

the various climate change impacts and vulnerability in Nigeria.

Changes in climate can be expected to have significant impacts on farm yields and product quality. The article by Anaeto, et al. focused on this issue and recommends an agricultural policy that is anchored on efficient and effective extension system – Njoku looked at climate change with particular reference to forests in South Eastern Nigeria. Using satellite data and computed Normalized Difference Vegetative Index (NDVI) the author presents results that suggest increasing stress on forest cover and largely attributable to increasing warming conditions. Such realities of global warming according to the author demand the development of counter measures aimed at stabilizing the forest in the region.

With over 1000km of coastline, Nigeria is considered highly vulnerable to climate change-induced sea level rise and possible flooding of coastal settlements. Badru, Odiunuga, and Amaeshi, used remote sensing and Global Information System (GIS,) technology to assess the Coastal Vulnerability Index (CVI) using the parameters of morphology, slope, shoreline change, and mean spring tide range and housing type. Using these parameters high CVI values were computed for this coastline.

Nwofor, Njokuobi and Dozie, looked at the possible impacts of climate change on the epidemiology of some microbial diseases with emphasis on water-borne and vector-borne diseases. They noted that increased incidence of most of these diseases would be encountered in a severe climate change regime.

Africa generates perhaps the largest fraction of global dust aerosol loading. In a review of over 50 published articles, Sa'id discussed the importance of dust aerosols in the global climate system. The author discussed among other things the direct, indirect and semi-direct aerosol radiative effects. The need to step up research into dust aerosol optical properties in order to narrow the uncertainty attributable to the aerosol effect is highlighted. Dike, Nwofor and Chineke presented satellite images that capture the black carbon aerosol emissions in Nigeria. This is considered by the authors as a good step towards downscaling and quantifying this very important aerosol type in Nigeria and other parts of West Africa.

As we look towards the future, it is apparent that deliberate modifications of the weather system holds strong potentials in mitigating some ugly impacts of climate changes in Africa. Onyeuwaoma et al. presented the concept of weather modification by cloud over-seeding. They showed by laboratory analysis that some leaves samples used by the traditional African "Rain Maker" are rich in potassium and calcium which by their chemistry might be good scavengers of water vapor and therefore capable of inhibiting droplet formation and rainfall. The last paper by Nwanya, Odo and Oparaku discussed the the impact of Climate Change on renewable energy resources and production systems with particular reference to Nigeria

The articles presented in this special issue cannot be said to have addressed all the relevant concerns about climate change as it relates to Africa. It is however note worthy that the submissions are quite representative of the myriad of subject areas required to address such concerns objectively.

We thank all the authors from whose articles we have made this compilation. We also thank many others who submitted papers that could not be published either as a result of the review and editorial decisions on them or due to fact that such submissions did not meet the deadline. We encourage these authors to continue to patronize the journal as an outlet for their research work.

All authors and organizations who are working in the area of climate change especially those whose works were consulted in the various articles presented in this issue are highly acknowledged.

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Imperatives of Independence of Perspectives in Nigeria's Response to Climate Change and Global Warming

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Abstract

This paper examines the issue of climate change and global warming and Nigeria's expected response. It discusses both Nigeria's vulnerability to climate change impacts as well as her potential culpability in future climatic changes. The need for Nigeria to build independent perspectives based on home-grown facts in her response to climate change and global warming issues is considered necessary as against the present situation where action seems to be largely based on stereotypes moderated by feelings in the more scientifically developed countries of the world.

Keywords: Climate change, Global warming, Perspectives, Nigeria, Independence.

1.0 Introduction

Climate refers to the long-term average of the prevailing weather conditions of an area. Even though changes in the weather conditions of an area are common and normal, the same cannot be said of average conditions especially if these are significant and sustained. Such sustained significant change in the average weather conditions around the globe is what is termed climate change. The climate system is indeed very complicated with a rather delicate non linear response to any perturbations. One of these comes from the heating of the earth's atmosphere either directly from incoming solar radiation or indirectly from long wave infra red radiation. Both of these components seem to be increasing in recent times causing what is now termed global warming.

