ENUGU FORUM POLICY PAPER 10

DEBATING POLICY OPTIONS FOR NATIONAL DEVELOPMENT

Implications of Climate Change for Economic Growth and Sustainable Development in Nigeria

AFRICAN INSTITUTE FOR APPLIED ECONOMICS

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IMPLICATIONS OF CLIMATE CHANGE FOR ECONOMIC GROWTH AND SUSTAINABLE DEVELOPMENT IN NIGERIA

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List of Acronyms and Abbreviations

AIACC	Assessments of Impacts and Adaptations to Climate Change
BOT	Build, Operate and Transfer
CBOs	Community Based Organizations
CSOs	Civil Society Organizations
DALYs	Disability-Adjusted Life Years
EIA	Environmental Impact Assessment
FME	Federal Ministry of Environment
GHG	Greenhouses Gas
GWSNP	Green Wall Sahara Nigeria Programme
IPCC	Intergovernmental Panel on Climate Change
LUV	Land Use and Vegetation
NAF	National Adaptation Framework
NBS	National Benchmark Survey
NCCC	National Climate Change Commission
NGOs	Non Governmental Organizations
PPP	Public-Private Partnership
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
WBGU	German Advisory Council on Global Change

About Enugu Forum

Introduction

Opening new spaces for domestic policy dialogue is one of the most important potential gains of democratic governance. Democratic space creates public policy arena in which government can be engaged by private sector and civil society on what it is doing or not doing, and hence be pressured to perform. Since the return to democratic rule in 1999, there has been an upsurge of private sector and civil society engagement with governments on economic policy and development issues. But, the upsurge of civic advocacy on economic and development issues has not been matched with commensurate improvements in the quality of debates on policy alternatives and roadmaps for national development.

ENUGU FORUM is intended to provide a civic arena for proposing and debating policy alternatives and roadmaps towards social, economic and political progress of the country. It is hoped that the FORUM will foster interaction between government and non-state actors towards good governance, accountability and participatory democracy.

Identity and Mission

Enugu Forum is a civic platform devoted to intellectual conversation and of policy issues affecting the growth and development of the country. It was founded in 2001 to promote informed and credible avenues of stakeholder dialogue and policy advocacy. It seeks to improve the policy process through high quality debate and non-partisan discourse of alternative solutions to contemporary development questions.

The Forum deploys both intellectual and empirical insight to nurture a shared understanding and objective scrutiny of policy issues on social, economic and political development of the country.

Activities

Enugu Forum's activities take several forms:

- Public Lectures
- Seminars
- Workshops
- Conferences
- Roundtables

The activities bring together diverse stakeholders including government officials, private sector operators, independent think-pots and civil society to exchange and constructively critique perspectives and experiences on critical policy imperatives. Attendance is by formal invitation.

Outputs

The outputs of the Forum's activities take the form of communiqué outlining key outcomes of discussions, conclusions and recommendations. The presentations and proceedings are further developed into Occasional Papers, Working Papers or Policy Briefs widely circulated to inform, sensitise and enlighten stakeholders.

Structure and Organisation

Enugu Forum is structured into a Steering Committee, a Coordinating Committee and the General Members. The Steering Committee governs the Forum through guides and policies agreed in consultation with the General Members. The Coordinating Committee executes the activities and programmes.

Membership

There are two classes of membership: individual and corporate. The Forums' activities are open and can be attended by all interested persons but formal invitations are issued to members and designated guests only. To be a member, one needs to register in the appropriate category. Registration can be done during the Forum's events, or at the Host Organisation - African Institute for Applied Economics, Enugu.

Sponsorship

Ownership of the Forum resides in the members. It is run on the goodwill contributions from corporate bodies and individuals. Sponsorship includes provision of venue, refreshments, logistics and facilitation of Guest Speakers and Resource Persons.

Host Institution

The Enugu Forum is hosted by the African Institute for Applied Economics (AIAE) Enugu. AIAE is a non-governmental, not-for-profit and independent organization devoted to economic policy research towards promoting evidence-based decision making.

Enugu Forum Policy Papers

Enugu Forum Policy Paper Series publishes the proceedings and outcomes of workshops, conferences, seminars or public lectures held by the Enugu Forum. The Series provides documentation of the topical presentations, debate, comments and perhaps consensus at the Forum.

It is intended to disseminate the Forum's intellectual discourse to a wider audience. The essence is to stimulate broader policy debate and promote multi-perspective dialogue on policy options.

Enugu Forum Policy Papers constitute an advocacy instrument to canvass alternative development solutions and policy roadmaps, for the overall purpose of enriching the policy discourse in the country. The Series also draws attention of government, private sector and civil society to salient dimensions of contemporary development challenges in Nigeria.

Introduction

Prof. Eric Eboh

Executive Director, African Institute for Applied Economics &

General Coordinator, Enugu Forum

The Enugu Forum Policy Seminar is an important element of ongoing efforts of the African Institute for Applied Economics, working with leading civil society organisations and private sector associations, to inform and influence public debate of policy options for dealing with challenges of economic growth and sustainable development in Nigeria. Since 2001 when the Seminar series was inaugurated, it has proved to be an effective gap-filler in promoting intellectual conversation of policy alternatives for social and economic progress of the country. Findings and recommendations from the Seminar series are promoted as inputs into decision-making in public and private sectors of the economy.

The present session of the Policy Seminar focuses on climate change and its implications for sustainable development in Nigeria. The focus is relevant to current efforts by stakeholders to increase awareness and appreciation of the negative effects of climate change for poverty, growth and sustainable development. There is now a strong global consensus that climate change presents an urgent challenge to human welfare and sustainable development.

Climate change has been defined by the Intergovernmental Panel on Climate Change (IPCC) as statistically significant variations that persist for an extended period, typically decades or longer. It includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature.

Climate change manifests in a number of ways. They include: changes in average climatic conditions – some regions may become drier or wetter on average; changes in climate variability – rainfall events may become more erratic in some regions; changes in the frequency and magnitude of extreme weather events and changes in sea levels. The rate and duration of warming observed during the 20th century are unprecedented. Increases in maximum temperature, numbers of hot days and the heat index have been recorded globally during the second half of the 20th century. The warming trend in the global average surface temperature is projected to continue with increases to a range of 1.4-5.8oC by 2100 in comparison to 1990. Since the early 1800s, when people began burning large amounts of coal and oil, the amount of carbon dioxide in the earth's atmosphere has increased by nearly 30%, and average global temperature appears to have risen between 1° and 2°F.

The single human activity that is most likely to have a large impact on the climate is the burning of "fossil fuels" such as coal, oil and gas. These fuels contain carbon. Burning them makes carbon dioxide gas. In addition, deforestation and de-vegetation remains an important potential factor in climate change.

Even if efforts to reduce greenhouses gas (GHG) emissions are successful, it is no longer possible to avoid some degree of global warming and climate change. The primary direct effects of climate change are an increase of droughts and floods, more seasonal peaks in river flow, and a higher probability of stronger tropical storms.

Countries in Sub-Saharan Africa, including Nigeria, are likely to suffer the most because of their geographical location, low incomes, and low institutional capacity, as well as their greater reliance on climate-sensitive renewable natural resources sectors like agriculture. The impacts of climate change on agriculture are projected to manifest through changes in land and water regimes, specifically, changes in the frequency and intensity of droughts, flooding, water shortages, worsening soil conditions, desertification, disease and pest outbreaks on crops and livestock.

Adaptation to climate risks and change therefore is increasingly important in developing countries. Building up resilience to increasing climate variability is the most significant climate challenge facing all countries, including Nigeria. Countries will need to factor climate risks and climate change adaptation into their developing planning, and consider the range of interventions that will increase their resilience to climate change.

Against this backdrop, the Seminar brings together researchers, policymakers and development practitioners to share informed opinions and experiences on the local manifestations of climate change and proffer ways to enhance policy and programmatic strategies and measures to mitigate its potentially negative impacts on livelihoods and sustainable development. The purpose of the Seminar is to increase stakeholder awareness on the local manifestations of the global problem of climate change, critically discuss community-level and policy-based climate change adaptation strategies and engender sustained attention to the development challenges which climate change poses to all stakeholders.

Based on the papers presented and the discussion by participants, the main observations of the Forum include:

1. Climate change is a global phenomenon which has huge implications for local people, their communities and their environments.

2. The framework for analysing the impacts of climate change extends beyond limited range of traditional environmental parameters to include microeconomic and economywide perspectives. This is because economic factors are implicated in both causes and consequences of climate change.

3. Human social and economic activities including deforestation, unsustainable agriculture, industrialisation and the production of energy have contributed significantly to global warming over time.

4. Among many other manifestations, global warming and its aftermaths have exposed many local communities to greater environmental risks such as flooding, drought, desertification, soil degradation, erratic rainfall patterns, heat stress, pests and diseases and others.

5. The environmental consequences of global warming are impacting negatively on livelihoods, employment and sustainable economies of local peoples.

6. Agriculture is a major victim of climate change impacts. The situation becomes more critical because agriculture contributes significantly to employment, livelihoods sustenance and poverty reduction in developing countries, including Nigeria.

7. At the economy-wide level, the effects of climate change could manifest in declining agricultural productivity and competitiveness, greater risks to human health, stymied prospects of increased employment, worsened poverty, diminished food security and conflicts of resource use.

8. Simultaneous measures should be taken at the household (micro) and national (macro) levels to mitigate the effects of climate change and manage adaptation mechanisms more efficiently and effectively.

9. At the household (micro) level, it is necessary to increase education, enlightenment and training on more efficient agricultural methods, less destructive/disruptive farming systems and viable agribusiness models.

10. Measures to enhance agricultural productivity through more efficient environmental-friendly technologies will alleviate the pressures to expand agriculture in unsustainable patterns.

11. There is need to explore and utilise alternative (clean) energy sources, to reduce environmental pollution and improve energy efficiency and sustainable energy production.

12. It is imperative to strengthen the mechanisms for constant tracking of climate change and its impacts across the country. Such tracking and monitoring mechanisms provide critical database upon which decisions can be made.

13. The Green Wall Sahara Nigeria Programme is crucial effort to combat environmental problems of drought, desertification and deforestation. The intensification of the programme will reverse the cycle of resource degradation, productivity decline and worsening poverty in local communities of affected areas.

14. The Climate Change Bill at the National Assembly is a welcome development. Stakeholders should assume their assigned responsibilities and functions under this legislative framework.

