	Afara

Along Lokoja - Okene road, between Itakpe and Kabba, more than twenty mini-sawmill using 7kva generator capacity to mill immature wood logs of about 0.4m in diameter into substandard timber gauge with impunity. In fact, according to MAWA-Foundation, Odolu community in Igalamela Local Government Area of the State has lost about 103 hectares of its coverage to deforestation due to illegal loggers between 2000 and 2021.

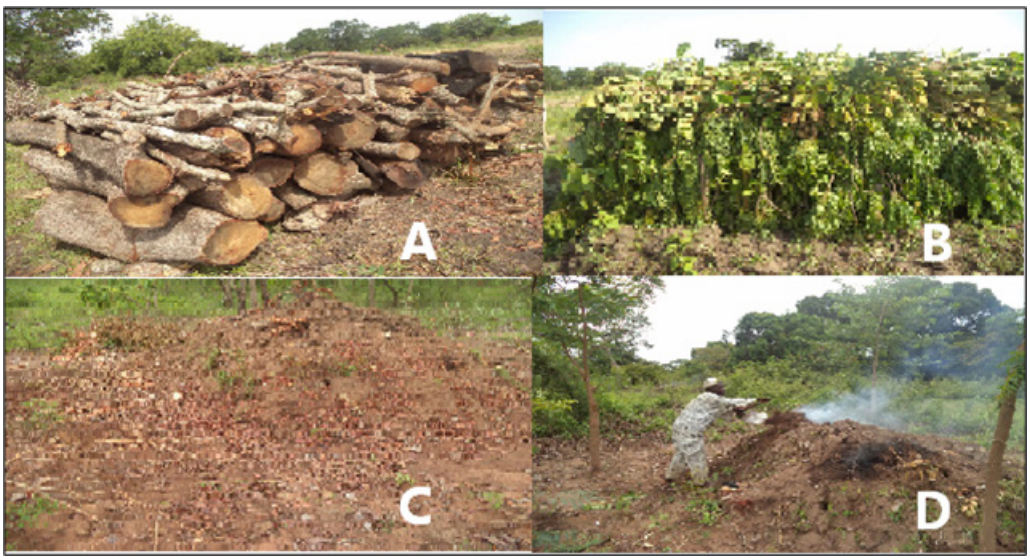
Informal commercial Charcoal Production

Charcoal is a dark grey residue consisting of Carbon produced by the slow process of heating wood and other substances in the absence of oxygen, called Pyrolysis. The production is best with hardwood species; therefore, the bulk of charcoal wood is harvested from primary and in some cases secondary forest (Brandley, 1991). The logs are covered with grasses/ leaves and thereafter, the leaves are covered with earth. The leaves/grasses serve as a lagging material between the logs of wood and the earth covering the entire setup. While covering, a small portion of the heap is left uncovered on any side of the entire setup for the introduction of fire. After lighting the opening is covered and tiny holes are created in various parts of the heap so as to enable the inflow of oxygen for combustion as revealed in **figure 6a, b, c, and d**; and usually hardwood species like Acacia, are preferred for Charcoal production.

This thermal degradation of biomass results in formation of products of incomplete combustion (PIC) such as CH_4, CO_2 alkanes, alkenes, oxygenated compound and particulate matter. In the work of Lacaux, et al., (1994), charcoal kiln emission ration of CO, CH_4, NMHC, and NH_3 to CO_2 are larger than those from savannah burning because CO, CH_4, NMHC have much higher global warming potential than CO_2. Emissions from charcoal production may pose a serious peril to the upper atmosphere. Emissions during charcoal production are significant and contribute heavily to global climate change impact.

Tropical Africa accounts for 70% of the exports and the market is all year round with a slight drop between July and September, (Omoakin et al, 2015). In fact, the charcoal industry is a multibillion-dollar global industry.

Figure 6. Local charcoal production processes in south-western Nigeria.



Source: Field survey.