The term "global warming" stems from what is perceived to be the generally elevated levels in the average surface temperature of the earth compared to what they were at least about 1000 years ago. Global warming and the associated climate change have been linked to a wide range of possible consequences for the climate and eco system such as drought, ravaging floods, increased frequency and intensity of extreme events, disappearance of species, spreading of diseases, and inception of new diseases. There is no doubt that changing climate

conditions are already being experienced in various parts of the African continent such as changing precipitation patterns (<http://www.climatehotmap.org>) and these have necessitated a wide range of response attitudes from Africa. It is this response attitude as it concerns Nigeria that is of interest to us in this paper.

Nigeria is an independent country in the West African sub-region. The country has in recent times been at the forefront of calls on Africa and the rest of the third world to forge a common position on climate change. Adequate climate change response strategy according to the Nigerian leadership is expected to be a requirement for enthroning sustainable development, alleviating poverty and achieving millennium development goals (MDG) (see Next newspaper, Monday September 6th, 2010). Recently Nigeria's Ministry of Environment made public its intention to "climate-proof" the country against the consequences of climate change by extending invitation to contractors to tender technical and financial proposals on the different aspects of the climate change problem (see The Nation Newspaper, Thursday September 2, 2010). These principally involve the following:

- Positioning the country for appropriate climate negotiations
- Undertaking various project designs.
- Championing various advocacy and cam-

paigns programs on climate change.

- Undertaking material procurements and installations related to the climate problem.

This attempt by the government of Nigeria to make the country “relevant” in global climate change matters raises several issues the most important of which is resolving the motivation behind government choice of contractors and companies to prosecute projects of high scientific and technical nature such as climate change that should routinely be handled by the various Universities and Research Institutes in the country.

The above response attitude in Nigeria is implicitly linked to the prevailing and by far erroneous notion in most African countries, that the continent is most vulnerable to climate change and must swallow any western world-generated prescriptions hook, line and sinker!. Very often, the fact is forgotten that Nigeria with over 160, 000, 000 people is Africa’s most populous country and also the continent’s top oil producer-; rapidly growing population especially in the cities and fast growth in manufacturing industries have combined to situate the country in a highly strategic position in global climate politics and economics with regard to emission of Green House Gases (GHG) and aerosols (Nwofor, 2009; 2010). The activities of the government of Nigeria with regard to global climate issues must therefore be significant within the African continent on account of the countries’ vulnerability as well as her projected culpability and associated socio-economic considerations of cutting down emissions unjustifiably. These facts demand a more conscious effort in the preparation of the documents that capture Nigeria’s position on climate matters.

In this paper, we underscore the fact that Nigeria occupies a strategic position in Africa which requires that her approach to global issues must have strong technical basis and not a mere response to stereotypes. Understanding the relationship between scientific facts and global perspectives of global warming is held as a condition for optimizing national responses to climate change in this era of the Intergovernmental Panel on Climate Change (IPCC) -driven climate change perspectives and Kyoto-driven demands on developing countries. It is argued that the climate change issue is obviously one where technical considerations cannot be swept aside. The

paper discusses some key issues that appear to have been ignored in the Federal government approach to the climate change problem and considers that the climate issue cannot be discussed without elaborate understanding of the global warming problem which inadvertently drives climatic changes. The role of well funded Universities and research institutes as well as the potentials of indigenous scientific knowledge in pro-active solutions to environmental problems are also discussed.

2.0 About the Facts and Perspectives of Climate Change

What might be termed a global scientific consensus on facts of global warming is today articulated by the IPCC of the United Nations Framework Convention For Climate Change (UNFCCC). IPCC posits that there is global warming and that there is convincing scientific evidence that implicates human activity (IPCC, 2001; 2007).

The Intergovernmental panel on climate change (IPCC) has posited that an average global surface temperature increase of $0.74 \pm 10.18^{\circ}\text{C}$ has occurred between the start and end of the 20th century. This trend is projected to continue if business remains as usual and that is if there is sustained increase in the causative factors, which according to the IPCC (2001; 2007) are linked to human activities such as burning of fossil fuels and deforestation tending- to increase the concentration of Green House Gases (GHG) and absorbing aerosols in the atmosphere. The scientific explanation of the atmospheric green house effect and aerosols can be found in specialized texts on the subject. Abnormal increases in the concentration of GHGs would increase the earth’s temperature to intolerable levels as one witness presently. GHGs include CO₂, Methane, Nitrous Oxide and water vapor (Hansen and Sato, 2001).

