

**CLIMATE CHANGE, FOOD SECURITY, NATIONAL SECURITY and  
ENVIRONMENTAL RESOURCES**

**GLOBAL ISSUES & LOCAL PERSPECTIVES**

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## **Preface**

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It eschews pedantry and lays bare the issues in such clarity that conduces to learning. The book elaborates on contemporaneous climate change, food security, national security and environmental resources issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate change, food security, national security and environmental resources issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate change, food security, national security and environmental resources necessary in policy making process that will stimulate increase in food production and environmental sustainability.

*Climate Change, Food Security, National Security and Environmental resources: Global issues and Local Perspectives* is organized in four parts. Part One deals with Climate Change with Six Chapters, Part Two is concerned with Food Security with Nine chapters, Part Three deals with National Security with Five Chapters, while Part Four pertains Environmental Resources, has Five Chapters.

**Ahmed Makarfi / Eteyen Nyong**

**April 2024**

## **Chapter 2:**

### **Environmental Resource Policy: Forestry and Climate Change Challenges.**

**Bolaji, K.A , Kabir G.H and Arowolo O.V.**

#### **Introduction**

The environment is the life supporting system for human existence and survival, and provides much of the physical milieu and the raw materials required for socio-economic progress. Humanity has no choice but to interact with it. Unfortunately, human interaction, natural disaster and climate change are putting unprecedented pressure and impact on the quality of our environmental conditions. Climate change, in particular, is currently one of the most critical issues facing mankind today. It strikes at the very heart of the sustainability of our life, and is compounding human efforts to attain sustainable development. Nigeria is strongly predisposed to severe negative impacts of climate change due to the nature of its economy, weak resilience and low adaptive capacity. Much of the economy is dependent on climate sensitive resources (Fellenberg, 1997). For instance, the agriculture sector (crop production, livestock and fishery) and forestry which employ up to 70% of the workforce and contributes about 22% of the rebased GDP is very climate sensitive (Bannikov,1996) . If the environment is properly managed, it can be a productive resource to meet our socio-economic and aesthetic needs, not only for today, but also for the future generations. Conversely, if poorly managed, the environment could easily become hazardous and threatening to the country's survival. Where human interaction with the environment results in degradation, it can be a significant source of economic loss and stress upon human societies. By the 1990s, a World Bank report estimated that Nigeria was losing about US\$5.1 billion per annum to environmental degradation, in the face of poor mitigation measures and initiatives. Nigeria's environment is under increasing threat from human activities and natural disasters. There are already certain ominous problems with the environment and visible scars associated with the destruction of the natural resource base (land, water and air) upon which all life depends are being

noted. The country's large population of about 170 million and its rapid growth rate of 2.8 per cent are contributing to its environmental degradation. (Nigeria Policy on Environment Revised 2016)

The key environmental issues facing Nigeria include land degradation, deforestation, and land, water and air pollution among others. Land is by far the most important resource necessary for subsistence. Simply put, land is that part of the earth's surface that is not covered by water, to this has to be added wetlands which are seasonally or permanently under water. Much of this land is rural, carrying farmlands and vegetation of various types as well as water reservoirs. This portion of the country's land area is the stock from which urban uses are aggressively incurring into to meet growing unbridled nonland use demands. Earth mining for urban development is a major component of this "eating" up the rural land that has evidently been ignored over the years. Left uncontrolled as it is today, future access to rural land for agriculture will be precarious. Effort must therefore be made now to enforce land demarcation for rural especially at the LGA levels. Such land declared as rural would not be allowed to be converted to urban uses of any form. There must also be a watch on idle urban land to control wastages associated with land speculation (Nigeria Policy on Environment Revised 2016)

Forests as one of the environmental resources are primarily referred to as the terrestrial ecosystem of the Earth. They are widely spread all over the surface of the Earth (World Economic Forum, 2024). The Food and Agriculture Organisation of the United Nations defined forest as Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in this situation. It does not include land that is predominantly under agricultural or urban use. By using this definition, Global Forest Resources Assessment 2020 has concluded that the total forest lands cover about 4.06 million hectares or 10 million acres of land which sums up to 31% of the total land on the Earth's surface in the year 2020. Forests are important for the survival of all living beings. According to World Wide for Nature (WWF), 2020, Over 1.6 billion people depend on forests for food or fuel, and some 70 million people worldwide - including many Indigenous communities - call forests home. They are vital for our life as they provide oxygen, food, shelter, fuel, and means of livelihood for the tribal people living in and around the forest area. Forests are home to 80% of the global terrestrial biodiversity and are the source that fulfills all basic needs for adjacent human settlements.

