AGRICULTURE, FORESTRY AND CLIMATE CHANGE: AN IMPERATIVE FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

It is my honour and privilege for me to put up this little piece at this National Symposium in honour of our most distinguished Professor in the Nigerian Agriculture, Forestry and Climate change issues. I wish to congratulate this great man – Prof. N.C Ohazuruike for his services generally in area of Agriculture, Forestry, Climate changeand generally in the area of Pathology (Mycology). I certainly remember the Almighty June, 2004 of yester-years. It was the month/year Prof. N.C Ohazuruike came to examine my PhD at Rivers State University of Science and Technology, Nkpolu, Port-Harcourt.

INTRODUCTION

The title of this paper - Agriculture, Forestry and Climate change issues was chosen to reflect the teaching and research efforts of the man being honoured today. He has been involved in the activities associated with the improvement of the Agriculture, Forestry and Climate change issues for the sake of improving a better world environment.

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation or wind patterns among other effects that occur over several decades. United Nations Framework Convention on Climate Change(UNFCCC) defines climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Over the past century, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere. The majority of greenhouse gases come from burning fossil fuels to produce energy, although deforestation, industrial processes and some agricultural

practices also emit gases into the atmosphere. The most important of the greenhouse gases is carbon dioxide (CO_2), which has risen from a concentration of 275 parts per million (ppm) prior to 1850 to the current value of 390 ppm. Levels of $CO_2$are expected to continue rising and current estimates predict a concentration of 525 – 950 ppm by the end of this century. The enhancement of the greenhouse effect by rising concentrations of these greenhouse gases is largely responsible for the issue of global warming. However, rising temperatures are only one consequence of the enhanced greenhouse effect, with changes to weather patterns and many aspects of the climate such as rainfall and humidity, these are referred to as climate change collectively.

A warming climate will bring changes that can effect water supplies, agriculture, forests and its conservation, power, transportation systems, the natural environment, our own health and safety. Carbon dioxide can stay in the atmosphere for nearly a century, so earth will continue to warm in the coming decades. The warmer gets, the greater, the risk for more severe changes to the climate and earth's system.

Carbon naturally cycle between the atmosphere, oceans, vegetation, animal life and soils. During the process of photosynthesis, trees absorb $CO_2$from the atmosphere and sequester (store) it in their woody tissues. Forests sequester (store) more carbon than other terrestrial ecosystem and an average forest tree can remove approximately 9 kg of $CO_2$from the atmosphere each year. On a global scale, forests potential to store carbon makes them critical for stabilizing atmospheric gases such as Co_2.

CLIMATE CHANGE AND EFFECTS ON FOREST GROWTH

Climate effects influences the function and structure of forest ecosystems and plays an essential role in forest health. Changing climate may worsen many of the threats to forests such as pest outbreaks, fires, human development and drought. Climate changes directly and indirectly affect the growth and productivity of forests: directly due to changes in atmospheric carbon dioxide and climate and indirectly through complex interactions in forest ecosystems. Climate also affects the frequency and severity of many forest disturbances. In conjunction with projected impacts of climate change, forests face impacts from land development, suppression of natural periodic forest fires and air pollution. Although, it is difficult to separate the effects of these different factors, the combined impact is leading to changes in forests.

As these changes are likely to continue in the decades ahead, some of the valuable goods and services provided by forests may be compromised. Three major factors are considered to influence the forests more – increase in carbon dioxide (CO_2), increase in temperature and change in precipitation (USEPA, 2012).

FORESTSAS A GLOBAL CONCERN

Forests are a crucial element for life on our planet and are under great pressure from a growing human population. Most countries in the world include forests as a top environmental concern. The most common reason is deforestation – the permanent loss of forest land but another is the decline of forest health. Forests are at the crux of global environmental concerns such as population growth, global climate change and the rise of infectious diseases.

