

PERSPECTIVES IN REGIONAL DEVELOPMENT IN NIGERIA.

A Festschrift In Honour of PROFESSOR ADEBISI FUNSHO ADEDAYO

EDITED BY:

Raphael Abiodun Olawepo, Ph.D
Lanre Tajudeen Ajibade, Ph.D
Ifatokun Paul Ifabiyi, Ph.D

Table of Contents

Climate and Water Resources

Perception and Adaptation to Desertification: Local Insight Towards Resilience Building of the Vulnerable Households in Katsina State, Nigeria- Yahaya, O. Y. and Malik, N.A	1
Climate Variability And Potential Wind Energy Generation In Sudano-Sahelian Region Of Nigeria- Adeniyi, Adedapo.....	15
The Phenomenon of Climate Change: Evidences and Implication for Food Security in Nigeria.Ifabiyl I. P.; B.A. Usman and Falilat Onundi-Lawal	29
Assessment of the Effects of Variation of Climate on Water Availability and Food Security in Northern Nigeria – A Review – Olaitan Razaq Abolaji and (Mrs.) Olusola O. Adetoro	43
Water Resources Development: An Overview of Nigeria's Surface and Groundwater Resources Challenges: Ekpeni, N. M. and Ayeni, A. O.	56
Reflections on Off-Grid Hydrokinetic Energy Potential and Rural Development in Nigeria- Salau Wahab ¹ , Ifatokun Paul Ifabiyl	67
Impact OfClimate Variability on The Price Of Staple Food In Major Markets In Ilorin, Kwara State, Nigeria. - K. O. Laro, E.A. Makinde, E. E. Ogbenjuwa & M.O. Owoseni	76
Statistical Analysis Of Temperature Pattern In Abeokuta South Local Government area, Nigeria: Adeleke, Elisha Ademola, Habib, Ademola And Adebanjo, Oladimeji Peter	86
Climate Change and Disaster Management In Nigeria: Issues And Challenges- AKPAN, Godwin Peter	101
Population Studies	
Population and Governance in Nigeria; Its Implications on Development: Fashagba, I	124
Spatial Distribution of Public Healthcare Facilities in Ilorin East, Kwara State: Ajibade, Lanre Tajudeen, Oyeniyl, Solomon Taiwo and Adisa, Mutiu Olayemi	134
Transportation and Communication	
Transport Security Problem: Pattern, Causes, Effects and Remedies to Highway Robbery and Kidnapping in Nigeria: Usman Bolaji Abdulkadir	146
Impact of the Standards of Training, Certification and Watch Seafarers (STCW) 78 Convention, As Amended, On Nigerian Maritime Education And Training (MET)	

Institutions	169
Effects of Market Locations on Traffic Flow in Metropolitan Lagos, Nigeria: Olawepo R.A., Asaju J.A., and Ojo T.K.	183
Pollution Waste and Management	
Analysis of Atmospheric Corrosion Potential of The Marine Environment Of Calabar Port, Cross River State, Nigeria- Evans, U. F and Esin, J. O	195
Pollution And Management: A Review Of Types, Causes And Management Strategies: Ogunbiyi T. F., Ayeni A. O. And Taiwo J.T.	208
Trace Elements In Soil Of Obajana Mining Site, Kogi State, Nigeria- Alemonu S.O.	219
Settlement Studies	
Making Cities Function Through Capacity Building In Urban Environmental Management for Sustainable Urban Development- Afolayan, G. P	232
Analysis Of Socio-Economic Development Differentials In Kogi State, Nigeria- Balogun, G. F, Adefila, J. O, Yusuf, R. O. & I. J. Musa	240
Perspectives On Urban-Rural Migration In Nigeria: Implications On Socio-Economic Development Of The Rural Landscape- Olawepo, R. A.	258
Settlements' Ranking and Infrastructure Provision in Niger State, Nigeria- Sulyman, A. O.	269
Theoretical Issues	
The Application of Spatial Analysis Approach for the Siting Of MSW Landfills- Ayo Babalola	287
Application Of Multi-Criteria Decision Model and GIS for Criterio Weight Estimation-Ayo Babalola	295
Nigeria: Imperative Of Spatial Database In Achieving Intelligence-Led Policing In Nigeria: A Case Study Of Ilorin Metropolis: Ogunfolaji, D. & Orire I. O. (Ph.D.) ... Estimation	306

CHAPTER THREE

The Phenomenon of Climate Change: Evidences and Implication for Food Security in Nigeria.

By

I. P. Ifabiyi; B.A. Usman and Falilat Onundi-Lawal

Department of Geography and Environmental Management, University of Ilorin, Ilorin.

Abstract

Climate change refers to a new mean climatic state, which takes place over a period of at least 150 years. Evidences from annual temperature record through the Hockey Stick Graph point to an increasing temperature trend across the world in the last 1000 years. This increase has been sharp since 1900. This paper examines the phenomenon of climate change, its causes, evidences and consequences on agricultural production in Nigeria. Climate change is caused by astronomical, extraterrestrial, terrestrial and human factors. The geographical location of Nigeria predisposes her to climate change. The three parts of Nigeria that have felt the impacts of climate change and climate variability more than others are: coastal Nigeria, Niger delta, and the sudano-sahelian zone. Evidences of climate change abound in Nigeria. Nigeria possesses a high potential for agricultural production. These potential are bedeviled by various challenges, many of which are either climate change induced or are directly or indirectly linked to climate. This paper discuss the potential of Nigeria at food adequacy; it examines the challenges to food security and the way forward. This paper concludes that despite the dimensions of climate change, Nigeria has the endowment for food adequacy provided there is a sound environment-related food policy and necessary political will.