GIS Analysis of Deforestation Impacts on Land Cover in the area between 2001 and 2024

In terms of terrain analysis of the central senatorial district of Kogi State, it is highly undulating with mountain ridges that are well forested as revealed in the Google image **figure 7**.

Figure 7. Google image of the Central Senatorial District of Kogi state.



The land use land cover change LULC analysis for the year 2001, 2014, and 2024 is as shown in **figure 8, 9, and 10**, while the change computation is as depicted in **tables 2 and 3** between the year 2001 and 2014, and between 2014 and 2024.

Table 2. Changes between 2001- 2014.

Legend	2001 LULC		2014 LULC		Magnitude	
	Square kilometres	Percentage	km2	Percentage	Change	Remark
Water Bodies	7.29225	0.42	4.769775	0.27	-2.522	Decline
Built-Up Area	80.844975	4.65	392.848	22.61	312.003	Increase
Vegetation	1097.18258	63.14	997.2306	57.39	-99.952	Decline
Farmland	277.055775	15.94	129.2978	7.44	-147.76	Decline
Bare Ground	275.301225	15.84	213.5306	12.29	-61.771	Decline
Total	1737.6768	100	1737.677	100		

The total area covers for vegetal cover in the year 2001 was 1087.18km^2, but in the year 2014, area coverage has dropped to 997.23 km^2 largely due to urbanization activities, the vegetation lose was about 99.95km^2. The built-up areas increase from 80.84km^2 to about 392.85km^2, an increase of about 312.01 km^2, which is more than double the base year.

