Global Advanced Research Journal of Educational Research and Review Vol. 1(5) pp. 057-067, June, 2012
Available online http://garj.org/garjerr/index.htm

Review

Integrating climate change issues into agricultural education teaching and learning in Nigeria

[1]Orusha, J.O., [2]Alukogu, C.T., [3]Chikaire, J., [1]Onogu, B., [1]Nwaigwe, M.O., [1]Ohuaka, P. and [1]Tim-Ashama, A.

[1]Department of Agricultural Science, Alvan Ikoku Federal College of Education, Owerri, Imo State.
[2]Olivet Heights Secondary School, Portharcourt, Rivers State.
[3]Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State, Nigeria

Accepted 22 May, 2012

Many of today's major challenges - energy security, national security, human health, and climate change are all closely related to the global food and agriculture enterprise. Academic institutions with programmes in agriculture are in a perfect position to foster the next generation of leaders and professionals needed to address these challenges. This means that good agricultural education should provide solutions to development challenges. There is a strong positive correlation between levels of education and economic development in any given country. Climate change, is adversely affecting practically all economic, social, political, and educational sectors. Africa is projected to have a future associated with scarce water, declining agricultural yields, desertification, drought and other serious problems. The agricultural work force must constantly respond to these changes through a well thought-out and comprehensive school curriculum to address the above situations. Agriculture therefore must adapt to a continually changing landscape of health and nutrition issues, consumer preferences, environmental impacts and many other factors. Because agriculture is affected by so many factors, its participants must always be prepared to react, to adapt, and to think ahead. Integrating climate change issues in our agricultural education curricula becomes imperative knowing that African countries, especially Nigeria are at risk. Therefore, to make agriculture increase yield and reduce food crisis, climate change issues must be included in agriculture education programme –from primary to tertiary levels. This paper thus suggests what topics to be included and taught in our schools and also proposed steps to transform agriculture education generally.

Keywords: Climate change, agricultural education, curriculum, teaching, environment.

INTRODUCTION

Climate change is global in its causes and consequences. Through advanced modeling, patterns of change in the world climate have been observed over time. These model results have shown that compared to the pre-Industrial era, the world temperature has warmed by half a degree centigrade. The major causes for this warming have been attributed to the rising stocks of greenhouse gases in the atmosphere including carbon dioxide ($C0_2$), methane (CH_4), nitrous oxide (N_20), chloro-and fluoro-carbons and a number of other gases that arise from industrial processes (Stern, 2006). The current level or stock of greenhouse gases in the atmosphere is estimated to be equivalent to

*Corresponding Author: Email: bankausta@yahoo.com

430 parts per million (ppm) of carbon dioxide compared to 280 ppm before the industrial revolution (Stern, 2006). If we continue with business as usual, it is predicted that by the end of 2035, there would be a 2°C increase in temperature (Stern, 2006). It is clear that climate change will impact heavily on agriculture and renewable natural resources. This means that our current practices may have to change significantly to adapt to and mitigate the changes.

It has long been perceived throughout the world, that Higher Education plays a critical role in preparing and providing the leadership to meet these challenges and to stimulate sustainable development (Bloom *et al.,* 2005). In Sub-Saharan Africa (SSA), Higher Education in agriculture and Natural Resource Management (NRM) in particular are well placed to contribute to this process. Despite past investments by African governments in Higher Education, the hope that Universities would provide solutions to Africa's problems is yet to be realized. There has been an enormous loss through emigration of talented faculty to other continents. It is estimated that 23,000 qualified academic professionals emigrate from Africa each year in search of better working conditions (BASIC, 2006). Many of these are in agriculture and natural resources-areas that are of crucial economic importance to most African countries. In addition to these challenges, it is also accepted that the current curricula, teaching and learning methods are unsuitable for achieving the objectives of agricultural education.

One of the environmental threats our planet faces today is the potential for long-term changes in the Earth's climate and temperature patterns known as global climate change (Wood et al., 1999). Scientists estimate that as a result of global climate change, the Earth's average temperature could increase as much as six and one-half degrees Fahrenheit by the year 2100 (Wood and Knipmeyer, 1999). While this may not sound like much of an increase, if the temperature increase approaches the six and one-half degree mark, the Earth will be a much different place than we know it today. To gain an appreciation of how different the Earth could be, consider that during the last ice age, when our planet was on average only nine degrees Fahrenheit cooler, the area that is now New York City was under 1,000 feet of ice in other parts of the world it was the same. To prevent this sort of disruption to the many natural and human systems that everyone on our planet depends on, we must all work to control global climate change (Wood and Knipmeyer, 1998).

Determining the potential causes of global climate change has been a long-term process that has involved the work of thousands of scientists around the world. An important step in this process was made in 1995 when over 2,500 scientists from around the world agreed for the first time that emissions of greenhouse gases from human activities have influenced the global climate. As a result, the question is no longer whether humans are altering the world's climate, but where, when, and by how much. The great importance of this scientific conclusion is that we now know that in order to prevent the onset of catastrophic changes to the Earth's climate, humans must reduce their emissions of greenhouse gases (Wood and Knipmeyer, 1998).