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC, 2001) defines climate change as, a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (Ayoade, 2005). Climate change is not climate variability. Climate variability emphasizes the dynamic nature of climate such as climatic trends, climatic cycles, and climatic fluctuations,

especially over relatively short period (30 years). It is a temporary deviation from the normal climatic state over a relatively short period. Climate change or change in climate refers to a new mean climatic state. It normally takes place over a period of at least 150 years

Since 1900, global temperatures have risen by 0.7 degrees Celsius and it has continued to rise at an estimated rate of 0.2 degrees per decade. From a pre-industrial concentration of 280 ppm, the current stock of greenhouse gases in the atmosphere is 430 ppm, and is increasing by approximately 2.5 ppm per year.

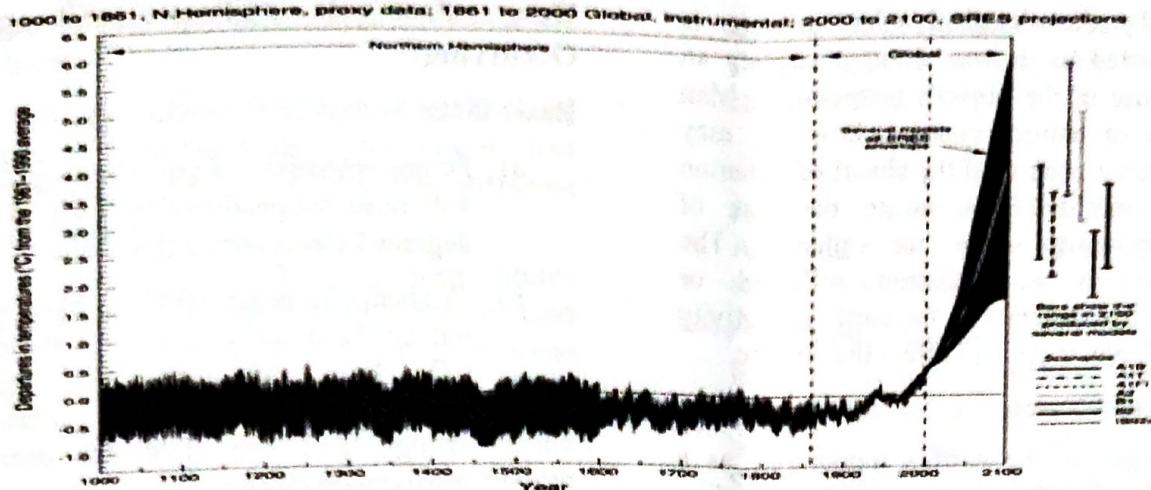


Figure 1: Hockey Stick Graph

The effect of climate change on temperature is demonstrated by the "Hockey Stick" graph (Figure 1). The graph, which measures temperature variation over the last 1,000 years, indicates a sharp rise in temperature in the post 1900 period.

Causes of Climate Change

Climate change can be caused as a result of the following:

a) Astronomical causes

- i. Changes in the eccentricity of the earth orbit about the sun: Eccentricity is, simply, the shape of the Earth's orbit around the Sun. This constantly fluctuating, orbital shape ranges between more and less elliptical (0 to 5% ellipticity) on a cycle of about 100,000 years. These oscillations, from more elliptic to less elliptic, are of prime importance to glaciation in that it alters the distance from the Earth to the Sun, thus changing the distance the sun's short wave radiation must travel to reach Earth, subsequently reducing or increasing the amount of radiation received at the Earth's surface in different seasons. The continuous alterations of the amount of received solar energy around the globe result in prominent changes in the earth's climate and glacial regimes.

- ii. Changes in the precession of the equinoxes: Precession is a change in the orientation of the rotational axis of a rotating body. It can be defined as a change in direction of the rotation axis. The gravitational force between the Sun and moon induces the precession in the Earth's orbit, which is the major cause of the widely known climate oscillation of Earth that has a period of 19,000 to 23,000 years. The changes in the parameters (e.g. orbital inclination, the angle between Earth's rotation axis and revolution orbit) of the orbit of Earth is an important field in the study of Ice Age in the theoretical astronomy.

- iii. Changes of the obliquity of the plane of ecliptic. The ecliptic is the apparent path of the Sun on the celestial sphere. The ecliptic is actually the apparent path of the Sun throughout the course of a year. Obliquity of the ecliptic is a name used by astronomers for the inclination of Earth's equator to the ecliptic,

b) Extraterrestrial causes

Variation in the amount of incident solar radiation: Variation in the absorption of solar radiation outside the earth's atmosphere. The object or surface that solar radiation strikes may be a planet, a terrestrial object inside the atmosphere of a planet, or an object exposed to solar rays outside of an atmosphere, such as spacecraft. Some of the radiation will be absorbed and the remainder reflected.

Usually the absorbed solar radiation is converted to thermal energy, causing an increase in the object's temperature. Man made or natural systems, however, may convert a portion of the absorbed radiation into another form, as in the case of photovoltaic cells or plants. The proportion of radiation reflected or absorbed depends on the earth reflectivity or albedo; these will affect the climate.

Terrestrial Causes

- i Changes in the earth's topography as a result of lithosphere motions including seafloor spreading and continental drift, continental uplift, and mountain- building.
- ii Changes in atmospheric chemistry due to extrusive volcanic eruptions, which contribute to atmospheric aerosols. This has capacity to absorb, reflects and radiates energy.
- iii Changes in snow and ice cover of the earth surface. This will affect albedo capacity of the earth.
- iv Changes in distribution of lands and water surfaces. Increase in sizes of water bodies affects energy balance of the earth and climate change.

d. Causes Due To Human Activities.

- i Industrial and agricultural practices including animal husbandry.
- ii Forest and grassland clearing and burning.
- iii Lumbering. Fuel wood and charcoal production.
- iv Oil extraction, burning of fossil, production of cement and all forms of quarrying and mining.

Models that have been used to identify the indices of climate change to comprise: surface albedo, annual mean temperature, mean temperature during growing season, day/night temperature range, extreme seasonal temperature, onset and cessation of the rains, rainfall seasonality and reliability of the mean rainfall regime, duration of the growing season and annual precipitation rates and shifts in rainfall belts

How Fast Is Climate Change Occurring?

