

# International Journal of Basic and Applied Sciences

(A peer reviewed International Journal)

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*International Journal of Basic and Applied Sciences, Vol. 1 No. 2. pp. 140-147 2277-1921. 2012*

ISSN 2277 – 1921

Article type *Review Article*

Submission date *23 March 2012*

Acceptance date *30 March 2012*

Publication date *15 April 2012*

Article URL <http://www.crdeep.org/category/ijbas>

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## ***Review Paper***

# **The Challenges of Forest Biodiversity Conservation under Climate change stress in Nigeria**

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## **ABSTRACT**

Desertification, drought, coastal inundation, irregular rainfall and temperature, erosion and flooding, increased pest and diseases incidence, land degradation, spread of invasive alien species and crop failures are some of the effects of Climate change in Nigeria, having direct and indirect grave effects on forest ecosystems, threatening the sustainability of the forest biodiversity, which is rich in endemic, economic and endangered species, and increasing the chances of forest fires. Food crop failures accentuated by climate change is forcing the rural dwellers and subsistence farmers into the forest causing over-exploitation of the non-timber forest products for food, aggressive deforestation, bush burning and conversion of forested lands into farmlands. Weather changes was also observed to have caused irregular fruiting pattern in some timber species, which could affect the ecosystem balance, reduce the regeneration potentials of these timber species and adversely affect the population of frugivorous animals that depend on them for food. While mitigation approaches are global, adaptation strategies for forest conservation in Nigeria include among others afforestation, regeneration of degraded forested areas, sustainable land use, establishment of green belt in the Sahel savannah ecoregions and community-based forestry management. Nigeria's response to climate change needs to be improved through legislation and strict implementation of conservation laws, integration of climate issues into economic planning and management, appropriate funding, reduced dependence on timber products for construction through promotion of alternative building and construction materials and upholstery, public awareness campaigns, reduced forest disturbance, reduction in rain-fed farming system through introduction of improved irrigation systems, exploitation of sustainable energy sources such as solar energy and the establishment of more forest plantations.

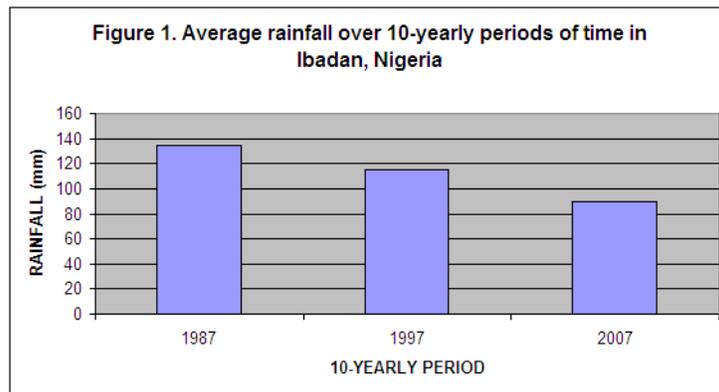
***Keywords:*** Climate change, Nigeria, Forest biodiversity, conservation.