Consequences of Global Climate Change

Although climate change may result in some benefits such as extended growing seasons or more moderate temperatures in some areas, the overall effects are likely to be harmful (Wood and Knipmeyer, 1999). Sea-level rise, as a result of climate change, could lead to the loss of many coastal wetlands, and entire island nations could disappear. Changes in the quality and availability of water resources could occur and worsen conflicts over water use. Healthy forests could be greatly reduced as the range of tree species shifts. Additionally, humans could suffer from increases in the spread of infectious diseases, heat-related deaths and air pollution . Global climate change could potentially cause sea levels to rise as oceans warm and expand and as a result of ice cap and snow cover melting. The Intergovernmental Panel on Climate Change projects a sea level increase of six inches to more than three feet by the year 2100.

The worldwide redistribution of disease vectors comprising the animals, insects, microorganisms and plants that transmit diseases - which is already upon us could increase due to global climate change. Many tropical diseases such as dengue fever, yellow fever, and malaria are beginning to be seen at higher latitudes and altitudes as warming occurs. This warming could potentially result in a greater number of people being exposed to these deadly diseases (Wood and Knipmeyer, 1999). Many ecosystems could have difficult adjusting to the rapid rate of climate change if the world does not reduce greenhouse gas emissions. Animals and plants that are excellent competitors under stable environmental conditions often cannot survive when their habitat is altered by rapid change. Instead, parasite species such as weeds, rodents, Insects, bacteria and viruses will quickly reproduce and colonize disturbed environments.

Africa is highly vulnerable to climate change with the areas of particular concern being water resources, agriculture, health, ecosystems and biodiversity, forestry, and coastal zones (UNECA,2005). The longer-term will include: changing rainfall patterns affecting agriculture and reducing food security, worsening water security and economic growth prospects; shifting temperature affecting vector diseases; and more challenging hurdles in reaching the Millennium Development Goals (MDGs). According to the recent Intergovernmental Panel on Climate Change (IPCC) report, the cost of adaptation in Africa could be as

high as 5 to 10% of the continent's Gross Domestic Product (GDP)(IPCC, 2007b).

Agriculture and food security are at stake. Over 95% of Africa's agriculture is rain-fed. Agricultural production, including access to food, in many African countries and sub-regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent in some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020 (IPCC, 2007b).

Half of Africa will face water- stress. Three-quarters of African countries are in zones where small reductions in rainfall could cause large declines in river water. By 2020, between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change. The problem of water scarcity is even more acute in North Africa in view of the very high population growth rates and already high rates of water resource use (UNECA, 2005).

Diseases will likely spread. The health effects of a rapidly changing climate are likely to be overwhelmingly negative. Africa is already vulnerable to a number of climate-sensitive diseases such as Rift valley fever, which afflicts both people and livestock; cholera, associated with both floods and droughts; and malaria, where warming climate has resulted in the extension of malaria to the highlands of Kenya, Rwanda and Tanzania. These factors are superimposed upon existing weak health systems (UNECA, 2005). Risk to coastal areas could force major population movements. Sea level rise resulting from global climate change threatens coasts, lagoons and mangrove forests of both eastern and western Africa. More than a quarter of Africa's population live within 100 kilometres of the coast, and projections suggest that the number of people at risk from coastal flooding will increase from 1 million in 1990 to 70 million in 2080 (UNECA,2005). Local food supplies are projected to be negatively affected by decreasing fisheries resources in large lakes due to rising water temperatures, which may be exacerbated by continued over-fishing.

The effects of climate change could further undermine peace and stability in the continent. Climate change impacts and their interaction with other vulnerabilities and environmental exposures will likely lead to significant population migrations internally as well as across borders with severe humanitarian impacts further undermining peace and stability. Scarce water resources are another contributor to an increased risk of conflict (UNECA,2005). More efforts will be needed to cost the impacts of climate change and to inform and sensitize domestic audiences. While the impacts of climate change are becoming better known, more efforts are needed to assess and estimate their socio-economic implications. Costing of the impacts will help highlight the development nature of climate change, as contrasted to a more narrow environmental issue, and thus attract attention of economists and development planners. Also, given that most adaptation efforts will take place at the local and sub-national levels, additional efforts are needed to better inform domestic audiences (e.g. mayors and local communities) on the impacts of climate change.