Basic facts

- a) Future emissions of greenhouse gases will raise temperatures by 1.4 to 5.8 degrees Celsius during this century.
- b) A change in ocean acidity is likely to reduce the ocean's capacity to absorb CO₂ from the atmosphere, thus compounding the effects of climate change, and will affect the entire marine food chain.
- c) Large-scale, irreversible system disruption and the destabilization of the Antarctic ice sheets are serious risks: changes to polar ice, glaciers and rainfall regimes have already occurred.

The realities:

- i Hurricane Mitch; which destroyed 1/4 of Honduras' GDP, and set back development by 20 years
- ii 1998 flood in Bangladesh: losses of \$3 billion, equivalent to 8 percent of country's GDP
- iii 1991/92 drought in Africa contracted real income by amounts ranging from 2-8 percent
- iv According to UNEP, economic losses due to natural disasters are doubling every 10 years

Consequences of Climate Change

The Stockholm Environment Institute estimates (moderate estimate) that by 2025 the proportion of the world's population living in countries of significant water stress will increase from 34 percent (in 1995) to 63 percent. In Africa's large catchment basins of Niger, Lake Chad and Senegal, the total available water has already decreased by 40-60 percent, and desertification has been aggravated.

Major consequences will be felt in the following sectors:

- a) *Water*: Rising global temperatures will lead to an intensification of the hydrological and water

rainy seasons, and subsequently (Floods and drought).

b) *Agriculture*: Declining crop yields are likely to leave hundreds of millions without the ability to produce or purchase sufficient food supplies.

c) *Ecosystems*: Changing temperatures will cause ecosystems to shift – forests, land types and plant species will dieback in some areas as temperatures rise.

d) *Health*: Higher temperatures expand the range of some dangerous vector-borne diseases, such as malaria and water borne diseases, which already kills one million people annually, most of whom are children in the developing world.

e) *Coastlines*: Melting ice and thermal expansion of oceans are the key factors driving sea level rise to greater erosion and flooding pressures, rising sea levels will also lead to salt water contamination of groundwater

f) *Melting glaciers* in the Arctic, where the effects of climate change is being felt more quickly and severely than anywhere else on the planet. Arctic temperature increased by about 5 degrees during the 20th Century (10 times faster than the global average) leading to building collapse in Russia.

a. *Changes in the quantity, quality and accessibility of water supplies* : Many of the world's countries already struggle under existing water stress from pressures such as irrigation demands, industrial pollution and water borne sewerage, this will increase.

b. Changes in the amounts or patterns of precipitation will change the route/residence time of water in the watershed, thereby affecting its quality. dissolved salts, raise water tables salt water intrusion in coastal groundwater supplies.

c. *Accessibility of water*: competition for dwindling resources; in the event of decreasing water tables as a result of climate change, industrial needs will be forced to compete with agricultural and domestic water supply sources, and could lead to conflict.

j. *Natural disasters*: The increase in natural disasters, primarily floods and droughts, will further exacerbate issues

over water availability and water quality. Of particular concern are increased risks from flooding.

Impacts on agriculture and food security: Agriculture will be one of the hardest-hit sectors by climate change,

i Warmer temperatures will lead to increased water evaporation, intensifying the need for irrigation precisely as water becomes even less available. Shiklomonov (2003) predicts that water withdrawal for agriculture will rise from 2 600 km³ in 2000 to 3 200 km³ by 2025.

ii In sub-Saharan Africa, for example, where up to 90 percent of agriculture is rain fed, the sector accounts for 70 percent of employment and 35 percent of GNP, and changes in rainfall will increase unemployment.

iii The International Rice Research Institute, for example, estimates that for every degree Celsius of night time temperature increase, there is at least a 10 percent decrease in rice production for the African region.

iv Some areas will benefit from longer growing seasons (such as northern Asia), changes in water regimes will render other areas unsuitable for traditionally-grown products,

v Some areas will become susceptible to new forms of crop and livestock diseases. In regions already affected by food shortage and famine, this could cause further disruptions in food supply.

vi Higher inland water temperature will impact negatively or positively on fish stocks in diverse ways. Increased stratification of water in lakes will lead to reduction in productivity and reduction in fish population.

vii Changes in precipitation quantity, location and timing that alter water availability will collectively alter abundance and composition of aquaculture.

viii Changes in lake water level will alter spawning and propagation of endemic fish species.

ix Lower water level will lead to low water quality due to reduced productivity capacity of photosynthetic balance.

x Ocean and freshwater changes as a result of projected climate changes will reduce performance leading to starvation or increased predation.

xi The biology and ecology of fish in large rivers are strongly linked to the hydrological regime in the main channel and the regular flooding of their adjacent floodplains.

xii The absolute and relative abundance and biomass of species of fish inhabiting large rivers are predicted to change in response to both natural intra-annual variations in flooding regimes as well as long-term climatic shifts.

xiii Spawning in many tropical fishes is connected to rising water levels (Hori, 2000).

k. *Health impacts:* Currently, more than 3 million people die each year from avoidable water-related diseases, namely:

- i Water-borne diseases: during floods and period of water scarcity
- ii Water-washed diseases: those resulting from inadequate personal hygiene
- iii Water-based diseases: those caused by parasites that use intermediate hosts living in/near water (e.g. guinea worm).
- iv Water-related diseases: borne by insect vectors that have habitats in/near water (such as malaria).
- v Further indirect health challenges include malnutrition arising from agricultural disruption and food insecurity.

l. *Decreases in economic activity:* Water plays a key role in economic growth and development.