## **INTRODUCTION**

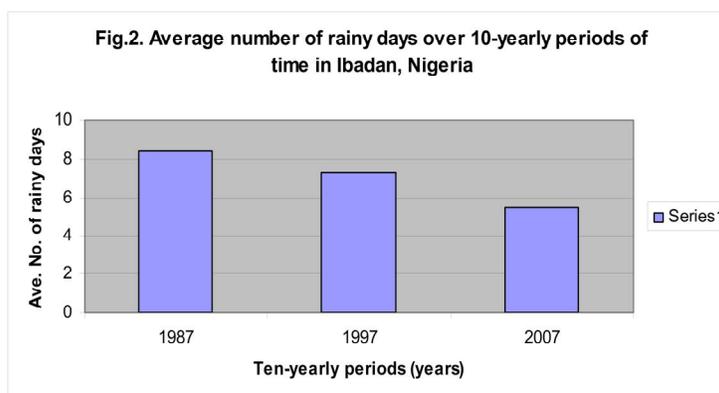
Climate change is real, especially in Nigeria which is bounded by two natural forces – the Sahara desert in the north and the Atlantic Ocean in the south – with Climate change catalyzing the actions of these two natural forces on adjacent areas in Nigeria. For instance, it has been estimated that between 50% and 75% of Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara States in Nigeria are being affected by desertification. These states, with a population of about 35 million people account for about 35% of the country's total land area. In addition, seven adjacent states to the south are reported to have about 10% to 15% of their land areas threatened by processes of desertification. It is estimated that the country is currently losing about 351,000 hectares of its landmass to desert conditions annually, and such conditions are estimated to be advancing southwards at the rate of about 0.6 km per year. As a result, Nigeria have experienced the resettlement of several villages in these affected states because of sand dunes and desert storms. Worse still, several coastal communities in Southern Nigeria have been repeatedly ravaged by coastal erosions, with Akwa Ibom state being the worst hit in recent times. All these are in addition to crop failures observed in several parts of the country. Another inevitable evidence of climate change is the decrease of the average area of Hadejia Nguru flood plain, North-east Nigeria from 2,350 Km<sup>2</sup> in 1969 to less than 1000 Km<sup>2</sup> in 1995. Inland Delta of Niger River decreased from 37,000 Km<sup>2</sup> in the early 1950s to about 15,000 Km<sup>2</sup> in 1990 (Ogunjinmi *et al.*, 2008). Lake Chad water stretched over 25 000 Km<sup>2</sup>. But today the Lake has continuously shrunk since the great draughts of the 70s, and now it covers an area of less than 1 000 Km<sup>2</sup> during the annual lowest water levels of

the region. Furthermore, the Lake is now one-twentieth of its original size while its maximum depth was 154 meters, compared with 2-4 meters today (LCBC, 2008; IUCN, 2004). Furthermore, several cities have recorded irregular rainfall and increasing trends of temperature, while erosion and flooding have become a regular event in several cities in Western and Southern Nigeria during the wet season. Figures 1-5 show the weather records in some parts of Nigeria over a long period of time, while plates 1-2 illustrate, with photographs, some of these effects of climate change in Nigeria. In another study by Nwajiuba and Onyeneke (2010), meteorological records for 4 states in South-eastern Nigeria from 1978 to 2007 showed a decreasing trend for rainfall and relative humidity, while data on temperature from 1978-2007 shows an increasing trend, with adverse effects on crop production (figures 6 and 7).

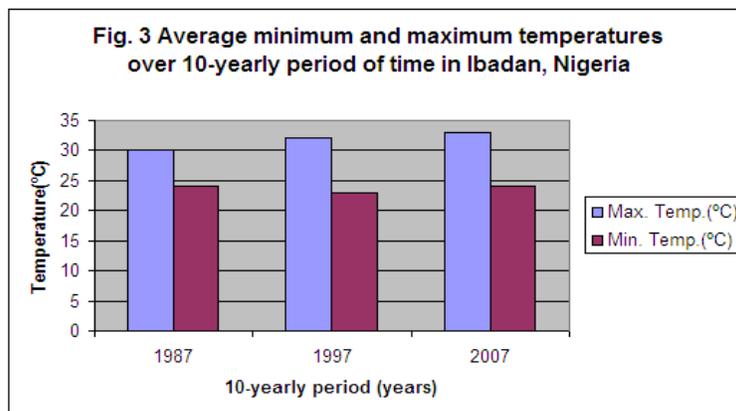
UNFCCC has defined climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability over comparable periods” (UNFCCC, 1992). IPCC (2001) referred climate change to any change in climate over time whether due to natural variability or as a result of human activities. Recent studies have shown that precipitation decrease in the humid regions of West Africa, including southern Nigeria, since the beginning of the century is about 10-25% or about 2-5% per decade. If this trend persists, rainfall in the humid regions of southern Nigeria may be about 50% to 80% of the 1900 values by 2100. With increase in ocean temperatures, however, there could be increase in the frequency of storms in the coastal zone of the country (IPCC, 2001; Adejuwon, 2004).