OBJECTIVE AND METHODOLOGY OF THE STUDY

In our schools today, we are still experimenting with curriculum inherited from the colonial masters or worse still with the same old topics of many years ago. There is need to introduce current and emerging relevant issues and topics to our educational system to speak the language the world is speaking. One of these new issues is THE CLIMATE CHANGE ISSUE gives the world great concern today. The objective of this paper therefore centers on the introduction of climate change issues in our school curriculum to prepare students for future emerging climatic challenge. This paper is a review/position paper. Due to limited materials on this topic in Nigeria, we made use of already existing literature we laid our hands on and also materials from the web to discuss and made this topic a success.

The Nigeria Climate

Observational records have shown that Africa has been warming throughout the 20th century at a rate of about 0.05℃ per decade, amounting to an increase of approximately 0.5℃. The warming has been more significant in the period of June - November each year. The most significant change to Africa's climate has been a long-term reduction in rainfall in the semi-arid regions of West Africa. In the Nigerian Sahel region, there has been a 25% decrease in precipitation on average in the last 30 years (Nkomo *et al.,* 2006). However, the reduction in precipitation has been more moderate in other parts of Africa

In the past 30 years, both droughts and floods have increased in frequency and severity on the continent. The regularity of drought periods has been a notable aspect of Nigerian climate in recent years, especially in the drier regions in the North. Well publicized droughts in the l970s and 1980s significantly affected West Africa in the 20 century and they severely affected large areas of Northern Nigeria and the Sahel region (DFID, 2009). In recent years, Africa has seen more frequent flood and cyclone episodes. The Nigerian delta has in particular seen a marked increase in flooding in the last few decades (Nkomo *et al*., 2006). Dust storms (which are partly due to changes in

land use such as grazing and deforestation) in some parts of the Sahel have also increased, particularly between the 1950s and 1980s. The Intergovernmental Panel on Climate Change (1PCC) Fourth Assessment Report explains that during 1961 to 2003, the average sea level rose by I .8 + 0.5 mm per year. While sea level rise varies between regions, Nigeria's entire coastline has been affected by this observed rise (IPCC, 2007). Such a rise will have already led to an increase in coastal erosion and exacerbated flooding damages,

Nigeria has a tropical climate with variable rainy and dry seasons, depending on the location. In the Southeast of Nigeria it is hot and wet most of the year, but it is dry in the Southwest and farther inland. In the North and west, a savannah climate with marked wet and dry seasons prevails, while a steppe climate with little precipitation is found in the far North. Generally speaking the length of the rainy season decreases from South to North. In the South (late rainy season lasts from March to November, compared to the far North, where it lasts from mid-May to September. In the South and the Southeast especially, precipitation is heavier with over 3,000 mm of rain a year (compared with about 1,800 mm in the Southwest). Rainfall decreases progressively away from the coast and the far North receives no more than 500mm a year (DFID, 2009; Chikaire, *et al.,* 2011a).

In the South of the country, temperature and humidity remain relatively constant throughout the year, while the seasons vary considerably in the North. On the coast the mean monthly maximum temperatures are steady throughout the year, remaining about 32 °C at Lagos and about 33°C at Port Harcourt; the mean monthly minimum temperatures are approximately 22 °C for Lagos and 20°C to Port Harcourt (DFID, 2009). When considering Nigeria by climatic region, three regions emerge: the far South, the far North, and the rest of the country . The far south is defined by its tropical rainforest climate, where annual rainfall is 2,300 to 3,200mm a year. The far north (Sahel region) is defined by its almost desert-like climate, where rain is less man 800 mm per year. The rest of the country, between the far South and the far North is savannah, and rainfall is between 800 mm and 2,300 mm per year (Chikaire, *et al.,* 2011a).

Available data from the Tyndall Centre for Climate Change Research, which is also used in the IPCC assessments, has been used to provide a best estimate scenario for temperature and precipitation changes in Nigeria. The best estimates for 2010 - 2050 were calculated from an average of the three different IPCC 'Special Report on Emissions Scenarios' (SRES) for the region. A low scenario has been calculated by using guidance from the Stern Report (multiplying the best estimate by a factor - in this case of 0.57). The high estimates are based on IPCC assessments for temperature and rainfall, but on latest research findings for sea level rise (IPCC, 2007).

Climate models suggest that Africa's climate will generally become more variable, but different authors have often stated conflicting views on the future of Africa's climate. For example, a more humid regime is predicted in the Sahel by Brooks (2004), based on observations since the 1990s of an amelioration of the regional climate with more rainfall. Other studies indicate that these general trends may include hidden variations (Hulme *et al,* 2001).

A global rise in sea level is expected to significantly affect Nigeria's coastline. The current IPCC predictions are a rise in sea level of between 18 and 59 cm by 2100 relative to 1980-1999, depending on the scenario (IPCC, 2007). The general consensus in the scientific community is that extreme events will continue to increase and become more severe across the continent. However, the IPCC has stated that there is insufficient information on which to assess possible changes in the spatial distribution and frequency of tropical cyclones affecting Africa. However, it is thought that a further 1°C rise in surface sea temperature in the Atlantic will create the conditions required to create hurricanes off the coast of Nigeria.