- i Women and children, to spend increased time gathering water, detracting from employment and educational opportunities.
- ii A greater proportion of household income may need to be spent on water delivered from private sources, such as

tankers, to supplement lack of water locally.

iii Further, water is a key input to industrial uses.

m. Conflict over water resources: Changes in accessibility to water have the potential to increase conflict, as the competing demands of private, agricultural, and industrial uses for water put pressure on resources. This may exacerbate conflict in existing water stressed areas competing locally for access to natural springs and rivers, as well as lead to conflicts on a larger international trans-boundary scale. This is already being experienced in Nigeria

Climate Change in Nigeria.

Nigeria is vulnerable to climate change in view of its geographical location to the Atlantic Ocean (Olaniran, 2002; Ayoade, 2003; Odjugo, 2007). Three major areas of Nigeria are mostly affected by climate change: coastal areas, Niger delta and Sudano-sahelian zone of Nigeria. Several ecological challenges are already been linked with climate change in Nigeria (Adebayo, 1998; Odjugo, 2010 and Ikhuoria, 2003; West 2003; Chindu and Nyelong, 2005; Odjugo 2005; Adefolalu, et al 2007).

Studies of climate change in Nigeria can be broadly classified into 3: studies of the thermal characteristics (Bello and Isiguiso, 1999; Adefolalu, 2005). Studies on the moisture characteristics (Adefolalu, 1986; Oguntinyinbo, 1986; Oladipo, 1990; Olaniran, 1988; Bello, 1998; Olaniran, 2002). Lastly are studies of the aerodynamic characteristics of climate in Nigeria (Adebayo, 1980; Omotosho, 1990).

Evidences of climate change abound in Nigeria, these include the following scenarios:

- a) Heavy precipitation that is associated with the on-going tropical sea surface temperature change. where 40% of Nigeria was recently affected by devastating flood

- b) Most studies on climate change in Nigeria are often based on short term and medium term time frame. Most recently, Odjugo (2010) used a 105 year data to assess temperature trend in Nigeria, he reported a steady increase in air temperature since the 1970s and he discovered that in 63% of the period of study (1971-2005) temperature were above normal.
- c) Lake Chad is now 5% of its former size of 22,902 km² 35 years ago (Fig. 1). This has greatly affected millions of fishermen who depend on the lake for food and income. Odjugo (2007) confirms that many rivers have dried up or becoming more seasonally navigable.
- d) The current global estimate of sea level rise is 0.2m and it is projected to increase to 1m by the year 2100 (Haengeveld *et al*, 2005). The implication is that the present 0.2m sea level rise has inundated 3400 km² of the coastal region of Nigeria, and if

the sea level rise attains the projected 1m on or before 2100 then 18,400km² of the coastal areas may be inundated (NEST,2003). Coastal settlements like Bonny, Forcados, Lagos, Port Harcourt, Warri and Calabar among others are less than 10m above sea-level would be seriously threatened by a metre rise of sea level.

- e) The incursion due to sea-level rise means invasion and destruction of mangrove ecosystems, coastal wetlands and coastal beaches. The communities facing this environmental problems includes Nembe, Eket and other fishing settlements in Bayelsa, Delta, Cross River, Rivers and Lagos
- f) Odjugo (2010) confirmed that the rate of temperature increase is higher in semi-arid region than what obtains in the coastal areas of Nigeria, for the 105 years of his study (Fig. 3a &b)

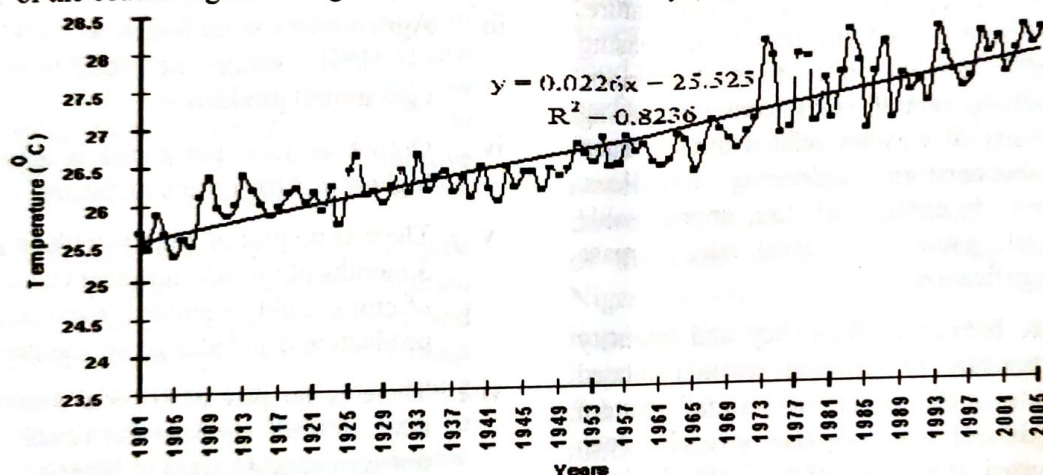


Figure 2 (a): Temperature in Nigeria (Odjugo, 2010)