Figure 8. LULC analysis of the Kogi Central Senatorial District as at 2001

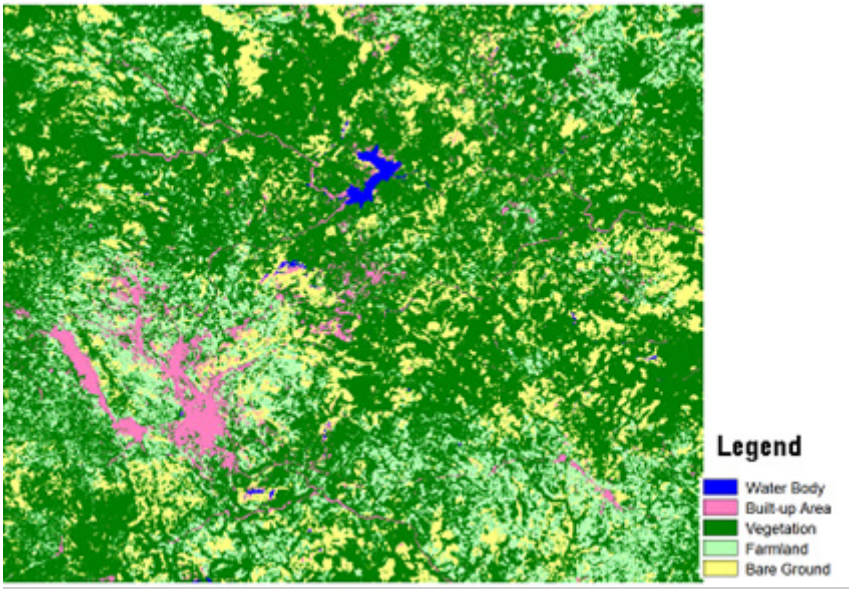


Figure 9. LULC analysis of the Kogi Central Senatorial District as at 2014

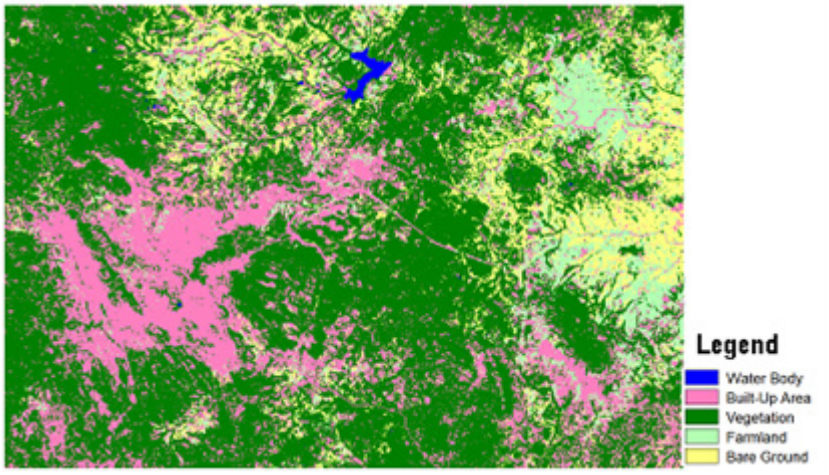
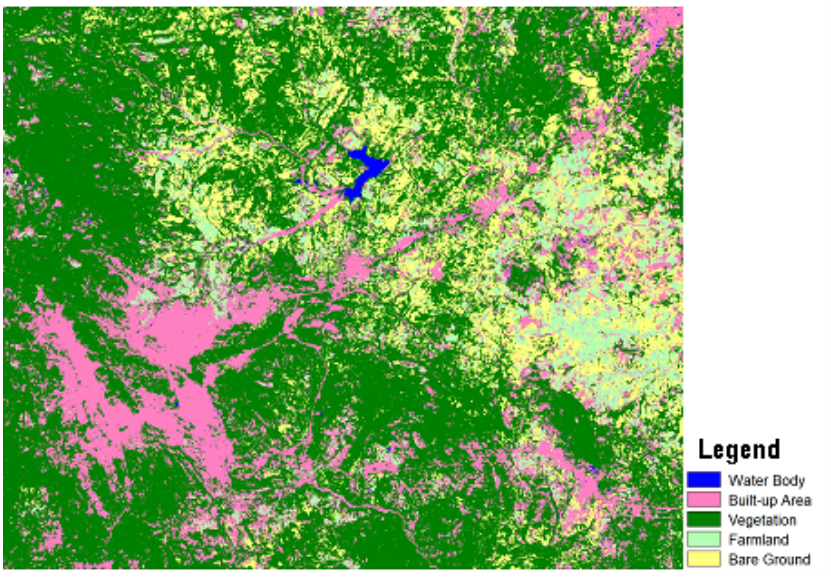


Figure 10. LULC analysis of the Kogi Central Senatorial District as at 2024



Between the years 2014 to 2024, this is another ten years of developmental activities at the expense of the vegetal areas, the vegetal lose was about 56.99 km^2. While the built-up areas increases by 312.00km^2, the farm land areas also decrease in area by 147.758 km^2 as revealed in figure 13 and **table 3**.

Table 3. Change between 2014- 2024

Legend	2014 LULC		2024LULC		Magnitude	
	Square kilometres	Percentage	Km2	Percentage	km2	Remark
Water Bodies	4.769775	0.27	6.2835	0.36	1.514	Increase
Built-Up Area	392.847975	22.61	401.7105	23.12	8.863	Increase
Vegetation	997.2306	57.39	940.24505	54.11	-56.986	Decline
Farmland	129.297825	7.44	125.784	7.24	-3.514	Decline
Bare Ground	213.530625	12.29	263.65365	15.17	50.123	Increase
Total	1737.6768	100	1737.6768	100		