A general increase in high-rainfall events is expected, coupled with the expected increase in atmospheric water vapour. The probability of extremely warm seasons is 100% for West Africa, with a 22% probability of extremely wet seasons. The IPCC has further predicted that 1 in 5 seasons will be extremely wet in the 21st century in West Africa (IPCC, 2007b). In terms of more recent study predictions highlighting positive feedback warming and stronger climate change, signals from observations have not been focused on Nigeria in particular.

Climate Change and Agricultural Education

Temu *et al.* (2003) describes the linkage between education and society. Education can be described as the process of preparing an individual to become a functional and acceptable member of society. Two concepts are inbuilt in the definition of education, namely: creation of knowledge and experience, and growth and development. Unless tertiary agricultural education (TAE) is able to respond to societal challenges and expectations, society will have difficulties in understanding the roles of TAE .

Society is today presented with climate change challenges. If education is going to make a contribution to the current challenge then there should be institutional innovations and changes to ensure that graduates produced from the tertiary agricultural institutions are abreast with the climate change issues including mitigation and adaptation strategies. The curricular content, teaching materials and methods and delivery approaches should be designed in such a way as to equip the student with the necessary skills and knowledge to tackle these global challenges and their interpretation in specific local situations. Learning materials are generally not adequately

contextualized in the local African environment. This is true for many agricultural subjects and for climate change. This implies that the tertiary education institutions are not responding adequately to societal challenges.

Shortfalls in current primary, secondary and tertiary Agricultural Education

The shortfalls in primary, secondary and tertiary agricultural education have been described. For example, Temu *et al,.*(2003) and Chakeredza *et al.,* (2008) opined that against the background of the current brain drain, it is observed that among other problems, the major constraints in tertiary agricultural education are as follows:

- Poor staffing of institutions to meet the desired curriculum coverage
- The training is predominantly based on curricula adopted from countries that had colonies in Africa. The curricula were founded on an agricultural philosophy that aimed at the production of cash crops for consumption by the colonizing countries.
- Teaching mode is not learner-centred
- There is very little interaction with farming communities. In fact, most of the universities are located in towns where there are no farming communities to work with nearby. In most cases the farming community is not involved in the design and delivery of agricultural curricula, and
- There is absence of Private Sector involvement in the design and delivery of agricultural curricula

As a result, it is not surprising that Sub-Saharan Africa tertiary agricultural institutions have so far done very little in the integration of climate change issues into tertiary agricultural education. There is a need to rethink and transform the tertiary agricultural education system so that it becomes responsive to the needs of the society. Temu et al. (2003) suggested a framework which could be followed to address shortfalls in tertiary agricultural institutions. The findings and recommendations are still relevant today as they were in 2003 and need to be addressed.

The Need for Climate Change in the Curricula

Increasingly, climate change is becoming a challenge to agricultural production because it increases risks and uncertainties for farmers. There is a need for graduating agricultural students to be well- versed with the challenges posed by climate change if they are going to advise the communities they will be working with appropriately. They also need to understand the implications of climate change to economic development and international trade. Educating those currently at school about climate change will help to shape and sustain future policy-making. Studies on climate change have so far been limited to adaptation and mitigation intervention strategies. Agriculture faculties and students should be able to contribute to the development of the body of knowledge as regards climate change.

Students should be aware of the various International Conventions and Protocols surrounding climate change. These include the United Nations Framework convention on climate change (UNFCCC), Kyoto protocol and a range of other informal partnerships and dialogues that provide a framework that supports co-operation, and a foundation from which to build further collective action. The challenges are to develop good curricula, produce relevant learning resources and capacitate educators.

Education as Part of Response to the Challenges

A crisis food security, climatic variation, and technology investment, however, is not the only concern for the world. There is an imminent agricultural education crisis, which is already apparent. The agricultural education sector is witnessing a largely unplanned and ad hoc rationalization of providers across the world at a time when farmers and grazers need to be highly qualified to effectively manage complex businesses and environments.

It is evident that most providers of agricultural education, whether it is at degree or vocational level, are struggling to attract and maintain sustainable student enrolments. The rural sector, however, needs all agricultural providers to be well resourced, vibrant and forward thinking, so they can adequately prepare top graduates for the future. There have been reports highlighting low enrolments and predicting the fate of agricultural education institutions, in Nigeria. That is not a good image for agriculture.