- POPULATION GROWTH

The world population topped 6.6 billion people in 2007 and continues to expand. Although the rate of growth may level off, the 20th century alone saw 75 percent of the growth in world population over the entire history of human. As a direct or indirect consequence, that century also saw a loss of nearly half of the world's original forest cover – some 3 billion hectares. Throughout the 1990's, many countries with rapid population growth also had high rates of deforestation.

The consumption of goods from forests has more than doubled in 30 years and will likely continue to increase. This rise is the result not only of an increased population, but also of individuals using more forest products. Developed countries account for most of the demand for forest products.

Forests respond to both short-term and longer-term variations in the environment (Innes and Peterson, 2001). Although, all biological activity in plants is ultimately dependent on absorbed solar radiation, it is obvious that solar radiation alone does not determine primary productivity. All plants require sunlight, carbon dioxide and water for photosynthesis. Beyond these basic requirements, the amount of foliage, water availability, ambient temperature, availability of soil nutrients are finer controls of forest productivity.The main abiotic controls of primary production (temperature, radiation and water) interact to impose complex and varying limitations on vegetation activity in different parts of the world (Nemani et al 2003). Physiological responses to changes in climate are highly dependent on the

limiting factors of a particular site to forest growth. For example, increasing temperature may also increase vapour pressure deficit of the air and thereby increase transpiration rates, resulting in adverse effects on dryer sites, unless stomata closes in response to other changes such as an increase in CO_2 or if increase in night-time temperature exceeds increase during the day.

Table 1: Summary of Published Change in Forest Productivity under Recent Climate

Variable	Change	Time Scale	Spatial Scale	Data Type	Reference
ANPP	+	1982-1999	Globe	Satellite	Nemani et al (2003)
ANPP	-	ENSO years	Tropics	Satellite	Nemani et al (2003)
ANPP	-	ENSO years	Tropics	Satellite	Braswell et al (1997)
ANPP	-	ENSO years	Tropics	Satellite	Asner et al (2000)
ANPP	-	ENSO years	Tropics	Satellite	Los et al (2001)
NDVI	+	1982-1999	Northern Hemisphere	Satellite	Slayback et al (2003)
ANBP	+	Growing season	Boreal aspen	Land-flux tower	Chen et al (1999)
ANPP	+	Growing season	North-western Europe	Satellite	Luchi et al (2002)
ANPP	+	1982-1999	China	Satellite	Fung et al (2003)
ANBP	-	1949-1980	China	Land biomass	Fung et al (2001a)
ANBP	+	1970s-1998	China planted forests	Land biomass	Fung et al (2001a)
ANBP	+	1982-1998	North America	Satellite	Hicke et al (2002)
ANBP	+	1945-1990	USA	Combined types	Houghton et al (1999)
NBP	+	1980-1989	USA	Atmospheric and land-flux tower	Pacala et al (2001)
NBP	+	1990s	European forests and grasslands	Combined types	Janssens et al (2004)
ANPP	+	Recent	Canadian and Alaska boreal forests	Combined types	Innes and Peterson (2001)
ANPP	-	1951-2000	Canadian Prairies boreal aspen	Land biomass	Hogg et al (2005)

