Effects of Climate Change on Agricultural Production, Economic Recovery, Growth and Sustainable Development in Nigeria

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ABSTRACT

Climate change is presently one of the biggest challenges this generation faces. African countries, including Nigeria are particularly vulnerable to climate change because of their dependence on rain fed agriculture, high levels of poverty and poor infrastructural capacity to cope with the effects. Evidences have shown that climate change impacts arising from different causes are already affecting agricultural activities with the most devastating adverse effects in Nigeria as extreme weather conditions, frequent drought, flooding, increased environmental damage, increased infestation of crops by pests and diseases, increased biodiversity loss, depletion of wildlife and other natural resource base, changes in the vegetation type, decline in forest resources, decline in soil conditions, and the spread of infectious diseases. These conditions emanating from climate change are bound to militate against agricultural production. Therefore building up resilience and developing adaptation strategies becomes very important if agricultural production in the country will experience any boost. This paper reviews some existing literatures on climate change and its impact on agriculture in Nigeria. The findings of this paper indicate that agriculture like many other sectors of Nigerian economy is directly vulnerable to the impacts of climate change thereby generally affecting the growth of the economy. The paper recommends more education/awareness on the impact of climate change and building farmers' capacity for effective climate change adaptation in Nigeria.

KEYWORDS*: Climate change, Impacts, Adaptations and Agricultural Production*

1.0 Introduction

Climate change is presently one of the biggest challenges this generation faces.Nigeria like other countries of sub-Saharan Africa is highly vulnerable to the impacts of climate change(IPCC, 2007). Though climate change is a threat to agriculture and nonagriculturalsocio-economic development, agricultural production activities are generally more vulnerable toclimate change than other sectors, (Kurukulasuriya, et. al., 2006). This is because agricultural production in mostsub-saharan African countries (Nigeria inclusive) is dependent on weather and climate. Analysis of 9000 farmersin 11 African countries predicted a fall in farm revenues with current climate scenarios, (Ole et. al., 2009).

Butt etal, (2005) went further to predict future economic losses and increase risk of hunger due to climate change. Smith and Skinner (2002) asserted that climate plays a dominant role in agriculture having a directimpact on the productivity of physical production factors, for example the soil's moisture and fertility. Adverseclimate effects can influence farming outputs at any stage from cultivation through the final harvest. Even if thereis sufficient rain, its irregularity can affect yields adversely if rains fail to arrive during the crucial growing stage ofthe crops (Rudolf and Hermann 2009).

In Nigeria, the agricultural sector is the mainstay of the economy though her development funds atpresent is derived more from petroleum oil and gas exploitation. Estimates in the1991 population census indicated that69% of Nigeria's population was engaged in agricultural activities and the sector contributes about 40% to thenation's Gross Domestic Product.

In view of the fact that stability and sustainability of sufficient food production in the agricultural sector isthe sure way of eradicating poverty, economic recovery, growth and development, and bearing in mind the threat posed by climate change to therealization of this goal, it becomes very important for the Agricultural system in the country to give climate changeissues seriousconsideration if the objective of increased food production is to be achieved. This paper therefore seeksto provide an understanding of climate change, its causes, impacts and possible ways of adapting or mitigating its impacts on agricultural production in Nigeria.

2.0 What is Climate Change

The Intergovernmental Panel on Climate Change (IPCC, 2007) defined climate change as statistically significantvariations that persist for an extended period, typically decades or longer. It includes shifts in the frequency andmagnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature.Ozor,(2009) defined climate change as change in climate over time, whether due to natural variability or as a resultof human activity and is widely recognized as the most serious environmental threat facing our planet today. Thisdefinition elicits the seriousness of the threat posed by climate change and the urgency of the need for countriesto rise up to this urgent clarion call of combating the negative effects of climate change. The climate we knowcannot be said to be static, but variations are very insignificant that it is only climatologists that identify it. Over theyears, the change becomes more pronounced and significant. This is as a result of earth's natural variations andman's activities which cause emissions of green house gases thereby increasing global warming.