There are inconsistencies between the demand and the supply sides of the agricultural education equation. A contradiction exists as many education providers cannot attract sufficient student enrolment to remain viable, and yet there are endless number of employment opportunities in the rural sector. As an industry, we need to develop a national strategy to address what is needed in the agricultural school sector, vocational and tertiary sectors with regard to the provision of agricultural education in both colleges of education and polytechnics, monotechnics and universities. We need to understand that many levels of skills are required in our industry and, if we are to thrive and meet future needs we need to plan carefully how each of the education sectors can contribute best to the mix of skills needed. We also need to gain acceptance by government that funding will need to be provided to attract the “best and brightest” school leavers into research careers in universities beyond the current small amount remuneration paid under scholarships arrangement available to few. If this does not occur, it is likely students with very high scores will be attracted to other industries that are perceived as more attractive. Other high paying

Table1. Emerging threats on teaching and learning activities

Climate change variable	Threats on teaching and learning activities	Consequences	Adaptation needs
Increased temperature (sun and heat)	Excessive heat in classroom	• Discomfort in the classroom as a result of sweating and heat stress • Weakness • Reduced mental capacity as shown in lack of readiness to learn, inability to understand and comprehend concepts • Teaching and class management becomes difficult	• Change in classroom design • Reduce number of students in a classroom • Increase number of class stream • Change in teaching and learning periods to early hours of the day and evenings • Teachers should utilize discovery/inquiry methods • More home work/assignments to children

sectors of industry that are experiencing skills shortages will suck workers away from agriculture-indeed, there is already evidence of this happening (Chikaire, *et al*., 2011b).

Important here is our need to do something for people who are currently working in agriculture we shouldn't be thinking only of training newcomers our industry is full of untapped human talent

Successful agricultural enterprises, vibrant rural communities, and individuals committed to our industry are each at least partially based on the levels of skills and knowledge that rural people have. Unless we address, our looming skills shortage through attracting more skilled and educated workers to industry, our world is likely to suffer from much more basic shortages, such as food and the other nutrients required for the survival our race, and for a peaceful co-existence across the globe.

Emerging Threats of Climate Change on Schools

Threats to teaching and learning activities as observed by the United Nations Intergovernmental Panel on Climate Change (IPCC, 2007), include extreme climatic events such as unusual storms, floods, changing patterns of rainfall, strong winds, droughts, and tidal waves. The adverse effects of climate change are already evident, natural disasters are more frequent and devastating, and developing countries are more vulnerable. This manifests in rising temperatures, sea level rise and shifts of climatic zones because of higher temperatures and altered precipitation patterns (AERC, 2008; Biello, 2008). In relation the school system, emerging threats, there conse quences and possible adaptation are summarized on Table 1.

Increased frequency and magnitude of extreme weather events such as increased heat, rainfall, storms and droughts is being observed in Nigeria. This is likely to pose threats to school activities such as teaching periods, learning capacities, mental capacity and performance in academic work. With poor school buildings in Nigeria education system, where most times, the classrooms are designed with poor ventilation and are too small for the number of pupils or students, increase in temperature is likely to result to discomfort in the classroom. This could be as a result of excessive heat production. Consequent to this is sweating, heat stress and weakness of the body which adversely affect the mental capacity of both the teacher and the students, ability to teach, learn new facts and comprehend concepts, or study for long periods. Moreover, the cognitive, psychomotor, and affective abilities which are the major objectives of the teaching and learning in the education system will be at stake (Nwajiuba, 2008).

Threats on School Physical environment. The type and frequency of severe weather events such as rainfall, droughts and storms have tremendous effect on school physical structures (WMO, 1997). The emerging threats on schools' physical environment are summarized on Table 2. Most school buildings in Nigeria are already dilapidated and are likely to be affected by erosion due to heavy rainfall. Floods, storms and strong wind are likely to pull down the buildings, the trees and plants which provide shades, play grounds and sometimes learning environment for children especially in unconducive environment for teaching and learning activities, and cause harm to

Table2. Emerging threats on School Physical Environment

Climate change variable	Threats on school physical environment	Consequences	Adaptation needs
Heavy rainfall, floods, strong winds, storms	a) Collapse of school buildings b) Trees and plants will be pulled down	a) Cause harm or death to school children b) Unconducive learning environment c) Non attendance to school	a) Solid school buildings should be built b) Trees in the school compound should be preserved c) Grasses and plants should planted in school compounds

Table3. Integrating climate change into the curriculum

Area	**Other aspects to be covered**
Introduction to Climate change	Implications of climate change to people's livelihoods and the world economy.
Global warming	The causes of global warming and projections under different scenarios.
Agro-biodiversity	The need to maintain agro-biodiversity under climate change threat; Impact of land use change on agro-biodiversity at ecosystems, species and within-species levels; Adaptation to climate change: agro-biodiversity options; Approaches for putting adaptation strategies into practice in research, extension and policy implementation.
Biofuels	The need for reduced carbon emissions. Alternative fuel production with special focus on biofuels. Socio-economic implications. Options available to adapt to the adverse effect of climate change
Adaptation Strategies	Options available to adapt to the adverse effect of climate change by different groups of people.
Mitigation Strategies	Current thinking on climate change mitigation strategies. Reduction of carbon emissions; Geo-engineering concepts and practices,
Global policy issues on climate change	Global policy framework, UNFCCC; Kyoto protocol; COM; NAPA

CDM - Clean Development Mechanism; NAPA- National Adaptation Plan of Action; UNFCC - United Nations Framework Convention on Climate Change.

children/teachers when learning and going to school. This implies that school attendance, achievement and attainment of students/pupils are threatened.

