CLIMATE CHANGE: A THREAT TO AGRICULTURAL PRODUCTION IN NIGERIA

Onuh, Martin Onuh and Nath. C. Ohazurike
Department of Crop Science and Biotechnology
Imo State University, Owerri

Abstract
In recent times, climate change has generated a global issue of discourse, because of its potential effects on the human interest, including agriculture. It is observed that absence of rapid response strategies to both short and long term climate change, including climate variability will have significant effect on the agricultural production. Climate change is of serious concern to Nigeria because of its effects on agricultural production and food security. This paper discussed on the general climate and climate components and the impact of their possible change on the Nigeria agriculture. The paper recommended the development and reporting of national inventories of green house gas emission sources and sinks; prompt and rapid forecasting and strategizing for potential climate change threat on Nigeria food production.
Keywords*: Agriculture; Agricultural production; Climate variability; Food security*
http://dx.doi.org/10.4314/jafs.v9i1.2

Introduction

There has been increasing frequency, and sometimes intensity of unusual weather-related changes in recent times. Disasters caused by heavy downpours, wind storms, floods, mud or landslides or by extreme temperatures, heat waves, droughts and famine, bush fires or ocean surge, occurring across the globe, have been reported in the world media more often than before. In Nigeria, delays have been experienced in the arrival of rains, usual rainfall patterns, increasing floods, usually warm periods even in between rains, and the harmattan which is sparsely noticed in some years, while it is intense in other years.

Statistics published by the Red Cross and Red Crescent societies in 2001 stated that the number of weather-related disasters more than doubled between 1996 and 2000; over 90 percent of those killed in natural disasters died from weather related matters (Okali and Ewah, 2004).

Over the last decade, climate change (in terms of long-term changes in the mean temperature or normal precipitation, as well as an increased frequency of extreme climate effects) has gradually been recognized as an additional factor which, with other conventional factors, will have significant effect on the form, scale and spatial and temporal impact on agricultural productivity.

It is observed that in the absence of adequate response strategies to long-term climate change as well as to climate variability, diverse and region-specific impacts will become more apparent. However, some impacts may be adverse, while others may be favourable (Pat duru, Personal communication).

Impacts of climate variability and change on the agricultural sector are projected to steadily manifest directly from changes in land and water regimes, the likely primary conduits of change. Climate change is expected to result in long-term water and other resources shortages, worsening

soil conditions, drought and desertification, disease and pest outbreaks on crops and livestock, sea-level rise, and so on. On the other hand, climate change is also expected to result in some beneficial effects, particularly in temperate regions, where lengthening of growing seasons, carbon fertilization effects, and improved conditions of crop growth are forecast to stimulate gains in agricultural productivity in high-latitude regions (Mendelsohn and Dinar, 1999).

The likely impacts of climate change on the agricultural sector have prompted concern over the magnitude of future global food production (Intergovernmental Panel on Climate Change (IPCC), 1996; Bindi and Olesen, 2000).

The concern with climate change is heightened given the linkage of agricultural sector to poverty. In particular, it is anticipated that adverse impact on the agricultural sector will exacerbate the incidence of rural poverty. Impacts on poverty are likely to be especially severe in developing countries where the agricultural sector is an important source of livelihood for a majority of the rural population. In Nigeria, estimates indicate that nearly 60 – 70 percent of the population is dependent on the agricultural sector for employment, and the sector contributes on average nearly 34 percent to gross domestic product (GDP) (Mohamed *et al;* 2002).

With lower technological and capital base, the agricultural sector in developing countries is likely to witness the additional pressures imposed by climate change without concerted response strategies. Given the growing urgency of adaptation of agriculture to climate changes, it is important that enough information should be provided on climate change for policy makers in Nigeria who, among other things, need to decide whether the phenomenon is sufficiently important to invest time and resources on, to achieve the desired food security in Nigeria. This paper attempts to discuss climate change and its threat to food production and security in Nigeria.

Climate Components and Climate Change

Climate is described as 'average weather' together with the variabilities arising from this average, over a period of time. The main elements of weather itself include temperature, rainfall, dew, humidity, wind, sunshine, mist, haze and clouds. It is the collective pattern of expression of these elements overtime that becomes described as climate of a place. Climate change is therefore, a change in the collective pattern of expression, not just one element of weather. According to Obioh (2002), it is the permanent departure of climate patterns from mean values of observed climate indices.

Global warming which is a consequence of climate change is of concern for three main reasons:

1. First, the warming is occurring more rapidly than past rises in temperature associated with natural climate change. Over the 20^{th} century, global mean surface temperature increased by 0.6 ± 0.2^0C (0.7^0C in Africa), more than during any other century in the last 1,000 years, the 1990s being the warmest decade of the millennium and 1998 the hottest year (IPCC, 2001).