This globalwarming is what actually induces the change in climate.Scientists have noted that the average temperature of the earth has increased by 0.74 degrees Celsiusover the past 100 years. And if nothing is done, there is going to be more rise in the earth's temperature to theextent that it will be difficult to cope with it.This statement buttresses more the seriousness of the threat posed by climate change to countries thatdepend mostly on climate-sensitive resources for sustenance of livelihood and overall development. Eboh (2009)stated that countries in sub-saharan Africa, including Nigeria are likely to suffer the most because of theirgeographical location, low incomes, low institutional capacity as well as their greater reliance on climate-sensitiverenewable natural resources sectors like agriculture. This is further supported by Watson (1997) as cited in Ifeanyi-Obi, *et al.* (2012) who stated thatAfrican countries are particularly vulnerable to climate change because of their

dependency on rain fedagriculture, high levels of poverty, low levels of human and physical capital, inequitable land distribution and poorinfrastructure.

3.0 Causes of Climate Change

There are four major causes of climate change namely; astronomical causes, volcanic eruptions, variations insolar output and changes in earth's environment as a result of human activity. The intergovernmental panel onclimate change (IPCC, 2007) says that human activity is the main cause of the changes seen in climate. This it doesthrough activities that cause emissions of greenhouse gases (mainly Carbon dioxide, water vapour,methane and nitrous oxide). Studies of long-termed climate change have discovered a connection between theconcentrations of carbon dioxide in the atmosphere and mean global temperature. Carbon dioxide is one of themost important gases responsible for the green house effect. These green house gases are able to alter theenergy balance of the earth by being able to absorb long wave radiation emitted from the earth's surface. Thenet result of this process and the re-emission of long wave back to the earth's surfaceincreases the quantity ofheat energy in the earth's climatic system. A growing world population, Deforestation and the burning of fossil fuels are some of important human activities that impact adversely on climate.

4.0 Effects of Climate Change

Globally, extreme weather is predicted to become more common and animals, plants and crops are all expectedto be badly affected. In Nigeria the effects of climate change are expected not just to stop atcrops, plants and animals but also human lives and overall development of the country. Eboh(2009) statedthat the effects of climate change are projected to manifest through changes in land and water regimes,specifically, changes in the frequency and intensity of droughts, flooding, water shortages, worsening of droughts,soil conditions, desertification, disease and pest outbreaks on crops and livestock. Anyadike (2009)stated that the general environmental effects of climate change include; rise in sea level due to melting of icecaps; changes in dates of onset and end of the rainy season; reduced rainfall amounts in some areas andincreased rainfall amounts in others, leading to flooding, erosion leading to low crop yields and increase in intensity of atmospheric disturbancessuch as thunderstorms and line squalls. He went further to state that climate change will deepen poverty bothdirectly and indirectly.

The direct impact he explained will manifest through the loss of lives, livelihoods, assets,infrastructure etc from climate extreme events. Ozor (2009) in listing the impact of climate change on nationaldevelopment of the country stated that climate change has led to devastating consequences andeffects in various parts of the country which include flooding, desertification, erosion, drought, sea level rise, heatstress, pests and diseases, erratic rainfall patterns and land degradation.

TheThird assessment report of IPCC (2001) stated that the poorest countries are more vulnerable to the risk ofclimate change and went further to identify a range of poverty-related climate change impacts as follows;reductions in crop yield(fall in agricultural productivity) in most tropical and subtropical regions due to decreasedrainfall, changes in food security, employment, incomes and economic growth, displacement of people fromcoastal and densely populated low lying areas, salinization of these fertile areas, exposure of millions of people tonew health risks, especially from vector-based diseases like malaria and schistosomiasis, as well as water-bornediseases like cholera and dysentery and malnutrition from the reduction in crop yields .