Everything from the oxygen breathe to the wood used for fuel to the use in construction comes from forests. It is a self-nourishing system, which is a host to a number of organisms. The ecosystem of every forest includes both biotic (living) and non-biotic components. The biotic components include plants, trees, shrubs, vines, grasses, mosses, algae, fungi, insects, mammals, birds, reptiles, amphibians, and microorganisms.

Nigeria, the home of tropical rainforest, has experienced a heavy decline in forest cover. The exploitation of the forest belt which accommodates woods, wildlife and other products are subjected to intense intrusion, vegetation degradation, de-reservation for agriculture use, industrialization and urban development. According to the Food and Agricultural Organization (FAO), it was reported that Nigeria has less than 10% forests coverage, with only 20,000 of hectares primary forests. Having lost about 95% of its forest coverage to a high rate of deforestation which is annually recorded at 5% ranging from 2010 and 2015 ([revolv.com/page/Deforestation-by-region](http://revolv.com/page/Deforestation-by-region) Retrieved 25th January 2019). The loss of forest coverage is characterized by illegal logging of forests wood and bad government policies. This requires adequate attention. Unfortunately, people do not regard natural forest as an adequate use of land, and it is this feeling of waste, as well as economic necessity, that induces them to enter forest reserves for the farm. Also, whatever legal situation, they may regard themselves as natural owners of land to do with as they like. In consequence, the local may connive with sawmillers to steal the trees from the forest or set it on fire in order to deny others what they have lost themselves (FAO 2010)

In Nigeria, inadequate regulations and sometimes uncontrollable exploitation or illegal logging poses a great danger to the forest industry and the forest resource base. This is rooted in the failure of States Forest Department in refraining political presence for issuing timber licenses and controlling the magnitude of felling cycles, theft, such that minimum girth felling limits are achieved. Nigeria as a member of African Timber Organization (ATO) and the International Tropical Timber Organization (ITTO), rich in forest resources, which account for about 2.5% of the GDP according to FRA 2010 report. Offering employment for over 2 million people via the supply of fuelwood and wood products. Nigeria is characterized by Tropical savanna climate. This climate has a pronounced dry season, with the driest month having precipitation less than 60 mm

and less than 1/25 of the total annual precipitation. Represented as: Aw Tropical savannah with dry winter  $P_{min} < 60$  mm in winter (FAO 2010). The total population stood at over 200 million, with annual population growth of 2.6% (Worldmeters, 2019)

**Tree Cover Loss in Nigeria:** Tree cover loss has to do with the change in natural and planted forest, which excludes the 'Act of Man' as the cause. In 2017, tree cover loss has grown up to 171kha an equivalence of 12.1 metrics tones of CO<sub>2</sub> of emissions. However, from 2010 to 2017, Nigeria has lost 738 kha of tree cover, equating 7.3% decrease since 2000, and 56.3 metrics tones of CO<sub>2</sub> of emissions. Forest loss during the period 2000–2017, defined as a stand-replacement disturbance, or a change from forest to non-forest state. "It is a stand level replace of vegetation greater than 5 meters, within a selected area (Hansen *et al.*, Science 2013).

**The Importance of Forests: Forests are natural habitats for many animals:** The trees supply oxygen to the atmosphere. They also provide us with wood, medicines, food, perfumes, paper, clothes, etc. Trees are the world's largest storehouses of carbon which is important to maintain global temperatures. The rise in carbon levels is believed to be the main reason behind global warming. In spite of the advantages of forests, deforestation has become very rampant in the modern era causing several problems like pollution, soil erosion, and climate change.

**Uses of Trees to Absorb Greenhouse Gases:** Forests maintain the ecosystem by absorbing greenhouse gases like carbon dioxide that are believed to be the reason for climate change. Carbon is stored in the biomass within the forests. Tropical forests alone harbor a huge amount of carbon (around a quarter of a trillion tons) that can be disastrous if it is released into the atmosphere.

**Importance of Trees to Provide a Natural Habitat:** Forests provide a sustainable environment for the survival of millions of animals. It is home to several species including snakes, turtles, crocodiles, insects, birds, butterflies, monkeys, and other wild animals. It provides an ecosystem for the animals to thrive. The forest floor is also a rich medium for microorganisms, which are essential for the conversion of dead matter into nutrients. Forests are also home to indigenous people who depend on them for their livelihood.

**Importance of Forests as Watershed Regions:** Forest-based water tables, rivers, streams, and lakes are critical sources of water. The green cover preserves the water reserves from sun radiation.

The Amazon forest is home to the world's largest watershed and river system. Importance of Forests to Support Biodiversity. Globally, around 90% of the species including various plants and animals thrive in forests. They offer the necessary habitat and support biodiversity. They are home to the genes of biodiversity.