One of the fallacies of the climate change “chants” taking root in many developing countries like Nigeria is that there is a global consensus on the climate change subject with regard to causes and prescribed actions- but we now know that irrespective of its popularity, the attribution of the global warming problem to GHGs mainly is not a consensus because the uncertainties are still large and underlying science not yet exhausted (AMS, 2003).

The IPCC position is viewed by some skeptics to be perspective-driven since it talks about “convincing evidence” which is hardly the same thing as “universal evidence”. Scientific perspectives unlike scientific facts are only situational and subject to universal acceptability. Whereas evidence is used for building facts, the interpretation of facts is used for building perspectives. The result is that although reference is often made to the so-called “global consensus” on global warming on account of massive endorsement by many distinguished scientists and by academies of sciences of leading countries, skepticism fueled by alternative interpretation of the scientific facts is growing. Although the “skeptics’ views are often treated as minority opinions these are nonetheless very strong and largely determining the trajectory of research in developed countries.

The several weak points of the IPCC-driven global warming scenario are about 44 in number according to “skeptics’ views” (see www.skepticalscience.com/argument.php). We list only seven:

- i) **Models:** Climate models used to simulate past and future climate scenarios are deficient in a number of imputes to capture warming trends.
- ii) **The Sun:** The evolution of the sun affects solar intensity as evident in changing solar cycles which have several modes. Projection of the solar cycle (wavelength - 10.7 yrs) over next 3 decades shows possible decrease in amplitude of solar activities which would result in temperature decline of order of 2°C (see Archibald, 2007).
- iii) **Ice Age:** The earth could just be emerging from an ice age meaning that temperatures will be expected to be elevated.
- iv) **Cosmic Rays:** Cosmic phenomenon might be involved in the perceived warming.
- v) **Warming of other planets:** Warming of planet mars strongly implicates solar physics or certain astrophysical phenomena as likely causes of global warming.
- vi) **Climate Sensitivity:** The planet cannot be easily sensitive to man-made warming or man made reduction on warming.
- vii) **Ocean Sink Process:** The size of oceans

will make predicted temperature changes improbable and response prescriptions have unrealistic time manifestation.

The “skeptics” views listed above have caused the intensification of the global warming debate in the developed world; but in Africa, lack of independent scientific data rubs scientists from the continent of equal opportunities to canvass their opinions objectively during the climate conventions. It is only when the science is understood independently to a high degree that probable biases and sentiments in the global problem can be isolated. This is the basis of science-based decision making which is now growing in popularity all over the world.

3.0 The Signal from the Developed World

Even though at present the Kyoto protocol based on the IPCC scenario apportions emissions targets for developed and developing countries to stem what is believed to be the anthropogenic warming trends, some countries including Nigeria are signatory to the protocol while some powerful countries such as the US and Japan at the time of writing this paper have not fully ratified the protocol. But one would quickly ask: Is Nigeria's position with regard to Kyoto based on sound and independent assessment of all issues associated with the warming debate?

Since the period following the Second World War, politicians in the industrialized world have shown strong inclination towards science-based decision making. Many of them show this reliance on science through improved funding of scientific research. This has not been the same with developing countries where poverty is adduced as a reason for not funding research. The Stern review on the economics of climate change submitted to the British government is argued to have become a basis for the British action on climate change, in calling for a curb to green house gas emissions (see Seo, 2007).

In the United States of America (USA), where the major opinions are located around the major political party divides of democrats versus republicans, one discovers that irrespective of the Oscar-winning campaign of former United States president Mr. Al

Gore in support of IPCC and Kyoto, former secretary of state, James Baker would argue that American's response to Kyoto should not be to the point of jeopardizing America's economic growth (CNN, 2008).

The preponderance of objective assessment based on fundamental science and national goals and objectives, must justify the inclination to any perspective of climate change and global warming taken by Nigeria. A suggestion on this technique of expert opinion preference ranking of relevant criteria has been made for the energy sector in Nigeria (see Nwofor *et al.*, 2007). It is also imperative to note that in preparing the various IPCC reports, countries who are signatories to United Nation framework convention on climatic change (UNFCCC) nominate scientists working in universities and national laboratories and not contractors to work as authors for the various chapters of the document. It is hence expected that these authors would bring their personal experiences to bear on the document and in line with their national perspectives. For countries where front-line research is not going on, nominated scientists are greatly disadvantaged and rely on other national laboratories for information or worse still contractors would be made to bid to represent the nation's views as is the case in Nigeria now. It is also important to note that being a signatory to UNFCCC does not stop a country from reviewing from time to time its stand as more scientific information emerges.