15. Effective collaboration and partnerships are critical to climate change adaptation, mitigation and management. There should be strong institutional collaboration and policy synergy between the Federal Ministry of Environment and Federal Ministry of Agriculture and Water Resources as well as with private sector and civil society organisations.

Climate Change and Sustainable Development in Nigeria: Conceptual and Empirical Issues

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Introduction: What is Climate Change?

Strictly speaking there is no such thing as a "normal" or average climate. For as the weather changes from day to day, so also does the climate change from year to year. These changes are however cyclical or largely unnoticed, except by climatologists. However, a situation in which a change in climate continues in one direction at a rapid rate and for an unusual long period of time (lasting for several years) is known as climate change. In the case of the present condition which we are experiencing, the foot print of this change is a steady and general increase of temperature.

Causes of Climate Change

There are three major causes of climate change. They include namely:

(a) Astronomical causes: These include; variations in the obliquity of the ecliptic; the eccentricity of the earth's orbit around the sun; precession of the equinoxes caused by the previous ones mentioned above; and the bombardment of the earth by extra-terrestrial objects.

(b) Volcanic eruptions.

(c) Changes to the earth's environment as a result of human socio-economic activities such as changes in the character of the earth's surface due to man's socio-economic activities e.g. deforestation, damming of rivers to create artificial lakes; addition of energy to the atmosphere by man's socio-economic activities e.g. combustion of fossil fuels such as petrol, diesel, coal; and changes in the composition of the earth's atmosphere by man's socio-economic activities such as gas flaring, bush burning, emission of gases by automobile exhausts.

All these have led to a build up of carbon monoxide (CO), methane (CH_4), sulphur (IV) oxide (SO_2) etc. These gases are collectively termed green house gases, because of their abilities to

absorb terrestrial radiation from the earth and re-radiating the heat back to earth, thereby leading to a general increase in temperature known as global warming.

In the general context of climate change in which our topic addresses, only the human causes are considered relevant.

Effects of Climate Change

The general environmental effects of climate change include; rise in sea level due to melting of ice caps, for example Antartica; changes in dates of onset and end of the rainy season; reduced rainfall amounts in some areas and increased rainfall amounts in others, leading to flooding; and increase in intensity of atmospheric disturbances such as thunderstorms and line squalls.

However, this paper will concentrate on the socio-economic effects of climate change. This will be discussed under the following major headings:

Climate Change and Energy

Most energy (electricity) production is by thermal means, i.e. burning of fossil fuels. Decisions related to the future production and use of energy will therefore be critical for the following considerations:

1. For the two billion people living without electricity, an increase in energy production is necessary to meet their basic needs (IISD, 2009).

2. Energy is also required to fuel economic development and to achieve and maintain a healthy standard of living in all countries, Nigeria included.

3. If greenhouse gas emissions from thermal electric generation remain at current levels the world could face an increase in average temperature of between 3^0 to 10^0 degrees Celsius.

4. Sea ice in the Arctic and Antarctica is already thinning and disappearing leading to a general rise in sea levels.

Climate Change and Resource Conflict

The complex chain of events that a warming climate could set in motion makes the global security picture 30 to 50 years from now a particularly challenging one for governments. Climate change leads to the continuing explosion in global demand for essential resources such as food, water and oil- coming just as our planet's ability to deliver many of these

materials is passing its peak. This scenario, in harness with the climate crisis, threatens to pose challenges to security of an order not previously faced in modern times (Moss, 2009). The death of more than 200,000 people in Dafur and displacement largely due to drought of around two million more may be seen as the world's first climate change war. Climate change and rising sea levels pose one of the biggest threats to security in the pacific (as well as Nigeria's coastal areas) and may also spark a global conflict over energy reserves under melting Arctic ice (Taylor, 2009). It will lead to an International race for undersea oil and gas deposits due to the melting of the Arctic Icecaps. Climate change will also lead to an increase in refugees from vulnerable lowlands and Islands due to rising sea levels. Finally, it could also lead to more illegal immigration and fishing, bringing disputes over access to scarce food resources.

Climate Change and Employment

The employment implications of climate change will lead to closing down some industries which exacerbate global warming. Many fishing communities along the west coast of Africa who are fully dependent on the fishing industry will now depend on government grants, child support grants, etc for their survival, due to the decline in the fishing industry.

The management of pollution, sanitation, waste disposal, water supply and public health, as well as provision of adequate infrastructure in urban areas, could become difficult and costly under changed climate conditions. A one-meter rise of the ocean will be tremendous in Africa. Nigeria's economic capital of Lagos would be under water, Alexandria, Egypt's second city, could be lost. Labour intensive African sectors would suffer. Oil production in the Niger Delta and elsewhere would be impaired (Mannak, 2007). The fertile Nile Delta would be lost to the advancing sea and another 10,000 hectares of productive crop land would be subject to erosion and salinization (Mannak, 2007). All these will affect the employment level in the country.

Climate Change and Livelihoods

Climate change threatens livelihoods along Africa's coasts. It will affect farmers, fishermen, hunters, and cattle-rearers. They will loose their sources of livelihoods following the impacts of climate change. The condition will further predispose them to hunger, sicknesses, resource over-exploitation and other social vices such as conflicts and militancy.

Climate Change and Poverty

Climate change is predicted to deepen poverty both directly and indirectly. The direct impacts include; the loss of life, livelihoods, assets, infrastructure, etc from climate extreme events. For example, following Hurricane Mitch in 1998, 165,000 people in Honduras fell below the poverty line. The poorest lost 18% of their assets; there was a 29% loss of crops and 20% of the hospitals and education centres were affected (World Bank, 2002). On the other hand, the indirect effects are predicated on economic growth. Continuing climate change variation is predicted to alter the sectoral origins of growth, including the ability of the poor to engage in the non-farm sector, as well as increase inequality, and therefore to reduce the elasticity of growth (ERM, 2002). A key milestone in defining the poverty impacts of climate change is the Third Assessment Report of the IPCC in 2001. This confirmed that the poorest (countries and people) are most at risk and identified a range of poverty-related climate change impacts to include:

1. Reductions in crop yield in most tropical and subtropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin America, many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even a small climate change. Fall in agricultural productivity of up to 30% over the 21st century are projected (Richards, 2003).

2. Such changes would have a major impact on food security, employment, incomes and economic growth. Reduction in crop yields can be expected to lead to localized food price rises.

3. There would be huge displacement of people from coastal and densely populated low-lying areas like the Mekong and Yangtze Deltas. Inundation would also result in salinisation of these fertile areas.

4. Exposure of millions of people to new health risks, especially from vector-based diseases like malaria and schistosomiasis, as well as water-born diseases like cholera and dysentery. Malnutrition from the reduction in crop yields would increase the severity of these diseases. Also, health impacts are likely to have an effect on growth (ERM, 2002).

5. Africa is particularly susceptible due to the desertification process, declining run-off from water catchments, declining soil fertility, dependency on subsistence agriculture, the prevalence of AIDS and vector-born diseases, inadequate government mechanism and rapid population growth.

Climate Change and Health

Health is closely linked to poverty, because poverty precludes most people from access to health care facilities. The aspects of health that will be exacerbated by climate change include; increased cases of cataracts (eye disease) in the northern parts of Nigeria due to low cloud cover and greater intensity of solar radiation; increased cases of malaria and typhoid due to increased rainfall and temperature in certain parts of the country; and increased cases of water-borne diseases such as cholera and dysentery due to urban flooding, and improper disposal of wastes.

Measures to Mitigate the Effects of Climate Changes

Available records show that the greatest concentrations of CO_2 which mainly cause global warming are due to the burning of fossil fuels, gas flaring and deforestation. This shows that human activities are mainly responsible for climate change. It means then that measures to mitigate the effects/impacts of climate change will involve mainly legislative and technological approaches. Unfortunately, most developing countries lack the technological capabilities to deal with this issue. Even when the bills are passed there are often implementation problems due to unnecessary bureaucracy.

In the case of Nigeria, mitigation measures should include:

1. Re-building and re-introducing rail transport in order to reduce the present massive use of long distance travel using Lorries, trucks, buses, et cetera.

2. Rearranging urban transportation to introduce car-free zones and urban mass transit systems in our cities.

3. Massive electrification of the entire country to reduce the use of generating sets. Attention should be turned to nuclear, solar and hydro energy.

4. Putting an immediate end to the present illegal practices of gas flaring in our oil fields in the Niger Delta. This can be achieved by gas re-injection and provision of very strict penalties to erring oil exploring firms.

5. Establishing a nation-wide programme of re-afforestation and planting of wind breaks to create shelter belts in the northern areas.

References

Afro-Archives (2009). Climate Change will affect Employment in Africa. International Confederation of Free Trade Unions.

Environmental Resources Management (ERM) (2002). Predicted Impact of Global Climate Change on Poverty and the Sustainable Achievement of the Millennium Development Goals. *Report Prepared for DFID by Environmental Resources Management*.

European Trade Union Confederation (ETUC) (2009). Study on Climate Change and Employment.

International Institute for Sustainable Development (IISD) (2009). Climate Change and Energy. Supporting the Transition to a clean, secure and sustainable future.

IPCC (2001). Impact, Adaptation and Vulnerability. Contribution of Working Group II of the Intergovernmental Panel on Climate Change to the Third Assessment Report of IPCC. London: Cambridge University Press.

IPCC (2007). Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change to the Third Assessment Report of IPCC. London: Cambridge University Press.

Mannak, M. (2007). Environment**;** Climate Change Threatens Livelihood along Africa's Coast.

Moss, T. (2009). Climate of War; Climate Change and Resource Conflict.

NBER (National Bureau of Economic Research) (2003). Climate Change and Economic Growth over the Last Half Century.

Richards, M. (2003). Poverty Reduction, Equity and Climate Change. Global Governance Synergies. *Oversea Development Institute*. Globalization and poverty Programme.

Taylor, R. (2009). Climate Change threatens Pacific, Artic Conflicts. Lanberra (Reuters).

World Bank, (2002). *The Environment and the Millennium Development Goals.* Washington D.C.: The World Bank.