**Importance of Forests to Purify the Air:** Photosynthesis is a critical function of plants to generate food and energy. Plants, shrubs, and trees absorb carbon dioxide from the atmosphere during the daytime and release oxygen. According to an estimate, an acre of mature trees can provide oxygen for 18 people. They act as giant lungs purifying the air in the atmosphere by removing carbon dioxide and maintaining balanced levels of oxygen that we breathe every day. Trees absorb odours and pollutant gases like ammonia and Sulphur dioxide out of the air. These toxins are trapped in the leaves and barks.

**Importance of Trees to Regulate Global Temperatures.:** Forests provide green cover which absorbs the Sun's radiation and keeps the temperature down. They regulate atmospheric temperature through evapotranspiration and breeze. Forests also promote rainfall that helps in maintaining the water table and a cool climate. Deforestation has the opposite effect causing the global temperature to rise dramatically.

**Importance of Forests to Enrich the Soil:** Dead leaves and broken branches ultimately are converted to soil through the decomposition process and this conversion enriches the soil with nutrients. Microorganisms present in the soil convert the biodegradable material to simpler particles that can be utilized by the plants again. Trees have very strong roots that hold the soil intact in cases of floods or any other reasons that cause soil erosion. They are very critical in hilly areas or stream slopes as they slow the runoff and keep the soil intact. Uncontrolled soil erosion can destroy the fertile soil leading to barren conditions.

**Importance of Forests to Regulate the Water Cycle:** Forest is an important component of the water cycle process. They regulate evaporation, condensation, and precipitation of the water. They also nourish the aquifers thereby replenishing groundwater supplies. Trees allow the rainwater to flow down the trunk into the soil thereby preventing the storm water from carrying pollutants to the ocean. They act as giant sponges that filter water and recharge the water table.

**Importance of Forests in Our Life;** Forests are rich in herbs, plants, and trees of medicinal value. The extracts, seeds, leaves, and bark from these plants and trees treat several diseases while being non-toxic to the human body. Some examples include quinine, curare, rosy periwinkle, wild yams, extracts of willow trees, Calabar bean and samambaia.

**Forests Provide Economic Benefits.;** Forests have a lot to offer to human beings. Every component of a tree including leaves, branches, stem, bark, fruits, seeds, and root are useful. Forests provide wood, timber, raw materials, vegetables, and fruits, which have significant economic value. The timber is used in construction and making furniture. Wood is also essential in the production of paper. The rubber extracted from trees is used to make several products. Even green waste has economic significance. Millions of trees are chopped off every year to support the increasing need of human beings. We have to take proactive measures to preserve forests and increase the green cover in the interest of millions of living beings that depend on them. as a valuable and more expressible service that generates revenue than those rendered by the defense force of the country. Various worms, insects, and various miniature organisms feed on the humans and the tunnel in the soil, thus, making it suitable as a portion of food for the plants. Forests also act as a natural defense against aerial attack by covering the entire land with its canopies.

**Forest Create Jobs:** More than 1.6 billion people rely on forests to some extent for their livelihoods, according to the U.N., and 10 million are directly employed in forest management or conservation. Forests contribute about 1% of the global gross domestic product through timber production and non-timber products, the latter of which alone support up to 80% of the population in many developing countries.

**They Muffle Noise Pollution:** Sound fades in forests, making trees a popular natural noise barrier. The muffling effect is largely due to rustling leaves plus other woodland white noise, like bird songs and just a few well-placed trees can cut background sound by 5 to 10 decibels, or about 50% as heard by human ears.

**Deforestation:** Deforestation is often described as the changing of land from forested to non-forested by means both natural and unnatural (Wikipedia).It could be purposeful clearing or thinning of trees and forests. Deforestation comes in many forms: wildfire, agricultural



clearcutting, livestock ranching, and logging for timber, among others. When deforestation occurs, much of the carbon stored by tree is released back into the atmosphere as carbon dioxide, which contributes to global warming. Trees absorb and store carbon dioxide, When trees are cut down or burned, the process is disrupted, releasing the stored carbon back into the atmosphere and contributing to the greenhouse effect so deforestation releases large amounts of CO<sub>2</sub> into the atmosphere, fueling global warming. It result into local and global weather patterns, leading to droughts, floods, pollution and other extreme weather events according to Gray Group International (GGI insight ,2024) Deforestation affects these natural ecosystems, which can have long-term consequences for both the environment and human well-being. This study shall review the following effects of climate change as a result of forest degradation:

According to United Nations Environmental Programme (UNEA), deforestation in Africa is twice the whole world rate. Therefore, understanding the drivers of deforestation and degradation is important for the development of policies and measures that aim to alter current trends in forest activities towards a more climate and biodiversity-friendly outcome. Deforestation and the consequences of environmental degradation are key factors challenging food security, community livelihood and sustainable development in Ethiopia (Mammo Siraj *et.al* 2016). On global account, an additional 290,000 km<sup>2</sup> of forests were cleared in the period 2007– 2012 compared with 2000–2006, which is a net increase of 29% between the two periods, prior to Hansen et al.'s total of 2.3 million km<sup>2</sup> of forest loss for the entire period (Hansen et al., 2013). The Food and Agriculture Organization of the UN says Nigeria loses about 350,000 to 400,000 hectares of land per year to deforestation. The organization, however, noted that, while the recommended forest cover for every nation is 26 per cent, the reverse is the case for Nigeria, because the country's forest cover is said to be less than six per cent. “The deforestation rate in the country is about 3.5 per cent per year, translating to a loss of 350,000–400,000 hectares of forest land per year (Institute of International Tropical Agriculture, IITA)

Deforestation increases the risk of flooding by reducing the ability of the earth to absorb and handle extreme weather pattern. Forest absorbs and disperse heavy rain, reducing its force and volume. The absence of tree cover removes this natural barrier and makes the ground less able to soak up water, leading to more runoff in a water bodies. This runoff carries with it soil and sediments,

raising riverbeds and reducing their capacity to contain water. The more the deforestation occurs, the greater the impact on nearer communities that experience increase frequency of floods. When natural forest are cut down for farming or building cities, the risk of flooding increases. These devastating flood can displace populations, it is extremely important to adopt sustainable land management techniques and promote reforestation to reduce impact of flood damage, less forest, more floods: Research from 56 countries shows that places with fewer forests have more floods. More specifically, the loss of natural forests increases flood frequency, severity, and the number of people displaced or killed by floods.

Trees are essential because they help soak up rainwater. Without them, water runs off the land too quickly, leading to heavier and increased frequency of floods. Trees stand as guardians of the water cycle, moderating the water flow. This balance is disrupted without them, leading to excessive runoff and erosion. Trees release moisture into the atmosphere, generating rainfall. Deforestation reduces this process, known as evapotranspiration. Diminished tree cover directly impacts precipitation intensity. Heavy rainfall events lack interception by foliage, reinforcing the cycle. The loss of trees triggers a cascade of effects on rainfall and evaporation. Trees conduct water from the soil and release it as water vapour through their leaves, contributing to cloud formation and precipitation. When trees are removed, the climate often becomes drier: Evapotranspiration declines, curtailing the release of moisture into the air. Rainfall becomes more intense and less frequent. Less moisture in the atmosphere can lead to diminished cloud cover and reduced overall rainfall. [Deforestation accelerates soil erosion](#), diminishing water absorption. The loss of topsoil reduces the soil's moisture content. Groundwater levels often drop as a result of reduced recharge. Lakes may shrink or become eutrophic from increased nutrient runoff. With the absence of deep-rooted trees, the soil's ability to retain water decreases: Erosion washes away the topsoil, critical for storing water, and carrying it slowly to groundwater systems. Groundwater supplies, which contribute to rivers and lakes, are not adequately replenished. This can lead to both depleted water sources in dry periods and increased surface runoff during periods of heavy rain, exacerbating the risk of flooding.

**Environmental Pollution:** Environmental pollution is an effect caused by undesirable changes in the natural environment that have a harmful effect on plants, animals and humans. The substance that causes pollution is known as a pollutant. Pollutants can exist as liquids, solids or gases. A substance becomes a pollutant when its concentration exceeds its natural abundance, and this increase in concentration is caused either by human activities or by natural phenomena (Protasov and Molchanov, 1997). Contaminants can decompose and are rapidly destroyed by natural processes similar to the decomposition of vegetables. We also have pollutants that take decades to decompose and are difficult to remove once released. DDT, plastics, heavy metals and nuclear waste are just a few examples.

One of the greatest scourges of our age is air pollution, not only because of its impact on climate change, but also because of its impact on the health of populations and individuals due to increased morbidity and mortality. There are many pollutants that are major contributors to disease in humans. Among them, particulate matter (PM), particles of variable but very small diameter, enter the respiratory system when inhaled, causing respiratory and cardiovascular disease, reproductive and central nervous system dysfunction, and cancer. Although ozone in the stratosphere plays a protective role against ultraviolet radiation, it is harmful in high concentrations at ground level, affecting the respiratory and cardiovascular systems as well. In addition, nitric oxide, sulfur dioxide, volatile organic compounds (VOCs), dioxins, and polycyclic aromatic hydrocarbons (PAHs) are considered air pollutants harmful to humans. Carbon monoxide can even cause direct poisoning if inhaled in large quantities. Heavy metals such as lead, when ingested, can lead to direct poisoning or chronic intoxication, depending on the exposure. Diseases resulting from the aforementioned substances include mainly respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, bronchiolitis, as well as lung cancer, cardiovascular diseases, central nervous system dysfunctions and skin diseases. Last but not least, climate change as a result of environmental pollution affects the geographic distribution of many infectious diseases, just like natural disasters. The only way to solve this problem is to raise public awareness, combined with an interdisciplinary approach of scientific experts; national and international organizations must respond to this threat and offer sustainable solutions. There are two types of air pollutants:

Primary pollutants which are those that directly contribute to air pollution such as Sulfur dioxide emitted from factories is the main pollutant and secondary pollutants that are formed as a result of mixing and reaction of primary pollutants. Smog is a secondary pollutant resulting from the mixing of smoke and fog. **Following** are the main causes of air pollution. Burning fossil fuels, Agricultural activities, Factories and industry, and Household Sources

**Water pollution:** Water quality is of vital importance to humanity as it is directly related to human well-being. When water becomes polluted, it has a direct or indirect negative effect on all forms of life that depend on it. The effects of water pollution can be felt for many years. Contaminated water is the cause of many waterborne diseases and epidemics that are widespread in many countries. Water pollution is defined as pollution of water bodies. Water pollution occurs when rivers, lakes, oceans, groundwater and aquifers are polluted by industrial and agricultural runoff. Water pollution is caused by urbanization, deforestation, industrial effluents, detergents and fertilizers, and agricultural effluents are all examples of pollution. The impact of water pollution is determined by the type and concentration of pollutants. The location of water bodies is also an important factor in determining pollution levels.

**Soil pollution:** Soil pollution is soil contamination with an abnormally high content of toxic substances. This is a serious environmental problem as it poses numerous health risks. Exposure to soil containing high concentrations of benzene, for example, increases the risk of developing leukemia. Xenobiotics - substances that do not occur naturally in nature, but are synthesized by humans, are among the most dangerous soil pollutants. Several xenobiotics have been identified as carcinogens. Heavy metals (such as lead and mercury in abnormally high concentrations) and Polycyclic aromatic hydrocarbons in soil can make them highly toxic to humans. (Adeoti, 2014)

**Noise Pollution:** Noise is an unpleasant and unwanted sound that causes discomfort to a person. Sound loudness is measured in decibels (dB). The human ear can detect the weakest sound at 1dB. As the population of civilizations grew, noise pollution became a problem. Among the main causes are vehicles, aircraft, industrial machines, loudspeakers, burglars and other similar devices. Other household appliances such as televisions, transistors, radios, etc.

contribute to noise pollution when used at high volumes. The following are types of noise pollution: Traffic noise, Noise in the neighborhood, the sound of gadgets, household items and nuclear pollution

**Water Management:** Water is an essential natural resource that supports our global life systems and a key driver of socio-economic development. Water is an indicator of life, a lack or under-supply of it increases the risk of infectious diseases, poor industrialization, poor personal and community hygienic, poor food production, conflicts, human rights abuses, poverty including achievement of international development targets (Onuh and Bassey, 2021). According to the Nigerian Federal Ministry of Water Resources (FMWR) (2016), water is one of the most important natural resource and Nigeria is considered to be abundantly blessed with it. The demand of water to national development has increased overtime vis-a-vis rapid population growth, urbanization, modernization of agriculture and industrial development following changes in consumption and production patterns. It is useful for direct human consumption, agricultural irrigation, livestock farming, fisheries, hydropower, industrial production, recreation, tourism, mineral processing, navigation, environmental protection and industrial effluents absorption amongst others (Onuh and Bassey 2021). However, the demand exceeds supply at critical times of the year or in years of low water availability therefore, the management and development of the water sector faces many challenges, including pressures on water resources (FMWR, 2016).

Water resource management system in Nigeria comprised of a central authority for the management of water resources by the Federal Ministry of Water Resources, a water resource ministry at the state level, and the local governments are responsible for distributing water to rural areas (Ezeabasili, 2014). The challenges of water resource management in Nigeria have been severally blamed on the paucity of data as well as, non-implementation of the integrated water management system (Adeoti, 2014). Water is a resource that is naturally abundant in the nation and has fundamental significance, but its underutilization and poor management are continuing to harm Nigeria's socioeconomic development (Odume & Slaughter, 2017; Salau, 2017; Oyebode *et al*, 2015).The British colonial government introduced efforts to manage and deliver water in a modern network system, even though Nigerians of various communities had always taken care of

their water needs in precolonial times by making the most of the various water sources made naturally available to them, like streams, springs, ponds, rain water, and the wells they had dug for themselves, particularly in the northern region. Improving the quality of drinking water and lowering the crippling effects of water-borne diseases on the populace were the primary goals behind the development, management, and supply of water resources, especially in areas situated along important trade and transportation routes supporting the export-oriented colonial economy (Mabogunje, 1965). The first water treatment plants were built in Iju, on the Ogun River, in 1910 to support the colonial administration in Lagos, the center of the colonial economy. By 1915, the plants were operational. Since then, as more cities and urbanizing communities have established water treatment plants, water management and supply have undergone many stages, phases, and dimensions of growth. Nearly 70 cities had access to modern water supplies in one way or another when they gained independence (Ayoade, 1975). Given the nature of the colonial economy and the rural-urban population drift, urban centers' water needs grew, resulting in an increase in water consumption from 52,238 cubic meters in 1953 to over 215,768 cubic meters in 1960 (Ayoade, 1975).