4.0 Issues for "Indigenous" Global Warming Research in Nigeria

Owing to the extensive nature of projected climate change and global warming impacts, and the possible consequences of action and inaction by countries, the topic has become very "hot" in political and economic cycles. This demands most times the scrutiny of the various scientific information on which global warming definitions, attribution, consequences etc. are based. It is this scenario that has necessitated the huge spending by many developed countries on research, geared towards raising the confidence in the definition, attribution, perceived consequences and vulnerability as well as adaptive capacities of nations.

Presently, the global warming problem is fast raising more skeptics in the African continent than believers on account of the bewildering manner in which information on the subject is being managed by those who claim to have the most informed access. The contentions have remained the following:

- The climate change problem is orchestrated without clearing the more fundamental issues of global warming.
- The various government-sponsored slogans continuously remind citizens of their "vulnerability" and for reasons that are not clear the citizens cannot partake in the "highly technical" evaluation of the conclusions on which their presumed vulnerability hinge.
- The underlying core atmospheric physics and chemistry concepts required to assess the credibility of global warming truth are not well researched in Nigerian Institutions rather, the Nigerian scientists as often are only committed to the "down-stream" sector of global warming research involving only analysis of impacts and vulnerability and public awareness campaigns to enable access to various "handouts" given as funds to supposedly ameliorate climate change situations.
- The average Nigerian, the highly educated inclusive is hardly substantially aware of the technical basis of the issues to which he is asked to respond in a manner that would usually involve considerable alterations in his lifestyle with potential consequences for his future.

Developing capacity for home-grown research to source, interpret and adapt scientific information on global warming and climate change in Nigeria should be along the following lines:

- Knowing independently if there is warming or not.
- Knowing independently the cause or causes of warming if there is.
- Knowing independently the consequences of warming to the global community and Nigeria in particular.
- Knowing independently what remedial actions is expected of Nigeria with regard to 1, 2, and 3 above.

- Knowing independently the various levels of adaptability, resilience and vulnerability of the Nigerian system.
- Evaluating objectively the relative consequences of action as in 4 and in-action on socio-economic development of Nigeria.

On the basis of the above, five major aspects of the global warming problem are identified. These are; Definition, Attribution, Consequences/Vulnerability, Action and Re-appraisal. Each of the aspects presents challenges for multidisciplinary research and is interrelated to others (Figure 1). For Nigeria to develop a sustainable climate change policy and response strategy, studies must be intensified within these subjects as described below:

4.1 Global Warming Definition

In spite of the IPCC position, one easily realizes that technically the definition of what would pass as global warming is not simple. To many laymen in Nigeria, definition of global warming is perceived from the obvious changes in the climate system. We have noted earlier that climatic changes can be driven by a whole lot of perturbations of which "anthropogenic" global warming is only one.

The temporal scale at which global warming seems obvious is very important in defining global warming and even more important is what happens beyond this scale. The issue of temporal scale is very important because it assures that the warming trend is stable. It is obvious that the temporal scales under which global warming are defined is still limited. The best records of temperature have been available for only 1000 years. Using ice-core data, indirect temperature constructions have been improved only slightly. Related is the issue of spatial scale at which warming is defined; one would for instance wish to know if there are disparities between warming noticed in cities and rural settlements:- i.e. the so-called Urban Heat Island (UHI) effect (See for example, Nwofor and Dike, 2010).