4.1. Crop and Animal Production

As temperature increases and rainfall pattern becomes more unpredictable, crop yields are expected to dropsignificantly. Also extreme weather events such as thunderstorms, heavy winds and floods devastate farmlandsand can lead to crop failure. Pests and diseases migrate in response to climate changes and variations. It isestimated that by 2100, Nigeria and other West African countries are likely to have agricultural loses of up to 4%of GDP due to climate change (Mendelsohn, *et al.* 2000). Parts of the country that experienced soil erosion andoperate rain fed agriculture could have decline in agricultural yield of up to 50% between 2000 and 2020 due toincreasing impact of climate change (IPCC 2007).Rudolf and Hermann (2009) stated that even if there is sufficient rain, itirregularity can affect yields adversely if rain fail to arrive during the crucial growing stage of the crops. Alsoextreme weather leads to drying up of streams which are sources of irrigation water used by farmers during dryseason crop production. Anyanwu (2008) as cited in Ifeanyi-Obi, *et al.* (2012) in studying the farmer's perception of impact of climate change onfood crop production in Ogbomosho Agricultural zone of Oyo State identified the significant effects of climatechange on crop production as; low yield of crop, stunted growth of crop, easy spread of pest and disease attackon crops, drying of seedling after germination and ineffectiveness of agricultural chemicals due to delay ofrainfall. This agrees with the statement of Ozor (2009) that variations in rainfall pattern will affect crop productionin varying ways depending on the location. Ozor (2009) stated that livestock production systems in Nigeriawould be vulnerable to climate change in respect of anticipated decrease in rainfall in the Sudan-sahelian zoneand consequent reduction in the available pastureland. This he explained further by listing the various ways theanticipated decrease in rainfall will affect livestock as declining availability of surface water resources for animals,possible increase in salinity at water resources for animals, possible increase in salinity at watering points due toincrease in temperature and evaporation in the face of reduced rainfall.This is to say that further changes in rainfall and temperature will affect livestock production as well asavailability of animal species.If global temperatures rise by 2 degrees Celsius, 30 percent of all land-livingspecies may be threatened by an increased risk of extinction. Though increase in temperature is generally seen tobe destructive to the production of crops and human lives. FAO (2009) noted that livestock production could beboosted by temperature increase. Conversely, Deressa and Hassan (2009) found increasing temperaturedamaging to the Ethiopian agriculture; a situation that is not uniformly distributed across agro-ecological zones.Issa (2009) as cited in Ifeanyi-Obi, *et al.* (2012) in agreement with the findings of Deressa and Hassan (2009) reported that commercial Livestockproducers are negatively affected by rising temperature. This is to say that varying climate has varying effects oncrops and livestock depending on the agro-ecological location.

4.2. Fisheries Production.

Fish farming and the associated processes are becoming an important source of revenue and employment inNigeria. Ozor (2009) stated that subtle changes in key environment variables such as temperature, salinity, windspeed and direction, ocean currents, strength of upwelling due to climate change could sharply alter theabundance, distribution and availability of fish production in the country. In the same vein, African Action (2009)as cited in Ifeanyi-Obi, *et al.* (2012) stated that changes in ocean dynamics could lead to changes in migrating patterns of fish and possibly reduce fish landings especially in coastal fisheries. All these will directly and indirectly affect the livelihoods

of fishfarmers, their immediate families and their defendants. It will also affect the revenue sustenance of those whowork or trade on fishery resources. Tubiello (2008) as cited in Ifeanyi-Obi, *et al.* (2012) noted three major pathways through which climate change willaffect fisheries and aquaculture, as well as dependent communities and their economic activities as;

• Physical and chemical changes in oceans and fresh waters, including increase in water temperature andchanges in salinity among others.

• Change in fish production, catch composition and species distribution resulting from a complex interplayof ecological changes and

• Physical changes to coasts, estuaries, wetlands, lakes and rivers caused by changing weather patterns,weather-driven natural disasters and sea-level rise. Fishery resources are known to be highly sensitive tomarine environmental changes. Though they had always coped with these changes, future climatechanges will likely be so extreme that it may be difficult for them to cope with. Therefore, identification ofproper adaptation strategies is a high priority for the fishery sector.

4.3. Forestry Production.

The forest reserves are not left out in the threat posed by climate change. Francesco,(2008) as cited in Ifeanyi-Obi, *et al.* (2012) statedthat climate change will affect agriculture and forestry through higher temperatures. As at 1985, deforestation claimed 1,544sq miles of thenation's forest land. Between 1983 and 1993 alone, Nigeria lost 20% of its forest and woodland areas. Nigeria'sprimary tropical forest in Cross River State has been decimated by 97%, mostly since 1990. The country'sbroader forest cover was estimated at over 12% in 2005, being depleted at a rate of 3.3% per annum. Themain cause is the demand for wood fuel. This depletion of the nation's forest reserves when critically looked at isnot far from indirect effect of climate change. As a result of the drying up of village or communities forest whichthe dwellers depend on for firewood, they resort to the depletion of forest reserve as a means of getting woodfuel.