DISCUSSION

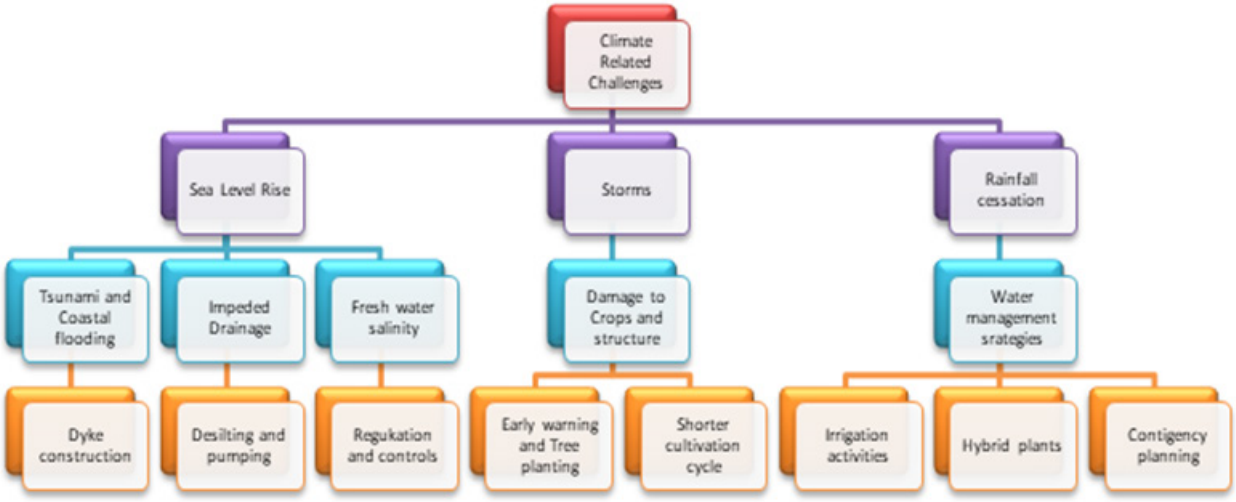
Poverty in its multiple dimensions has a strong influence on people's vulnerability to disaster, and vice versa. It is important not only to consider the economic aspect of poverty, which is perhaps the most apparent, but also the socio-political dimensions. Deprivation due to political maladministration affect not only the economically poor – though more obvious, but also the middle class if such still exist. People in or below this social stratum often lack the political power and resources to actualize their dreamed standard buildings that can better withstand hazards, even though embedded in the nation's constitution. And because of the complex relationship between poverty and vulnerability, disasters typically worsen the poverty situation of these groups, as well as their vulnerability to future risk.

Ironically, poverty translates into environmental mismanagement with human induced disasters in all its forms that make the attainment of the United Nations Sustainable Development Goals (SDGs) a mirage in many society. The United Nations (2016) confirmed that Yemen, Somalia, South Sudan and Nigeria top the list of countries where over 20 million people facing the threat of starvation and famine are found. Nigeria in particular may be facing its largest humanitarian crisis as poverty aggravates in the land due to insecurity and fuel subsidy removal. The excess consumption of fuel wood and other traditional fuel is at great cost to the community, the economy and the environment. The health hazards to individual during combustion, depletion of community-based resources, and the deforestation that is aggravating the current climate change and its effects is daunting (Fawehinmi and Oyerinde, 2002).

Poverty in Nigeria is not unconnected to the nation's fail governance and its population that is growing faster than its economy, as by 2050, according to the UN, In the year 2020, Nigeria was the seventh most populous nation in the world, with 206.1 million people. But however, projected to reach 401.3 million people by 2050 (Intelpoint, 2025). In fact, the 2018 budget was to run on deficit, and to be funded by much borrowing in addition to the existing foreign national debts according to President Mohammad Buhari. More so, the country's recent dwindling oil revenue due to the global oil market recession affected the nation's GDP negatively leading to more rate of unemployment in the country.

