



The impacts of climate change on agricultural production and food security: Nigerian experience

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ABSTRACT

Climate change is attributed directly or indirectly to human activities resulting in the alteration of the composition of global atmosphere in addition to natural climate variability observed over a comparable time periods. Climate change has adversely affected agriculture and food security in Nigeria and other West African Countries. It is estimated that by 2100 Nigeria and other West African Countries would have agriculture losses of up to 4% Gross Domestic Product (GDP) due to climate change. Agricultural experts has also observed that parts of the Country that experience soil erosion and operate rain-fed agriculture would have decline in agriculture yield of up to 5% between 2000 and 2020. In 2012, most states (Balyasae, Rivers, Bauchi, Kogi, Adamawa and Imo) in Nigeria witnessed serious flooding which affected adversely humans, farm lands and livestock. The flood which resulted from excessive rainfall attributed to climate change constituted a threat to agriculture and food security in all the geo-political zones of the Country. Desertification in the Northern part of Nigeria has also dealt a great blow to agriculture. The ravaging impacts of climate change on agriculture and food security calls for coping or adaptable measures such as construction of gas re-injection plants, public awareness campaigns, forest conservation, Taungaya and agrosilviculture. However, the ultimate remediation is drastic reduction of the release of greenhouse gases into the atmosphere.

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Introduction

Climate change is a threat to both mankind and the environment. It constitutes social security and political threat to humanity. A major factor responsible for climate change is the increasing contributions of greenhouse gases (sulphur dioxide, nitrous dioxide, methane, perfluoride (PFCs). Hydrofluoride (HCFs), sulphur hexafluoride (SF₆) and chlorofluorocarbons). These gases causes rise in atmospheric temperature a phenomenon known as global warning. Global warming causes the melting of icecaps resulting in rise in sea level, coastal erosion and flooding. Nigeria is among the Countries that emits high concentrations of greenhouse gases with over 123 gas flare sites (Achilike, 2012). All the flare sites are located in the Niger Delta basin of Nigeria thus making the region very vulnerable to the impacts of climate change. It should be recalled that the region witnessed coastal erosion and flooding in 2012 which claimed a lot of life and property worth billions of naira. The world has realized that climate change is not solely an environmental problem, but that of economic, security and survival issue (Tessy Igomu, 2010).

Effects of climate change on agriculture

The negative impacts of climate change on the agricultural sector cannot be over stressed. The Nigerian agricultural sector which contributes about 45% employment opportunity for the labour force. Agriculture is the main source of food, industrial raw materials in Nigeria with about 85 percent of the entire population depending on it for survival. About 90 percent of agricultural practice in Nigeria is essentially rain fed. Uncertainties in the onset of the farming season due to changes in the rainfall characteristics affects agriculture in Nigeria very

adversely. Early rains are not often sustained; and crops planted at their instance may become smothered by heat waves. In 1998, most crops planted in different parts of Nigeria especially in the Northern region were smothered by heat waves arising from excessive temperature. This resulted in decline in crop yield in the affected areas.

Excessive rainfall

Excessive rainfall has led to terrible flood which in itself has caused serious loss of crops, livestock, fisheries, forestry and income. There are reported cases of flood in many parts of the world including Nigeria in recent times (Tables 1 and 2). These food disasters have been attributed to climate change (Achilike, 2012). There were reported cases of flood in Lagos, Anambra, Kogi, Delta, Kwara, Kebbi and Niger States in 2012. The flood which was attributed to excessive rainfall arising from climate change dealt devastating blow on the agricultural sectors as crops were adversely affected. Earlier in 1980, the Ndiegoro flood disaster in Imo State of Nigeria destroyed vast acres of arable land and displaced thousands of people. (Tables 1 and 2). It is a fact that flood arising from excessive rainfall aggravates erosion of the soil. According to the Nigerian Meteorological Agency (NIMET), 2012, amount of rainfall Northern Nigeria is estimated at between 300 and 1100 mm/year and between 3000 and 3100mm/year in the south. This forecast indicates imminent crises for even years to come (Achilike, 2012).