ANPP	+	Since 1970	Boreal/tundra forest	Land biomass	Gamacheand Payette (2004)
NBP	+	1950–1999	European forests	Land biomass	Nabuurs et al (2003)
ANPP	+	20th century	Canadian Cordillera	Land biomass	Luckman et al (2004)
ANBP	+	During PDO events	Pacific Northwest	Land biomass	Peterson and Peterson (2001)
ANBP	+	During PDO events	Pacific Northwest	Land biomass	Peterson et al (2002)
ANPP	-	1926–2001	Northwest Russia	Land-soil fluxes	Lawrence et al (2005)
ANPP	+	20th century	Scots Pine in Lapland	Land biomass	Mielikainen and Sennov (1996)
ANPP	0	20th century	Scots Pine southern Finland	Land biomass	Mielikainen and Sennov (1996)
ANPP	+	20th century	Sweden	Land biomass	Elfving et al (1996)
ANPP	+	1953–1992	Swedish forest	Land biomass	Ericksson and Karlsson (1996)
ANPP	+	Since 1960s	Sweden	Land biomass	Ericksson and Karlsson (1996)
ANPP	+	1920s–1990	Danish beech forest	Land biomass	Skovsgaard andHenriksen (1996)
ANPP	+	1975–2000	Eastern Germany	Land biomass	Untheim (1996)
ANPP	+	Last 150 years	France	Land biomass	Badeau et al (1996)
ANPP	+	Since 1905	Topwaald Switzerland	Land biomass	Braker (1996)
ANPP	+	20th century	Norway spruce in the Swiss Jura	Land biomass	Schneider and Hartmann (1996)
ANBP	+	1947-1995	Japan	Land biomass	Fang et al (2005)
ANPP	+	100 years	Various parts of Switzerland	Land biomass	Zingg (1996)
ANPP	+	Since 1961	Austria	Land biomass	Schadauer (1996)
ANPP	+	Since 1961	Austria	Land biomass	Hasenauer et al (1999)
ANPP	+	1947-1990	Slovanian beech forests	Land biomass	Kotar (1996)

BIODIVERSITY AND CLIMATE CHANGE

Biodiversity is usually the term given to variety of life on earth and it provides goods and services that sustain our lives, including genetic variety within a species population and species variety within an ecological community. Human pressures on ecosystem are causing changes and losses at rates not seen historically. People are changing ecosystems more rapidly and more extensively than over any other period in human history. Climate change adds yet another pressure on natural ecosystems. Forests have the greatest species diversity of all terrestrial ecosystems, holding about two-thirds of the world's known terrestrial species. However, when forests are degraded or diminished, diversity is also reduced. Human caused pressures such as agriculture, hunting and logging tend to decrease overall numbers of species, threaten local native species and often create favourable conditions for non-native species to colonize. Invasions by non-native species are a major threat to global biodiversity as a whole and to forests in particular. Invasive plants and animals often do not have natural predators to impede their reproduction and they tend to both grow and reproduce quickly.

Climate changes projected to further adversely affect key development challenges, including providing clean water, energy services and food, maintaining a healthy environment and conserving ecological systems and their biodiversity and associated ecological goods and services. The major projections reported in the Millennium Ecosystem Assessment (MA, 2005) report are:

- Climate change is projected to exacerbate the loss of biodiversity and increase the risk of extinction for many species especially those already at risk due to factors such as low population numbers, restricted or patchy habitats and limited climatic ranges with medium to high certainty.
- Water availability and quality are projected to decrease in many arid and semi-arid regions.
- The risk of floods and droughts is projected to increase.
- The reliability of hydropower and biomass production is projected to decrease in some regions.
- Incidence of vector-borne diseases such as malaria, dengue and water borne diseases such as cholera is projected to increase in many regions.
- Heat stress mortality and threats of decreased nutrition in many regions, along with severe weather traumatic injury and death.

