

Anthropogenic factors and climate change as agents of desertification in a developing economy such as Nigeria

Abstract

Anthropogenic/Human factors and Climate Change are major agents that cause Desertification and adverse Biodiversity Changes in Nigeria and the neighboring countries in the Sahel Zone of the Sudan and Guinea Savannah environments that occur south of the Sahara Desert. Natural factors environmental degradation and weathering, earthquakes, volcanic eruption etc. that may cause Desert spreading and encroachment are exacerbated by human factors of high population increases, density and migration, increased agricultural practices, industrialization etc. resulting in releases of noxious Green House Gases, higher temperatures and heat waves, massive water loss, heavy dust storms, flooding, erosion, pollution and contamination etc. of the environment. The interplays of these events during the *Geologic and post Pre-Cambrian Times* to the *Archaeological Times* and to the recent *Holocene Times* trigger off at various rates of environmental activities in different places of the world the resulting *Desertification, Climate Change and Biodiversity Change*. These occurrences are displayed, *in situ*, in preset *Geographic Landforms* and the *Paleogeography* of the global community with their obvious negative implications and destructive impacts.

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BCE Egboka, EI Okoye, SN Chibuzor

Dept. of Geological Sciences and Dept. of Applied Geophysics, Nnamdi Azikiwe University, Nigeria

Correspondence: BC E Egboka, Department of Geological Sciences and Dept. of Applied Geophysics, Nnamdi Azikiwe University, Awka, Nigeria, Email boniegbok@gmail.com

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Introduction

The Sahara desert that has its lower boundary at the northern parts of Nigeria through its Sahel Zone/Guinea Savannah as well as Climate Change have negative/severe and disastrous effects/impacts on the socioeconomic (human and material) resources of the country and also to her neighboring countries of Africa (Figure 1). Nigeria has the Tropical Climate. Heat waves occur due to high temperatures, low humidity and excessive aridity during the Dry Season in the months of October to April of the year; there are warm/hot winds that blow light and heavy dust/sand storms southwards from the Sahara Desert; the aridity is due to severe rainlessness; the sandstorms generate sand dunes that cause destructions of lives and property.¹ The Rainy Season begins in the month of March and ends in September of the same year. Average annual rainfall south of Nigeria at the Atlantic Ocean coastal areas to the Middle belt region fall in the range of about 2500-2000mm while the far-northern areas may be as low as 1000mm or less. The rains are ushered in with thunderous storms that may degenerate into frightful lightening and blizzards, heavy rainstorms/downpours and severe flooding/flash floods, soil/gully erosion and landslides. The highest period occurs sometime within the months of June/July/August when there occurs sudden stop of rainout or rain break for about one to two weeks period that is called "August Break". The Impacts of Climate Change have exacerbated the above incidences/climatic occurrences that happen during the Dry and Rainy Seasons. It must be emphasized that the natural occurrences affected by Natural Causes (Acts of God) are further affected adversely by Anthropogenic/Human Factors of Pollution, Deforestation etc. as are discussed below.

Desertification and climate change in parts of Nigeria and beyond

Desertification is the originating of Desert or spread/encroachment of an existing Desert conditions into a non-desert environment. These changes into a Desert result into changes of the normal green/virgin lands that have undergone some drastic environmental changes after use(s). These changes occur in Virgin/Vegetated/Forested Lands

Environment within the Atmosphere and solid/liquid Earthsphere that were used to be positive/supportive enough for human, animal and plant lives to conveniently-subsist with bounteous water resources and ample means of livelihood. Such extreme Climatic Conditions may then turn the virgin lands into a hostile Desert Environment. A non-desert or non-desertified Environment supports large human, animal and plant populations in both urban and rural areas, clement weather conditions, different water sources/resources for potable water supplies and irrigation, good soils for Agriculture and food production etc. There are veritable infrastructure of roads, buildings, hospitals, schools, markets, industries, churches/mosques etc. all for ease of living and existence. These aspects of positive environment for good life/living are what Desertification and desertified or desertifying environment are very hostile/inclement towards and are usually destroyed and abandoned during Desertification.