4.2 Global Warming Attribution

Scientific evidence that implicates human activity in global warming is held by many researchers to be overwhelming and the Kyoto protocol seen as the possibly the most important tool for collectively

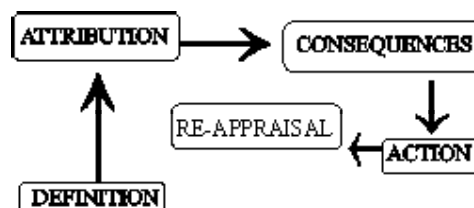


Figure 1: Important Global Warming Subject Areas

tackling the climate change problem (Berger, 2002). However our understanding of the mechanisms of global warming and therefore its proper attribution is limited by our level of scientific knowledge of the various components of the very complicated climate system. For instance of about 12 major climate change forcing agents, only the forcing due to the mixed green house gases e.g. N_2O , CH_4 , CO_2 and halocarbons are well understood, whereas the low atmosphere residence time forcing agents e.g. aerosols in the troposphere are poorly understood (IPCC, 2007). Understanding the extensive physics and chemistry of the global atmosphere including possible effects of galactic and stellar evolution, solar activity, etc are important in attribution of global warming. From the above and as a consequence of several deliberations on the key problems of the climate system, 3 areas of need in our understanding of the climate issues that would help in more reliable attribution of global warming have been identified (Guy Brasseur; personal communication). These are:

- Need to understand variations in solar irradiance i.e solar physics, space weather effects, astronomical effects including cosmology etc.
- Need to obtain accurate knowledge of vegetation/atmosphere/ocean interaction. This requires improved monitoring of CO_2 and other green house gases as well as model enhancement for assessing the phenomena.
- Need to understand aerosol loading, dispersion and microphysics.

4.3 Global Warming Consequences and Vulnerabilities

Global warming is today considered an issue of major socio-economic interest to Nigeria because of the country's high vulnerability. Vulnerability is usually defined in terms of the degree of exposure to a condition i.e. the frequency and intensity and of

transmitted risks. It also involves adaptive capacity i.e. the ability of the system to prepare for or cope with or recover from the condition. There is no doubt that various indications exist that point to extreme climate conditions already in the African continent with intensity and frequency that link them to the so-called global warming (see:-<http://www.climate-hotmap.org>). -Global warming-induced shifts in temperature is associated to changing precipitation patterns which have become very obvious in many parts of Nigeria (see for example Chineke et al, 2010). The following account for Nigeria's much talked-about vulnerability which requires constant re-appraisal.

- Its large population makes it difficult to manage climate induced migration, displacements and competition for scarce resources.
- Its large diversity in climate zones;-including the equatorial 'humid, the moist sub-humid, the sub-Sahel, and the arid regions make climate change processes and their aftermaths most probable and inevitable at least within a region of the country. The response of different climate zones to climate change would vary in a complicated manner that would task the scientific potentials of the country.
- Its poverty/low infrastructural base would make adaptation to climate change more difficult.
- Its high illiteracy and poor scientific know-how makes it difficult for appropriation of various technical information related to climate change.
- Nigeria with approximately 1000km shoreline will be devastated by sea level rise. Coastal oil cities such as Port Harcourt and Warri, would be at risk of flooding. This will exacerbate Niger Delta crisis due to effects on fishing, farmlands and habitats leading to migration, hunger, social tension, unemployment and more militancy.

4.4 Global Warming Action

Political action is most important because it gives implementation to scientific and economic programs. The plethora of scientific evidence in support of a hypothesis may not always generate response if the dangers of such responses to individual or group

interests far out-weigh the perceived consequences of in-action. Consequently the response to global warming prescription such as the Kyoto protocol has been met with serious resistance in the United States of America and so many other countries where it is thought that the scientific conclusions on which the demands for actions are based are regarded as inconclusive. Political response is very difficult especially when action involves considerable human dimensions such as energy which is still the dominant issue. The historical responsibility of developed countries for climate change does not place them at a moral position to suggest reduction in emission via energy diversification without emphasis on potential impacts on socio-economic development. The funding required for the so-called clean energy sources such as solar and nuclear in developing countries should be cushioned by technology transfer which has been an important aspect of the climate negotiations but without much outcome yet.

4.5 The Role of Universities and Research Institutes

Data on the climate change issue are grossly lacking in Nigeria and often inaccessible. Nigeria's capacity to analyze climate change trends is poorly coordinated and under-funded. Nigeria has over 100 universities that are grossly under-funded to undertake high quality research. The best Nigerian university occupies a distant 35 in Africa in the latest world ranking of universities. The Nigerian government by its non-funding of the universities will continue to incur huge financial expenditures by contracting out projects that should routinely be handled by the universities and research institutes.