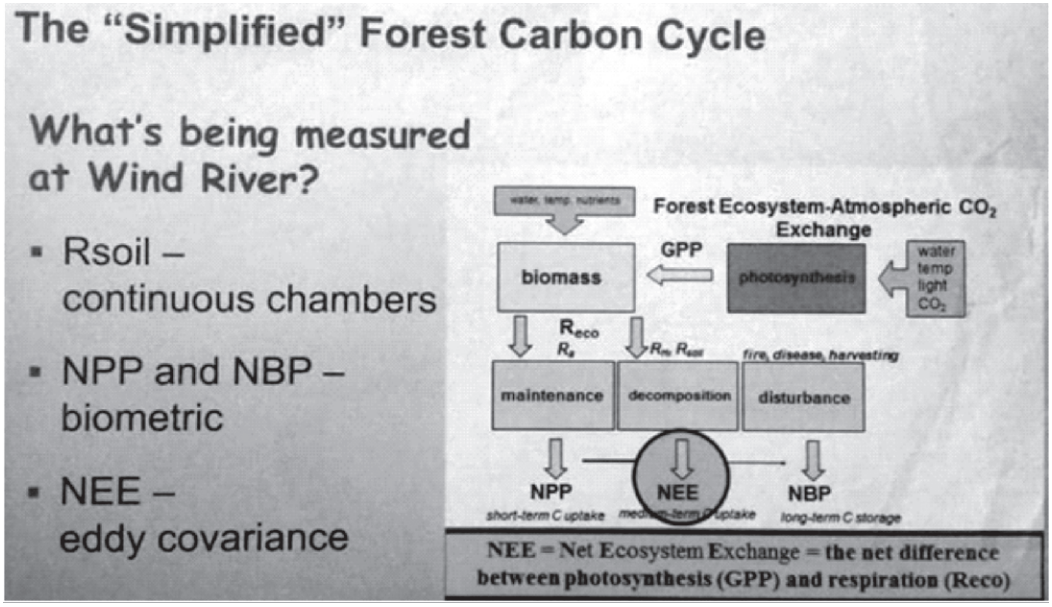
- **GLOBAL CLIMATE CHANGE**

Forests are interrelated with the issue of global climate change. The amount of carbon dioxide (CO_2) in the atmosphere rose 30 percent from 1850-1998, mostly as a result of human burning fossil fuels, but also from burning wood for cooking and heating. Climate models predict that more CO_2 will warm the earth's atmosphere, causing changes in precipitation, sea level and weather patterns as well as in the distribution, extent and structure of the world's ecosystem.

Carbon naturally cycles between the atmosphere, oceans, vegetation, animal life and soils. During the process of photosynthesis, trees absorb $CO_2$from the atmosphere and sequester (store)it in their woody tissues. Forests sequester (store) more carbon than other terrestrial ecosystem and an average forest tree can remove approximately 9 kg of $CO_2$from the atmosphere each year. On a global scale, forests potential to store carbon makes them critical for stabilizing atmospheric gases such as Co_2.

- **INFECTIOUS DISEASES**

Human health may also be closely related to forest health. For example, in the depths of the tropical rain forest belt, people are contacting malaria, a disease that was unknown in that region until recently. Scientists have found that deforestationis directly involved in this new disease pattern. Apparently, as the forest is cleared and as wildlife is eliminated, the mosquitoes that carry the disease must seek out new hosts – namely humans. Although, most malaria cases originate in the tropics.



WHY FOREST MANAGEMENT EFFORTS HAVE FAILED IN NIGERIA:

To date, the management of the tropical forest has remained constrained by the lack of appropriate technology, political and economicsupport and moreimportantly, socialfactors. Forestry departments in Nigeria are desperately starved of resources and generally have much less input to government decision – making because they are mostly supervised by the Ministries of Agriculture as appendages. At both national and global levels, forestry has been marginalized. At the FAO, only 4% of the budget is spent on forestry. The situation in Nigeria, especially in the states, is alarming. In most cases, forestry is allocated less than 2% of the state budget.

Against a background of a fast diminishing resource base and a complex ecosystem, the forestry system is a nightmare in addition, the following contribute to Forest/Agriculture management failure in Nigeria.

1. The demands for forest products and reservation for agricultural lands far outstrip the supply because of the ever-increasing population, (from 55 million in 1963 to 100 million today), wood deficit in Nigeria could rise to 60 million m^3. Fuelwood is expected to account for more than half of this deficit.
2. The tropical forest ecosystem is very complex and the level of knowledge of its ecology required for appropriate management prescriptions has not been attained.
3. Early management efforts were based on trial and error because both Agriculture/Forest managers were mainly foreigners who knew little about the resource.
4. Rainforest ecosystem is not as renewable as originally believed. The treatment of the resource as a highly renewable one has been partly responsible for its misuse. The tropical rainforest as a resource does not satisfy this criteria.

The federaland state forestry outfits as well as the Environmental Protection Agencies must be strengthened to effect the proper development and sustainable management of our environment and forest resources.

