



Deforestation, Desert Encroachment, Climate Change and Agricultural Production in the Sudano-Sahelian Region of Nigeria

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ABSTRACT: This work presents a systematic review of relevant literatures centered on the deforestation, desertification climate change hazards and agriculture related problems caused as a result of these natural and human activities with the hope of understanding the situation for better way out. Findings revealed that desertification affects about one sixth of the world's population, 70% of all dry lands, amounting to 3.6 billion ha, and one quarter of the total land area of the world. The worsening problem of desertification is quite glaring that an estimate of between 50 % and 75 % of Adamawa, Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara states in Nigeria are affected by desertification and are particularly vulnerable to wind erosion due to land clearing for agricultural purposes such as grazing, planting of crops, demand for woods, mining, growth of urbanization and development of infrastructures. Desert encroachment as a degradation of land in arid, semi-arid and sub-humid dry areas caused mainly by climatic changes and human activities; In Nigeria, the dry land parts of the country are more prone to desertification. However, climate change causes uncertainties and variation in the pattern of rainfalls, high temperatures, floods and farmlands destruction, pests and diseases. Leading to irregular and unpredictable rains and increase in sunshine hours, crops and livestock failures as well as food insecurity in general. It was suggested therefore that effective policy and planning measures should be put in place in order to overcome these problems.

DOI: <https://dx.doi.org/10.4314/jasem.v24i1.18>

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Dates: Received: 30 November 2019; Revised: 20 December 2019; Accepted: 23 December 2019

Keywords: Deforestation, desert encroachment, climate change, agriculture

The world's forest environments cover 31 per cent of the Earth's total land area that is more than four billion hectares (Global Perspective, 2011). Forests and trees support sustainable agriculture, stabilize soils and climate, regulate water flows, give shade and shelter, and provide a habitat for pollinators and the natural predators of agricultural pests and contribute to the food security and income for hundreds of millions of people. Yet, agriculture remains the major driver of deforestation globally (FAO, 2010). Deforestation is one of today's pressing worldwide problems relating to human survival, welfare and development (Abdullahi *et al.*, 2017). Deforestation constitutes one of the global development challenges. Specifically, it is the most serious long-term environmental problem facing the world and Nigeria is not an exception (Ogunwale, 2015). Nigeria has the world's highest annual deforestation rate of primary forest at 55.7%. The country is one of the two largest losers of annual natural forests in Africa. At 11.1%, Nigeria's annual deforestation rate of natural forest is the highest in the world and puts it on the pace to lose virtually all its primary forest within few years. It is a major problem occurring in many parts of the country and the most

adversely affected region is the less endowed Northern part of the country (Abdullahi *et al.*, 2017). Climate change is the biggest environmental problem of our time that is threatening the existence of man and the environment. It is a major threat to agricultural system and food security in many countries in sub-Saharan Africa (Nigeria inclusive) is dependent on weather. Climate change has a direct impact on the productivity of physical production factors such as soil's moisture and soil fertility and this affects farming outputs which in turn impacts negatively on food security. In other words, the food security of a nation depends on the stability and sustainability of sufficient food from the agricultural sector (Josephine and Amaechi, 2014).

Deforestation in Nigeria: Deforestation occurs in many ways. Most of the clearing is done for agricultural purposes as grazing cattle, planting crops. Poor farmers chop down a small area (typically a few acres) and burn the tree trunks—a process called Slash and Burn agriculture. Intensive, or modern, agriculture occurs on a much larger scale, sometimes deforesting several square miles at a time. Large cattle pasture often replaces rain forest to grow beef for the world

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market (National Aeronautics and Space Administration [NASA], 1998). Deforestation in Nigeria has been mainly attributed to the grassroots poor people who means of survival were basically embedded in the forests but on the other hands are been denied access to these resources. Other agents of forest depletion are mainly developmental projects oriented. Persistent deforestation is further compounded by the fact that majority of the Nigerian populace lacked in-depth knowledge of the consequences of deforestation (Ogundele et al., 2016). Ojekunle (2014) reported that between 1976/1978 and 1993/1995, the area occupied by natural forest (excluding plantations) shrubs/grassland decreased from 23,439,000 ha, which is 26% of the country to 15,097,000 ha (16.6%). Since 1990, the country has lost some 6.1 million hectares or 35.7 percent of its forest covers. The pressure from available forest resources for housing, farming, mining has contributed to deforestation in Nigeria Ogunwale (2015). It is also reported that the growth of urbanization and the development of infrastructures have greatly influence the depletion of forest resources in Nigeria. Similarly, the creation of forest plantations through artificial regeneration method (afforestation projects) has resulted into large scale destruction of existing forest vegetation (Neha, 2012).