There are challenges of both water quantity and water quality in Nigeria where pollution of water sources is posing major problems for water users as well as hindering the maintenance of natural ecosystems. The country has to some extent artificially overcome natural variability by supply-side infrastructure to guarantee reliable supply and reduce risks, though at very high cost and mostly with negative impacts on the environment, livelihood and sometimes on human health. The goal six of the SDG aims to fulfill, particularly, all domestic water needs by 2030. In spite of the fundamental significance of water, a resource naturally made available in its abundance in the country, its poor management and under-utilization is continuing to undermine the socio-economic development of Nigeria (Oyebode *et al*, 2015).

The dearth in the water management and supply system in Nigeria has led to many citizens resorting to self-help and exploiting the underground water resources in an unstructured and uncoordinated, and unsustainable manner (Onuh and Bassey, 2021). Omole (2013) noted that, over 60% of Nigerians with access to drinking water now get it from underground sources. He also noted that sustainable groundwater use in Nigeria is challenged by funding, weak institutions, poor

data management system, poor implementation of groundwater exploitation regulation, in addition to hydrological factors. Obeta (2019) reported that many private businesses have continued to emerge from the decadence of water management and supply in Nigeria in which most poor and rural dwelling citizens are challenged by access to clean water supply. Whereas, the dependence on private for-profit water ventures to meet the water needs of the population is unsustainable (Obeta, 2019).

**Environmental Resources Policy:** Environmental policy is the commitment of an organization or government to the laws, regulations, and other policy mechanisms concerning environmental issues. These environmental issues generally include air and water pollution, waste management, ecosystem management, maintenance of biodiversity, the management of natural resources, wildlife and endangered species. Environmental policy tends to focus on problems arising from human impact on the environment, which is important to human society by having a (negative) impact on human values. Such human values are often labelled as good health or the 'clean and green' environment. Tackling climate change requires aggressive efforts to stop deforestation through policy changes, reforestation initiatives, and sustainable practices. With rapid and comprehensive climate action to curb deforestation, we can help mitigate climate change and its wide-ranging impacts.

Environmental resource policies on pollution aim to address and mitigate the adverse impacts of pollution on the environment, human health, and ecosystems. These policies typically involve a combination of regulations, incentives, and educational efforts to promote sustainable practices and reduce the release of pollutants into the air, water, and soil. Externality such as when a factory produces waste pollution which may be discharged into a river, ultimately contaminating water. The cost of such action is paid by society-at-large as they must clean the water before drinking it and is external to the costs of the polluter. Government policies are carefully formulated so that the individual measures do not undermine one another, or create a rigid and cost-ineffective framework. Nigeria had several environmental policies and regulations aimed at addressing pollution and promoting sustainable environmental management. Some key elements of Nigeria's environmental policy on pollution included:

**National Environmental Standards and Regulations Enforcement Agency (NESREA):**

NESREA is the federal agency responsible for the enforcement of environmental laws, regulations, and standards in Nigeria. It plays a crucial role in overseeing and regulating activities that may lead to pollution. Administered by the Ministry of Environment, the National Environment Standards and Regulation Enforcement Agency (NESREA) Act of 2007 replaced the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources.

Section 7 provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitoring and regulatory measures. Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation. Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding, N1,000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of N50,000, for every day the offence persists.

**Regulations (Under NESREA):** National Effluent Limitation Regulations. Section 1 (1) requires industry facilities to have anti-pollution equipment for the treatment of effluent. Section 3 (2) requires a submission to the agency of a composition of the industry's treated effluents. National Environment Protection (Pollution Abatement in Industries and Facilities producing Waste) Regulations (1991). Section 1 Prohibits the release of hazardous substances into the air, land or water of Nigeria beyond approved limits set by the Agency. Section 4 and 5 requires industries to report a discharge if it occurs and to submit a comprehensive list of chemicals used for production to the Agency.

**Federal Solid and Hazardous Waste Management Regulations (1991):** Section 1 makes it an obligation for industries to identify solid hazardous wastes which are dangerous to public health and the environment and to research into the possibility of their recycling. Section 20 makes



notification of any discharge to the Agency mandatory. Section 108 stipulates penalties for contravening any regulation.