Implications of Climate Change for National Development – The Way Forward

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Abstract

There is no doubt that the global climate in changing. These changes have been attributed to natural variability and human activity on the environment. As a result, gases termed as greenhouse gases are emitted into the atmosphere and cause global warming. The paper sought to describe using illustrations, the processes that lead to climate change so as to enable a better understanding of the concept. It described in details the impacts of climate change on various issues of national development such as low agricultural productivity, food insecurity, resource conflicts, unemployment, environmentally-induced migration, livelihood problems and health issues. These impacts are as a result of devastating effects of flooding, drought, erosion, desertification, sea level rise, heat stress, pests and diseases, erratic rainfall patterns, etc which are all due to climate change. The paper further emphasized the need for climate policy in Nigeria, the establishment of Nigerian Climate Change Commission (NCCC), the development of a national framework for climate change adaptation, and the embracing of emerging technologies among others. It showcased the new role of agricultural extension in the face of climate risk management. These include awareness creation, mobilization, training, assistance, and dissemination of proven measures of mitigation/adaptation to climate change among vulnerable communities in Nigeria.

Introduction

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet today (Ozor, 2009). According to IPCC (2007), the changes in climate are attributed directly or indirectly to human activities and alter the composition of the global atmosphere over comparable time periods. These changes occur due to variations in different climate parameters such as cloud cover, precipitation, temperature and vapour pressure, etc (Federal Ministry of Environment, 2003).

Agriculture contributes about 40% to Nigeria's Gross Domestic Product and production in most of the sectors is dependent on weather and climate (Ozor, 2009). The onset of rains for

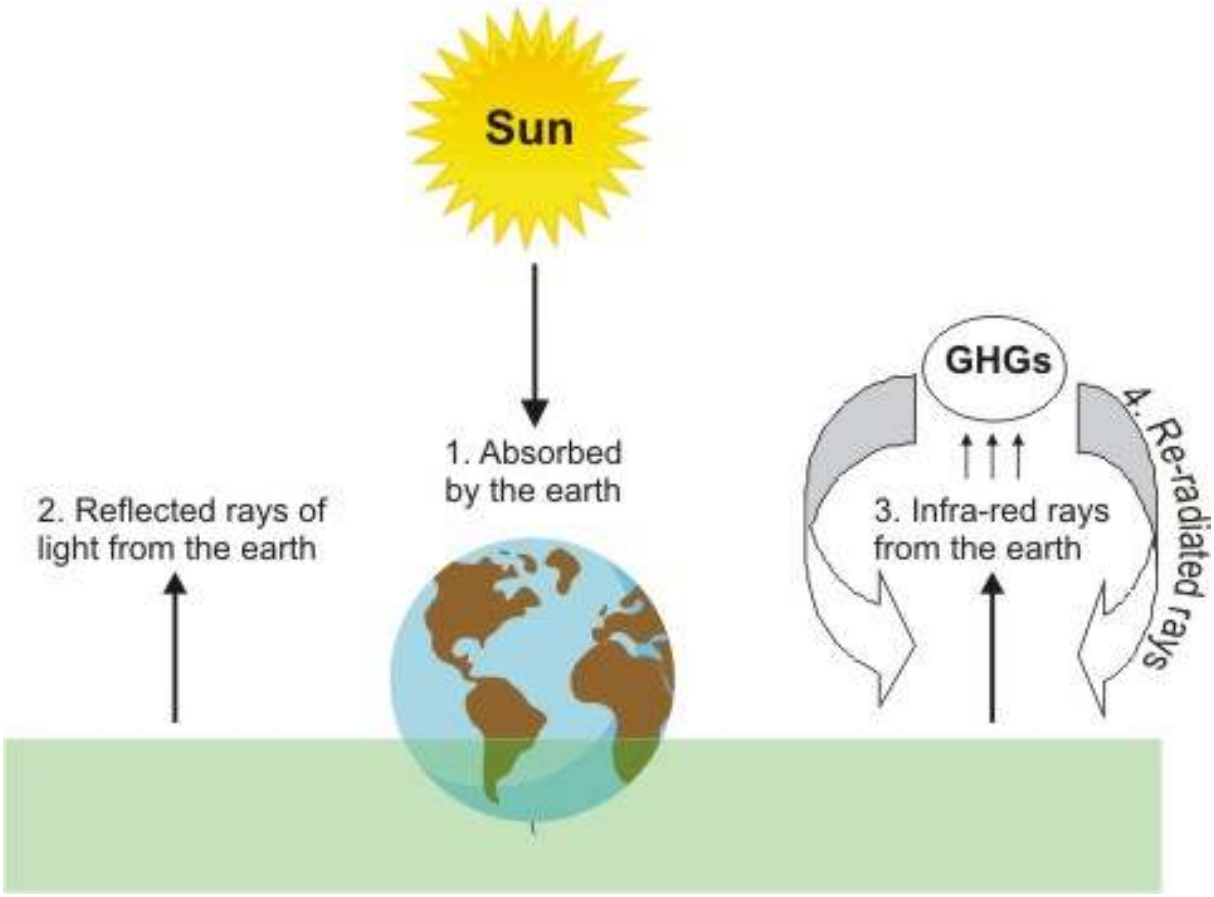
instance signals the beginning of crop production activities (Nnamchi and Ozor, 2009). Therefore, given that agriculture in Nigeria is largely non-mechanized, weather/climate assumes significance in every phase including the timing of cultivation, planting and harvesting operations, variety selection and transplanting (Odekunle, 2004; Adejuwon, 2006; Nnamchi *et al.,* 2009). Farmers have then learnt to 'follow' the weather/climate pattern as a major determinant for their farming operations.

Unfortunately, the weather/climatic conditions are no longer the same as it used to be. Farmers have been misled and often threatened by the uncertainties in rainfall pattern, temperature increases, sea level rises, prolonged drought, desert encroachment, flooding, erosion, crop failures, low productivity, pest and diseases just to mention a few. Research and observations have confirmed that these uncertainties are linked with changes in climate. The changes in climate are as a result of astronomical causes, volcanic eruption and most importantly, human activities. All these have led to a build up of carbon IV oxide (CO2), carbon monoxide (CO), methane (CH_4), sulphur IV oxide (SO_2), etc which are collectively known as greenhouse gases (GHG).

What turns up the heat? What are the implications of climate change for national development? And what is the way forward? The paper seeks to provide answers to these unassuming questions.

What turns up the heat?

The earth is getting warmer and human beings are mainly to blame (Spore, 2008). Scientists earlier noted that the rapid warming in the last several decades is due mostly to human-induced changes to the atmosphere, on top of some natural variations (Pittock, 2005). Human beings are blamed because of the changes in the character of the earth's surface due to man's socio-economic activities such as deforestation, cropping, irrigation, damming of rivers to create artificial lakes, farm animals and the destruction of carbon rich soils. They are also blamed because of their addition of energy to the atmosphere through combustion of fossil fuels such as petrol, diesel and coal. They are also blamed through the changes in the composition of the earth's atmosphere by man's socio-economic activities such as gas flaring, bush burning, manufacture of cement from limestone and emission of gases by automobile exhausts. All these activities leads to the production of gases referred to as the greenhouse gases (GHGs) (Ozor and Fodeke, 2009). They include carbon IV oxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).



A quick explanation of how weather patterns work will lead to easier understanding of the concept of climate change. According to Spore (2008) each day, the sun emits rays of light onto the earth's surface. The earth absorbs part of the heat, reflects another share into the atmosphere and sends out a third share in the form of infra-red rays. These rays are cushioned by the clouds and water vapour, which stabilizes the earth's temperature under normal circumstances. The problem we are facing today is that the concentration of GHGs produced by human activity has increased significantly. The gases absorb the terrestrial radiations from the earth and re-radiate the heat back to earth, thereby leading to a general increase in temperature known as global warming (Fig. 1). This is the infamous greenhouse effect, a phenomenon first explained in 1824 (Spore, 2008).

Figure 1: Radiation processes that lead to climate change

Impacts of climate change on national development

Global climate change is a threat that is already having initial tangible impacts upon humankind and nature today (German Advisory Council on Global Change (WBGU, 2003). Reports show that USA and Europe account for more than half of global GHG emissions, sub-Sahara 1.59% and the small island States 0.37% (Spore, 2008). Unfortunately, the

impacts of climate change on livelihoods and agriculture in countries of the South (including Nigeria) are inversely proportional to the nation's responsibility for the problem. This is because the GHGs know no borders. In other words, countries that significantly contribute to climate change (North) do not suffer much from its effects because of their natural advantage, wealth statuses, high adaptation strategies, high technologies, and stable polity. The opposite is the case for countries in the South who are disadvantaged because they already have high temperatures, they are relatively poor, have very low adaptive capacities amidst low technologies, and intermittently suffer from political instability.

Over the past few years, Nigeria like many other African countries has been beset by a lot of climate anomalies. Consequences of extreme climate events due to global warming have been so dramatic that there has been considerable and disturbing concern among various governments and peoples in the country. The variation in weather and climate has led to a lot of devastating consequences and effects in various parts of the country. These include flooding, desertification, erosion, drought, sea level rise, heat stress, pests and diseases, erratic rainfall patterns, and land degradation. More specifically, the Southsouth geopolitical zone is mainly affected by sea level rise and deforestation-induced changes; the Southwest zone also is affected by sea level rise and deforestation-induced changes; Southeast by erosion, flooding, and land degradation; North-central by changes due to de-vegetation and overgrazing; Northeast by drought, desertification and heat stress; and Northwest also by drought, desertification and heat stress.

Besides the effects on ecology and biodiversity, the above mentioned effects of climate change will have devastating impacts on many vulnerable communities in Nigeria such as farmers, pastoralists, foresters, fisher folks and hunters. The observable impacts include low agricultural productivity, food insecurity, water stress, low income, poverty, unemployment, resource conflicts, environmentally-induced migration, hunger and starvation, health problems, violence, and the ultimate price- death. All these conditions impact negatively on national development. A more detailed picture of the issues is given below:

Impacts on agricultural productivity and food security: With increasing incidences of flooding, erosion, bush burning, pests and diseases, increased temperature, erratic rainfall, and drought, it is less difficult to believe that agricultural productivity under these circumstances will be very low. Consequently, the low yield will change the supply and demand pattern, and thus the commodity prices, the profitability of farming, and the affordability of food, food security, and human health. According to Pittock (2005), the impacts of climate change on food production, prices and food security depend on regional climate change, biological effects of increasing atmospheric carbon dioxide, changes in floods, droughts and other

extreme events, existing agricultural systems, adaptive capacity, changes in population, economic growth and technological innovation.

Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) requires 'ensuring that food production is not threatened'. In assessing the climate change impacts on food production, the adaptive capacity of agricultural systems has to be taken into consideration (WGBU, 2003). This capacity differs substantially between regions. Unfortunately, the regions affected most are the ones with the least adaptive capacity – i.e. the developing countries (IPCC, 2001).

More than 850 million people worldwide are undernourished (German Advisory Council on Global Change WBGU, 2007). This situation is likely to worsen in future as a result of climate change, as food insecurity in many developing countries like Nigeria, will increase with a temperature rise of just $2^{o}C$ (relative to the 1990 baseline). With global warming of 2-$4^{o}C$, a drop in agricultural productivity is anticipated worldwide with more devastating effects in the tropics because crops are often close to their thermal optimum in the region (WBGU, 2003). This trend will be substantially reinforced by desertification, soil salinization or water scarcity. Already in many African countries, the areas suitable for agriculture are largely exploited. This may trigger regional food crises and further undermine the economic performance of weak and unstable states like Nigeria, thereby exacerbating destabilization, the collapse of social systems, and violent conflicts.

The expected changes in crop development and phonology can cause shortening or lengthening of crop cycles that could lead to decreases or increases in productivity. Structural changes, especially in carbohydrate status of plants can also occur. This may affect the nutritional value, taste and storage quality of some fruits and vegetables. Increases in CO_2 can also lower crop water requirements by reducing transpiration per unit leaf area.

Heavier than normal rainfall in the southern part of the country would lead to destruction of crops in the field, greater post-harvest losses, loss of arable land and increased growth of weeds. Significant reduction of rainfall in the Sudan-Sahel belt would make the region drier with consequent reduction in crop productivity. Decreased rainfall in the region would also reduce the primary productivity of the grassland areas in which livestock production is currently important. It would also have significant effects on the ecosystems; new eco-climatic environment for livestock would emerge, possibly shifting towards the coast in many parts of the country.

The livestock production systems in Nigeria would be vulnerable to climate change in respect of anticipated decrease in rainfall in Sudan-Sahelian zone and consequent reduction in the available pastureland; 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 to increase in temperature and evaporation in the face of reduced rainfall. Climate change leads to decrease in livestock production resulting in an impaired availability of animal protein including meat, egg, milk and animal products such as hides and skins. These have implications for food security.

Fishing, fish farming and fish processing and trading are important sources of revenue, employment and proteins in Africa, with estimated 10 million people depending on them in some way or the other (UNEP, 2007). Fishery resources are of particular importance in Nigeria as they provide a considerable amount of dietary protein in the country. Subtle changes in key environmental variables such as temperature, salinity, wind speed and direction, ocean currents, strength of upwelling due to climate change could sharply alter the abundance, distribution and availability of fish population in the country. Changes in ocean dynamics could lead to changes in migrating patterns of fish and possibly reduced fish landings especially in coastal fisheries (African Action, 2007).

Indirect effects of climate change on agriculture include effects on pests and diseases and the impacts of these on agricultural production. It is thought that various pests including the tobacco cut worm, rice sting bug, rice weevil and soybean pod borer would probably expand their distribution areas in the events of climate change. Also, an increase in the frequency of extreme events such as prolonged drought or intense flooding could create conditions that could be conducive to disease or pest outbreaks and severely disrupt the predator-prey relationships that normally restrict the proliferation of pests. Warmer and more humid conditions could enhance the growth of bacteria and mould on many types of stored foods, and this would increase food spoilage and create some specific toxicological health hazards.

Sea levels around Africa are projected to rise by 15 – 95cm by the year 2000 (IPCC, 2001). The rise in sea level in Atlantic Ocean may have catastrophic impacts on large coastal cities such as Banju (Gambia), part of Lagos (Nigeria) and Alexandria (Egypt) (Nichols and Tol, 2006). Sea level rise would lead to submergence of the lowlands along the coast and much of the land currently used for agriculture would be lost leading to socio-economic and socio-cultural problems.

Resource conflicts: Climate change is anticipated to increase conflicts as a result of struggles for resource use. The increasing supply and demand for resources such as food, water, oil, etc cannot be further assured with the inability of the climate to support its provision apart from other pressures coming from population growth. Evidences abound in Nigeria between the Fulani cattle rearers and the farming communities in Nigeria for struggle over graze land and water bodies especially. For example, the Mutumbiu and Mambila highlands in Taraba State,

and the Fufore community in Adamawa State (Ozor, 2009). These crises have led to several deaths of farmers and pastoralists in the region.

Also, the drying of streams and rivers (Fig. 2) in some communities due to climate change ultimately lead to their search for water in neighbouring communities with its attendant man hour losses, propensity to trigger conflicts and hardships on the people.

Figure 2: Farmers at Umulumgbe showing part of the Okeze Stream that is gradually drying up (DelPHE 326 research photo by Dr. Nicholas Ozor, 2009)

The situation could worsen for more millions of people as climate change alters the variability and quantity of available water. At the same time, the demand for water is increasing due to the country's growing population and its mounting aspirations. This situation triggers distributional conflicts and poses major challenges to water management systems in Nigeria. Nigeria will be hit in water stress because of our inadequate political and institutional framework necessary for the adaptation of water and crisis management systems.

Impacts on livelihoods: Peoples' means of sustenance will be threatened with the increasing effects of climate change. With low yields in crops and animals, farmers' income will diminish and their ability to meet household needs (food, feed, fibre, fun, income, etc) will be difficult. The oceanic acidification and increase in surface water temperature, especially around the coast, will affect fish stocks and as a result, threaten the livelihood of small-scale fishing communities in the area. Reports of the IPCC (2007) show that climate change will pose great threats to communities that depend on fishing for their survival. The loss of lives, livelihoods, assets, infrastructure, etc from climate extreme events will further deepen the vulnerability of the poor.

Models indicate that for a 1^{o}C warming a significant number of developing countries appear likely to experience net losses (WBGU, 2003). The projected distribution of economic impacts is such that it would increase the socio-economic disparity between developing countries and developed countries, with disparity growing in step with warming, as impacts will fall disproportionately upon developing countries and the poor persons within them.

Impacts on employment: There is no doubt that jobs will be lost as a result of the looming danger of climate change. This will further over-stretch the unemployment rate in Nigeria. Firstly, industries that depend on agricultural products, fisheries and livestock for their raw material supply will receive the initial blow. They will be forced to cut down their employees in the short run in order to accommodate the reduction in scale of operation. At the long run, such industries might fold up if nothing is done to reverse the situation. Again, closing down industries that contribute to global warming will make more people to be unemployed. Furthermore, climate change will lead to reduction in stream flows which will cause reduction in hydropower production, leading to negative effects on industrial productivity and costly relocation of some industrial plants. This will have effects on employment and income.

Environmentally-induced migration: The effects of climate change are certain to displace some categories of people. The number of environmental migrants will substantially increase in future due to the impacts of climate change (WBGU, 2007). In developing countries like Nigeria, the increase in drought, soil degradation and growing water scarcity in combination with high population growth, unstable institutions, poverty or a high level of dependency on agriculture means that there is a particularly significant risk of environmental migration occurring and increasing in scale (WBGU, 2007). For instance, people living in low lying islands and Deltas face the threat of being submerged by water, hence the only coping strategy will be to move out of the risk sites to more habitable areas (Ozor, 2009). This movement will greatly affect such people in many ways such as loss of their livelihoods, loss of social systems and values, loss of property and age-long acquired wealth, injuries and sometimes death. At the transit and destination points, it might generate conflicts of different dimensions, hunger and starvation, and health problems, including epidemic. This situation is worsened where there are no effective and efficient emergency management services to take care of the displaced people. In Nigeria, officials of such agencies have been accused of even diverting the goods and services meant for the people in trouble to other sources for their personal gains.

Impacts on health: According to WBGU (2003), health is important in climate change debate for three reasons: a) health is recognized by all cultures, religions, states and social groups worldwide as an asset worthy of protection; b) health is affected by all drivers of global environmental change; and c) a population's state of health can be used as an indicator

to measure the impacts of climate change (Krafft et al., 2002), in a manner comparable to the key role of health within the Human Development Index (HDI). There is no doubt therefore that climate change will induce health problems as a result of such factors like hunger and starvation, water stress, pests and diseases, resource conflicts, injuries and stress from extreme weather events. Besides, health has a direct implication on agricultural productivity.

According to Pittock (2005), climate change will increase threats to human health thereby affecting their productivity. Already, a study by the World health Organization shows that climate change is the cause of 150,000 deaths every year (WBGU, 2003). Campbell-Lendrum et al. (2003) have estimated the health impacts of climate change to include malaria, malnutrition, diarrhea, and flood related accidents. They estimated an annual health impact of 5.5 million DALYs (Disability-Adjusted Life Years). This represents the loss of healthy or productive life years (WHO, 2002). This cumulative measure has been developed as an indicator of a population's total disease burden (premature mortality, disease and disability). Results showed that the greatest health burden arising in the regions where vulnerability and population growth are greatest were in sub-Saharan Africa and south Asia (WBGU, 2003).

Detailed analysis of the health damage triggered by climate change permits a distinction between direct and indirect impacts (IPCC, 2001). Direct impacts include, for instance, the effects of extreme weather events (e.g. cardiovascular disease, asthma) or weather-related disasters (e.g. coastal or inland flooding and landslides). However, the greatest health damage arises through indirect effects, as in the case of vector-borne infectious diseases (e.g. infections caused by mosquitoes, ticks or flies). The IPCC predicts that by 2080, about 260-320 million more people will be exposed to malaria worldwide (IPCC, 2001). Dengue fever or tick-transmitted meningitis are also vector-borne infectious diseases that can be influenced by climate change

Implications of climate change for policy

There is urgent need for climate policy at the global, regional, national, and local levels in order to avert the imminent dangers of climate change. It is assumed that without more intensified mitigation efforts, by the end of the 21st century, globally averaged surface temperatures will rise by 2-7^{o}C relative to the pre-industrial value. This depends on the amount of GHGs emitted into the atmosphere and the uncertainties in the climate system. A successful climate policy then becomes preventive as experts have noted that if the rise in globally averaged surface temperatures does not exceed 2^{o}C relative to the pre-industrial value, the climate-induced threat to the international security would be averted (WBGU, 2007). In the event of the mitigation efforts failing, it is anticipated that climate-induced security risks will greatly manifest in various regions of the world from around 2025-2040.