2. Secondly, there is a strong correlation between global warming and increases in the atmospheric concentration of a set of heat-trapping gases known as green house gases.
3. Third is the uncomfortable realization that climate change is human-induced. Human activities, not only at the industrial level but, to some extent, also at the subsistence level (e.g. cutting and burning of firewood), have altered and continue to alter the composition of the atmosphere in ways that affect the climate.

Greenhouse gases, which are central to the climate change problem, are so called because they produce greenhouse effect. Greenhouse effects come about as a result of the inability of the heat enclosed within the atmosphere to escape into the space. The greater the concentration of these greenhouse gases, the more heat they retain around the earth, causing the earth to be warmer than it should be. Climate change, led by global warming, is occurring essentially because human activity is bringing about a rapid increase, beyond natural limits, of the concentration of greenhouse gases in the atmosphere, which is of great concern.

Carbon dioxide (Co_2) is by far the most important greenhouse gas, contributing more than 60% of the greenhouse effect. Carbon dioxide is mainly produced by the combustion of the fossil fuels, coal, oil and gas and it formed 80% of the greenhouse gas emissions of industrialized countries. Since pre-industrial times, the atmospheric concentration of CO_2 has increased from about 280 parts per million volumes (PPMV) to 370 PPMV, which is about 30% (Okali and Ewah, 2004).

Carbondioxide is emitted naturally into the atmosphere by respiration of most living things, both plants and animals; by decay of organic matter and chemical breakdown or combustion of carbon and oxygen-containing minerals like calcium carbonate (used for making cement) or biomass burning and from volcanic eruptions. These are the natural source of the gas. Conversely, carbondioxide is absorbed and sequestered naturally by plants in photosynthesis, on land and in water bodies, especially the oceans. Naturally, CO_2 dissolves in and is released by the oceans, so that the oceans, land and the atmosphere exchange carbon dioxide, maintaining a natural balance, which however, fluctuates with time.

This balance is disrupted by global warming which is chiefly caused by:

1. Accelerated combustion of the fossil fuels, coal, oil and natural gas, for transportation, manufacturing, driving machinery, heating and cooling and generating energy for other purposes.
2. Biomass burning-fuel wood, bush fires, farm residues.
3. Land use changes, especially deforestation and desertification which reduce the size of "Sink" for carbon dioxide absorption; this is driven by the demand for farmland, human settlements, wood and other materials for the increasing human populations.

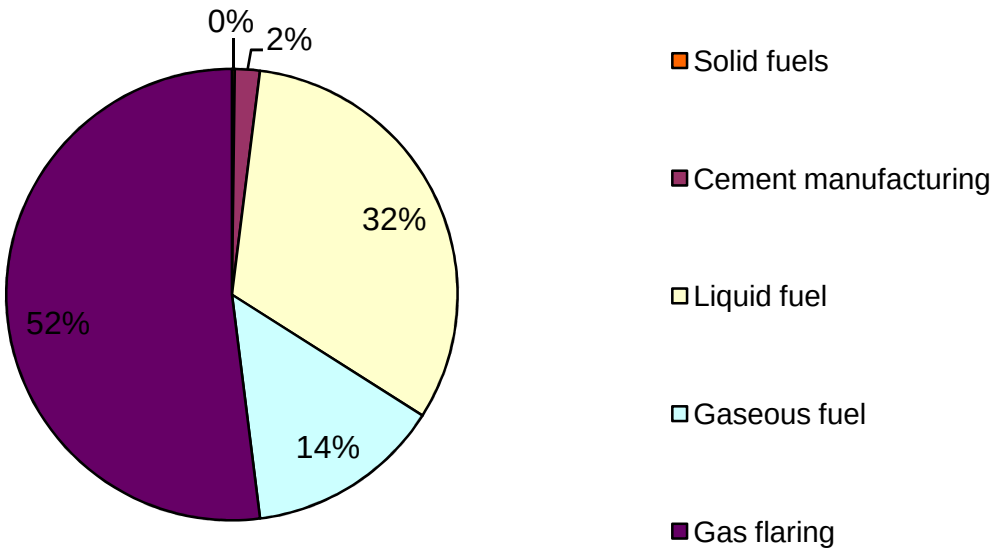
The following tables and charts explain the emission of carbon dioxide in Nigeria, compared to the total CO_2 emissions in the Sub-Saharan Africa and the world over.

Table 1: Carbondioxide (CO_2) emission (in thousand metric tonnes of CO_2).