Establishing, maintaining and running national laboratories is very important. The present designation of some universities as centers of excellence in specific research fields as interesting as it seems is only on paper and not properly co-ordinated. The activities going on in these centers should be well circulated to other universities for willing staff who may wish to collaborate. Results from these centers also ought to be widely circulated as technical reports to help assess their productivity. There is need for strong links between activities going on in Nigerian universities, polytechnics and other research centers and the "presidential villa"

as the quality of political viewpoints cannot go beyond the quality of work going on in these Institutes. Several of the existing laboratories are very relevant in a well coordinated global warming and climate change program which may be overseen by a “**NATIONAL INSTITUTE FOR GLOBAL WARMING AND CLIMATE CHANGE STUDIES (NIGWACS)**”.

The following centers are already doing useful work in the country and their activities only need to be stepped up to undertake research in various aspects of the climate change and global warming problem:

- National centre for Basic Space Science Nsukka
- National Centre for Remote Sensing Jos.
- National Centres for Energy Research and development (NCERD) Nssuka, Sokoto, and Ife.
- National Institute for Oceanography and Marine Research (NIOMR).
- Nigerian Meteorological Agency.
- National Mathematical Center, Abuja.
- National institute for policy and strategic studies.

4.6 Potentials in Indigenous African Science

Peculiar indigenous African practices are largely seen today as reminders of Africa's underdevelopment that must be done away with. It is however noteworthy that these methods are derived from processes that are based on humanistic views of nature and essentially proactive in solving problems of human natural environment as opposed to the purely mechanistic attributes of western science, which is only reactive in handing fallouts from its scientific products. In relation to the present challenges of changing climate it may be noted that the basic motivation behind indigenous practices is environmental sustainability which can be tapped and advanced for global use.

Enormous potentials therefore exist in the content of Indigenous African Science (IAS) that have remained untapped in a world calling for deliberate changes in attitudes to halt the rapidly uncontrollable evolution of technologies with the consequent degenerating changes in the environment. In promoting values for home-grown research as being advocated in this paper the IAS concepts must be

preserved and possibly married with Western science to improve efficiency (see Okeke and Nwofor, 2005).

There are some implications of this prescribed symbiosis for teaching in Nigerian schools. First, it is essential that science should not be presented as an exotic experience which at loggerheads with the peoples cultural views, rather it should be taught in a manner as to exhibit its inert link with the people's daily living. Science should not be construed as a process that can be transferred across cultures but that which should be developed within the people's cultural framework. Growing independent opinions on global warming and climate requires this new form of science education.

5.0 Summary and Conclusions

This paper has reviewed several issues that show that the present strategy to award contracts for “climate proofing” Nigeria has several structural defects. In particular it is noted that global warming and associated climate change symptoms, detection and general as well as particular consequences on local, regional and global scales are well known and documented. What is however not common knowledge is the fact that climate change and the associated research have also constituted a political issue, especially with disparities in interpretations given to scientific evidences of global warming.

It is noted that even within the body of scientists especially in the developed world, the interpretation of facts of global warming and climate change vary in the conclusions with many scientists positing that global warming is not driven by anthropogenic factors as canvassed by mainstream IPCC scientists but rather by natural factors such as varying solar cycle.

The phenomenal interaction between politics and science in the climate change issue calls for establishing of quality climate research capabilities in Nigeria, for the purpose of generating reliable and independent facts about the climate question for possible corroboration to those from leading scientists from other nations. It is also noted that all the information we have in Nigeria and in most African countries about global climate change are based on data analyses, models and scenarios constructed

by the developed world hence the projected consequences and expected actions are as prescribed by these countries as contained in the various IPCC prescriptions-;International protocols which are designed to forge a global approach to the problem are usually ignored by the more powerful and scientifically advanced countries- an attitude that often hinge on some form of superior and independent scientific data.

It is therefore proper that developing countries like Nigeria should develop their indigenous capacity to source and generate indigenous and independent information for interpreting and adapting scientific knowledge on climate change for their benefit and for developing local adaptive strategies for coping with aftermaths.

The universities and research institutes will play a key role in this. Great potential exists in African indigenous knowledge systems for addressing the various climate challenges.

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