The key challenge is to take resolute climate change policy action urgently in order to avert the socioeconomic distortions and security of the world at large. The Kyoto protocol was a step in the right direction. In this protocol, 30 industrialized countries pledged to cut their emissions of six GHGs by 5.2% (compared with 1990 levels) by 2012. The question now is how have they complied with this agreement? From recent investigations and reports, the answer is not yet in the affirmative.

Nigeria has no climate change policy and bills to enhance good practice for sustainable environment are not yet implemented. For instance, the deadline to stop gas flaring in Nigeria was moved from 2008 to 2009 and then 2011. These inconsistencies in policy implementations are not helpful especially with the excruciating effects/impacts of climate change. Nigeria therefore needs to make climate change policy in line with the international provisions (Ozor, 2009).

Implications of climate change for agricultural extension

Agricultural extension has been defined as a series of embedded communicative interventions that are meant, among other things, to develop and/or induce innovations which supposedly help to resolve (usually multi-actor) problematic situations (Leeuwis, 2006). This definition confers to agricultural extension the mandate to accommodate issues of climate change in its duties so long as it will impact on varied ranges of its clientele which include farmers, pastoralists, fisher folks, hunters, blacksmiths, and other small-scale entrepreneurs in local communities (Ozor, 2009). However, in order to achieve results, there is need for change in roles and capacity in the extension system so as to accommodate the new dimensions brought about by climate change.

Firstly, staff of extension organization need to be re-trained so as to acquire necessary skills and knowledge in climate risk management. They have to be aware of the immediate and remote causes of climate change, its effects, and the local knowledge and practices used by communities to mitigate or adapt to climate change (Ozor and Umehai, 2009). This will enable them know how to apply the necessary interventions in order to scale up or replicate coping/adaptation strategies (Ozor, 2009).

With the mandate to change the livelihoods of rural people out from peasantry and low productivity, agricultural extension sets to transform rural communities through the transfer and dissemination of relevant/improved agricultural technologies. Their training role will empower vulnerable communities to take actions that will enable them acquire the capability to deal with issues of climate change. Extension can achieve this feat using many strategies such as information exchange with people at climate risk sites; information on early warning systems for agricultural production; training of local people on tested measures for mitigation

and adaptation to the effects of climate change; and assistance in disaster/conflict situations. They can encourage the formation of farmer groups, cooperative organizations, and young farmers clubs which has multiple benefits of not only achieving economy of scale, and access to credits and inputs among other things, but can lead to the formation of veritable climate action groups for sustainable development.

Conclusion and way forward

The paper described what climate change is all about. It portrays climate change as change in climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural variability observed over comparable time periods (IPCC, 2007). Such changes were attributed to the emission of gases known as greenhouse gases mainly; CO_2, CO, CH_4, N_2O, HFCs, PFCs, and SF_6 into the atmosphere. These gases trap the terrestrial radiations from the earth and re-radiate the heat back to earth, thereby leading to a general increase in temperature known as global warming. The paper further described the effects of climate change to include flooding, drought, erosion, desertification, sea level rise, heat stress, pests and diseases, erratic rainfall pattern among others. These effects will undoubtedly impact on national development in the following ways; low agricultural productivity, food insecurity, resource conflicts, poverty, unemployment, environmentally-induced migration, health issues and livelihood problems. The paper then suggests appropriate climate policy at national and local levels as the first step towards dealing with climate change problems. Similarly, the paper underpinned the new role of agricultural extension in the transfer of improved knowledge and practices aimed at climate risk management.

Some recommendations

The paper recommends the following measures to enhance better understanding and capability in dealing with climate change issues in Nigeria.

- A bill for the establishment of National Climate Change Commission (NCCC) in Nigeria with the mandate to deal with all climate change issues.
- Commission a National Benchmark Survey (NBS) to identify the remote and immediate causes of climate change, its effects, local knowledge and practices across our six geopolitical zones.
- Develop a National Adaptation Framework (NAF) for all the geopolitical zones in Nigeria. This will include plans for resettlement of victims of environmentally-induced migration, resource conflicts, and crime and violence associated with climate risks. It will also include requests from developed countries for

compensations/preferential supports for vulnerable countries that produce less of the GHGs but are mostly affected by its effects.

- Pursue vigorously the ban on gas flaring at the National Assembly.
- Partnerships between governments and other stakeholders including NGOs, CBOs, farmers, private sectors, and local communities to ensure a win-win situation against climate risks.
- *Going green*. This implies the use of environmentally-friendly equipment, machines, infrastructure, and technology that produce less of the GHGs. For example, improvement in rail transport, use of bio-fuels, and energy saving devices among others.
- Embracing emerging technologies such as biotechnology and nanotechnology. According to WBGU (2003), the use of specially designed genetically modified organisms could be a way to increase the adaptive capacity of crops.

References

Adejuwon, J.O. (2006). *Food security, climate variability and climate change in sub-Saharan West Africa.* Assessments of Impacts and Adaptations to Climate Change (AIACC), Project No. AF 23 A Final Report, AIACC Project Office, Washington, D.C.

Africa Action (2007). Africa Policy e-Journal. Available at http://www.africaaction.org (12/11/07).

Campbell-Lendrum, D. H, Pruss-Ustun, A. and Corvalan, C. (2003). How much disease could climate change cause? In: A. J. McMichael, D. H. Campbell-Lendrum, C. Corvalan, K. Ebi, A Githeko, J. Scheraga and A. Woodward (eds) *Climate Change and Health: Risks and Responses*. WHO, Geneva.

FAO (2007). Adaptation to climate change in Agriculture, forestry and fisheries: Perspective, Framework and priorities. Rome. Available at: www.fao.org/icatalog/inter.e.htm (13/11/07).

Federal Ministry of Environment (FME) of the Federal Republic of Nigeria, (2003). Nigeria's First National Communication under the United Nations Framework Convention on Climate Change.

German Advisory Council on Global Change (WBGU) (2003). *Climate Protection Strategies for the 21st Century: Kyoto and beyond*. Special Report. Berlin, Germany, WBGU: 1.

German Advisory Council on Global Change (WBGU) (2007). *World in Transition: Climate Change as a Security Risk*. Berlin, Germany, WBGU: p13.

Intergovernmental Panel on Climate Change (IPCC) (2007). Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change to the Third Assessment Report of IPCC. London: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC) (2001). Impact, Adaptation and Vulnerability. Contribution of Working Group II of the Intergovernmental Panel on Climate Change to the Third Assessment Report of IPCC. London: Cambridge University Press.

Krafft, T., Bissel, R. and Rosenberg, M. (2002). *Health and the Environment. A Cross Cutting Issues in Global Change Research*. German National Committee for Global Change Research (NKGCF), Munich.

Leeuwis, Cees (2006). Communication for Rural Innovation: Rethinking Agricultural Extension, 3rd ed. The Netherlands: Blackwell Publishing p.27.

Nnamchi, H.C., Anyadike, R.N.C. and Emeribe, E.N. (2009). "Spatial Patterns of Twentieth Century Mean Seasonal Precipitation over West Africa". *Nigerian Journal of Space Research. Vol. 6, (in press*).

Nnamchi, H.C. and Ozor, N. (2009). "Climate Change and the Uncertainties Facing Farming Communities in the Middle Belt Region of West Africa". Paper presented at the 7th International Science Conference on the Human Dimensions of Global Environmental Change (IHDP Open Meeting 2009) held at the United Nations University, Bonn, Germany between 26 April and 1 May.

Nicholls, R.J. and Tol, R.S.J. (2006). Impacts and Responses to Sea Level Rise: a Global Analysis of the GRES scenarios over the twenty-first century. Philosophical Transactions of the Royal Society 364: 1073-1095.

Odekunle, T.O. (2004). "Rainfall and the Length of the Growing Season in Nigeria". *International Journal of Climatology.* 24, pp. 467-479.

Ozor, N. (2009). "Understanding Climate Change: Implications for Nigerian Agriculture, Policy and Extension". Paper presented at the National Conference on "Climate Change and the Nigerian Environment", organized by the Department of Geography, University of Nigeria, Nsukka, 29 June – 2 July.

Ozor, N. and Fodeke, V. (2009). "The Role of the Designated National Authority (DNA) Capacity Building". Paper presented at the 2009 Africa Energy Week titled "Energy, Economy, and Environment" which held in Cape Town, South Africa from 6-10 July.

Ozor, N. and Umehai, M.C. (2009). **"**Effects of Climate Change on the Livelihoods of Wetland Inhabitants in Nigeria – A Review". Paper presented at the National Conference on "Climate Change and the Nigerian Environment", organized by the Department of Geography, University of Nigeria, Nsukka, 29 June – 2 July.

Pittock, A.B. (2005). *Climate Change: Turning up the Heat*. London: Earthscan: pp.1-23.

Spore, (2008). Climate Change. A Bi-monthly Magazine of the Technical Centre for Agricultural and Rural Cooperation (CTA). Wageningen.

United Nations Environmental programme UNEP (2007). "Global Environmental Outlook". *Environment for Development* Kenya, p 540.

World Health Organization (WHO) (2002). World Health Report 2002: Reducing Risks, Promoting Healthy Life. WHO, Geneva.

Climate Change and Sustainable Development in Nigeria: The Mitigating Role of Green Wall Sahara Nigeria Programme

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Abstract

The contemporary world today is paying the prize of industrialization and unwholesome human activities that are manifested in form of climate change. This is all about global warming, and global warming has now been elevated to a global warning. The time to take heed of this warning is now. The paper examined the threats presented by changes in climate all over the world with particular reference to developing countries (Nigeria) where agriculture is a dominant sector and depends on weather and climate. The paper further used the sustainable development model in the form of the Green Wall Sahara Nigeria Programme (GWSNP) as a strategy for greening the drought-prone and desert infested areas of Northern Nigeria (11 States). The paper concludes with the assertion that the challenges of climate change to economic growth and sustainable development in Nigeria require creative thinking, holistic ideas, innovative solutions and the involvement of all stakeholders.

Introduction

After nearly two decades of scepticism, climate change is now in the front burner as the primary environmental threat of the 21st Century, it has even been elevated as a global political agenda as never before (Oladipo, 2008). Besides potential devastating effect of climate on sustainable livelihood, there is now an overwhelming evidence of optimism that out of the bad situation, good opportunities abound to enhance human well-being. Given the global scale and impacts of climate change and the expected severity impacts for many developing counties, climate change warrants, and is increasingly receiving great attention from development policy-makers and practitioners (IPCC, 2007).