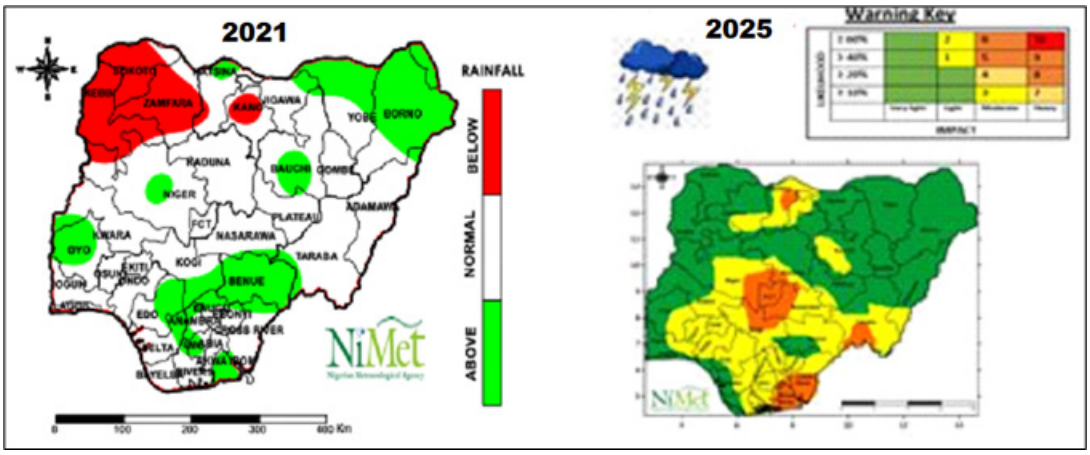
In Nigeria, the sources of irrigation water are highly vulnerable to climate variability and change. In fact, the gradual disappearance of Lake Chad has become a continental and global concerns as it affects agriculture and societal sustainability. Insufficient rain and temperature rise cause drought, whereas intense rain within short period reduces groundwater recharge by accelerating runoff and causes floods. Both situations induce negative impacts on the agricultural sector, see **figure 11** for such impacts.

Figure 11. Climate-related challenges to Agriculture.



For instance, the weather prediction for 2021 growing season was earlier than normal in most parts of the country, while later than normal onset dates are expected over parts of Lagos, Ogun, Kebbi and Niger states and below normal rainfall of about 300 is predicted for some places in the extreme North such as Sokoto and Kano which is likely to create water stress for both rain fed and irrigated farmlands. In the year 2025, there is the prediction of rainfall above normal in states like Jigawa, Taraba Kogi, and FCT with potential flash flood, and large-scale displacement of people due to flooding (see **Fig 12a. b**).

Figure 12. NIMET seasonal prediction for the year 2021 and 2025.

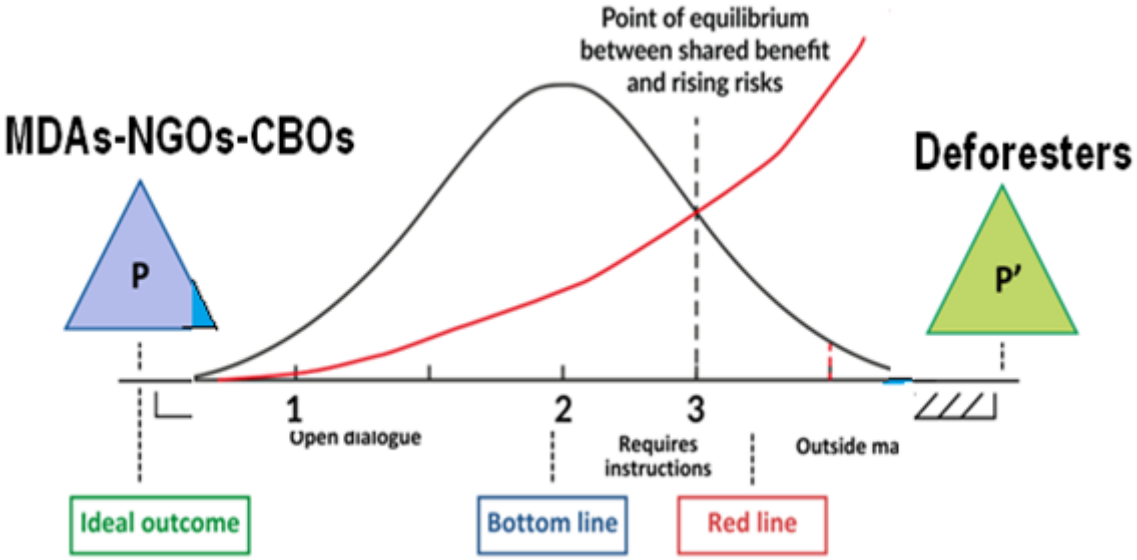


According to the National Oceanic and Atmospheric Administration (NOAA), 2020 has so far been the second-warmest year to date (January through April) recorded in 141 years of record-keeping with January through April having 1.14 degrees Celsus above average. Farmers are the biggest global water users operating directly or indirectly under the influence of regional climate factors such as the ITCZ and the global El Nino (Alvaro et. al., 2010).