Temperature rise

There has been reported rise in temperature in Nigeria especially in the Northern part (NIMET, 2012) and this has affected food supply. The temperature in the Northern and Southern parts rose to 38°C and 30°C respectively in 2012.

Temperature rise could hit crop yields by about 25 percent and affect entire communities that depend on agriculture for income. Ch estimated that Nigeriaange in temperature can easily cause resource scarcity and shrinking of agricultural inputs. Extreme climate variations both hot and cold could have disastrous effect on the earth's ecosystem. High or low temperature and relative humidity normally would seriously affect storage of agricultural products. High temperatures will always affect feed consumption and conversion in livestock and poultry while high relative humidity will affect storage of grains mainly.

Land Degradation

Soil or land degradation is one of the ugly, consequences of climate change resulting from excessive flood. Land degradation can be seen as the structural, involves physical and bio-chemical nature of the land and the factors that cause the land to disintegrate are flood, erosion and deforestation. Physical land degradation involves clearing, tilling and leveling of land manually or mechanically while chemical degradation is the pollution of the land by chemicals such as fertilizers.

Apart from human activities, most states of Nigeria such as Lagos, Rivers, Cross River, Delta Edo, Imo and Abia have a low-lying topography and hence very prone to flooding. Flooding arising from climate change has resulted in serious land degradation in these states resulting in the loss of crops, fishery, livestock, pollution of aquatic environment, destruction of the flora and fauna with adverse effect on human and animal health. It has been estimated that by 2100 Nigeria and other West African Countries are likely to have agricultural losses of up to 4% of Gross Domestic Product (GDP) due to climate change (Achilike, 2012). It has also been estimated that parts of Nigeria that experience soil erosion and operate rain-fed agriculture could have a decline in agricultural yield of 5% between 2000 and 2020 due to increasing impacts of climate change (Achilike, 2012).

Desert encroachment

Whereas excessive flooding has hurt farming in coastal communities and the middle belt of Nigeria, desert encroachment also arising from climate change is affecting farming in the North. This is caused by deforestation, overgrazing, and continuous cultivation. Grasses are scanty, due to minimal annual rainfall aggravated by climate change; Continuous felling of trees without afforestation practices has been the common thepractice among the rural inhabitants of Northern Nigeria. It is estimated that about 80 percent of the people of Northern Nigeria use firewood for cooking. This has made it possible for the desert to advance at a fast rate towards the southern part of Nigeria. This has resulted in decline in food production in these areas. Experts have observed that there is a reduction of harmattan season to only two months now; January to February as against November to March annually thus increasing the rate of desertification.

Effect of climate change on food security

Nigeria is the largest importer of food, spending as much as N1.3 billion on the importation of rice and wheat. Climate change has affected food security in most states of Nigeria thus increasing the rate of importation of food. This trend of large-scale importation has not helped Nigeria in terms of food security and sufficiency. The World food supply depends on the cultivation of three cereals: wheat, rice and maize (CTA, 1988, Moshood, 2010). With the rampaging flood disaster in most parts of the World including Nigeria, food security is now being threatened.

The local farmers in Nigeria are seriously concerned about weather variations because of its impacts on food security, availability, accessibility, stability and utilization. Climate change affects crop yield and with decline in agricultural production, purchasing power, industrial supply, foreign exchange earnings and gross domestic product (GDP) also declines resulting in increase in the prices of food items. The damage arising from climate change is very devastating and is affecting the lean resources available to government to inject into the agricultural sector for economic growth. This is more worrisome now that the government has parts of the roads such as programme is to ensure adequate food security. The worst hit by climate change is the Nigerian small scale farmers (Ozoma, 1995).

The agricultural sector strongly impacts food security, industrial growth, quality of life, economic growth, political stability and to a certain extent a nation's position in international relations and trade. The agricultural sector holds the key to national food security. Food security is of great importance in improving the nutritional status of many millions of people who suffer from acute hunger. A country is said to be food secured when individual households that make up the country have access to enough food (Kennedy and Heddad, 1999). The key elements here to food security are availability, stability of supply, food access and utilization.