Climate change is a serious threat to poverty reduction and sustainable development all over the world especially among developing countries (Nigeria inclusive). Nigeria has a large population directly depending on climate-sensitive economic and development sectors (agriculture and fisheries) and natural resources (such as water, biodiversity, grassland) for their sustenance and livelihoods (Nigeria's First National Communication, 2003). In addition, the adaptive capacity of the rural majority to climate change impacts is very low. Unfortunately, most current development strategies in the country tend to overlook climate

change risks. The costs of not addressing climate change or to adapt to it are very uncertain but, their welfare consequences are expected to be enormous.

This paper sought to underpin the benefit of adopting a sustainable greener approach to mitigating climate change through the Nigeria's Green Wall Sahara Programme. It also identified the expected impacts of climate change in Nigeria.

Concept of Sustainable Development

The term "Sustainable Development" was brought into common use by the World Commission on Environmental Development (The Brundtland Commission) in 1987, calling for development that "meets the needs of the present generation without compromising the needs of future generations". The Brundtland Commission Reports highlighted the need to simultaneously address developmental and environmental imperatives. Since then, substantial work has been undertaken to draw out the operational implications of the concept of sustainable development. This was the main theme of the World Bank Development Report 1992. The banks current work is not to generate theory of sustainability but rather to make concerted effort to integrate the viewpoints of three disciplines: economics, ecology and sociology (Serageldin and Steer, 1994). The economists seek to maximize human welfare within the constraints of existing capital stock and technologies; the ecologist stress preserving the integrity of ecological systems viewed as critical for the overall stability of the global ecosystem; the sociologist emphasizes that the key actors in development are human beings whose patterns of social organization were crucial for devising viable solutions to achieving sustainable development.

Figure 3: Viable solutions towards achieving sustainable development

In other words, the sustainable development hub seeks to promote prosperity (economic objectives) through growth, equity, and efficiency in all sectors of development. It seeks to support a people (social objectives) through empowerment, participation of all stakeholders, social mobility, cultural identity, and various institutional developments. Finally in the tripod, it seeks to maintain the planet (ecological objectives) through improving the state of the ecosystem, biodiversity conservation, ensuring adequate carrying capacity and responding in sustainable manners to other global issues.

In 1992, the United Nations Conference on Environment and Development (UNCED) - the Earth Summit in Rio de Janeiro drew a clear message that without better environmental stewardship, development will be undermined and without accelerated development in poor countries, environmental policies will fail. In sub-Saharan Africa for instance, "slash and burn" (bush burning) in the face of rising population growth are creating vicious cycles of soil degradation and impaired productivity.

The 1997 Kyoto Treaty on world climate change to cut gas emissions, and UN's World Summit on sustainable development held in Johannesburg South Africa in 2002 also emphasized the need for increased effort to support sustainable development in the world. At Johannesburg meeting, an opportunity was to build a more secure future, by embracing a more sustainable form of development that will improve lives today and build a better world for our children and grand children.

Indicators of Sustainable Development

The definitions of sustainable development have a number of common elements, which can be used to indicate issues (and practices) of sustainable development (Onuoha, 2008a). This is the Natural environment and its resources (both renewable and non-renewable). The natural environment and its resources are impacted upon by people who utilize them for and in their day-to-day living. This concept naturally involves economic process (the utilization of natural resources and the manner it is done), a social process (the interactional relationship formed in the course of the utilization of the resources) and a political process (the type of order and form of governance brought to bear on the course of the utilization of the resources).

Sustainable development therefore, would deal with improving the quality of human life in the following ways:

(i) Economically viable way such as:

(a) Minimizing use or waste on non- renewable resources including minimizing the consumption of fossil fuels and substituting with renewable resources where feasible. Also by reducing use, reusing, recycling and reclaiming scarce mineral resources.

(b) Sustainable use of renewable resources – including using fresh water, soil and forests in ways that ensure a natural rate of recharge.

(c) Keeping within the absorptive capacity of load and global sinks for wastes – including the capacity of rivers to break down biodegradable and the capacity of global environmental system to absorb green house gases.

(ii) A socially desirable way such as reducing population pressure on resources (like food and water), regulating population growth rate, checking incidences of pests and diseases, enhancing the fulfilment of the people's cultural and spiritual needs.

(iii) A politically effectual way of achieving sustainable development is predicated on good governance. This would mean involving the people right down to the grassroots in making decisions that impact directly on their lives and interests, in a transparent and accountable manner that will make for stability and unity of the policy and that would enhance the realization of the plans and set targets. Agricultural extension service with the mandate of working with the local people can stimulate this process and ensure that local people are empowered to action in becoming self reliant.

Impacts of Climate Change on Nigeria's Sustainable Economic Growth and Development

Here we are referring to what Nigeria has lost over the years from renewable and non-renewable natural resources as a result of climate change (global warming) (Eboh *et al.,* 2006). For renewable natural resources, up to 50% of forest/woodland is estimated to have been lost over the past 4 -5 decades. The Land Use and Vegetation (LUV) data from 1976/1978 to 1993/1995 reveal a decline in savannas and other grazing lands from 50% to 42% of total Nigerian territory (Eboh *et al.,* 2006). During the subsequent decade, another 6-8% point of rangelands might have been lost to crop cultivation and other land use. Moreover, the LUV data reveal severe losses in savannah vegetation density, and recent estimates obtained from sources at NAPRI indicate declines in fodder yields of 10-20 percent from

1985-2003. The annual cost of yield decline from the 1980's to 2004 is estimated at ₦500 billon. A significant loss given by the Federal Capital Budget in 2004 was ₦350 billion. The estimated cost of the deforestation and losses in non timber forest products in the last five were ₦120 billion per year, or 1.7% of GDP in 2003, a loss close to the Federal Budget for Health and Education in 2004 (₦153 billion). On the whole, poor cropland management, forest and rangeland degradation are costing at least ₦465 billion (US $3.4 billion) per year or at least 6.4 % of GDP in 2003.

For non-renewable natural resources, a record of 24 billion cubic meters (43%) of gas produced in Nigeria is flared annually. It is said to be enough to power a good portion of Africa for a whole year. The economic impact of this is that daily about ₦2.2billion ($18.2 million) worth of gas is wasted. This amounts to a yearly loss of about ₦1.5 trllion ($12.5 billion) worth of gas. Gas flaring has a terrible impact on the environment because it has contributed to global warming and has increased the incidence of acid rain in oil producing communities of the Niger-Delta region of Nigeria. Besides, either by their geographical location or by their socio-economic classification, most of the oil exporting countries is located in the developing world. Their location in the marginal areas of the world have made them more vulnerable to the impact of climate change such as global warming, rising seas and oceans, gully erosion and rising health risks. In the sphere of socio-economic impact, the UNFCCC and Kyoto Protocol "cap and trade" approach largely target CO_2 emissions and by extension the production and consumption of energy particularly oil, gas and coal. The introduction of carbon tax to reduce consumption of these commodities and hence, emissions will cut back their demands resulting in declining revenue for Nigeria. The significant impact of this will be the inability to meet her sustainable development objective such as providing social services as education, health, water supply, extension services, etc.

The Green Wall Sahara Nigeria Programme (GWSNP)

As stated earlier in the introduction, the GWSNP represents an overwhelming evidence of optimism out of bad situation (created by cataclysmic effect of climate change) and hence, provide good opportunities to enhance sustainable human well being. It is a ₦2.5 trillion climate change mitigating measures on drought and desertification, designed to convert the desert land into green land and wealth (Onuoha, 2008b).

Location

The Green Wall Sahara Nigeria Programme (GWSNP) is located in the arid land of Nigeria found between 11^{o} 00'N and 13^{o} 40′ and 3^{o} 30'E and 14^{o} 40′ and found with the tropics of West Africa. It contains the present states of Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, Bauchi, Yobe, Borno, Adamawa and Gombe (11 Frontline States of the North). By its latitudinal and geographical locations they receive less annual rainfall sometimes as little as 250mm while some southern states receive as much as 3500mm annually. Expectedly, the vegetation here is a residue of a ground diminution of mangrove and rain forest of the south. As expected due to less afforestation here the soil lacks the rich soil nutrition of the rain forest. The general vegetation outlook is grassland interspersed with scrubs. This makes it difficult for the ecology to withstand the onslaught of the twin hazards of drought and desert encroachment which leads to siltation of the surface waters, infertility of soil fuel, wood extraction for construction, bush burning, grazing and cultivation of marginal land.

Green Walls and African Union (AU) Challenge

The African Union (AU) met in Libya in 2006 to endorse the Green Wall Sahara Program for 23 African countries affected by drought and desertification with the overall objective of controlling land degradation, enhancing environmental sustainability, promoting integrated natural resource management, contributing to poverty reduction, as well as creating job and wealth.

Green Wall and Its Components

In order to achieve its objectives, the Nigerian perspective of the programme- GWSNP, had the following design components: 1500km by 10km major shelterbelt, 1500km by 1km desert farming, 1500km by 500m minor shelter belt, 37000 hectares of jatropha plants, that is about 3500 hectares per state (11 frontline states of the North), 37000 hectares of *Cactus opuntus*, 37000 hectares of Neem tree. In addition 37000 hectares of desert for food were factored into the design, that is, about 3500 hectares per state. But in each plots of land in the state, it is expected that each plot will be lined with trees inside and outside with 3 metre hedges. The same applies to the 37000 hectares livestock plots. This is also true of the 3000km oasis international car and bicycle track for race. The eleven thousand houses and 22 industries which are going to be built in this green wall belt will be lined up with hedges as described above. It is also expected that in order to hold the soil firm from being moved by the ferocious North-East Trade Wind, fast survival grasses like vertiver would be used to cover 1.5 million hectares of areas susceptible to land cover vulnerability. Altogether, the design is to make the entire area as much greenish as possible, which supports the concept of brown to green, it is

expected that the project will generate employment for up to 4.5 million Nigerians in the next 5-8 years, enhance biodiversity and reduce desert encroachment from the present 0.6km per year to 0.1km per year.