Further, these extreme weather events have both short-term and long-term socioeconomic and health effects on students, pupils and even teachers. Increased spread of endemic water and vector-borne diseases, shortage of water and food are threats posed by climate change. Consequent to this is infection with diseases which could lead to death of school children and reduce attendance to school which will eventually result to poor performance in academic work. School children are likely to suffer from malnutrition as a result of famine and may not be fit for school.

The ravaging effects of drought persist in the desert areas of Sub-Saharan Africa (Richard *et al.,* 2000). Communities living in these regions are continuously in a state of poverty and, as much research has shown, are as a consequence prone to civil strife and political turmoil. The knowledge vacuum on the economic as well as social impacts of climate change on Africa's development prospects is large. A pressing social impact is tilted towards migration. There may be large scale human migration due to climate induced stresses. Families will tend to relocate to other comfortable areas. The implication for the education system is the increase in enrolment in schools, lack of educational facilities, dearth of teachers and poor education standards.

Integrating Climate Change into Agricultural Curricular

Climate Change should be integrated into the curricula of tertiary agricultural institutions as a matter of urgency. There is need for concrete scientific data based on African experiences to be infused into the curricula. The suggested areas of emphasis are as presented in Table 3. The curricula can be handled as a separate subject or infused and Integrated into the various agricultural and natural resources management subjects. The recommended teaching and learning methods should be lectures (including guest lecturers), seminars, group discussions,

visits to sites demonstrating the impact of climate change and or adaptation and mitigation work in progress, on-farm discussions and surveys. eLearning enhanced with research repositories can also be pursued where possible (Temu and Chakeredza, 2008).

Disciplines could also be selected with the greatest potential to deliver mainstreaming climate change into tertiary agricultural and natural resources management education. The objective will be to ensure that graduating students in agriculture and natural resources management fully understand and grasp the implications of climate change on the whole global economy. The thrust should be towards building a cadre of academics and researchers with appropriate knowledge and skills on the key issues affecting society and be in a position to advise policy makers, educational establishments and practitioners.

It is essential that schools in Nigeria do not avoid subjects dealing with climate issues as being contentious or too difficult or even optional for students/pupils. These subjects should be taught at all levels as well as made compulsory. In any case, many times children appreciate nature and are in tune with the world and its natural interconnections. Environmental subjects and related issues which describes seasons, and weather events should be taught. The ability to observe and describe weather events are important skills to develop in the children. This will help create awareness on the frequency in changes in weather events and the adverse effects to human life. It is the task of trained and experienced teachers in environmental studies to expose children to environmental issues at all levels. The use of observation methods is important. Observation methods could be very important in understanding concepts in science especially in environmental issues such as observing changes in seasons, and weather events. The education system in Nigeria should be saddled with the responsibility of training and providing qualified teachers in environmental studies to expose children to climate changes and related issues (Chikaire, *et al*., 2011).

Suggested Climate Change related Education Modules for Schools

The Modules generally consist of a conceptual framework, a glossary of natural disaster terms, a training manual containing lessons, activities and tasks, and resources including case studies and worksheets.

1) **Module on Climate Change**

Overview: The module be designed to help teachers understand climate change issues in a global and regionally relevant context, and incorporate lessons into their curriculum.

Activities:
1) The Atmosphere and the Earth's Energy Budget
2) Weather and Climate
3) Climate Change
4) Act Now
5) Developing Lesson Plans

2) **Module on Environmental Education**

This module be designed to help teachers integrate environmental issues and concepts into the core curriculum for any subject or discipline so as to increase the overall environmental literacy of students.

Activities:
1) What is environment?
2) Why do we need to protect the environment?
3) Environmental literacy and Education for Sustainable Development
4) Integrating environmental issues into the curriculum

2) **Module on Natural Disaster Preparedness and Response**

Overview: The module should promote the inclusion of natural disaster preparedness and response school curricula. It involves young people and teachers action plan of development and evolve community participation strategies.

Activities:
1) Learning about Earthquakes
2) Learning about Floods
3) Learning about Typhoons/Storms, Hurricanes, and Cyclones
4) Learning about Tsunamis
5) Learning about Volcanoes

Steps for Achieving Change in Agricultural Education

The following steps should be implemented to better enable agricultural education programs to meet the needs of students, employers, and the broader society. If institutions of higher learning do not address the changes needed, they risk becoming irrelevant. Without significant action, graduates of these programs will have difficulty keeping up with the changing needs of society and building stable careers, and the nation will miss its opportunity for leadership in addressing the global challenges related to food and agriculture.