Negotiation and Do Nothing Approach to latent challenges

Environmental and disaster management is globally accepted as every one's business. There is therefore the need for negotiation and dialogue among the stakeholders to arrive at consensus mitigation approaches. The MDAs and NGOs in an effort to mediate with the local community on environmental hazards management like climate induced activities, there must be round table negotiation accept compliance and own the final policy formation and implementation. **Figure 13** is a typical life field operation of wooing and wining communities to accept new mitigation and adaptation policies.

Figure 13. Compromise and dialoging in community policy implementation.



To decide whether or not to adopt reactive or do-nothing approach as leaders of policy maker, one has to conduct a risk-benefit analysis based on different negotiation scenarios. Deforestation in any community depends on the poverty and ignorance level that can be eroded or reduced by the level of existing ethics and knowledge in that community, see equation below:

$$Deforestation = \frac{\text{Poverty} + \text{Ignorance}}{\text{Ethics} + \text{Knowledge}}$$

Where the appropriate action is not taking, the following are the expected results that are not always palatable to all:

i. Incubation of climate hazards (drought, flood, erosion, heat wave, whirlwind etc)
ii. Aggravation of food insecurity
iii. Invasions of new pathogen and epidemic
iv. Skyrocketing victims relief costs
v. Lose of Eco-services
vi. Safety Compromises
vii. Morale damping and low turnover

Services from irrigation system is becoming poor due to alternation of precipitation pattern, changes in groundwater availability, change in surface flows (extreme rainfall patterns, flood, droughts, etc.). Most of the irrigation systems in Nigeria are fed by medium or small rivers, which entirely depend on the rain. Moreover, water use efficiency and agricultural productivity in both the traditional farm managed practices and large public irrigation system are found to be low. Among the other obstacles, inadequate irrigation is the major limiting input to increase agricultural productivity. Though rainfall provides partial protection against drought, irrigated agriculture is very dependent on the rainfall. Any changes to rainfall patterns and other climatic parameters will affect both supply and demand for irrigation water and will have a direct impact on its system.

CONCLUSION

As Nigeria is one of the developing countries of the world that wholly depends on extractive and agrarian industry under democratic government, the policy makers at all levels must deepen their knowledge of climate dynamics as a major determinism of the socioeconomic and political growth and stability. The continuous increase in Temperature and precipitation dynamics leading to drought and flood have negatively affected the ecological systems and eco-services such as supply and demand of water, carbon sequestration, crop suitability, and health challenges etc. All these have direct or indirect negative impacts on the built environment and food production that define national GDP. It becomes crucial to identify approaches that strengthen ongoing economic development efforts that will reduce climate change impacts vulnerability and enhance the adaptive capacity of stakeholders, climate vulnerable communities and ecosystems. The appropriate adaptation measures are essential for making community climate-resilient through research, policy arrangements, institutional capacity building and substantial investment in R&D sectors. The long term adaptation planning will support ecological services, and adoption of the eco-development paradigm crusade that enhances the adaptive capacity and climate resilience.

The Way Forward

i. Develop programmes that will discourage the production of charcoal in the senatorial district, while subsidizing sustainable domestic energy like the LPG
ii. Government to stop lip-service to the achievement of

the SDGs and the COPs resolution at all levels.

iii. Resuscitate the moribund forest guards across the state, and within the central senatorial district.

iv. Identify and map areas vulnerable ecological settings to prepare disaster risk management plans.

v. There is the need for urgent local forest vanguards in each of the local government to watch their forest reserves,

vi. Adapt and implement Integrated Environmental Management approach across the key stakeholders within the state.

vii. Re-invoke the bi-laws that control the access and use of the eco-services within the state.

viii. Government should educate, sensitize, and encourage all elements of green building crusade.

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