Effects of deforestation in Nigeria: As of 2005, Nigeria has the highest rate of deforestation in the world according to the Food and Agriculture Organization of the United Nations (FAO, 2010). In 2005 12.2%, the equivalent of 11,089,000 hectares (27,400,000 acres) had been forested in Nigeria. Between 1990 and 2000, Nigeria lost an average of 409,700 ha of forest every year equal to an average annual deforestation rate of 2.38%. Between 1990 and 2005, Nigeria lost 35.7% of its forest cover, or around 6,145,000 ha. Deforestation accounts for 87 percent of total carbon emission in Nigeria Air pollution is increased due to the reduction in the number of forests that usually help in absorbing the pollutants in the air. The Guardian, September 10, 2017 reported that deforestation.

Desert encroachment: Desertification as defined by Agenda 21 is the degradation of land in arid, semi-arid and sub-humid dry areas caused mainly by climatic changes and human activities. It is accompanied by a reduction in the natural potentials of the land, and depletion in surface and ground water resources. But above all, it has negative repercussions on the living conditions and the economic development of the people affected by it. Desertification affects about one sixth of the world's population, 70% of all dry lands,

amounting to 3.6 billion hectares, and one quarter of the total land area of the world. In Nigeria the dry land part of the country is more prone to desertification. This zone forms an undulating plain at a general elevation from about 450m to 700m. More than half of the region is covered by ferruginous tropical soils which are highly weathered and markedly laterite. The worsening problem of desertification is quite glaring that an estimate of between 50 % and 75 % of Adamawa, Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe and Zamfara states in Nigeria are affected by desertification and are particularly vulnerable to wind erosion. These states, with a population of about 50 million people, account for about 43 % of the country's total land area. With the country losing over 350,000 hectares of land yearly to desertification, it could not afford to watch while arable land is being lost to desert encroachment. The effect of the advancing Sahara Desert is more directly felt in the extreme northern parts of Nigeria. This portion of the country extends from about latitude 12°N to the boundary of the Republic of Niger. The area already exposed to the effects of desertification in Nigeria is estimated at about 326,000 square kilometers. This semi-arid zone cuts across Sokoto, Kebbi, Zamfara, Kano, Jigawa, Borno, Yobe, Katsina, Gombe, Adamawa and Bauchi states (Medugu, 2009). The region north of latitude 10°N is generally regarded as the most desertification prone areas often been described as desertification frontline areas (Table 1) with states such as Adamawa, Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe and Zamfara (Figure 1).

In 2012, Nigeria Federal Ministry of Environment (FME), reported that the visible signs of desertification in the sub-region includes the gradual shift in vegetation from grasses, bushes and dotted trees to expansive areas of desert-like sand. Between the period of 1976/78 and 1993 and 1995, sand dunes increased by approximately 17 % from 820 to 4,830 km² (FME, 2012).

Some villages and major access roads have been buried under sand dunes in the extreme northern parts of Katsina, Sokoto, Jigawa, Borno and Yobe states. In addition, many rivers and lakes have silted, leading to rapid drying up of water bodies after the rains. A typical example is the case of the receding Lake Chad (LCBC) (FME, 2012). Gully erosion, that hitherto was not a major threat, increased, threatening about 18,400 km² (compared to only 122 km² in 1976/78) (FME, 2012).

Table 1: Desertification frontline areas of Nigeria

Areas	Land area		Population		Desertification
	(Km ²)	% of Nigeria	Number	Density (km ²)	
Sokoto	27,825	3.06	3,702,676	133	Severe
Zamfara	37,931	4.17	3,278,873	86	Severe
Katsina	23,561	2.59	5,801,584	246	Severe
Jigawa	23,287	2.56	4,361,002	187	Severe
Kano	20,280	2.23	9,401,286	464	Moderate
Kebbi	36,985	4.06	3,256,541	88	Severe
Kaduna	42,481	4.67	6,113,503	144	Moderate
Borno	72,609	7.98	4,171,104	57	Severe
Yobe	46,609	5.12	2,321,339	50	Severe
Bauchi	41,119	4.52	4,653,066	113	Moderate
Gombe	17,100	1.88	2,365,040	138	Moderate
Adamawa	38,700	4.25	3,178,950	82	Moderate
Taraba	56,282	6.19	2,294,800	41	Moderate
Niger	68,925	7.58	3,954,772	57	Moderate
Plateau	27,147	2.98	3,206,531	118	Moderate
Total	580,841	63.83	62,061,067	107	

Source: Olagunju (2015)

*Moderate: 26 to 50% of plant community consists of climax species, or 25 to 75% of original topsoil lost, or soil salinity has reduced crop yields 10 to 50%. *Severe: 10 to 25% of plant community consists of climax species, or erosion has removed all or practically all of the topsoil, or salinity controllable by drainage and leaching has reduced crop yield by more than 50%.