Food availability and stability imply that food consumption will not fall below the consumption requirements. It is worthy of note that 60 percent of food such as rice, wheat, tomatoes, carrot, gabbage, onions, sheep, goats and cattle are produced in the Northern Nigeria and transported to the south. With the recent heavy rainfall, most roads in Nigeria such as Abuja-Lokoja road are usually flooded making the transportation of these food materials very difficult. With this ugly scenario, the dream of food availability and stability may remain an illusion. Food security incorporates questions of production, storage, supply as well as access to supply.

Recommendations

From the foregoing, climate change has adverse effects on agriculture and food security.. The question that should agitate our minds now is how to mitigate its negative effects on the Nigerian farmers especially and on agriculture generally. Some of the measures that can be taken to mitigate negative effects of climate change include:

De-silting of drainage

Many of the drainage facilities in Nigeria are blocked, a development viewed as a major factor for the ravaging action of flood. With the heavy rainfall and its attendant flood disaster, there is need to de-silt blocked drainage facilities. It is also important to construct adequate drainage facilities that will cope with the current excessive floods ravaging most parts of Nigeria. Environmental impact assessment (EIA) should be carried out in sitting civil structure projects. Holistic enlightenment should be adopted for people to understand the strength of problems before salvaging. Areas that are vulnerable to flood must be assessed before projects are sited.

This assists the waste management agency in disposing the refuse. The patronage of cart wheel operators results in the dumping of refuse in wrong places or use of teenagers to cart away refuse. This many give rise to crisis that comes often with flood disaster.

Public enlightenment

There is need for public awareness programs and information systems on the impacts of climate change on

agriculture. There should be regular public awareness on the increasing impacts of climate change on the environment. Both the print and electronic media should be used to create awareness on climate change; government and the organized private sector should sponsor workshops and seminars on climate change.

All tiers of government should legislate and recommend tough penalties against indiscriminate bush burning and deforestation. Tree planting campaign should be embarked on. The use of forests trees as a place to collect carbon dioxide (CO₂), "carbon sinks" should be emphasized. Trees absorb and store carbon dioxide only while alive: when they die, decomposition releases the carbon dioxide (CO₂) back into the atmosphere. Tree planting campaign should be mounted in all the states of the federation. Environmental laws should be implemented by the Federal Ministry of Environment so as to ensure adequate protection of the environment. Ecological funds should be released and the use strictly monitored to avoid misappropriation. This involves a synergy and aggregation of efforts by both the Federal and State governments.

Indiscriminate soil excavation amounts to environmental degradation and soil erosion. The government should do everything possible to mitigate climate change and its horrible effects on agriculture, our environment and food security. In the health sector, wealthier fluctuations cause insurgence of infectious disease such as malaria, cholera and meningitis thereby affecting farmers output and health. This reduces the quality of life of farmers. Therefore, creating awareness on the dangers inherent in activities that will alter the climate is paramount.

Gas flaring

This occasional activity in this region has been aggravated by can be achieved by reducing the emission of pollutants that cause ozone production near earth's surface.

Gas flaring and other sources of greenhouses should be monitored on more regular basis; scrubbers should be installed at sites where greenhouse gases are released. Re-injection gas plants should be built at flow stations so as to minimize gas flaring. With about 123 gas flare sites, Nigeria flares over 70 per cent of her associated natural gas while Saudi Arabia flares only 6.9 per cent. The use of smoky vehicles which release obnoxious gases into the atmosphere and use of firewood for cooking purposes should be reduced; the use of air fresheners, insecticides and perfume that are not ozone friendly should also be avoided.

The Federal Government should initiate and promogate a new law that will protect the oil producing communities from environmental degradation. The government to make frantic effort to discourage complete flare of gas.