**National Environmental (Sanitation and Wastes Control) Regulations:** These regulations provide guidelines on waste management, including the collection, transportation, treatment, and disposal of solid and liquid wastes. They aim to prevent environmental pollution from improper waste disposal.

**Harmful Waste (Special Criminal Provisions) Act Cap H1, LFN 2004:** The Harmful Waste Act prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable. Section 6 provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence. Section 7 makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where the offence is committed by a company. Section 12 defines the civil liability of any offender. He would be liable to persons who have suffered injury as a result of his offending act.

**Hydrocarbon Oil Refineries Act, Cap H5, LFN 2004:** The Hydrocarbon Oil Refineries Act is concerned with the licensing and control of refining activities. Relevant sections include the following: - Section 1 prohibits any unlicensed refining of hydrocarbon oils in places other than a refinery. Section 9 requires refineries to maintain pollution prevention facilities.

**Oil in Navigable Waters Act, Cap 06, LFN 2004:** The Oil in Navigable Waters Act is concerned with the discharge of oil from ships. The following sections are significant: - Section 1 (1) prohibits the discharge of oil from a Nigerian ship into territorial waters or shorelines. Section 3 makes it an offence for a ship master, occupier of land, or operator of apparatus for transferring oil to discharge oil into Nigerian Waters. It also requires the installation of anti-pollution equipment in ships. Section 6 makes punishable such discharge with a fine of N2, 000 (Two thousand naira). Section 7 requires the records of occasions of oil discharge.

**Associated Gas Re-Injection Act, Cap 20, LFN 2004:** The Associated Gas Re-Injection Act deals with the gas flaring activities of oil and gas companies in Nigeria. The following sections are relevant to pollution prevention:-Section 3 (1) prohibits, without lawful permission, any oil and gas company from flaring gas in Nigeria. Section 4 stipulates the penalty for breach of permit conditions.

**The Endangered Species Act, Cap E9, LFN 2004:** This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction as a result of overexploitation. These sections are noteworthy: Section 1 prohibits, except under a valid license, the hunting, capture or trade in animal species, either presently or likely to be in danger of extinction. Section 5 defines the liability of any offender under this Act. Section 7 provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.

**Sea Fisheries Act, Cap S4, LFN 2004:** The Sea Fisheries Act makes it illegal to take or harm fishes within Nigerian waters by use of explosives, poisonous or noxious substances. Relevant sections include the following: - Section 1 prohibits any unlicensed operation of motor fishing boats within Nigerian waters. Section 10 makes destruction of fishes punishable with a fine of N50, 000 or an imprisonment term of 2 years. Section 14 (2) provides authority to make for the protection and conservation of sea fishes.

**Inland Fisheries Act, Cap I10, LFN 2004:** Focused on the protection of the water habitat and its species, the following sections are instructive: Section 1 prohibits unlicensed operations of motor fishing boats within the inland waters of Nigeria. Section 6 prohibits the taking or destruction of fish by harmful means. This offence is punishable with a fine of N3, 000 or an imprisonment term of 2 years or both.

**Exclusive Economic Zone Act, Cap E11, LFN 2004:** The Exclusive Economic Zone Act makes it illegal to explore or exploit natural resources within the Exclusive zone without lawful authority. The Federal Government regulates the activities of the Exclusive Zone.

**Environmental Policy and its Enforcement in Nigeria:** National Policy on the Environment is to ‘ensure environmental protection and the conservation of natural resources for sustainable development’. The protection of the environment, human health, and natural resources is the common objective of all environmental laws and regulations, which differ from nation to nation. These laws deal with a wide range of topics, such as waste management, habitat protection, air and water quality, and emissions reduction. In Nigeria for instance, there is not a single all-encompassing law/regulation or body that deals with Environmental laws and sustainable practices.

The basis of environmental policy in Nigeria is contained in the 1999 Constitution of the Federal Republic of Nigeria. Pursuant to section 20 of the Constitution, the State is empowered to protect and improve the environment and safeguard the water, air and land, forest and wildlife of Nigeria. In addition to this, section 2 of the Environmental Impact Assessment Act of 1992 (EIA Act) provides that the public or private sector of the economy shall not undertake or embark on or authorise projects or activities without prior consideration of the effect on the environment. In this regard, the Federal Government of Nigeria has promulgated various laws and Regulations to safeguard the Nigerian environment.

**Strategic Objectives:** The strategic objective of the National Policy on the Environment is to coordinate environmental protection and natural resources conservation for sustainable development. This goal will be achieved by the following strategic objectives: i. securing a quality of environment adequate for good health and wellbeing; ii. promoting sustainable use of natural resources and the restoration and maintenance of the biological diversity of ecosystems; iii. promoting an understanding of the essential linkages between the environment, social and economic development issues; iv. encouraging individual and community participation in environmental improvement initiatives; v. raising public awareness and engendering a national culture of environmental preservation; and vi. building partnership among all stakeholders, including government at all levels, international institutions and governments, non-governmental agencies and communities on environmental matters.