5.0 Adaptation Strategies

Adaptation refers to adjustments in practices, processes or structures in response to projected or actual changesin climate (Dixon, 2003) as cited in Ifeanyi-Obi, *et al.* (2012) with the goal of maintaining the capacity to deal with current and future changes.Adaptation to climate change also refers to activities that reduce the negative impacts of climate change and/ortakes advantage of new opportunities that may be presented. It includes activities that are taken before impactsare observed (anticipatory) and after impacts have been felt (reactive). Eboh (2009) stated that even if efforts toreduce greenhouse gas (GHG) emissions are successful, it is no longer possible to avoid some degree of globalwarming and climate change. This is supported by Francesco (2008) which stated that as a result of greenhousegases already in the atmosphere from past and current emissions, our planet is already committed to at least asmuch warming over the 21st century as it has experienced over the 20th century (0.75^0C). This implies that inaddition to mitigation practices being developed to combat climate change, adaptation to the anticipated climatechange is essential. This fact is also made more explicit in Ozor (2009) which stated that whilemitigation is necessary to reduce the rate and magnitude of climate change, adaptation is essential to reduce thedamages from climate change that cannot be avoided. The Nigerian Agricultural sector in the 21st century willtherefore be facing dual significant challenges, arising from the need to increase the nation's food supply as wellas adjusting to variation in climate. Also the fact that Agriculture is practiced across a broad range of climates andenvironmental conditions makes it necessary for the country to develop an array of

adaptation options that willmeet the different conditions of the different ecological locations of the nation.

There are two basic types ofadaptation; planned adaptation and autonomous adaptation. Autonomous adaptation refers to reaction of farmersto changing precipitation patterns, in that he/she changes crops, uses different harvest and planting/sowing dateswhile planned adaptation measures are conscious policy options or response strategies, often multi-sectorial innature and aimed at altering the adaptive capacity of the agricultural system of facilitating specific adaptations. Alot of adaptation options have been tried on the different areas of agriculture. Some yielded positive results whilethe effects of the rest are still being observed. Some of the generally used adaptation options include;

In livestock management, the common adaptation strategies employed by producers include; modifyingthe time of grazing; altering forage and animal species/breeds; altering the integration within mixed livestock andcrop systems including the use of adapted forage crops; ensuring adequate water supplies and usingsupplementary feeds and concentrate.

In crop production, a lot of cropping options are also available, these include: altering of the timing orlocation of cropping activities; improved water management through use of technologies to 'harvest' water,conserve soil moisture (for example, through crop residue retention) and use/transport water more effectively;altering inputs such as crop varieties and species to those with more appropriate thermal time and verbalization;diversifying livelihood strategy to include income from other farming and non farming activities; improving theeffectiveness of pest , disease and weed management practices through wider use of integrated pest andpathogen management, development and the use of varieties and species resistant to pests and diseases andmaintaining or improving quarantine capabilities and monitoring programs; using climate forecasting tools toreduce production risk.

These adaptation options/strategies must not be used in isolation, farmers can combine two optionswhere necessary in order to achieve the desired result. The fact that Agricultural practices are still climatesensitiveand variations in climate may not be avoided in the nearest future, building up adaptation strategies tocope with the varying climate becomes the most realistic option for farmers to employ in combating climatechange risk.

6.0 Conclusion and Recommendations

From the review it is clear that climate change is already seriously impacting on agriculture in Nigeria and if nothing is done, it is bound to have more serious impacts in the future. Consequently the paper recommends the following:

- Public awareness through Non-governmental and Community Based Organization on the impacts of climate change and how to cope with such changes when they occur.
- The Nigerian Meteorological Agency should issue seasonal weather forecast to farmers to enable them adapt to current year to year variability through the use of advanced information.
- Rain water harvesting should be adopted. Rain water is harvested or captured in water tanks or containers and/or depressions within fields or in stream flood plains for domestic use and agriculture to produce high value crops such as vegetables and livestock watering.

- Crop varieties should be bred for heat and drought resistance, low –water –use efficiency and salt tolerance for use in dry lands and flood tolerance for coastal region. The use of such varieties still enable farmers to diversify and produce profitably even under adverse conditions.