**Figure 1:** Average rainfall over 10-yearly period of time in Ibadan, Nigeria



**Figure 2:** Average number of rainy days over 10-yearly periods of time in Ibadan, Nigeria



**Figure 3:** Average minimum and maximum temperatures over 10-yearly period of time in Ibadan, Nigeria

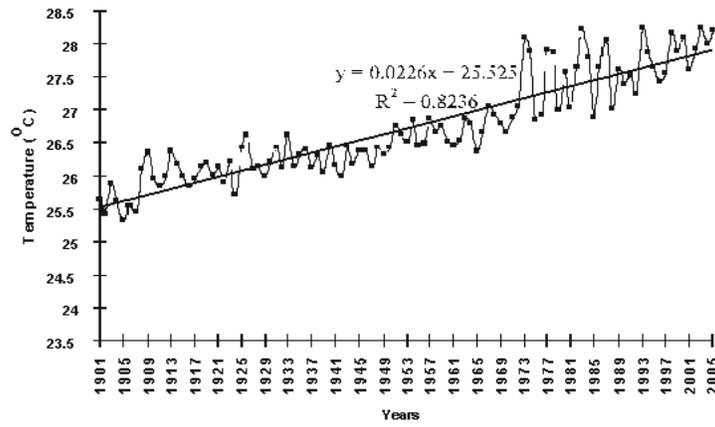


Figure 4: Air temperature distribution in Nigeria between 1901 and 2005

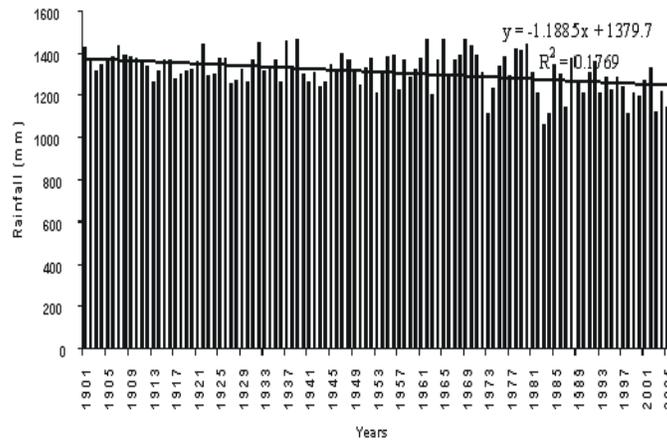


Figure 5: Rainfall distribution in Nigeria between 1901 and 2005

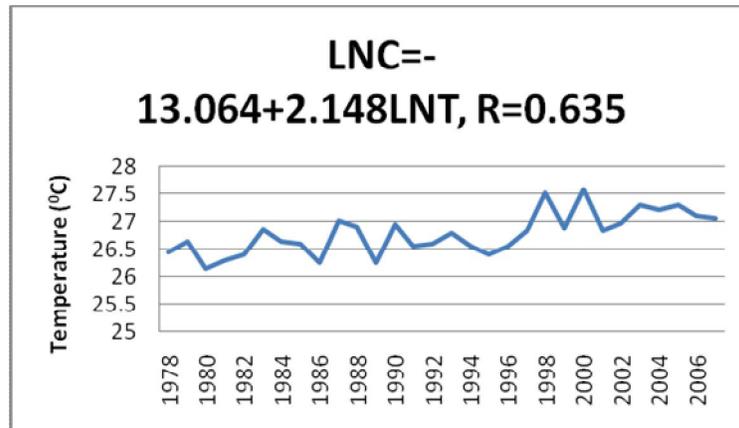
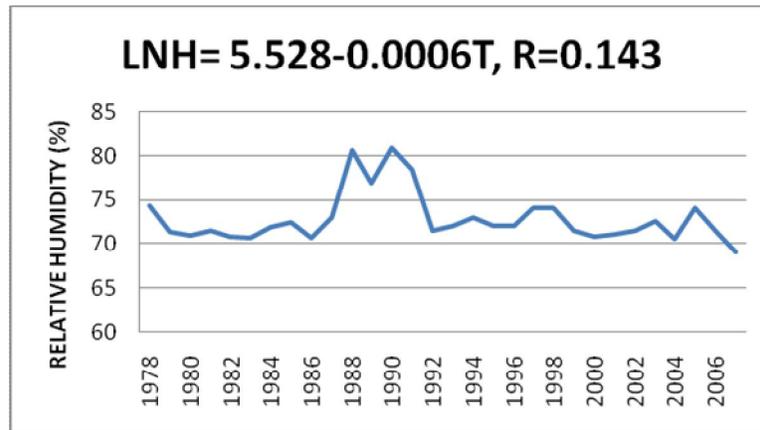


Figure 6: Trend of Temperature for the Southeast Rainforest Zone of Nigeria from 1978-2007  
Source: Nwajiuba & Onyeneke (2010)