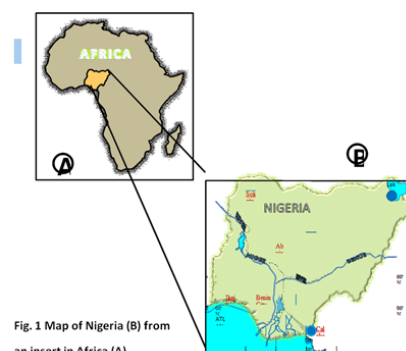


Fig. 1 Map of Nigeria (B) from an insert in Africa (A)

Figure 1 Map of Nigeria (B) from an insert in Africa (A)

A Desert is a very hostile and inclement environment that is unfit for human occupation or habitation; and if there is life existing at all, it must be very stir and harsh to the extreme that it becomes most difficult to manage for life. The climate is most severe, temperature very high and rainfall is sparse/most irregular and about 250mm per annum. Sometimes, there may occur accidental rainout that may cause flash floods of short duration. Sandstorms can cause blindness

while excessive heat waves may perpetuate meningitis to the few people who live or travel through the desert. Surface water and shallow groundwater are very scarce and are even unavailable to the few people who live or travel in the deserts except in shallow oases that are few for long distances. The extreme aridity makes water for animals and plants most scarce and really unavailable. They're very few motorable roads that can be used by the people. Parts of Nigeria are suffering from severe Desertification and Savannah Encroachment thereby creating severe socioeconomic problems for the people and the Nigerian Biodiversity and the Total Environment (as discussed below).

Natural causes of desertification/climate change {acts of god} in Nigeria

a) Natural causes of desertification and savannah encroachment

During Creation when the Earthsphere came to be, by the Act of God, or through the Processes of Biological Evolution and Biodiversity Changes, the Earth's and Atmospheric constituents of air, lands, soils, rocks, waters, humans, animals, plants etc. were exposed to different environmental impacts-events that were positive or negative.²⁻⁴ These events and their occurrences stretched from Geologic times of the Pre-Cambrian/Cambrian to the Archaeological times to the present Holocene times. Examples of such natural occurrences that were/are slow and non-perceptible include erosion and rock weathering to form sediments; tsunamis, earthquakes and volcanic eruptions that are violent and most destructive to rocks and lands.^{5,6} These natural occurrences contribute(d) tremendously towards the origin of the shape and forms of the landscapes and the Paleogeography of the Total Environment we see in the world today.

b) Natural and anthropogenic causes of climate change in Nigeria and the environs

In the last about two hundred years, more or less, as a result of ingress of Industrial Revolution and the use of coal for energy in steam engines; increase in human population; worldwide urbanization and excessive uses of coal; during the later years, the discovery of petroleum resources of oil and natural gas for massive uses in industries, transportation and other various human uses/living; carbon/sulphur and carbonated/sulphurated compounds in solid and gaseous compounds/forms are being released/loaded into the Total Environment. These excessive loading of pollutants/contaminants adversely-affect the naturally-existent climatic conditions resulting in Climate Change. Furthermore, Green House Gases of water vapour, gases from burning of petroleum and natural gas that produce loads of carbon dioxide, sulphur dioxide, nitrogen dioxide/nitrous oxide, methane etc., incineration of solid wastes in landfills, barnyards, deforestation and agricultural waste/solid products etc., chlorofluorocarbons, aerosols etc. Since petroleum oil and natural gas were discovered at Oloiburu in the Niger Delta of Nigeria in 1956, the "Liquid Gold" has been drilled and exported for sales overseas and the precious natural gas separated and flared/burnt all over the oil producing communities' Total Environment with adverse pollution and contamination. In their natural concentrations in the Total Environment these chemicals act as Atmospheric Envelope described as Green House Effect that prevents dangerous x-radiation from the sun from adversely-penetrating into the Earthsphere and causing cancerous diseases on humans. While some of the gaseous activities may cause negative environmental impacts such as in Global Warming of the Climate, some may cause a positive Cooling Effect.