7.0 References

Akinro, A. O., Opeyemi, D. A., and Ologunagba, I.B (2008). Climate Change and Environmental Degradation inthe Niger Delta Region of Nigeria:Its vulnerability, impacts and possible mitigations. Research Journal ofApplied Sciences. 3 (3); Pp 167-173.

Anyadike, R.N.C. (2009). Climate change and sustainable Development in Nigeria; conceptual and empirical issues. Enugu forum policy paper 10. African Institute for Applied Economics, Nigeria.

Butt, A.T, McCarl B.A, Angerer J, Dyke, P.T,Stuth, J.W. (2005). The Economic and Food SecurityImplications of Climate change. Climatic Change;68:355-378.

Deressa, T.; Hassan, R.M.; Alemu, T.; Yesuf, M. and Ringler, C.(2009). Analyzing the Determinants of Farmers' Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia. International Food Policy Research Institute (IFPRI) Discussion Paper No. 00798. Environment and Production Technology Division, IFPRI, Washington D.C.

Eboh, E. (2009). Implications of climate change for Economic growth and sustainable Development in Nigeria. Enugu forum policy paper 10. African Institute for applied economics. Nigeria.

FAO (2009). Climate change in Africa: The threat to Agriculture. http://www.fao.org.africa. International Food Policy Research Institute (2009). Climate change: Impact on Agriculture and costs of adaptation.http://www.ifpri.org/publication. Retrieved 10th August, 2017.

Ifeanyi-Obi, C.C.; Etuk, U.R. and Jike-Wai, O. (2012). Climate Change, Effects and Adaptation Strategies: Implications for Agricultural Extension System in Nigeria. *Greener Journal of Agricultural Sciences*. Vol.2 (2) pp. 053-060.

Intergovernmental Panel on Climate Change (IPCC) (2001). Impact, Adaptation and vulnerability. Contribution of Working Group 11 of the intergovernmental panel on climate change to the Third Assessment Report of IPCC. London : Cambridge University Press.

IPCC (2007). Climate Change 2007: The Physical Science Basis (Summary for Policy),Intergovernmental Panel on ClimateChange. Cambridge: Cambridge University Press.

Kurukulasuriya, P. Mendelsohn, R. Hassan, R, Benhin, J. Deressa, T. Dip. M.Fosu, K. Y. Jain, S. Mano, R.Molua E. Ouda, S. Sene, I,Seo S. N. and Dinar, A. (2006). Will African agriculture survive climatechange? World Bank Economic Review 20(3) 67-88.

Mendelsohn, R. Hassan, R, Benhin, J. Deressa, T. Dip. M.Fosu, K. Y. Jain, S. Mano, R. Molua E. Ouda, S. Sene, I,Seo S. N. and Dinar, A. (2006) Will African agriculturesurvive climate change? World Bank Economic Review 20(3) 67-88.

Ole, M. Cheikh, M. Anette, R. and Awa, D. (2009) Farmers Perceptions of Climate Change and Agricultural Strategiesin Rural Sahel. Journal of Environmental Management 4(3) 804-816.

Ozor, N. (2009). Understanding Climate Change. Implications for Nigerian Agriculture, Policy and Extension. Paper Presented at the National Conference on climate change and the Nigeria Environment. Organized by the Department of geography, university of Nigeria, Nsukka, 29 June-2nd July.

Rudolf, W. Hermann, W. (2009). Climate risk and farming Systems in Rural Cameroon. Institute of Development andAgricultural Economics. University of Hannover, Germany pp. 21-24.

Smith, B. and Skinner, M. (2002). Adaptation options in Agriculture to climate change: A typology, mitigation andAdaptation Strategies for Global Change. African Journal of Agriculture and Resource Economics 3(5) pp. 78-82.

Tubiello, F.N. (2008). Developing Climate change Impact Metrics for Agriculture. Vol. 8 (1). Pp 165-184

World Bank (2008).World Bank Development Report: Agriculture for Development. Washington, DC: World Bank in: Ifeanyi-Obi, C.C.; Etuk, U.R. and Jike-Wai, O., (2012). Climate Change, Effects and Adaptation Strategies; Implications for Agricultural Extension Systems in Nigeria. Greener Journal of Agricultural Sciences, Vol 2 (2) pp 053-060.