Soil fertility management

Soils in the Niger Delta region especially the Southeast zone are characterized by high porosity and permeability. This makes the soil very vulnerable to erosion. It is a fact that erosional activities in the region has increased in recent times due to excessive rainfall arising from climate change. Therefore, soil fertility management is necessary. This looks at a range of practices which lead to sustainable agriculture. The measures to be taken here include agroforestry, intensive fallowing, green manuring, use of mulch, compost manure and farm yard manure. The aim of all these practices is the maintenance of soil fertility using a minimum of external inputs like chemical fertilizers. It all implies that farmers need to improve on the way they are managing their land. People who live on the slopes

need to plant trees to reduce erosion. The leaves of these trees fall and decay to increase soil fertility, retain moisture in the soil and roots bind soil particles thereby reducing erosion.

Conservation of forest

Within the next 20 years, with the onset of demand and supply pressures, forest materials and supply pressures, forest materials will be more depleted. This will result in more global warming and depletion of ozone layer. Deforestation in Nigeria was about 2.1 million hectares per year between 1980 and 1990. With increased urbanization, road construction, fuel needs resulting from population explosion, the picture will change and this calls for proper conservation of Nigeria forest resources.

Foresters should start on a clean slate at both village, local government, state and National levels to plan their future operations with great care. Exploitation of forests for timber and firewood has been rapacious and would amount to shame to think we could not learn from our past mistakes. Selective logging, prohibition by legislation should be adopted in desert areas to reduce desert encroachment. Restrictions of this type will reduce the intensity of harvesting, promotes regeneration, succession and salvage merchantable timber. In the past, people realized this and planted rubber, oil bean, pears, mangoes, cashew, etc along road sides. The effects of climate change may be less dramatic in the short run, but over the next two to three decades, climate change could cause irremediable harm to the environment and habitats upon which human societies depend for survival.

There is need to practice farm diversification. The main objective is crop production complimented by forest and its resources. The emphasis is on forest resources while the arable crops in supplementary. However in all cases of agroforestry there must be a symbiotic relationship between the forest crops and arable crops.

Adaptable agroforestry systems

Taungya 1

This is practiced where tree plantation is being established as in an agroforestry programme in forest reserves or wood lot establishment by individual farmers. Here the main objective is tree/timber production while agricultural crops come into supplement the trees.

The system is practicable within the early stages of the plantation, because as soon as the trees close canopy, the agriculturist/farmer abandons the farm.

Agri-liviculture

This is a variant of the Taungya stem. Here the farmer can stay longer on the farm. The spacing for the trees is usually wider to accommodate more agricultural crops than in the taungya. Here strict silvicultural practices such as pruning and thinning are practiced.

Agropastoralism

This is the rearing of animals like cattle, sheep, goats etc alongside forest plantation. This is common in savanna areas. The trees provide shade for the animals while the animals fertilize the farm with their droppings/dung. This can be practiced in Okigwe areas of Imo State. The attendant problem with this method is occasional conflict between the pastoralists and the forester as the animals may damage the trees through browsing. Planting of trees that are not eaten by animals can help reduce the conflicts.

Control hedge rows

This is an agroforestry technology that is practiced in sloppy ground and along contour lines to reduce soil erosion.

Table 1. Weather-related disasters (2007) Effects of floods

Countries	Humans	Livestocks	Crops
Mexico	Flood left 500,000 homeless	Several thousands of farm animals died.	Crops in the farm submerged
Dominican Republic	Flood displaced 65,000	-	-
Bolivia	Flood displaced 25,000	-	-
India	Flood affected 30 million people	-	Several hectares of farm crops damaged.
Pakistan	Flood displaced 377,000 people and hundreds dead	-	-
North Korea	Widespread flood severally hit 960,000, leaves many dead.	-	-
Bangladesh	Flooding affected 8.5 million people and killed over 3,000	Killed 1.5 million farm animals	Destroyed several hectares of farm crops
Madagascar	Flood displaced 33,00 people	-	Destroyed crops of 260,000 farmers
Sudan	Flood displaced 150,000 people	-	-
Leotho		-	High temperatures and drought destroyed farms crops
Britain	More than 350,000 were affected by the worst flooding in over 60 years.	-	Many farmlands washed away
China	931 two million people died	-	-
West African	Floods affected 800,000 people in 14 countries	-	-