While the desk study of this project was going on, about 35 plants species were identified. But in view of the objectives of the African Union on Green Wall Sahara, two parameters were used to select and eliminate the plants to be used in the programme. First was survivability under very little moisture. Second, the economics of the plants and how it can enhance sustainable livelihood of the people in this area. Some of them like vertiver have been subjected to trial runs in Yobe State. The result has been encouraging and amazing.

As already been said, the components of the Green Wall Sahara Programme are major shelter belt, desert farming, minor shelter belt, jatropha plantation, *Cactus opuntus*, livestock farming, desert to food, neem plantation, gum Arabic plantation and eucalyptus. It depends on the final implementation of the design because if each plot is properly lined on its inside and outside perimeter by 3 meters set-out and every bare ground planted up with vertiver grass, it is certain that the objective of having a green wall will be achieved. In the case of shelter belts, they are merely trees and such are capable of creating microclimate and minimizing climate change.

Green Wall and Manpower Requirement (Employment)

In order to find out the manpower requirement, each of the eight components was divided into various activities. For example the major shelter belt had activities as Baseline studies, Environmental Impact Assessment (EIA), mobilization of communities, planting up more than 800 million trees, establishment of more than 44 seedling nurseries, screening and evacuation of sand, establishment of 4 jatropha refineries, drilling many thousands of boreholes, administrative work and low level manpower work. Each component is arranged in terms of how many technologists, technicians, labourers, administrative, personnel, etc are required. Within these manpower resource requirements in an activity, about 55 % of women and 35% of youths will be required at least for the project to set out in earnest. Generally, about 4.5 million Nigerians will be employed in the next 5-8 years.

Green Wall and Investment Prospects

The Federal Government of Nigeria has tremendous interest on the programme in the following ways: First, by approving the National Steering Committee of the programme made up of 8 cabinet Ministers, 11 Deputy Governors, many members of Technical Committee and professionals who served in different sub-committees especially in the 11 frontline states. It is this steering committee that approved the conceptual framework document. Also, the

document has encouraged investors to invest on the different components of the programme as they agree with the Federal Ministry of Environment. The agreement could be on Public-Private Partnership (PPP) Build, Operate and Transfer (B.O.T), outright humanitarian or any other arrangement the government feels comfortable with. Efforts are made to get the government involved on baseline studies, Environmental Impact Assessment (EIA) and mobilization of communities. This situates the Federal Government as the partner on the driving seat. States and Local Government have their contributions and benefits to make and to derive. Investors have started showing interest in the programme. For instance, a German company Hagen Engineering Company Ltd has indicated interest to do the entire major shelterbelt, minor shelterbelt and Hagen Farming Components at almost about 1.5billion Euro (₦300billion). On the 15th of December 2008, an MoU was signed between the Hagen Engineering Ltd and the Federal Ministry of Environment. Again, an Israeli company AGRIDEV and a Nigerian company FRAMAN, indicated interest in the entire Desert for Food Programme at about 15million dollars in the 11 frontline states covering altogether 37000 hectares. An MoU was signed between the company and the Federal Government on a PPP arrangement. This MoU of 2006 was reviewed in 2008 to increase the contribution ratio of AGRIDEV in the arrangement. It is expected that another MoU to reflect the new arrangement will be signed. Moreover, companies have indicated interest in jatropha and *Cactus opuntus* because jatropha produces bio-diesel fuel while this specie of cactus produces ethanol. Some companies from Ireland, South Africa, etc have indicated interest on the car race (3000km car race). It is expected that when they are ready, they will meet the Federal Ministry of Environment for discussion. The slots for livestock, Neem, Gum Arabic, are still empty. As soon as a company is interested it will write a letter of interest to the Honourable Minister of Environment expressing such interest.

Conclusion

In conclusion, it is pertinent to note that the challenges of climate change to economic growth and sustainable development in Nigeria require creative thinking, holistic ideas, innovative solutions and the participation of all the stakeholders. Such stakeholders will include governments, non-governmental organizations (NGOs), private sectors, community based organizations (CBOs), civil society organizations (CSOs) among others. Fortunately, these are represented in the Green Wall Programme. Climate change creates new opportunities. One may ask; is the current low growth occasioned by recession, stagflation and drive for low carbon economy, not the end of high mass consumption? While credit is tight for businesses, banks, and consumers alike, it is also perhaps the best opportunity to align consumption with resources and to readjust to a dematerialization of the economy and a rebalancing towards services rather than goods. Specialists can come together in an initiative to redesign the

economy from the end of high mass consumption into a green and sustainable growth and development.

References

Eboh, E.C. *et al.,* (2006). Renewable Natural Resources, Sustainable Economic Growth and Poverty Reduction in Nigeria. African Institute for Applied Economics, Enugu. Research paper 1.

Intergovernmental Panel on Climate Change (IPCC) (2007). Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change to the Third Assessment Report of IPCC, London: Cambridge University Press.

Nigerian's First National Communication (2003). Under the United Nations Framework Convention on Climate Change (UNFCCC). Ministry of Environment Abuja, November.

Oladipo, E. (2008). Climate Change and Sustainable livelihoods: Greening Options of Nigeria. In Report of the First National Environment; Sustainable Greening the Environment for Sustainable Economic Development 20th - 21st October.

Onuoha, C.M. (2008a). Sustainable Development and Poverty Reduction in Nigeria. In Conference Proceedings at the 3rd Green Economics Annual International Conference, Mansfield College, Oxford University, UK, July 17- 18.

Onuoha, C.M. (2008b). Understanding climate change in African Economies. The Green Economist-International Journal of the Green Economics Institute, UK; Vol. 3 Issue 2, Autumn (www.greeneconomics.org.uk).

Onuoha, C.M. and Ononiwu, N. (2008). Economics of Green Wall Sahara Nigeria Programme. Proceedings of the Green Economics International Conference/Retreat, Somerset England 24-26th October.

Serageldin, I. and Steer, A. (1994). *Making Development Sustainable: From Concept to Action.;* Washington D.C.: The World Bank

The Development Challenge of Climate Change and Impacts on Nigeria

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Introduction

During the 1992 Earth Summit in Rio, nations signed up to the United Nations Framework Convention on Climate Change (UNFCCC) with the objective of stabilizing the concentration of greenhouses gases in the atmosphere in other to allow ecosystems to adapt naturally, ensure that food production is not threatened, enable economic development to proceed in a sustainable manner. This objective is aimed at eventually stopping climate change. Following the Earth Summit, the G-8 plus the BRIC (Brazil, Russia, India and China) nations, in 1995, endorsed the IPCC's (Intergovernmental Panel on Climate Change) conclusions urging governments to take urgent actions to curb the impact of climate change. In a recent report, IPCC indicated that global greenhouse gas emissions must be reduced by at least 80% over the next four decades to give us a chance of keeping temperature increases to less than $2^{o}C$. Otherwise, according to the report, the world will face irreparable damage to its natural resources (Practical Action, 2007) and human socioeconomic conditions.

Figure 4: Man rescues a child after a flood menace in Ikorodu neighbourhood in Lagos (Source: Reuters/George Esiri, Nigeria).

The global pessimism about the science of climate change was laid to rest in 2007 following IPCC's work and scientific evidence associated with its reports. Climate change is no longer a distant possibility but a current reality (World Bank, 2008). Climate change impacts and consequences have the potential to wipe out development gains and significantly reduce the standard of living. Climate change is currently affecting developing countries, setting back their development and compounding poverty (Practical Action, 2009). Climate change, therefore, is one of the most significant challenges threatening the realization of MDGs in Nigeria and other developing nations of the world.

Fallacies and Truths about Climate Change

Although many developing countries have given adaptation action a high, even urgent attention, it is true that developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt: socially, technologically and financially (UNFCCC, 2007). Climate change is anticipated to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals (MDGs) by 2015 (UN, 2007).

With respect to climate change, millions of dollars have gone down the drain spreading the misinformation about the phenomenon. Cynics have tried to deny the existence of any scientific evidence for global warming. Although these cynics have lately accepted the fact of anthropogenic climate change, they argue that the impact will not be great and therefore we can always and see. Besides, according to them, we can always fix the problem if it turns out to be substantial.

However, there are overwhelming scientific evidence that does not support these fallacious arguments. Several UNFCCC and IPCC reports have shown that widespread damage will occur even for small increases in global temperature. So, strong efforts are needed to hold the average global temperature rise below $2^{o}C$ relative to its preindustrial period. For instance, CO_2 must not be allowed to exceed 450 parts per million (now nearly 390 ppm). Before 2050, global emissions of CO_2 must be reduced to below 50% of the 1990 level (currently 15% above that level. Average emissions in developed countries must be reduced by at least 80% of the 1990 level. There is the great need to ensure that global CO_2 emissions stop rising (current increase is more than 3% per annum) and decline steadily towards 2050.

Furthermore, tropical deforestation, responsible for 20% of greenhouse gas emissions, must be halted within the next decade or two. For the 21^{st} century Nigeria, the most significant climate changes expected are with respect to temperature and temperature-related parameters. Minimum and maximum temperatures of the order of 5 degrees Celsius or more are expected in certain parts of the country, and such changes are likely to impact multiple sectors

including agriculture, health, water, biodiversity and forestry. There are also prospects for higher rate of increase in night temperature than day temperature. Significant increase in atmospheric energy – increase in frequency and intensity of stormy weather are equally anticipated, while additional water need created by higher temperature may not be met by increases in rainfall. In perennially humid regions, day temperature may attain levels unknown to areas outside the hot desert regions – oppressive heat and sultriness. Therefore, what is required now is the recognition that anthropogenic climate change will severely affect our children, grand children, world's ecosystem and world's poorer communities. The severity of the impact can be substantially alleviated by taking serious and credible actions now.

Processes, Characteristics and Threats of Climate Change

Several anthropogenic activities lead to climate change processes (Fig. 2 below). Such human activities include burning of fossil fuels (agriculture, transport, heating, industry) and land use changes (deforestation, urbanization, and increase in impermeable surface). While fossil fuel burning release greenhouse gases (CO_2, CH_4, NO_2), land use changes lead to disturbances in the carbon cycle and release of greenhouse gases which ultimately results in greenhouse effect.

This greenhouse effect leads to the alteration of main climate characteristics including the melting of ice caps, average temperature rise (global warming), changes in precipitation, ocean circulation upheaval, and clouds, thereby causing abrupt climate change. Following this abrupt climate change, therefore, are major threats (to economy and livelihood) including disasters such as sea-level rise, disease spread, drought and famines, economic losses, floods, heat-waves, cyclones, biodiversity losses, etc.