Anthropogenic causes of desertification and climate change in Nigeria

a) Nigeria as a developing economy vis-a-vis developed economies

Nigeria got her Political Independence in 1960; but today, she is yet to secure her Economic Independence; after so many years of securing her political freedom from Great Britain. Despite her large and (un)exploited deposits of petroleum oil and natural gas; also a member of OPEC for many years and blessed with enormous pool of manpower and huge material resources, yet Nigeria is still within the League of Developing Economies of the global community. There are brilliant and large population of high-level human Capital, bounteous solid/liquid mineral resources, extensive Atlantic Ocean Coastal Environment, available surface water and groundwater resources, rich soils and Agricultural Lands, tolerable climatic conditions, virgin forests/lands etc.⁷⁻⁹ All these would have comparatively placed Nigeria into the membership/league of Developed Economies. Developed countries of Asia such as Saudi Arabia and the United Arab Emirate (UAE) have fought the Arabian Desert to a standstill with built-heavy and stable infrastructure and they have been harnessing mineral and water resources from their lands; so also are the Israelis doing accordingly from their arid lands. The Europeans, Canadians and Americans have been fighting doggedly their Ecological Hazards such as Climate Change, Environmental Pollution and Contamination etc. and thereby trying to prevent wrong actions as caused by their predecessors that precipitated some of these problems. Unfortunately, Developing Economies seem not to learn to do likewise instead they continue to repeat and even tend to worsen the destructive mistakes of the past.

b) Anthropogenic causes of desertification and climate change

Human Migration through the porous borders in Nigeria from the Sahel Zone of the northern Cameroon, Chad, Niger, Mali, Sudan, Libya etc. into Nigeria has been in progress for many years up till today. The migrants are escaping from the hostile environment of the Sahara Desert and the harsh Sudan Savannah Climate. While some are herdsmen with their families, large herds of cows and goats, others are merchants/traders. The vegetation and water resources are non-existent in the Desert while they are sparse in the Sudan and Guinea Savannah Zones. Their large populations migrate southwards into Nigeria (northern and southern areas) in search for better life for themselves, families and animals. Their presence put severe pressures on the indigenous populations, vegetation, lands, water, security and other needful resources that must be shared; they result in insecurity and internecine/bloody conflicts with some of the indigenous populations.¹⁰ Extensive cattle rearing through movements and open grazing of large populations of herders and their animals result in consumption of enormous vegetation and bush burning that cumulatively join other environmental forces of wind/sandstorms, high temperatures and extreme aridity to render the lands threadbare. These results in disturbance of peace and security within the northern and Middlebelt parts of the country; and the situation is gradually creeping down into the southern parts of the country where parts of the Rainforest Region have become occupied and turned into the hostile Guinea Savannah climatic conditions. Meanwhile, the formerly thick, evergreen and luscious vegetation of the Rainforest Belt of southern Nigeria and parts of the Middlebelt have been terribly-deforested up to 60% thereby drastically-changing the Biodiversity of the area and undergoing diverse changes in both Flora and Fauna. Urban and peri-urban fast growth, establishment of new human settlements, exploitation of timber for infrastructure etc. have had their negative

tolls in major losses in wild animals for hunting and medicinal plants for Herbal Medicine.

Urbanization and Creation of new Human Settlements as a result of the exodus of migrants from outside the country and displaced indigenous people running away from insecurity in the Sahel Zone; also there are indigenous people from rural areas who are escaping from dune sands that have destroyed their homes put untold stresses on the lands, living resources and urban centres in quest for earth resources to subsist/live. Urbanization is accompanied by quasi-Industrial growth that generates many poorly-disposed solid/liquid/gaseous waste products. These introduce severe pollution and contamination products into the environment which exacerbate the incidences of Climate Change and Biodiversity Change with their attendant environmental damages. While the Developed Economies are working very hard to curtail their excesses in generating agents of pollution and contamination in their environments, Developing Economies are doing the opposite; refusing to learn from the problems/lessons of the other thereby and consequently destroying their virgin atmosphere, humans, animals, plants, lands, waters and other elements of their environments.

There are many large and small Dams, captured artificial water reservoirs and almost intense mining of shallow water table aquifers in parts of northern Nigeria. These are used for a variety of purposes namely irrigation/shadof Agriculture, electricity/energy generation, fisheries, potable water supply etc. As a result, a lot of water is lost from Total Environment through many pathways namely Irrigation, Evaporation, Evapotranspiration, Siltation from sandstorms, Human and Animal Consumption etc. Many streams have been lost through water loss and drying up while some Lakes and Rivers have suffered from loss of water volume and fall in water level and so also are the shallow watertable aquifers.¹⁰ The great Lake Chad of inland water drainage in the desertifying environment of the Sahel Zone that is bounded by countries of Nigeria, Chad, Cameroon, Central African Republic and Niger has lost about 90% of its surface water volume leaving contested islands by Riparian partners-countries on Lake lands. Some of the rivers that recharge the lake are dammed downstream of the Lake such that much water does not flow into the Lake anymore. This unfortunate heavy water-loss from the Lake has thrown the people and the environment into severe loss of jobs of fishing and huge fish sales and costly insecurity problems for the Riparian communities etc.