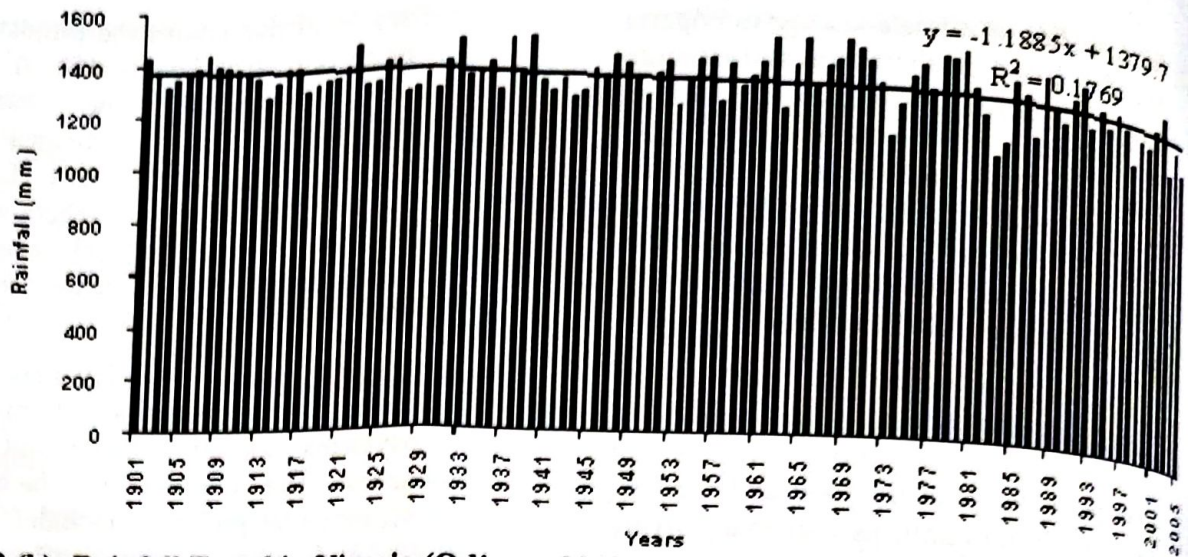


Figure 2 (b): Rainfall Trend in Nigeria (Odjugo, 2010).

- g) Odjugo (2010) reported an average increase of 1.7°C in air temperature for in Nigeria, 1.2°C for Niger delta area and 2°C for Sudan- Sahel zone of Nigeria.
- h) Ahmad and Ahmad (2000), IPCC (2001), NEST (2003), and Hangaveled et al (2005) all reported increasing temperature, increasing evapotranspiration, decreasing rainfall amount in continental interiors, increasing rainfall in the coast, increasing intensity of weather related disaster such as thunderstorm, lightening, landslides, floods, droughts, bush fire, unpredictable rainfall pattern, sea level rise, increase desertification,
- i) Also, Increasing frequency and intensity of unusual or extreme weather related events such as erratic rainfall pattern floods and sea level rise have also been reported (Odjugo, 2005; 2009, Molega, 2006; Nnodu et al; Umoh, 2007).
- j) Political conflicts induced by climate change on water resources have been recorded in Nigeria. between Nigeria and Niger, lake Chad between Cameroun and Nigeria, etc (Niasse,2005)
- Potential of Nigeria for food adequacy**
- Nigeria has every potential not only to feed herself, but to be the food basket of Africa in view of several physical and human ecological indices. Some of these indices include the fact that:
- Nigeria has a land area of 98.3million ha in which 74 million ha is good for farming; but less than half is being explored. Suggesting that Nigeria has lots of untapped arable land.
 - The population involved in farming is (60 – 70%), meaning that the Nigerian agricultural sector has a huge human resource which is largely underutilized
 - Agriculture's contribution to GDP is just (41.50%), suggesting inefficiencies in agricultural production.
 - Output of food per capita is among the highest in Africa south of Sahara.
 - There is no part of Nigeria without at least 3 months of rainfall, meaning that all types of crops could be planted; also that animal production could also go on unhindered.
 - There is no part of Nigeria without less than 18°C of temperature; hence frost is not agricultural hazard in Nigeria.
 - Nigeria has different agro-ecological zones which are favorable to all forms of crops. These agro zones also provides comfortable baseline for agricultural zonation and crop specialization which encourages better yield per hectare in different eco-zones..
 - Nigeria is rich in both surface and groundwater resources and it has high potential for rainfall harvesting; hence, irrigation agriculture for dry season farming could be done easily in any part of Nigeria.
 - The soils in Nigeria have high rate of organic productivity, hence they have high rate of organic turnover and relatively high soil fertility.

- x It has abundant and teeming youth population who are mostly unemployed and unemployable in the highly skilled profession. Population of Nigeria is about 70% youthful. Hence, in the context of national planning and regional development, the Nigerian agricultural sector could be used to arrest the massive youth unemployment problem in Nigeria,
- xi It has large market for food crops with a population forming about 70% of the total population almost 170 million and surrounded by many countries with marginal agro- climate, especially the various sahelian nations of west and north Africa.
- xii Crops, livestock and fish have potentials for providing food and nutrition as protein intake of Nigerian are till low..
- xiii Nigeria has high agricultural biodiversity, it currently is home to 62 varieties of rice,
- xiv Food in-take and nutritional well-being of many households are of relatively low quality; and are affected by their low economic status. This suggest that, a slight increase in income will improve purchasing power of people.
- xv The vulnerable and food insecure include the poor, smallholder farmers, children, pregnant women, lactating mothers and the elderly. This suggest a need to develop agriculture for purposes of alleviating poverty, meaning that Nigeria need to produce more food for purposes of dietetic intake..
- xvi About 60.8% Nigerians are malnourished.
- xvii Iron deficiency, which affects physical capacity, and in severe cases lead to death and susceptibility to infections. Agriculture in Nigeria, needed to be expanded.
- xviii There is a manifestation of Protein Energy Malnutrition (PEM), which causes growth failure in children, and weight loss in adults;
- xix There is a manifestation of PEM induced infections like measles, diarrhea, whopping cough, tuberculosis, and malaria.

xx There is Vitamin A, deficiency, which assist resistance to infections.

xxi Obesity is on the increase; it affects more of urban dwellers; and results from imbalanced nutrition. It is accompanied by hypertension, diabetes mellitus, and cardiovascular diseases. All these and many more should form an impetus to assist the nation to take agriculture more seriously.

The above issues point to the fact that with the necessary socio economic development the entire Nigerian agriculture will turn around, not only in the area of food-crop production, but also it will become a great employer of labour.