Year and Sources of CO_2 emission	**Nigeria**	**Sub-Saharan Africa**	**World**
Total Emission in 2001	78.455	515,001	24,215,376
Percentage change since 2002	-12%	10%	8%
Emissions as a percentage of global CO_2 production	0.3%	2.1%	
Emission in 2002 from:			
- Solid fuels	172	292,852	8,654,368
- Liquid fuels	25,410	151,843	10,160,272
- Gaseous fuels	11,325	16,330	447,080
- Gas flaring	40,203	42,110	172,208
- Cement manufacturing	1,345	11,865	758,448

Source: Earth Trends (2003)

Percentage emission of CO_2 by different sources in Nigeria:



Source: Earth Trends (2003)

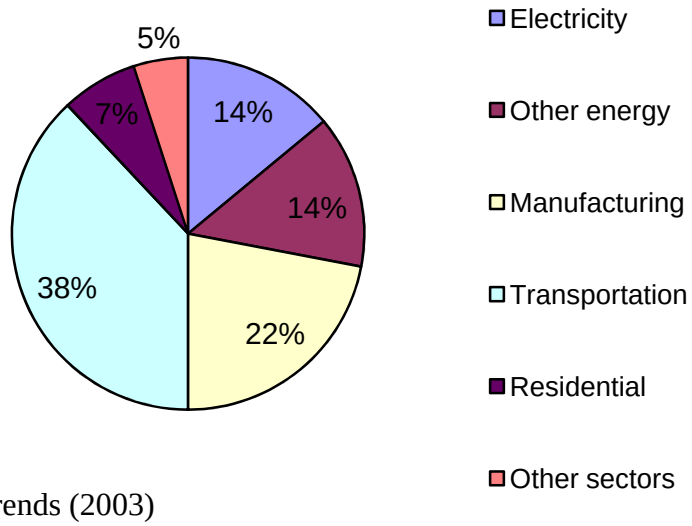
Fig 1: CO_2 Emission in Nigeria, by Source in 1998.

Table 2: CO_2 Emissions by sector 2002 (in Million metric tonnes of CO_2)

Different Sectors of CO_2 emission	Nigeria	World
Public electricity, heat production	6	8,8693
Other Energy industries	6	1205
Manufacturing industries and construction	9	4337
Transportation	16	5505
Residential	3	1802
Other sectors	2	5640
Total emissions of all sectors	**43**	**27180**

Source: Earth Trends (2003)

Percentage emission of CO_2 by different sources in Nigeria:



Source: Earth trends (2003)

Fig 2: CO_2 Emission in Nigeria by sector, in 2002.

It is significant to note that all the greenhouse gases have strong human sources. These sources are activities we undertake on a daily basis in the course of ordinary living or while pursuing development generating energy for driving machines, transportation, cooking, heating, cooling and manufacturing; producing food by farming, applying fertilizer, livestock production (Fig. 2). We contribute to increasing atmospheric concentrations of greenhouse gases from land use changes and reduction in forest cover that we bring about in expanding human settlements or agriculture, as well as from the garbage we generate in human settlements. It is this strong link of the generation of greenhouse gases with ordinary human activities that makes the climate change problem very complicated.

Consequences of Climate Change to Agriculture

There are four ways in which climate can have physical effect on crops:

First, changes in temperature and precipitation may alter the distribution of agro-ecological zones. Change in soil moisture and content and the timing and length of growing seasons will be affected in various ways in Nigeria. Reduction in precipitations is likely to intensify further aquifer exploitation for agriculture and place additional burdens on other surface and groundwater resources from non-agricultural use. An increase of potential evapo-transpiration is likely to intensify drought stress, especially in the semiarid tropics and subtropics.

Second, carbondioxide effects are expected to have a positive impact due to, greater water use efficiency and higher rate of photosynthesis, especially in C_3 plants.

Third, water availability is a critical factor in determining the impact of climate change in many places, particularly in Africa.

Fourth, agricultural losses can result from climatic variability and the increased frequency of extreme events such as droughts and floods or changes in precipitation and temperature variance. According to Rosenzweig and Hillel (1995), a higher frequency of droughts is likely to increase pressure on water supplies for reasons ranging from plant transpiration to allocation. In contrast, increases in rainfall intensity in some regions can lead to higher rates of soil erosion, leaching of agricultural chemicals, and run offs that carry livestock waste and nutrients into water bodies.

Climate Change and Threat to Food Security in Nigeria

Climate change is of serious concern to Nigeria because of the following reasons.