**Figure 7:** Trend of Relative humidity for the Southeast Rainforest Zone of Nigeria from 1978-2007  
 Source: Nwajiuba & Onyeneke (2010)



**Figure 9:** Sand dunes in Yunusari Local Govt of Yobe State

**Plate 1:** Sand dunes in Yunusari Local Government of Yobe State



**Plate 2:** Rising sea level destroyed houses in Ibuot Utan, Mbo LGA, Akwa Ibom State

### EFFECTS OF CLIMATE CHANGE ON FOREST BIODIVERSITY IN NIGERIA

Nigerian forests are very important, being part of the West African Guinean forests, one of the 25 global hotspots for biodiversity (Myers *et al.*, 2001). Nigeria has a land area of 92.4 million hectares, while the estimates of the forest cover range from 9.7 million hectares to 13.5 million hectares (FAO, 2005). In another report, the savanna zones of the

country occupy 86% of the total land area and have 7.5 million hectares of forest reserve; while high forest zone of the country occupies 14% of the total land area and account for 2.1 million hectares of forest reserves (Leipzig, 1996). Species of *Meliaceae* and *Fabaceae* such as *Khaya spp*, *Entandrophragma spp*, *Lovoa trichilioides* and *Gosweilerodendron balsamiferum* are characteristic of the rainforest area; whereas species of *Sterculiaceae*, *Ulmaceae*

and *Moraceae* such as *Nesogordonia papaverifera*, *Triplochiton scleroxylon*, *Celtis spp* and *Melicia excelsa* characterize semi-deciduous forests. Riparian forests are the only closed forest in the savanna zone, characterized by species such as *Mitragyna ciliata* and *Uapaca spp*. Important secondary forest species in degraded forest are *Trema guineensis*, *Pentaclethra macrophylla*, *Musanga cecropioides* and *Anthocleista spp*. Forest tree species in Nigeria are particularly diverse, and many of these have commercial importance. Nigerian moist forests are rich in epiphytic ferns and orchids, and contain over 560 species of trees which attain heights of at least 12 metres and girth of 60 centimetres (Oguntala *et al.*, 1996). In Cross River state alone, the Forestry Research Institute of Nigeria lists 85 endangered tree species, and many of these are endemics, found only in this region. Five of them are monospecific, that is, the only representative of a particular genus found in the world (Oguntala, *et al.*, 1996). In addition, IUCN listed 69 plants found in Nigeria forests as endangered species (IUCN, 2004), an example of which *Gossweilerodendron balsamiferum*, a tree species that is endemic to the region and harvested that is listed as endangered due to habitat loss and over-harvesting (ITTO, 2005). Furthermore, two plants are listed in the CITES Appendix I and 44 in Appendix II (CITES, 2005). Most publications on the effects of climate change on forests and biodiversity are mere future projections, but in Nigeria, we are already observing severe effects of climate change on forest biodiversity. These effects are explained below:

- Forest Health: In South-west Nigeria, various species of mahogany (*Khaya senegalensis*) are being attacked by shoot borers such as *Hypsiphyla robusta* and *Phytolya fusca* which normally attack iroko (*Milicia excelsa*), (Aluko *et al.*, 2008). This new development is attributed to climate change. Aluko *et al.* (2008) pointed out that potential impacts of climate change would have adverse effects on species as they may have to face new competitors, predators, diseases and alien species for which they have no natural defense.
- Disruptions in life cycle: In 2009, the author was one of the exploration team that travelled to Southern part of Nigeria for the collection of *Khaya grandifoliola* fruits for research studies. However, in all places visited, the fruits were yet to mature, while the residents in those areas decried a 'strange' weather in their area for the past several months. This illustrates how climate change disrupts the fruiting potentials and season of these tree crops and this in itself, has grave effects. Disruptions in the fruiting season and potentials of the trees can threaten the regeneration ability of the trees, thus reducing their natural potentials for increase in population. Furthermore, the survival of many frugivorous birds and animals that depend on the fruits of the trees is threatened, in which they die or are forced to migrate to new areas in search for food. If these animals migrate from a protected area, they risk being hunted and killed. This explains the fact that life cycle of many wild plants and animals are closely linked to seasonal variations (Meduna *et al.*, 2008).
- Increased forest dependence: Agriculture in Nigeria is mainly rain-fed. In the recent past, there has been decrease in crop yield, and sometimes total crop

failure in some areas, due to irregular rainfall and excessive temperature exacerbated by climate change. For sustenance, most of the farmers hit by crop failure descend on the forest timber and non-timber products for survival in that famine. This leads to increased exploitation of the forest resources, thereby threatening their sustainability.