Food security in Nigeria

The Food and Agricultural Organization (FAO) (2002) defines food security as a situation that exist when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life. According to Jerome (2012), Nigeria staple food production is experiencing a downward trend, Nigeria is put at the top of the chart of food importing nations. Nigerians are spending N1bn daily on imported rice and N1.3tn annually on other imported basic items like wheat, sugar and fish. It currently consumed about five million metric tonnes of rice per annum and could increase the rate of consumption to 36 million metric tonnes by 2015. The country ranked the largest importer of frozen fish and the second largest importer of rice, spending about N356bn on two million metric tonnes of milled rice annually. Nigeria is boosting the economy of countries and have the vast agriculture potential to cater for our food needs. The huge sums of money spent on importation could be invested in farming while the government could substitute food importation with domestic food production to create jobs.

According to Abubakar, (2013) despite the much celebrated federal government's

Agricultural Transformation Agenda (ATA), targeted at improving agricultural production and ensuring food security in Nigeria, 2013 mid-term report of the Nigerian Ports Authority indicate that import of agricultural products increased within the period. An online statement made available to Daily Trust by the General Manager of the Nigerian Ports Authority (NPA) Public Affairs department, Captain Iheanacho Ebubeogu, indicates increase in the quantity of food items brought into the country through the

nation's seaports between January and June this year.

The report captioned 'half year 2013 commodity analysis of cargo handled at the Nigerian Ports Authority (excluding crude oil terminal) export cargo, stated that wheat Grain/Offal recorded the highest import in the category of dry bulk cargo with a total of 1,913,511 metric tons in the half year report performance review. Table 3 present a list of Nigerian crops that are already under the threat of climate change.

Table 3: List of Some Endangered and Extinct Crops in Nigeria.

Tree Crops	Food Crops	Vegetables	Seeds And Nuts
1 Iroko	Millet	Mushroom	Bambara Nut,
2 Obeche	Wheat	Varieties Of Vegetables:Shear Nuts	
3 Mahogany	Acha	Ebolo, Odu, Beni-Seed	
4 Bread Fruit	Irish Potatoes	Worowo, Yanrin, Ajefofowo, Elegede, Isapa Palm Kernel	
5	Cocoyam		Groundnuts
6	Bread Fruit		
7	Coffee		

Source: Olaniran, (2002)

Challenges against addressing the problem of Food Security In Nigeria

The challenges of food security in Nigeria are numerous. All these challenges can be linked to issues of climate change; some of these are:

- i *Soil infertility problems which are caused by water and wind erosion.* The problems of agriculture in Nigeria begin with the soil. Most of the farmable land in Nigeria contains soil that is low to medium in productivity.
- ii The main problem that affects soil fertility is soil erosion. Strong winds expose seedlings and crop root systems by blowing away loose, fine grain soil particles. Another effect is the accumulation of soil particles in drifts, which can cover crops. Also, wind erosion changes the texture of the soil.

The particles responsible for water retention and fertility, such as clay, silt, and organic matter are generally lost, leaving behind a sandy soil. Another type of erosion that affects fertility is water erosion. Erosion has given risk to land degradation and poor yield of crops. The menace of soil erosion and soil infertility are widely experienced in Nigeria, they have been intensified by climate change.

- iii *Inadequacy of rain-fed agriculture.* The era in which rainfall was highly relied upon by farmers for sufficient crop production is gone. However, Nigeria still practice rain fed agriculture whereby farmers are at the "mercy of nature" to produce adequate food and the needed raw materials for the few agro allied industries. There is changes in the characteristics of

rainfall occasioned by climate change uncertainties surround the reliabilities of the onset, duration, cessation, total annual amount of rainfall, intensity and its annual distribution across the growing season months. This situation threatens food availability and security.

iv *Non fine-tuning of macroeconomic and agricultural sector policies to meet the need of farmers and investors in agriculture.* The Nigerian agricultural sector is growing at seven to eight percent, this suggests that Nigeria has the ability to assure food security as well as develop a value-chain for exports. This sector in Nigeria needed to be coordinated differently to create jobs and be made attractive to youth, it has to be modernized. Improved technologies in terms of seeds, fertilizers and water management methods have to be introduced. Indeed, the success of any agricultural policy depends on the phenomenon of climate change.

v *Uncontrolled food import including those with local substitutes:* Nigeria has a land area of 98.3million hectares out of which 79 million hectares is suitable for farming but much less than half is being explored. About 60 – 70% of Nigeria's population is engaged in farming while agriculture contributes about 41.5% to GDP. The country's farming production has not kept pace, resulting in major increases of food imports in crops such as soy meal, etc. indeed; climate change is a major cause of this. Nigeria, imports 3 million tons of rice annually, at a cost of close to \$700 million. Also, about 100,000 tons of soya meal valued at over \$50 million is imported to feed livestock. Soy imports have risen almost 10 times in the past 5 years, from around 11,000 tons in 2005. Food import induced by climate change has affected food production.

vi *Lack of External Development Assistance:* Proliferation of donors in recent decades, and fragmentation of aid among an increasing number of countries and projects, has increased calls for coordination. More than 45 countries and 21 multilateral organizations reported providing official development assistance (ODA) in 2010. An estimated 150 countries received this assistance in 2010, with the United States alone providing aid to 139 countries. Many developing countries host officials from dozens of bilateral and multilateral aid agencies each year. This diffuse aid structure, is argued, leads to redundancy, policy incoherence, inefficient use of resources, and unnecessary administrative burdens on host countries

vii *Poor Tools and Farm Machines:* Farmers still rely on the use of tools like hoe, cutlass, rake, etc for their activities, instead of using the mechanized implements. The consequences of this on farmers are: (i) drudgery, (ii) time wasting (iii) short life span (iv) low yield, and (v) low income. However, among the poor farmers mechanization is: (i) very expensive to procure and maintain, (ii) highly technical to use, (iii) cannot be used in small farm holdings, (iv) cannot be used in some soils, (v) cannot be used for some crops like yams. The phenomenon of climate change and its effects on natural disasters such as erosion, sedimentation, flood, drought, and frost have introduced another dimension into agricultural mechanization.