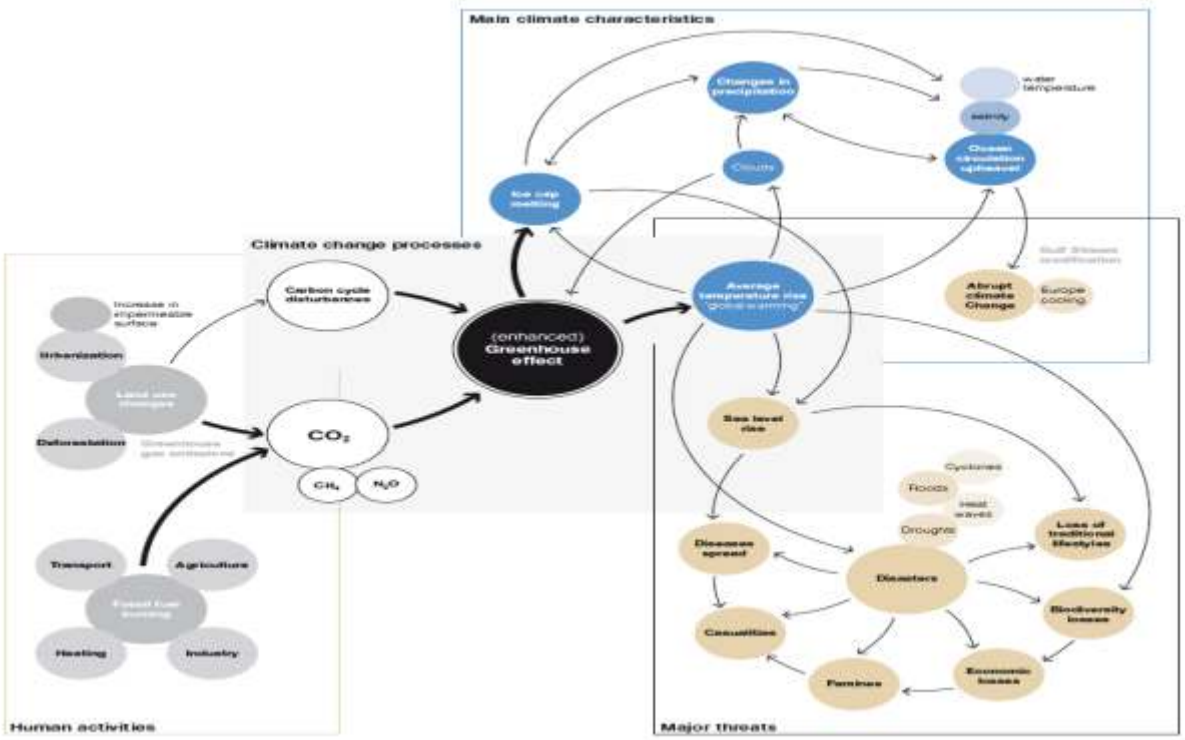

Figure 5: Climate Change Processes, Characteristics and Threats (Source: UNEP/GRID-Arendal, 2008)

What Actions can we take now?

The Development Challenge

The negative impact of climate change-related disasters can pose a development challenge for both the 7-point agenda/NEEDS II and the MDGs. Such disasters can hinder economic growth, slow the pace of human development, cause sharp increases in poverty, and hurt the poor in the short run while reducing their chances of escaping poverty in the long run. Climate change-related disasters, therefore, can potentially cause deviations from sustainable development paths depending on their magnitude. For this reason, it is imperative that all sectoral policies should contain and address climate change issues relating to each sector.

The Political Challenge

The political challenge for all stakeholders are in terms of the need for a domestic climate change policy, funding and legislative action. The climate change policy for Nigeria must contain three types of actions. These are mitigation (efforts to prevent climate change), adaption (responses to climate-related disasters that are not prevented by mitigation efforts) and resilience (preparation for disasters to reduce suffering and loss they bring).

Climate change can be mitigated with deliberate efforts directed towards conservation of resources and the development and deployment of alternative energy sources. This will require behavioural changes in the way and manner in which people use their energy and non-energy resources. Another useful tool for mitigating climate change is technology. Nigeria needs to develop or adapt measures that can provide the same energy services with half or quarter of the energy. In other words, the nation needs to implement existing or available conservation technologies, and develop additional and clean-fuel technologies. So, emphasis must shift from amount of fossil-based energy to amount of energy services available to people, and from more highways to more public transport.

How do we cope with climate change effects we cannot or will not prevent? A climate change policy for Nigeria should clearly address climate change adaptation strategies in terms roadmaps for helping vulnerable individuals and communities. The requirements for a successful adaptation are resilience and social cohesion. Social cohesion, which is a prerequisite for resilience, requires identifying with larger social goals than own immediate interest. Social cohesion, therefore, should be an unavoidable component of the rebranding effort for the nation.

Resilience means strengthening least advantaged groups in society. This can be done by developing and strengthening supportive institutions especially at the local level, and education and communication of the phenomenon.

Besides, there is the need for a trust fund dedicated to climate change activities. Such activities must include scientific research and development, technological research and development, regulatory programmes, and voluntary and public education programmes.

Moreover, in terms of legislative actions, the National Assembly recently passed the bill to establish a National Climate Change Agency/Commission. Although this is an important threshold, the opinion in certain quarters is that bureaucracy may not be the panacea for every problem besieging the nation. However, if the Climate Change Agency/Commission must succeed, then it must pursue and address holistically and drastically climate changes issues through an act/bill of the National Assembly. Such a 21st century climate change bill must address various aspects, e.g. tax incentives for clean/green technologies, emission taxes, climate change research, greenhouse gases reporting or registration, planning and carrying out of adaptation to expected climate changes in specific sectors nationwide, and an annual appropriation for climate change programmes.

Conclusion

Climate change is one of the greatest environmental challenges facing the world today. It is already well recognized that climate Change and its associated extreme events will have a wide range of effects on the environment, and on socioeconomic and other related sectors including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zone. Recent experiences of the nation have shown that Nigeria is vulnerable to climate change. Its impact on Nigeria, however, will depend to large extent on the strength of measures (both policy and non-policy wise) put in place to mitigate and adapt to the consequences of climate change.

References

Practical Action. (2009). "Climate Change Diaries". http://practicalaction.org/?id= climatechange_diaries

Practical Action. (2007). Gordon, Do you get the Climate Change yet? www.makethelink.org. uk.

World Bank. (2008). Climate Resilient Cities: 2008 Primer – Reducing Vulnerability to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities. International Bank for Reconstruction and Development/The World Bank, Global Facility for Disaster Reduction and Recovery, and International Strategy for Disaster Reduction.

UN (2007). *The Millennium Development Goals Report.* New York: United Nations.

UNFCCC. (2007). Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries. United Nations Framework Convention on Climate Change (UNFCCC).

Discussions

Questions Raised

Is there any way to stop the kind of climate problem that happened in the United States of America? For example, the hurricane Katrina and Andrews. If a country like United States which has a Space Agency could not stop such occurrences how can we without at least a National Commission for Climate Change stop such a catastrophic experience that destroy houses and kill thousands of people in our country.

When there is a particular change in climate in a particular direction either increasing or decreasing over a period of time usually five to ten years we say there is a change in climate. However, there have been examples in the last two years where the climate has changed. How do we harmonize these issues?

Many local people do not know what is going on and they are losing their lifestyles. This has resulted in militancy in areas such as the Niger Delta. The oxygen level has fallen such that mental stability is affected. There is no enforcement of human rights in our country. Even though it is recognized that we are entitled to it in the constitution, there is no framework for its enforcement. There should be a holistic approach in the study of climate change to be able to make a meaningful impact.

Even though there have been some efforts in sensitizing the people on the effects of climate change, it is evident that many people do not actually know that fossil fuel that we burn everyday is a major cause of climate change. The beginning of the mitigation of the effects of climate change begins with the sensitization of the public with right knowledge of what causes climate change. The Non Governmental Organizations (NGOs) should include the issues of climate change in their mandates. The idea of establishing meteorological stations across the LGAs in the country is important as a major tool in warning the people when there is an impending disaster as we have in developed countries. How do we harness wind energy to be able to use it for economic and development purposes?

What are the Universities doing as their contribution to check erosions? What are their efforts in ensuring food production using available land and technologies within their reach? Until we begin to practically get involved in some of these things, the problem will still be there with us.

Clarifications given

1. One of the consequences of climate change is increase in atmospheric changes. That is what causes hurricanes and there is nothing one can do about it. It is important that we, the public is sensitized but the sensitization being with evidence and knowledge of what to do. The NGOs should popularize the problem of climate change.
2. Research should be focused at issues of benchmarking. It is by so doing we have advocacy tools to engage the government and the media to begin to propagate and enlighten our people across the communities and local governments. Is it possible to have two or three committees that will articulate actions that will be presented to the forum in order to move the discussion to the next level for actions?
3. There should be more proactive measures in dealing with the problems of climatic change. The NGOs should form pressure groups to challenge government on the issue of enforcement of environmental laws especially to arrest those who set bushes on fire.
4. There is strong relationship between poverty and environmental degradation. (1) Beyond Enugu Forum there is need for stake holder's forum to deal with all the ramifications of climate change. (2) Effective use of development communication to reach the grass roots. (3) Pay more attention to poverty reduction issues. (4) Environmental degradation should be made a governance issues.
5. The public should begin to ask questions about how the ecological fund is used. The civil society appears to be docile in challenging the government. If they challenge the government there will be a better application of the ecological fund.
6. There is interface between climate change and technology. Business community and entrepreneurs should begin to think about how to consider the issues of environmental change in their projects. Special tax should be imposed on those who violate the environment.
7. Any local government that will benefit from the FADAMA II programme must have a weather recording station and will be willing to re-train extension officers to have a measurable knowledge of weather issues. The Institute (AIAE) can take this research further to identify the kind of mitigating measures that need to be deployed before engaging in advocacy.
8. Climate Change is not to be left to government alone. We should start with the kind of energy we consume in our private homes. The type of electric bulbs we use in the house; we should also use cars that do not emit black smokes. We can engage in tree planting by making sure that each one tree that is cut is replaced.
9. The public is encouraged to contribute to waste management. People should avoid throwing used materials outside the stipulated places.