- Natural disasters: In addition to several buildings destroyed and hundreds rendered homeless, several trees in the savanna woodlands and rainforests were hit and killed by heavy rainstorms, thunder strikes and winds associated with rainfall. Though these natural agents are natural in occurrence, an increase in their occurrence in the recent pasts has been attributed to climate change.
- Proliferation of invasive species: Invasive alien plants have increase tremendously in the recent past, especially in the country's protected areas. And worse still, many of the staff has little or no training on the prevention, management and eradication of invasive species. These invasive species thrive well due to their adaptability to withstand harsh weather, which the indigenous species are not familiar and adapted to, and cause greater damage and threat to the survival of these protected, endangered and indigenous species.

In addition to these already occurring events induced by climate change, several other projections were being made with regards to the effect of climate change on the forest biodiversity in Nigeria:

- Migration of protected species from protected areas: Meduna *et al.*, (2008) pointed out that the restriction of plants and animals to protected areas within only one climatic zone may face great risk of extinction or migration of these species when hot by climate change. As they migrate from the protected area, they face danger of being hunted or killed, thereby defeating the purpose of conservation.
- Increased desertification: With the current trends of climate change, desertification is expected to continue, increasing the vulnerability of Sahel ecoregion and adjacent savanna woodlands and ecosystems unless actions are taken to combat it.
- Increasing temperature: Higher temperatures throughout Nigeria are likely, with the potentials of causing increased evapotranspiration, shorter growing periods, drying of the soil, increased pest and disease pressure, shifts in suitable areas for growing crops and livestock, and other problems for agriculture and forestry.
- Greater extinction risk: Populations of many species that are already threatened are expected to be placed at greater risk by the synergy between the stresses of changing climate and land-use change that fragments the habitats. As a result, some species that are currently classified as "critically endangered" could become extinct, without adaptation.
- Ecosystem change: Species composition and dominance could be altered, resulting in ecosystem changes.
- Reduction in Biomass: In arid or semi-arid areas (dry forests, woodlands and rangelands) where climate change is expected to decrease the

available soil moisture, biomass productivity is expected to decrease.

## SUGGESTED SOLUTIONS

Adaptation and Mitigation are the key words being discussed today, with respect to Climate change. Mitigation is defined as an anthropogenic intervention to reduce the sources or enhance the sinks of GHGs; while Adaptation is adjustment in natural or human systems in response to actual or expected climatic stimuli and their impacts on natural and socio-economic systems, which moderates harm or exploits beneficial opportunities (IPCC, 2002). Nigeria seems to be halfway prepared for climate change effects on forest biodiversity. Many of the foresters are not trained in GIS and remote sensing of protected areas; deforestation is still on the increase and land use change and degradation is fast expanding into the forests. Nigeria can be judged to be fully prepared for climate change if the following are done:

- **Afforestation and reforestation:** Forest conservation measures which may include aggressive afforestation, reforestation and nationwide tree planting campaigns in an effort to replenish the diminishing forest cover. Afforestation and reforestation are also included under Article 3.3 as well as Article 12 of Kyoto Protocol under CDM. This may also take the form of urban park and tree planting (urban forestry) in urban settlements. Forests, especially the biodiversity rich tropical forests are more resilient to climate impacts than monoculture plantations or any artificial forest. A forest consisting of multiple species are more resilient or less vulnerable due to different climate tolerance of different species, different migration abilities and effectiveness of invading species (IPCC, 2001). Native species are less likely to be vulnerable than exotic species to climate change. Promotion of regeneration of native species through protection and natural regeneration in degraded natural forest lands, to reduce vulnerability to changing climate; Promotion of multi-species plantation forestry incorporating native species, in place of monoculture plantation of exotic species to reduce vulnerability; Adoption of short rotation species in commercial or industrial forestry to enable adaptation to any adverse impact of climate change; Incorporation of several silvicultural practices such as sanitation harvest, increased thinning to reduce occurrence of pests and diseases; Incorporation of fire protection measures to reduce vulnerability of forests to fire hazard due to warming accompanied by droughts; Incorporation of soil and water conservation measures to reduce the adverse impacts of drought on forest growth.
- **Protected area management:** Expansion of protected area and its management could lead to protection of forests from degradation and promote regrowth of trees since formation of protected area and its effective management prevents forest degradation and conversion. Prevention of felling of trees and conversion of forestland leads to conservation of carbon sink in the forests. Regrowth of trees due to effective protection will lead to carbon sequestration. Formation and management of protected areas also leads to conservation of biodiversity, in turn reducing the vulnerability to climate change. One of the additional adaptation strategies to be incorporated while forming a protected area is to link different protected areas to create opportunities for migration of flora and fauna, which facilitates adaptation to changing climate.
- **Sustainable Forest Management:** Currently only a small proportion of the forest is sustainably managed leading to reduction in CO<sub>2</sub> emissions. Sustainable forest management practices not only contribute to reduction in CO<sub>2</sub> emissions but also reduce the vulnerability of forests to climate change. The protection, sustainable management and enhancement of terrestrial and marine ecosystems, which act as carbon sinks and reservoirs to greenhouse gases are also very important, and this may involve creating refuges and buffer zones, while deforestation should be reduced to the barest minimum and afforestation highly encouraged. This helps in two-ways: climate change amelioration through ecological services of the trees in acting as carbon lungs and in the release of oxygen into the atmosphere;
- **Agroforestry:** Agroforestry has a large potential to sequester carbon, particularly in tropical countries. Agroforestry practices including planting of multipurpose trees and leguminous tree species that can reduce the vulnerability of crop production to climate change, particularly droughts.
- **Organic Agriculture:** Enhancing soil organic matter content; through organic manuring to increase the moisture retention and soil fertility not only reduces the vulnerability to drought and moisture stress but also increases the carbon sequestration rates of trees as well as grass species. Agriculture systems in Nigeria need to be improved. Protection of the forest requires improved agricultural practices through the use of fertilizers rather than the current dependence on the natural fertility of the forest soils as mostly practised in Nigeria. Nigeria should start to invest heavily on irrigation farming rather than relying more on rainfed agriculture that is highly unreliable and becoming more unpredictable. Investment on improved agricultural technology, which should include the manufacturing and establishment of storage facilities, are very necessary. This will help to store excess agricultural produce for future use. The on-going plan to supply water to the disappearing Lake Chad from the Congo Basin should be intensified and brought into fruition within the shortest possible time. Moreover, bush burning either for hunting, farm clearing or by herdsmen to facilitate the sprouting of fresh grasses for their animals to graze on should be stopped. Increased food production reduces human dependence on the forest and exploitation of the NTFPs.
- **Green technology:** Green technology can be defined as the sustainable development and technical advancement in a way that reduces greenhouse gas emission and ensures conservation of natural resources. To reduce the emission of greenhouse gases, clean and environment friendly technologies are needed. Industrial productions

should convert to machines that emit limited or no greenhouse gases. Automobiles and industrial machines should be improved upon to use only ethanol, solar engines, electric engines or hybrid electric engines. Gas flaring especially in the Niger Delta region of Nigeria should be reduced to the barest minimum. Nigeria should encourage the use of renewable energy sources such as photovoltaic cells in a small scale. Furthermore, the widespread use of low-cost solar energy cookers instead of wood burning devices will also limit the current pressure on the Nigeria forest for firewood. Moreover the use of fuel cells that convert hydrogen fuel directly into electricity without first burning it to produce heat should be encouraged.