viii *Rural urban migration:* Rural communities share this burden through loss of manpower necessary for agricultural activities and production. The impoverishment of rural areas in Nigeria is partly explainable by out-

migration of able youths in search of employment in cities. Most of the migration is now climate and weather induced, particularly in northern Nigeria. This has led to employment crisis and avoidable importation of agricultural products, which together have over the years had 4 negative net effects on local industries and productions as well as international trade balances.

ix *Storage problems* : Post-harvest losses, due largely to the absence of viable storage and processing facilities, are some of these challenges which have impoverished farmers and dampened their enthusiasm for farming. Many delicious and juicy fruits, vegetables, and Cash-Crops are largely produced in Nigeria; but, large percentage of these often get damaged and wasted before their final consumer. The changing weather and climate has also affected storages of these crops.

x *Others*: in addition to what obtains above, Nigeria is still having several problems such as the problem of illiteracy; farmers are not educated and they find it difficult to operate the machines; Land tenure systems prevent large farm holdings; the soil types do not suit the operational techniques of the machines; no machines has been invented locally to work effectively on the soils; the debris from clearing, stumping and logs pose an obstacle to mechanization; spare parts are not available locally; there is inadequate manpower to service the implements and machines; the nature of land, topography and landscape are not good for mechanization; farmers are too poor to be able to buy the expensive machines. These and many more affects food security in Nigeria.

Way forward

- i *Changes in the seasonal cropping calendar*: The challenges of climate change-related hazards are hitting smallholder farmers hard, and many of them have no access to international climate finance. Hence, losses and damages from extreme weather events keep increasing, as the patterns of droughts, floods and tropical storms are becoming more unpredictable. Also, rural livelihood is undermined by the creeping effects of erosion, land degradation and loss of biodiversity. There is a need for necessary programming instruments to address these emerging problems.
- ii *Adaptation of new crops to changing conditions*: From the climate analyses and vulnerability assessment, the need for adaptation is obvious. Water supply from rain could reduce in many areas as evaporation losses increases and rainfall reduces. In other places, risks of floods are higher as rainfall increases. Furthermore, the vulnerability assessment shows that the country has weak adaptive capacity. For example most farmers become completely helpless if any harvests fail. The Sokoto flood of 2010 which washed away large acreages of farm crops left many local farmers economically devastated as they had no significant alternative sources of livelihood. There is a need for research into crops that will adapted to these scenarios.
- iii *Improved seasonal climate prediction*: Agriculture is the basic activity by which humans live and survive on the earth. The dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create a need for a more articulate climate prediction effort.
- iv *Mitigating the effects of droughts*: The entire semi-arid zone of Nigeria lies approximately between Latitude 10°N and 14°N and is affected by desertification. It has consistently suffered most from all recorded drought episodes in Nigeria's recent history. The situation is being aggravated by the increase in human population, which appears to be stressing

the natural support system. In many areas, sustainable-yield threshold of the vegetation and soils are being breached. Mitigation measures will no doubt assist food security, particularly in this expansive zone.

- v *Improvement on the method of monitoring climate at the micro synoptic scales:* climatic data collected at micro level is important to climate prediction. This allows generation of actual climate and results of predictions made at such levels become more realistic. In Nigeria, the number of meteorological station per unit area is generally unacceptable. This explains the quality of some of our predictions. Improved and reliable micro synoptic data will go a long way in assisting food security.
- vi *Improve water management and irrigation:* Nigeria is rich in water resources, it has extensive mangrove ecosystem, estimated to cover between 500,000 and 885,000 hectares. The major rivers are covers about 10,812,400 hectares, these rivers make up about 11.5% of the total surface area of Nigeria which is estimated to be approximately 94,185,000 hectares. The inland water system includes thirteen lakes and reservoirs with a surface area of between 4,000 hectares and 550,000 hectares with a total surface area of 853,600 hectares which represents about one percent of the total area of Nigeria. But yet water scarcity is experienced in many part of Nigeria, particularly in dry season. A proper management and coordination is required to make water available for irrigation.
- vii *Creation of climate change and food security network in all ecological zones.* This will allow proper coordination of the consequences of climate change on agriculture.
- viii *Data and Information.* Promote greater collaboration in data-collection, monitoring and access to national information. This will facilitate better planning on the part of government.
- ix *Awareness-raising:* there is need to build local understanding on the links between

predicted climate change and the impacts that this will have on water resources and agriculture at a local level.

- x *Household water conservation efforts should be intensified in the following respect:*
 - i Use of contour, gully plugging, and check dams and dykes to catch rainwater and give it time to soak into the ground (reduce runoff), this will lift water tables and made water available of drinking water.
 - ii Rainwater harvesting (i.e. from rooftops) and tanks: to store rain water as an alternative source of drinking water.
 - iii Community ponds: to irrigate surrounding land, provide a water source and options for fish cultivation.
 - iv Alternative cropping patterns: Use of drought resistant crops which require less water input and hence have less impact on water tables.
 - v Raised hand-pumps: to protect drinking water from flood contamination.

Conclusion

Climate change is already with us, it is already established, the evidences abound in Nigeria. It is currently affecting food security. Nigeria is one of the countries that is seriously affected because Nigeria still depend on unprocessed natural resources such as water, crops, soils , etc. the only way out is a multifaceted approach to tackle the impasse. Conclusively, the opinion in this paper is that despite the dimensions of climate change, Nigeria has the endowment for food adequacy provided there is a sound food policy and the necessary political will.