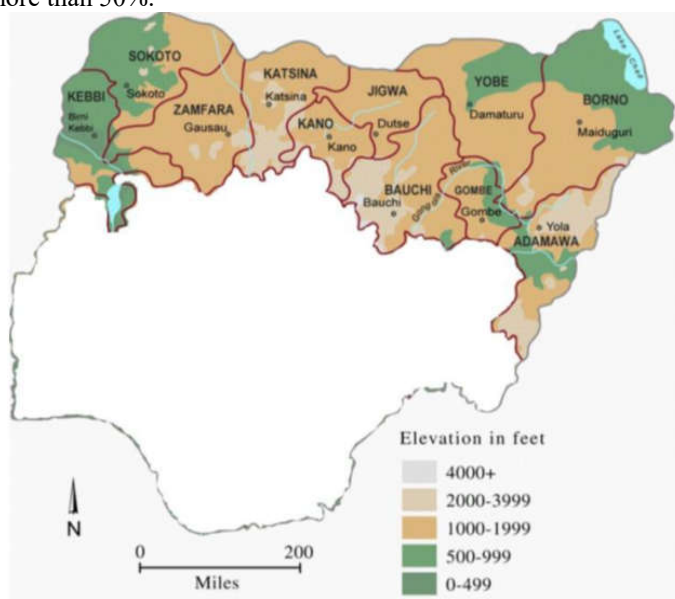


Fig. 1: Nigeria desertification prone frontline states. Source: Federal Ministry of Environment (2012)

Effects of Desert Encouragement on Climatic Variable: Climatic variability is a major driver of many environmental degradation phenomena. Alteration of climatic conditions leads to naturally occurring phenomena of drought and desertification (Olagunju, 2015). There has been increasing level of greenhouse gases causing global warming which in turn increase the variability of climate conditions such decrease in the amount of rainfall in dry lands, high temperature, low rainfall, drought and poor growth of vegetation (Onyeausi and Onimisi, 2015). In northern Nigeria, the positive effects of climatic variables have led to environmental imbalance and the gradual disruption of the natural balance of water and

nutrient for crops cultivation. The soil is so hard (red ferralite) that rainfall hardly seep into the ground, instead it simply flows across the surface. The implication of this is the traditional and systematic use of mechanize-irrigation system and the use of fertilizer applications to revamp the soil nutrient for agricultural purpose. In south Nigeria, the differential in soil type (hydro-morphic and juvenile) and climatic patterns have led to variance in crops production. In addition, the positives variables have led to the ease production of cereals crops and animal husbandry is the north and more roots and tuber crops to the south and middle belt (Agbebaku, 2015).

Effects of deforestation and climate Change on Agricultural Production: The major contribution to the decline has been linked with the negative effects of climate change on crop production in Sub-Saharan Africa (SSA) (Okunola and Ikuomola, 2010). Higher temperatures, longer droughts and increasingly frequent and violent storms are predicted to exacerbate the current challenges faced by agricultural productions system in Nigeria (Okunola and Ikuomola, 2010). Deforestation increases the amount of carbon dioxide (CO₂) and other trace gases in the atmosphere, (NASA, 1998). Deforestation, partly resulting from unsustainable agricultural practices and fuel wood exploitation are exacerbating problems of environmental degradation especially desertification and soil erosion and loss of biodiversity in the more humid guinea Savanna and rain forest regions (Aliyu *et al.*, 2014). Agricultural sustainability in northern Nigeria is majorly by irrigation system which again predisposes such inland areas to saline soils and reduced crop productivity if not properly managed and at least 50,000 farmers in about 100 villages in Yobe state were at risk of abandoning farming due to reduced agricultural output caused by dunes covering a large expanse of their farmlands (Olagunju, 2015). Effects of changes in climate on agriculture tend to be gradual until a threshold is reached, (Brown *et al.*, 2015). For example, at increasingly high temperatures, plants may continue to grow at a reduced pace until a particular temperature is reached (with the precise temperature specific to the crop type and variety). At the point that the plant ceases to grow, it has reached a threshold temperature (Brown *et al.*, 2015).

Food Insecurity and Social Upheavals: Despite the numerous efforts made by the present administration lead by Mohammad Buhari to boost food production, availability and accessibility by a common through various program and policies in the country still the problem of food insecurity remain high, this is could be attributed climate variability and change , current economic recession leading to abject poverty poor are facing, inflation of foodstuff, farmers – herders conflict both in the country’s North and South, Boko Harm, agitators such as IPOB, insurgencies, poor handling of agricultural policies/program in the country among others. Food is a basic necessity of life, this is due to the fact that it is a basic means of sustenance also an adequate food intake, in terms of quality and quantity, is a key to a healthy and productive life. According to Eme *et al.* (2014), food security is of three folds, these are food availability, food accessibility and food affordability. Food availability for farming households means ensuring sufficient food for the households through production. However, it should be noted that simply making food