Source: United Nations Office for the Co-ordination of Humanitarian Affairs (2012)

Table 2. Flood disaster and its effects some States of Nigeria Effects of floods

Noth Central States	Human	Livestocks	Crops
Benue Plateau Kwara Nassarawwa Niger Kogu	Over 7,500 house-holds were displaced in these states while two farmers committed suicide in plateau. Roads were closed to both human and vehicular traffic	Over 300 farm animals were lost to flood.	Paddy field, maize and wheat farms were submerged
North Easter States			
Taraba Yobe Bauchi	Households were displaced	Farm animals swept away by flood	Several hectares of crops submerged
North Western States			
Kibbi Kaduna Zamfara	-	Farm animals were swept away	Destroyed many hectares of farm land and crops.
South Eastern State			
Anambra Abia Imo Ebonyi	Many households were displaced in these stats, and they need emergency relief. Many roads closed to traffic	Farm animals and aquatic eco-system destroyed	Crops were submerged farmers labored to scoop out water from farms to enable them harvest their yams untimely/prematurely
South Southern States			
Cross River Delta River Bayelsa Edo Akwa Ibom	Loss of human lives	Household were seriously displaced	Farms were submerged
South Western State			
Lagos Oyo Ondo		Several households were displaced	Several hectares of farm crops destroyed

Source: Mooshod (2012)

The main message here is the use of –A- frame to trace the contour lines along which the trees and other plants are planted multipurpose tree species and shrubs (MTPS) are usually favoured.

Legumes like *Ghricidia*, *Sapium pterocarpus* species etc are used. Also *vertiveria zazoniadies* (vertiver grass) or pineapple suckers can be used. Use of pineapple suckers is usually preferred because of the fruit.

This practice is done in such a way that the tree crops are planted first and are allowed to mature before introducing the arable crops or it can be carried out in already established forest, with the arable crops planted in hedge rows near the trees. The trees help to control erosion, floods, and heavy rain drops. These trees as earlier mentioned, hold the carbon dioxide (CO₂) which if released to the atmosphere will lead to alteration of the climate, that is climate change as we are encountering now worldwide. Australian floods that destroyed so many homes and lives, the recent storms and tornadoes in America, Southern Russia and others are cases in mind. Finally agroforestry practices helps to control soil degradation and limits ozone layer depletion and preserves our natural resources for use by the future generation.

Environmental transformation commission

Various levels of Government should set up a body known as Environmental Transformation Commission (ENTRACO). The task of this commission is to ensure strict compliance to environmental laws. This commission should also have the mandate to demolish all illegal structures erected along water ways and probably prosecute the culprit to serve as a deterrent to other people. Road construction should be supervised properly so that standard drainages/gutters are put, pure water sachets properly disposed. The same commission should monitor burial ceremonies where canon shots are shot indiscriminately with accompanying smoke/carbon that goes with it into the atmosphere. The smoke from these canon shots are not ozone friendly.

Environmental deterioration is a common sight in our immediate environment today, hence the cause of these problems facing us today.

Conclusions

Climate change is one of the most critical challenges ever to face humanity. It can cause the worst economic, social, security and political threat to humanity. The and problems associated

with climate change include flood, high temperature, erosion menace, land degradation and extreme weather conditions and these have adversely affected agricultural production and food security in Nigeria.

In Nigeria, flood shotage. loss of farm lands and human lives as well as displacement of homes has become a common problem in recent times due to flood disaster. The impacts of climate change on food security, availability, stability, accessibility and utilization calls for concerted efforts to mitigate against climate change. If this is not done agricultural production, purchasing power will decline, which would result in sky-rocketing of food prices. The damage arising from climate change is devastating and immeasurable and affects the dwindling resources of the government and the farmer.

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