Implement Strategy Planning

Colleges and Universities with agriculture programs should

act strategically to recruit, retain, and prepare the agriculture graduate of today and tomorrow. Strategic planning is needed that involves a broad array of participants, including faculty within and outside of agriculture colleges, current and former students, employers, disciplinary societies, commodity groups, local organizations, farmers, and representatives of the public. Institutions should develop and implement a strategic plan within the next two years and revisit it every 3-5 years thereafter to evaluate progress and to refine and improve new programs and policies.

Broaden Treatment of Agriculture in the Overall Curriculum

Topics related to agriculture are found in numerous disciplines, from engineering and technology to chemistry and biology to the social sciences. Accordingly, academic institutions should broaden the treatment of agriculture in the overall undergraduate curriculum. In particular, faculties in colleges of agriculture should encourage discussion of agriculture in courses throughout the institution and work with colleagues from other departments to develop shared introductory courses that serve multiple populations and can illuminate underlying themes shared by agriculture and other discipline.

Broaden the Student Experience

The skills and knowledge that employers value most are not always well aligned with undergraduate agriculture programs. Institutions should broaden the undergraduate student experience to include training in transferable skills such as communication, teamwork, and management. Institutions should also increase student opportunities to participate in the outreach and extension activities common in many colleges of agriculture as well as undergraduate research, internships, and similar programs.

Prepare Faculty to Teach Effectively

Despite recent advances in the understanding of how people learn, university faculty do not generally receive much training in effective teaching, and universities still tend to use an outmoded method of teaching focused on facts and lecturing. As a result, many classes fail to engage students. Academic institutions, professional societies, and funding agencies should support faculty development activities focused on effective teaching. These activities should also provide appropriate training to graduate students and postdoctoral researchers-the next generation of agriculture faculty. Academic institutions should ensure that the responsibility for faculty development rests with departments, colleges, and institutions, rather than on individual faculty members.

Reward Exemplary Teaching

Achievements in teaching are only rarely rewarded in substantive ways. Efforts by academic institutions, funding agencies, and professional societies are needed to support effective teaching. Academic institutions should enhance institutional rewards for high quality teaching and curriculum development, especially including rigorous consideration in hiring, tenure, and promotion. Funding agencies should also support and reward excellence in teaching. Professional societies should raise the profile of teaching within disciplines, for example by sponsoring education sessions at society meetings, hosting workshops on teaching and learning, supporting education-focused articles in society publications, and facilitating the dissemination of teaching materials.

Build Stronger Connections among Institutions

Academic programs in agriculture tend to exist in isolation, with few connections between institutions-even between those in the same geographic area. In addition, community and tribal colleges produce large numbers of students, including high percentages of members of traditionally underrepresented groups, but there are currently few pathways for those students to pursue agricultural careers. Institutions should partner with each other to better support the needs of students in agriculture, such as by establishing joint programs and courses and developing pathways for students pursuing careers in agriculture.

Start Early

Increased awareness of agriculture's important role in addressing major societal problems can help to raise the profile of the field and attract more students. It is, therefore, in the best interest of institutions with programs in agriculture to foster greater awareness among pre-college students. Colleges and Universities should reach out to expose students and teachers to agricultural topics and generate interest in agricultural careers. Programs that might be considered include agriculture-based high schools, urban-agricultural education programs, summer high-school or youth programs in agriculture, and partnerships with youth-focused programs.

Build Strategic Partnerships

Although Colleges and Universities are responsible for

preparing students for careers in agriculture, there is little communication between educational institutions and the employers of their graduates and academic institutions should include representatives of industry and other employers on visiting committees, on advisory boards, and in strategic planning. Conversely, companies should include academic faculty on their advisory committees. In addition, exchange programs should be developed to enable agriculture professionals to spend semesters teaching at academic institutions and enable faculty to spend sabbaticals working outside of academic. Finally, opportunities for students to work in professional settings should be developed and expanded. These opportunities can include internships, cooperative education programs, summer opportunities, mentoring and career programs, job shadowing, and other experiences.

Climate Change Adaptation Strategies in Schools

The adaptation strategies for the education system include the following:

1) Change teaching and learning hours to early hours of the day, and mid-late hours and probably reduce teaching periods (duration). Teaching technique should be more of inquiry/discovery method where students will be given the opportunity to search for information and transform it into meaningful knowledge. However, this will help reduce the number of hours spent in the classroom as well as enhance learning. In addition, more home work/assignments should be given to students/pupils. There will be need to reduce number of students in a classroom to thirty five students per class with comfortable furniture. By implication, the number of streams will be increased to accommodate the students.

2) Building solid structures in the school environment and creating conducive physical environment for school curricula and extra curricula activities. Trees and plants should be planted in schools, old ones should be preserved.

3) Several of the challenges confronting climate change are attitudinal, and arise from the socialization process. For instance how people have been cultured to live, use energy, generate heat, transport and communicate, have to be modified. The best time to inculcate that is as part of the training process is through school curriculum and with appropriate teaching techniques/methods.