available is not enough; one must also be able to purchase it, especially the low-income households (Eme *et al.*, 2014). Food insecurity is the absence of food security. It exists over different time horizons and affects people through both under- and overconsumption. Much of the scientific literature to date addresses the former issue, though the latter is now receiving more attention (Brown *et al.*, 2015). Alternatively, households that face unexpected or short-term food deficits experience “transient food insecurity,” often the result of reductions in food production, lack of imports, higher prices, or climatic events (Brown *et al.*, 2015). Food insecurity has emerged as a major problem facing developing countries. Despite a reduction in the global prevalence of malnutrition from 20 percent in 1990–92 to 16 percent in 2010, an estimate of 795 million people in the world still does not have enough food to lead a healthy active life. Of these people, 12.9% lives in developing countries with vast majority in sub-Saharan Africa, including Nigeria. The level of poverty in Nigeria was reported to increase from 27.2% in the 1980’s to 65.6% in 1996. Although, this reduced to 54.4% in 2004, about 6.4% of the populations were estimated to be undernourished (Francis *et al.*, 2016). Food insecurity is the result of a confluence of factors. The raging conflicts in Africa and drought in parts of southern Africa alone need not cause food insecurity. Food security, by definition, is not simply about availability of food, it also entails accessibility, that is, the ability of individuals or a nation to acquire food on a sustainable basis. Food security is also about the reliability and distribution of food. The former relates to utilization and consumption of safe and nutritious food, while the latter relates to the equitable provision of food to points of demand at the right time and place (Vahyala *et al.*, 2016).

Causes of food insecurity: Today, social upheavals such as agitators, desertification, climate variability and change, economic instability, low salaries and wages, ethno – religious crises, natural calamities such as flood, violent wind storm, dry spell and early cessation seems to be the causes of food insecurity. Food Insecurity: Implications for Nigeria and the World at Large’ came up with six causes of food insecurity. These includes Poverty, rapid growing population, fluctuations in the world commodity price, natural disaster, discovery of oils wells that led to the neglect of agricultural sector, indiscriminate use of chemicals, violent, political and ethnic crisis and climate change.

Poverty: this has been suggested to as the leading root cause of chronic inadequate access to sufficient food.

Rapid growing population: this is another root cause of food insecurity, undernourishment and poverty in Nigeria, as the Nigerian economy seems to be an example of what the Rev. Thomas Malthus was predicting long ago, that population is growing at a geometric rate while food production is growing at an arithmetic rate.

Fluctuations in world commodity prices: this happens in response to the trade, fiscal and monetary policies of large exporting and importing countries.

Natural disasters: this includes drought, floods and climate change that affect agricultural produce.

Discovery of oil that led to the neglect of the agricultural sector: this is another cause of food insecurity in Nigeria.

Other causes of food insecurity in Nigeria include Indiscriminate use of chemicals such as herbicides, pesticides, etc.

Violent political and ethnic crisis

Climate change.

An upheaval as defined by the Collins online dictionary is simply referred to as a big change which causes a lot of trouble, confusion, and worry. Social upheavals as defined by Merriam Webster (online dictionary) simply refers to extreme agitation or disorder or a major change or period of change that causes a lot of conflict, confusion, anger, etc. A free dictionary considers Social upheavals as a sudden, violent disruption or upset. In line with the above definition one can simply consider the activities of Fulani herdsmen, IPOB, Niger Delta Militia forces, Boko Haram among others as examples of social upheavals in Nigeria.

Growing desertification and violence in Nigeria are forcing thousands of Muslim herdsmen to move south, leading to clashes with Christian crop farmers. Residents and activists report that hundreds have been killed. Scarcity of fertile land and violence at the hands of Boko Haram jihadists in the north of Nigeria are driving thousands of people southwards, dividing the country down ethnic and religious lines. Thousands of people from the roaming Fulani ethnic group are reported to have fled south this year, running up against Christian crop farmers, who accuse the Muslim herdsmen of violence against villagers. The threat of desert encroachment and desertification are assuming frightening dimensions especially as it affects the nation's arable land mass. This has become a source of threat to food production; it is equally believed that the hostile impact of climate change in Northern Nigeria poses a serious threat to national security and poverty alleviation strategies in the country as those

most affected are the most vulnerable in the security that dwell in the villages ravaged by this scourge (Vanguard, 2010).

Conclusion: In conclusion, deforestation is one of the most serious, and long-term environmental challenges facing the world at large in particular (Nigeria); high demand of land by people to boost agriculture, urban expansion, timber cultivation, firewood collections were among the major causes. In Nigeria, the areas most extremely affected is estimated at 326,000 square kilometers across Sokoto, Kebbi, Zamfara, Kano, Jigawa, Borno, Yobe, Katsina, Gombe, Adamawa and Bauchi states.

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