RECOMMENDATION:

Agriculture and Forestry systems needs a complete overhaul if it is to succeed. There is need to examine the system and put together a package of rules and regulations which would help to make the job of the manager less daunting and result-oriented. These rules and regulations must address the following:

1. **Co-operation between Agriculture and Forestry**: A good combination of agriculture and forestry operations can be very beneficial to both Agriculture and Forestry and render marginal lands productive in states like Imo Anambra, Abia, Akwa-Ibom and Enugu states where there is land hunger. Agroforestry is capable of taking pressure off reserved forests.
2. **Ex-Situ and In-Situ conservation measures**: Conservation programmes (Ex-Situ and In-Situ) must be pursued aggressively. Ex-Situ stands of the rainforest should be developed to serve as live seed banks, long term in-situ genetic management plans should be developed. The concept of a network of biosphere reserves should be practicalised.
3. **Land use capability classification**: A proper land use planning will allocate agriculture, forest areas to different functions, which should include multiple use by local communities, biodiversity conservation, watershed protection and timber production.
4. **Adequate financing**: The training research and extension components of forest management must receive sustained political support at all levels of government and ensure adequate funding for long term conservation programmes, training of relevant professionals and technical staff.
5. **Government must encourage multiple use of lands – Agriculture/Forestry Projects**: These must include Eco-tourism. These other uses of the forest may in fact yield more revenue than timber. Non-timber products could be of more value and ensure sustainable production.
6. **Special funds for Forestry/Agriculture and Climate change mitigation**: A special fund should be derived from ecological fund to attend to the tropical rainforest since it plays many ecological roles. The funds will be used for financing afforestation/reforestation, natural regeneration and other agricultural/silvicultural practices involved in the conservation, management and development of the Nigerian rainforest.
7. **Population control**: Expanding population has been implicated in the vicious circle of poverty in the developing world. Land space is finite. The expanding population of Nigeria is the greatest threat to our forest. Population needs to be kept at manageable levels through the acceptable control measures.
8. **Social forestry must be encouraged through the National Tree Planting Campaign**: The establishment of woodlots through the

Local Government Area at the grassroots levels must be encouraged.

9. There is need to find suitable alternative fuelwood for heating, cooking and processing agricultural products. Fuelwood will account for a high percentage of the expected 60 million m^3wood deficit by the year 2024 AD.

10. **Creation of ministry of forestry**: Lack of a coordinated approach to environmental problems has mainly been responsible for the poor status of the rainforest.

CONCLUDING REMARKS

Land degradation is a global problem which results from industrialization, mis-use of natural resources, faulty land use practices and general indifference to and ignorance about the environment. Forests play very vital roles in environmental stabilization. They help in ameliorating micro-climates and influence global climate by acting as sinks for carbon dioxide (CO_2)hence reducing the rate of CO_2in the atmosphere. Agricultural plants and trees/forests help in controlling land degradation, preserve biodiversity and ensure food securities for the ever increasing human population. The destruction of such a resource through wanton exploitation in an unsustainable manner must be seriously addressed if the forests must continue to perform their important function of environmental sanitization and stabilization. At the local level, mismanagement of agricultural/forest land, disease problem must be reduced by building upon local norms, traditions and cultures that will promote sustainable management. Such approach must respect the rights of indigenous populations and the wisdoms of their institutions. At the national level, effective management of our forest resources requires a commitment to our conservation, land-use planning, secured property rights and sustainable agroforestry. This will ensure that forests/agriculture provide a continued flow of goods and services with minimal ecological disruption.

We honour a distinguished professor who have contributed immensely to the development of Agriculture, Forestry and Pathology (Mycology) through research and teaching in these areasinfluences economic development.Prof. N.C Ohazuruike, his works in Pathology specifically influences the farming system of our country.

We salute this great Nigerian who recently retired into private life. But old soldier never die. We will always remember the strict and objective

upbringing which we received from you. We will also be thankful to God that we had you. As for me, I have had a good share of your depths of knowledge and words of wisdom.

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I thank the organizers of this symposium and wish our eminent Scientist and Professor the very best in his retirement.

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