4) Children should be educated on appropriate lifestyle and behaviours. Skills and attitudes should be developed in children so that they could grow up and be inspired to become lifelong climate advocates.

5) Children should be taught that simple changes in their everyday lives can slow climate change. Children should be taught on how to make their homes energy efficient such as reducing heating and electricity use, and-proper disposal of trashes and organic waste. This will help improve public health.

CONCLUSION

There are emerging issues and threats posed by climate change on the education system. This is found in teaching and learning activities, school physical environment and the content in schools. It has therefore, become imperative for school administrators and policy makers to take decisions and address the issue of school population, school buildings/structures physical environment, curriculum and teacher qualification to adapt to climate changes. The education system needs to develop a good understanding of the social, cultural, economic, and political interconnectedness, so that issues associated with taking actions individually and collectively in order to combat climate change adverse effects for the benefit of all.

REFERENCES

AERC (2008). Climate Change and Economic Development. African Economic Research Development –Available at www.aercafircan org/htm/announcements 2. Asp?.

BASIC (2006). Building Africas Scientific and Institutional Capacity for Agriculture and Natural Resources. An ANAFE Publication. African Network for Agriculture Agro-forestry and Natural Resources Education, Malawi.

Biello D (2008). Toasted Bus. Scientific American. Available at www.SciAm.com

Bloom D, Canning D, Chan K (2005). Higher Education and Economic Development in African. World Bank Report. Washington, D.C

Brooks N (2004). Drought in the African Sahel: Variability, Change and Agency. Tyndale Center for Climate Change. University of East Anglia, Norwich.

Chakaredza S, TEMU AB, Saka JDK, Muntali DC, Muir- Leresche K, Akimifesi FK, Ajayi OC, Sileshi G (2008). Tailoring Tertiary Agricultural Education for Sustainable Development in sub-Sahara African : Opportunities and Challenges. *Scientific Research Essay, Vol 3(8):326-332.*

Chikaire J, Nnadi FN (2011a). Adapting the inland fisheries and Aquaculture to Socio- economic Challenge of Climate Change in Nigeria: The Need for Enhanced Extension Capabilities. *World Rural Observations 3 (3). 105-113.*

*C*hikaire J, Orusha JO, Onogu B, Okafor OE, Nwoye EO, Okoli CF(2011b). Repositioning Tertiary Agriculture Education Curriculum for Sustainable Development in Nigeria: Challenges and Opportunities. *Academia Arena 3(10):7-14*.

Corresponding author: Chikaire, J. Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State, Nigeria.

DFID (2009). Impact of Climate on Nigeria's Economy. Final Report. Department for International Development. United Kingdom.

Hulme M, Doherty R, Ngara T, New M, Lister D (2001). African Climate Change: 1900-2000. *Climate Research 17:145-168.*

IPCC (2007). The Physical Science Basis: Contributions of Working Group 1 to the Forth Assessment Report of the Intergovernmental Panel on Climate Change. Switzerland.

IPCC (2007B). Impact, Adaptation and Vulnerability: Contributions of Working Group II to the Forth Assessment Report of the Intergovernmental Panel on Climate Change. Switzerland.

Nkomo JC, Nyong AO, Kulindwa K (2006). The Impact of Climate Change in African. Final draft submitted to Stern Review on the Economics of Climate Change: Tyndale Center. Norwich.

Nwajiuba CA (2008). Emerging Issues of Climate Change in the Education System:Adaptation Strategies: In Nwajiuba,C.A. (ED) Climate Change and Adaptation in Nigeria. Farming and Rural Systems Economic. Hohenheim- Stuttgart University, Magraf verlag, Germany.

Richard SJ, Fankhauser S, Tol S, Richard GR, Smith JB (2000). How Much Damage will Climate Do? Recent Estimate. Available at www.unihamburg.de/wiss.

Rudebjer P, Temu AB, Kungu J (2005). Developing Agroforestry Curricula: A Pratical Guide for Academic Institutions in African and Asia. World Agroforestry Center, Bogor.

Stern N (2006). The Economics of Climate Changes: A Review. Available at www. Hm –treasury.gov.uk/independent-review-economics-climates –change/ sterm-review-report.fm.

Temu AB, Mwanje I, Mogotsi K (2003). Improving Agricultural and Natural Resources Education in African : A Stitch in Time. World Agroforestry Center , Nairobi, Kenya.

UNECA (2005). Assessing Sustainable Development in African: African's Sustainable Development Bulletin, United Nations Economic Commission for African. Addis Ababa, Ethiopia.

WMO (1997). World Metrological Organization. Available at www.agric org/ipccza/06.html.

Wood C, Knipmeyer CK (1998). Global Climate Change and Environmental Stewardship by Ruminant Livestock Producers. Natural Council for Agricultural Education. University of Missouri