References

- Adebayo, S.I. (1998). Climate change and global warming and high frequency of storm surges along the Atlantic Coast of Nigeria. *Proceedings of Sustain Africa*, 4: 6-8.
- Adebayo, S.I. (1989) Trajectories of advected Saharan dust in Nigeria *Atmospheric Environment*, 23 (7) :1581-1589
- Adebayo, S.I. (1980) Pronounced dust haze spell over Nigeria, 2-11 March 1977.
- Adefolalu, D.O. (1986) Further aspects of sahelian drought as evident from rainfall regime of Nigeria *ARCH MET GEOPH. Biocl. Series B*, 36277-295.
- Adefolalu, D.O. (2005) climate change-Global warming, local warning in Nigeria. NASS Senate 33rd Annual Conference. ABJ- 29pp.
- Adefolalu, D.O.A (2007) Climate change and economic sustainability in Nigeria. *Paper presented at the International conference on climate change, Nnamdi Azikiwe University*,
- Anyadike, R.N.C. (2009) Climate change and sustainable development in Nigeria: Conceptual and empirical issues. Debating Policy Options for National Development; Enugu Forum Policy Paper 10; African Institute for Applied Economics (AIAE); Enugu, Nigeria: 13-18. Available at: <http://www.aiaenigeria.org/Publications/Polycypaper10.pdf> (viewed 13 November 2014). Awka 12-14 June 2007.
- Ayoade JO (2003). Climate Change, Vantage Publishers, Ibadan, pp.45-66
- Bello, N.J (1998) Evidence of climate change based on rainfall records in Nigeria. *Weather* 53 (12) 412-418.
- Bello, N.J and Isiguzo, V.G. (1999) Evaluation of climate-change in some forest ecosystems in Nigeria. *Environmental Analar* (1): 182-191).
- Bello, N.J. (2010) climate change: implications for food production and security in Nigeria. In *Climate Change Impacts and Adaptation: Developmental Issues 1-14 NMets D' ENVIRONS*, Akure, Ondo state Nigeria.
- Chindo A, Nyelong PN (2005) Lake Chad: From Megalake to Minilake *Arid Wetland Bulletin* (6) : 24 - 27.
- Eboh, E. C. (2009) Introduction: Debating Policy Options for National Development; *Enugu Forum Policy Paper* 10. African Institute for Applied Economics (AIAE), Enugu, Nigeria: 9-12. Available at: <http://www.aiaenigeria.org/Publications/Polycypaper10.Pdf> (viewed 14 November 2009).
- Hengeveld H, Whitewood B, Fergusson A (2005). An introduction to climate change: A Canadian perspective. *Environment Canada*, Canada, pp. 7-27.
- Hirji, R. (2001). Water Resources and Environmental Management. *World Bank Environment Strategy Paper* 2 World Bank Washington D.C.
- Hirji, R. (2002). Environmental Sustainability in Water Resources Management in Southern Africa. SARDC. Hits: 256
- Intergovernmental Panel on Climate (IPCC) (2001). The report of working Group I of the Intergovernmental Panel on climate change, survey for policymakers. Intergovernmental Panel on Climate (IPCC), 2007, "Climate change 2007: Synthesis report. Summary for policy makers", available at: <http://www.ipcc-wgl-ucar.edu/wgl/wgl-report.htm>, (accessed 26 October 2009).
- IPCC. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the *Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York,
- Molega AU (2006). Rainfall anomalies in Nigeria. *Journal of Arid Environment*, 5(1): 1-8.

- Mortimore, M. and Adams, W. M. (1999). Working the Sahel. Environment and society in Northern Nigeria. Routledge, London, 226pp.
- Niasse, M. (2011) Access to land and water for the rural poor in a context of growing resource scarcity , conference on new directions for small holder agriculture, 24th to 25th January, 2011, Rome IFAD HQ
- Nigerian Environmental Study/Action Team (NEST) 2003. *Climate Change in Nigeria. A Communication Guide for Reporters and Educators*. Ibadan: NEST pp. 5-16.
- Nnodu VC, Onwuka SV, Okoye CV 2007. Climatic variability and its impact on runoff in South-eastern Nigeria. *Paper presented at the International Conference on Climate Change and Economic Climate Change- Strategies for mitigation and adaptation for Spatial Planners*. Earthscan Publishers NY, USA, 2001: 881 pp.
- Odjugo PAO 2007. The impact of climate change on water resources; global and regional analysis.. *The Indonesian Journal of Geography*, 39: 23-41.
- Odjugo, P.A.O. (2010) Quantifying the Cost of Climate Change Impact in Nigeria: Emphasis on Wind and Rainstorms. *Journal of Human Ecology*, 28(2): 93-101 (2009)
- Oladipo, E.O. (1990) the persistence of wet and dry days during the growing season in northern Nigeria. *Theoretical and Applied Climatology*.
- Olaniran, O.J. (1988) the distribution in space of rain days of different daily amounts in the tropics Nigeria as a case study . *Geoforum*. 19 (4) 507-520.
- Olaniran, O.J. (1988) The July-August rainfall anomaly in Nigeria. *Climatological Bulletin* 22 (2) 26-28.
- Omotosho, J.A. (1990) Contribution of the line squall meso-system to rainfall in West Africa. *Journal of climate*.
- Oyebade (2013) hydrological extremes and ecological disasters, *NAHS Proceedings* (5):2-12
- Shehu Abubakar (2013) Agriculture Published on Thursday, 26 September 2013 06:00
- Smith DW (Tech. ed.), Ryan WL, Christensen V, Crum J, Heinke GW. Cold Regions Utilities Monograph. American Society of Civil Engineers, New York, 1996:840 pp.
- Umoh E (2007) Flooding problems in Rivers state *Journal of Environmental Science* 4(2): 44-60.
- UNFCC (2001) Conference Of The Parties Sixth Session, Part Two Bonn, 16-27 July 2001 Agenda Items 4 And 7review Of The Implementation Of Commitments And Of Other Provisions Of The Convention Preparations For The First Session Of The Conference Of The Parties Serving As The Meeting Of The Parties To The Kyoto Protocol (Decision 8/Cp.4) Decision 5/Cp.6
- UNFCCC (2003) Caring for climate: a guide to climate change convention and the Kyoto protocol. Climate change secretariat, Bonn, Germany.
- UNICEF (1995). Strategies in Water and Environmental Sanitation.