**The Need for a National Forest Policy:** The forest estate of Nigeria is one of the most important and valuable national assets. Indeed it constitutes a renewable resource infinite in diversity and potential. A concerted national effort is therefore imperative in order to salvage the forestry sector from the onslaught of stakeholders who are interested only in the revenue potential of the sector and greatly scared of the pertinent resource needs. A national approach to the problem is urgently necessary because forestry matters are not compartmentalized within political boundaries. Much more importantly, it should be stressed that most of the disasters that have occurred within Nigeria over the last five years are directly traceable to forest misuse. For instance, disasters such drought desert encroachment, floods, siltation, soil erosion, decreasing agricultural productivity and economic recession are, to some extent due to the poor management of our forest resources. These disasters are national in character and impact. Our forests constitute a natural environmental buffer against most of the disasters. The problem therefore needs national solutions since the destruction of forests in one State could lead to disasters in neighbouring States. The supply and demand of forest resources in one State cannot and ought not to be pursued in isolation of the requirements of the other States of the federation. Therefore the national ecosystem of the country can only be improved upon if a national management policy is enunciated and takes into consideration the ecological potentialities of the various parts of the country and rationalizes those potentialities within a national planning perspective designed to enhance the welfare of all Nigerians.

**The Nigeria National Forest Policy:** The national forest policy was promulgated by Nigeria Government in 2006 to protect the forest and forest services and was reviewed in 2022. The Federal Government of Nigeria, inaugurated the National Forest Policy for sustainable forest management and promoting good forest governance to improve livelihood in April, 2022. The policy would sustain management of forest ecosystems, environment, socio-economic growth and provision of goods and services for domestic purposes and export for the benefit of the nation. The guiding principles are centred on sustainable forest and national development agenda of poverty reduction, good forest governance, transparency and accountability. The policy is also for biodiversity conservation, sustainable provision of forest goods and services as well as value chain additional and fulfilment of international commitments. The policy enunciated relevant strategies in line with globally accepted priority areas of sustainable forest management, which include

extent of forest resource, forest health and vitality among others. The national target of increasing the total forest covered from 10 per cent to 25 per cent by 2022 and the various international commitments appears a daunting task. The effort was to enhance community's inclusiveness in sustainable forest management because forest sector remained an important natural capital asset in the attainment of the national development objectives of the country..

**Climate Change Policy in Nigeria:** The vision of the National Policy on Climate Change is a low-carbon, climate-resilient Nigeria. Policy Mission Ensure sustainable development and a climate proofed economy through multi-stakeholder engagement. The Policy's overall goal is to promote a low-carbon, climate-resilient and gender-responsive sustainable socio-economic development. Some of the expected outcomes of the policy's goal includes: reduced vulnerability to climate change impacts across all sectors. ii. Improved social, cultural, economic and ecological resilience. iii. Reduced greenhouse gas emissions. iv. Increased awareness of climate change impacts and adaptation and mitigation measures. v. Enhanced and strengthened research, innovation and technology development and transfer and systematic observations. vi. Enhanced capacity to implement climate change related interventions at national, state and community levels. vii. Climate change and its cross-cutting issues mainstreamed in development. The goal of Nigeria's Climate Change Policy will be achieved through the attainment of the following objectives: i. implementing adaptation and mitigation measures that promote low-carbon development; ii. Strengthening capacities and synergies at local, sub-national and national levels and at individual and institutional levels to implement climate change response; iii. Promoting scientific research, technology and innovations to address the challenges of climate change; iv. Developing and implementing appropriate strategies and actions to reduce the vulnerability of Nigerians to the impacts of climate change across all sectors; v. Mainstreaming gender, children and youth, and other vulnerable groups into all climate change interventions; Promoting sustainable land-use systems that enhance agricultural production, ensure food security and maintain ecosystem integrity; vii. Promoting climate-proofing of construction and infrastructural development; viii. Enhancing national capacity to mobilize international and national resources, both technical and financial, for investment in climate change; ix. Developing an effective climate change communication and information management system that facilitates access by all

stakeholders to climate information; x. Strengthening national institutions and mechanisms (policy, legislative and economic) to establish a suitable and functional system for climate change governance (FGN ministry of Environment, 2021)

**Conclusion:** The strategic objective of the National Policy on the Environment is to coordinate environmental protection and natural resources conservation for sustainable development. This goal will be achieved by the following strategic objectives and their implementations of the goals by the applicable stakeholders. Environmental regulations and sustainable practices are very important in managing the resources and mitigating the climate change effect in Nigeria.

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