- Public Enlightenment: The people need to be given thorough education and enlightenment of the public on the hazards of climate change due to human activities, for example bush burning. This will require all forms of media and the journalists.
- Reduction of Deforestation: The dependence on timber and timber products in Nigeria is very high, partly because of the high human population. Changes are needed in building and furniture materials in Nigeria so as to reduce this dependence of timber. Roofing materials, doors and furniture in most buildings in Nigeria, are made of wood. Odjugo and Ikhuoria (2003) noted that average of 320 sticks was used to support the decking of a three-bed-room flat building, plus the plywoods used for the floor of the decking. They also stated that these supporting sticks and plywoods are hardly used twice since they are sold as fuel wood immediately they are removed as support. One could therefore appreciate the number of trees destroyed annually with the current vertical growth of Nigerian cities. The deforestation processes can be reversed if iron and steel and aluminium are used for construction of our buildings and household furniture; *and*
- Weather stations: There is the need to establish better-equipped weather stations as against the scanty and ill-equipped ones we currently have in Nigeria. With these, accurate weather forecast and predictions will be possible and this will help to prevent weather-related disasters through early warning and effective response system. For example, a violent tropical cyclone in Central and North America in 1970 killed 30,000 people whereas similar cyclones in 1992 and 1994 caused only 13,000 and 200 deaths respectively as a result of improved forecast and early warning (Adefolalu 2007). Another important factor is the establishment of disaster mitigation plans in a more formal setting and the upgrading of all systems based on advance in science and technology, with emphasis on space science. With the decreasing rainfall amount and duration, frequent drought and desertification, drought resistant and short duration high yielding crops should be developed and made available to farmers.
- Capacity building: Protected area managers in Nigeria are technically ill-equipped for the management of the protected areas under climate change stress. Trainings are needed in several

areas, most especially GIS and remote sensing of forests.

## CONCLUSION

Climate change may not be controlled, but we can control the factors that accelerate it and as well mitigate the effects in our natural environment. Urgent and appropriate actions need to be taken on climate change in Nigeria by all the stakeholders in order to preserve the rich and diverse forest resources in Nigeria.

## REFERENCES

- Adefolalu D.O.A (2007). Climate change and economic sustainability in Nigeria. *Paper presented at the International Conference on Climate Change, Nnamdi Azikwe University, Awka 12-14 June 2007.*
- Aluko, A.P *et al.* (2008). Climate change: a threat to food security and environmental protection. *In: Climate Change and Sustainable Renewable Natural Resources Management. 32nd Annual Conference of Forestry Association of Nigeria.*
- CITES (2005). CITES Listed Species Database. Available from <http://www.cites.org/eng/resources/species.html> (accessed September 2005).
- FAO (2005). State of the World's Forests 2005. FAO, Rome, Italy.
- IPCC, (2001). Climate Change 2001: The Scientific Basis, Summary for Policy Makers and Technical Summary of the Working Group I Report, Intergovernmental Panel on Climate Change, Geneva, Switzerland, 2001.
- IPCC (2002). Climate and biodiversity. IPCC technical paper V. Habiba G, Avelino S, Robert T and David Jon Dokken (eds). Intergovernmental Panel on Climate Change, Geneva, Switzerland, 2001.
- ITTO (2005). Status of Tropical Forest Management 2005, Summary report of International Tropical Timber Organisation, Yokohama, Japan. (pp. 35)
- IUCN (2004). 2004 IUCN Red List of Threatened Species. Available from: <http://www.redlist.org> (Accessed September 2005).
- LCBC (2008). High-level conference on water for agriculture and energy in Africa: the challenges of climate change Sirte, Libyan Arab Jamahiriya, 15 – 17 December 2008. pp 12
- Leipzig (1996). Nigeria: Country Report to the FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany. Prepared by Sarumi, M.B., D.O. Ladipo, L. Denton, E.O. Olapade, K. Badaru and C. Ughasoro. 51pp.
- Meduna A.J *et al.* (2008). Climate change and implications for biodiversity conservation. *In: Climate Change and Sustainable Renewable Natural Resources Management. 32nd Annual Conference of Forestry Association of Nigeria.*
- Nwajiuba C and Onyeneke R (2010). Effects of climate on the agriculture of sub-Saharan Africa: Lessons from Southeast Rainforest Zone of Nigeria. Paper presented at 2010 Oxford Business & Economics Conference Program,

St. Hugh's College, Oxford University, Oxford, UK. June 28 – 30, 2010.

Odjugo P.A.O and Ikhuoria A.I (2003). The impact of climate change and anthropogenic factors on desertification in the semi-arid region of Nigeria. *Global Journal of Environmental Science*, 2(2): 118-126.

Ogunjinmi A.A *et al.* (2008). Potential impacts of climate change on biodiversity and cultural values of National Parks. *In: Climate Change and Sustainable Renewable Natural Resources Management. 32nd Annual Conference of Forestry Association of Nigeria.*

Oguntala A.B, Soladoye M.O, Ugbogu O.A & Fashola A.T. (1996). A review of endangered tree species of Cross River State and Environs. *In: Obot and Barker, 1996, pp. 120 – 125.*