Excessive Deforestation for timber/electric poles harvesting and firewood collection, Bush clearing and burning for intensive Agricultural Practices and food production and hunting of animals are commonplace thereby exposing/rendering the lands and the Total Environment open to the vagaries of the hostile/inclement weather.

Desertification and climate change problems and their solutions in Nigeria

Anthropogenic/Human Impacts and eventual Losses have created enormous negative impacts and problems. Large migration of humans, families and animals populations from the Sahel region who are escaping from the vagaries of the Sahara Desert climate and insecurity has put a lot of negative stresses and pressures on the Nigerian environment. These adversely-affect and exacerbate the already existing scarce human and material resources of lands, vegetation, water, foods etc. Enough efforts should be put in place to curtail these.

Uncontrolled Harvesting of vegetation for timber and firewood and bush burning/clearing for Agriculture and hunting for animals/game

exacerbate the incidence of Deforestation and adverse Climate and Biodiversity Changes which all disturb the Balance of Green House Gases in the Atmospheric Environment; and these unwholesome activities must be checked.

Industrial activities such as in Cement Factories in parts of Nigeria and refining/processing in petroliferous industries in oil and natural gas particularly in the oil and gas rich Niger Delta produce high loads of noxious gases and chlorofluorocarbons into the Atmosphere that may affect/upset its Green House Balance and cause increases in temperatures. The anti -Pollution and Gas Flaring Laws should be effectively and fully-enforced.

As the high winds from the Sahara Desert blow down into the Guinea Savannah region of Nigeria thereby introducing its high temperatures into the threatened parts of the country to change its average annual temperature of about 29°C to high one of about 40°C or more. There was Construction of Greenbelt Vegetation being planned and executed in some areas of northern Nigeria to check the downward movement of the Savannah and eventual encroachment of Desert; this exercise should be continued with greater vigour and success.

The damming of surface waters of rivers, springs, streams and mining of shallow aquifers for irrigation Agriculture and other socioeconomic purposes as well as siltation from desert sand dunes all result in severe waterloss and scarcity. The present existing dams should be reviewed, evaluated and their reservoirs desilted and maintained while care and caution should be taking in the possible execution of more dams in the present and future.

The sand storms disturb land and air transport while deposited dune sands destroy lands, infrastructure of buildings etc., Agricultural farms and water resources. Such diseases/ailments as poverty, hunger blindness, meningitis etc. in humans and some animal diseases are of regular occurrence.

While the above menaces occur predominantly in the Guinea Savannah region of northern Nigeria, but to a lesser degree in the southern areas of Nigeria. Floods, Soil and Gully Erosion/landslides predominantly occur in the south particularly in the southeast area where they have reached disastrous conditions;¹¹ destroying lands, lives and property, animals and plant lives, Agricultural fields, surface water and groundwater resources etc. that are worth billions of Naira/Dollars (Figure 2A & 2B). National and international Aid Agencies are called upon for funding support and assistance.



Figure 2 (A) Gully erosion and (B) flood disasters in the rural and peri-urban environments

The illegal and poorly-controlled migration of aliens across the borders, increased and unmanageable population of humans and animals have precipitated serious insecurity problems nationwide. These immigrants forcefully-construct huts for abodes in forests as they deforest the lands and live there with their families from where they rear and manage their livestock in nearby environment.

Local, national, regional and international governments and Aid Agencies should widely-sponsor/support Research Programmes in

various fields for Environmental Scientists, Engineers, Technologists and Social Scientists from Developing Economies for further understanding of these myriad of environmental problems and establish suitable Control/Containment Measures to check/stop these Environmental Disasters and Destructions that are squarely-facing the human race.

There is a great need to curtail the excessive Anthropogenic/Human Activities that bring into play the destruction of a virgin or distressed environment into incidences of Desertification and Climate Change or exacerbation of either or both. There is also the great need to safeguard the borders to check illegal migration of men and animals into Nigeria. This would also lead to containment of insecurity. The reckless acts of Deforestation should be stopped.

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Conflicts of interest

The authors declare no conflicts of interest.

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