1. **High vulnerability** Nigeria's high vulnerability to climate change thus stems first from its geographical location in the tropics and with long coastline. It stems secondly from our being a developing country with little capacity to adapt to climate change due to low levels of awareness, human and financial resources, and institutional and technological capability.
2. **Precarious coastal region:** Nigeria has a coastline of more than 800km long. Calculations show that a 0.2m rise in sea-level will cover 3,400 km^2 of our coast land; a 1.0m rise will cover 18,400 km^2. The whole of Niger Delta is under 6000km^2 and the total mangrove area in the country is about 800km^2 (Onofeghara, 1990). It is predicted that Nigeria may lose close to $9 billion as a result of the sea-level rise, while at least 80 percent of the Nigeria Delta inhabitants will be displaced (Guardian, September 17, 2001, p. 80).
3. **Tendency to Drought and Desertification:** Some parts of Nigeria are readily exposed to desertification, and predications suggest that desertification will increase by climate change.
4. **Threat to water Resources:** Water is an important resource in our sub-humid to arid regions. It is also an important source of energy to our economy. One of the predicted

impacts of climate change is reduction in soil moisture in the sub-humid to arid regions of Africa. Trends for Africa in the last decade already show a 17% decrease in rain runoff (IPCC, 2001) to which water reservoir storage is markedly sensitive. Drought and water shortage could affect energy supplies from hydropower stations, as being experienced in Nigeria recently.

5. **Impact on Food Security and Livelihoods:** Climate change will affect efforts made in increasing food production and the poverty alleviation programmes. Agriculture everywhere in the country, being dependent on rainfall, will be adversely affected by increased variability in timing and amount of rainfall, while coastal regions that rely heavily on fishing may be hit as climate change will upset ocean currents and fisheries.

Recommendations

The following are essential things that can be considered to overcome the devastating impact of climate change in Nigeria.

1. Developing and reporting on national inventories of greenhouse gas emissions source and "sinks" (like forests which absorb carbon dioxide).
2. Developing and reporting on national and zonal programmes to mitigate and adapt to climate change.
3. Promoting sustainable development and co-operation in:

   (i) The development, application and diffusion technologies, practices and processes that control, reduce or prevent human-induced emissions of greenhouse gases.
   (ii) Preparing for adaptation to the impacts of climate change.
   (iii) Conservation and enhancement of sinks of greenhouse gases.
   (iv) Research to reduce uncertainties concerning scientific knowledge of climate change.
   (v) Integrating climate considerations with other relevant social, economic and environmental policies and actions.

4. The adopted Kyoto protocol of 1997 should be respected by the signatory countries, concerning the rate of emission of gases that cause climate change.

References

Bindi, M. And J.E. Olesen (2000). "Agriculture". In: M. L. Parry ed. Assessment of potential Effects and Adaptations for climate change in Europe: The Europe ACACIA Project. Norwich, United Kingdom: Jackson environment Institute, University of East Anglia.

Earth Trends (2003). http://earthtrends.wri.org

Hillel, D. and C. Rosenzweig (1989). The greenhouse Effect and its Implications Regarding Global Agriculture. In: Res. Bull. No. 724. Univ. Massachusetts, Agricultural Experiment Station, Amherst, M.A.

Hulme, M. (1996). Climate Change and Southern Africa. Norwich, United Kingdom: Climate Research unit, University of East Anglia.

Intergovernmental Panel on Climate Change (IPCC) (1996). . Impacts, adaptations, and mitigation of climate change: Scientific Technical Analyses – Contribution of working group II to the IPCC Second Assessment Report. Cambridge, UK Cambridge University. Press.

Intergovernmental Panel on Climate Change (IPCC) (2001). Third Assessment Report. Cambridge, UK Cambridge University Press.

Mendelsohn, R. and A. Dinar (1999). Climate change, Agriculture and Developing countries: Does Adaptation Matter? *The World Bank Research Observer* 14(2): 277 – 293.

Mohamed, A.B., N.V. Duivenbooden, and S. Abdoussalam (2002). Impact of climate change on Agricultural production in the sahel – Part I. Methodological Approach and case study for millet in Niger. *Climate change* 54(3): 327 – 348.

Obioh, I.B. (2002). Climate change: Causes, analysis and Management. Paper presented at a climate change workshop. Abuja, Abuja, April 2002.

Okali, D. and O.E. Ewah (2004). Climate change and Nigeria: a guide for policy makers. In: Nigeria climate change. Published by Canada – Nigeria Climate Change Capacity Development Project, Canadian International Development Agency, Federal Ministry of Environment, Abuja, Nigeria.

Onofeghara, F.A. (1990). Nigerian Wetlands: An overview. In: T.V.I. Akpata & D.U.U. Okali (Eds). Nigerian Wetlands pp 14 26. man and the biosphere (MAB) National Committee, Nigeria, UNESCO National Commission, Federal Ministry of Education.

Reiily J. (2002). Farming forecast: rainy and warm; farmers confronted with an uncertain climate future will need to adapt quickly to changing conditions. Forum for Applied Research and Public Policy, summer 2002 16(4): 64 – 70.

Rosenzweig, C. and D. Hillel (1995). Climate change and the Global Harvest; Potential Impacts on the Greenhouse Effect on Agriculture, New York, NY: Oxford University Press.