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Environmental Policy and Climate Change in Nigeria: Bridging the Gap between Challenges and Reality

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This study reviews the state of play of on-going Nigeria's environmental policy and pinpoints key issues for Nigeria in the area of environmental and climate policies. In addition to traditional themes that require urgent actions (biodiversity, forestry, land use, water, agriculture), special attention is paid to emerging cross-cutting issues (circular economy, sustainability, eco-innovation). Nigeria efforts in addressing climate change are reviewed, highlighting specific implementation challenges and their relevance for international climate policy. *It is believed that if these policy strategies are followed judiciously, they will facilitate sustainable environment in many places and thus reduce pressure on the natural resources. The natural resources with less human interference coupled with good and sustainable management practices and policy, will therefore regenerate naturally and may attain stability, thus helping to reduce the effect of climate change.*

Keywords: Environment; policy; climate changes; natural resources; sustainability.

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1. INTRODUCTION

The tropical rainforest in ensuring decent climate and environment cannot be overstressed. The forest purifies the atmosphere of pollutant gasses especially excessive carbondioxide. It has been established that tropical rainforest is the major global sink of the largest volume of excess carbondioxide in the atmosphere [1,2]. The implication of forest technology in combating climate change is the most feasible and plausible approach for solving the problem of climate change not only in Nigeria but all-over the world [3,4]. Forest helps to ameliorate global warming, conserves the ecological system and conserve the nations biodiversity [5,6].

The contribution of the forest to environmental sustainability cannot be overemphasized. Vegetation covers are known to play regulatory and protective roles on the total environment through their abilities to improve water regimes, ameliorate ambient temperature, reduce the erosivities and destructive effects of rainfall and wind. Similarly, they can reduce solar radiation intensities at the ground level and regulate CO_2 and 0_2 levels of the air. Sustainability of man and the environment depends highly on the forest. Any negative impact on the forest will also affect the environment negatively which in turn affect man's existence, therefore the conservation, protection and sustainable use of the forest is undebatable through a modern and scientific environmental and climate change policy.

Climate change is a major concern of the whole world. It is mostly caused by human activities since the industrial revolution through the use of fossil fuels, cement production, deforestation and unsustainable agricultural practices which has doubled the amount of green house gases (GHG) in the atmosphere [7,8]. The menace thus resulted in climate-weather variations on all temporal and spatial scales, ranging from short-lived severe storms to decadal droughts arid century shifts in temperature and ice cover [9,10]. The expansion of agriculture over the past three decades involved the cultivation of marginal areas and clearance of important natural habitats such as forests and wetlands. The conversion has now become major driving force behind land degradation. Loss of natural habitats has reduced vegetation cover and exposed soils to wind and water erosion which leads to a significant reduction of the productive capacity of land.

2. OBJECTIVES

To achieve a better understanding of the reasons for policy and institutional failures in environment and climate change policy.

To suggest policy criteria for enhancing the likelihood of practical achievements in the field.

To propose solutions to the currently prevailing policy in order to increase the chances of success of environment and climate change.

3. THE PERFORMANCE OF NIGERIA CONCERNING THE GOAL AND TARGETS OF ENSURING ENVIRONMENTAL SUSTAINABILITY, AN APPRAISAL

3.1 Performance of Nigeria on Selected Targets and Indicators for Ensuring Environmental Sustainability

The proportion of land covered by forest and the Average Annual Deforestation (Target 9, Indicator 25 of the MDGs).

The top performers concerning the size of their forests are Russia Federation, Brazil, Canada, USA, China, Australia, Congo (Democratic Republic), Indonesia, Peru, India, Sudan, Mexico, Angola and Bolivia. All of these countries have more than 500,000 Km^2. of land covered by forest. The area of land forested in Nigeria was estimated to be 111,000 Km^2 [11] while the deforestation rate for Nigeria was calculated to be 2.4% per annum.

Among the five Sub-Saharan Africa (SSA) countries selected for this appraisal, only Cameroon performed better than Nigeria with a land area of 212,000 km2 and a deforestation rate of 0,9%. South Africa, Ghana and Kenya were outscored by Nigeria in terms of the size of land covered by forest.

However, their deforestation rates were respectively 0.0%, 1.7% and 3%. Details are shown in Appendix 1.

The Average Annual Deforestation of some countries between 1990 and 2005 are shown below. Burundi leads the pack with 3.1%. Others are Togo (2.9%), Honduras (2.5%), Mauritania (2.4%), Nigeria (2.4%), Afghanistan (2.3%), and Philippines (2.2%). It can be observed that

Ghana (1.7%), Cameroon (0.9%), Kenya (0.3%) and South Africa (0.0%) have lower Average Annual Deforestation than Nigeria.

3.2 Average Annual Deforestation (1990 - 2005): Countries with Rates greater than 2% (Target 9, Indicator 25)

SN	Country	Deforestation Rate	
2	Burundi	3.1	
8	Togo	2.9	
4	Honduras	2.5	
5	Mauritania	2.4	
6	Nigeria	2.4	#
1	Afghanistan	2.3	
7	Philippines	2.2	
11	Ghana	1.7	
3	Cameroon	0.9	
10	Kenya	0.3	
9	South Africa	0.0	

Source: World Bank (2007). 2007 World Development Indicator. Washington DC, USA page 140

3.3 Natural Protected Areas Deforestation and Biodiversity (Target 9, Indicator 26 of the MDGs)

Columbia has the highest proportion of land area (74.4%) protected as shown in Appendix 2. Other countries' that have more than 25% of their land as natural protected areas include Vietnam, Tanzania, Zambia, Saudi Arabia, Ukraine, Germany, Botswana, Malaysia, Switzerland, Austria, Netherlands, China (Hong Kong), Sri Lanka, Denmark and USA.

Nigeria's figure of 6% is the lowest among the selected SSA countries used for this appraisal sources of other countries in this group include those of Ghana (16.2%), Kenya (12.6%), Cameroon (8.0%), and South Africa (6.1%) [11].

3.4 CO_2Emission (Target 9, Indicator 28 of MDGs)

Appendix 3 shows the figures for Carbon Dioxide Emission (Metric Tons per capita) in 1990 and 2003 respectively. Thirteen countries have CO_2 emission figures greater than 10 MT per capita. These include United Arab Republic (33.4), Kuwait (32.7), Trinidad and Tobago (22.1), USA (19.9), Australia (19.8), Canada (17.9), Saudi Arabia (13.9), Estonia (13.3), Finland (13.0), Czech Republic (11.4), Singapore (11.4), Kazakhstan (10.7) and Denmark (10.1).

Among selected countries in SSA, South Africa had the highest figure of 7.9 in 2003. Nigeria and Ghana have the same figure 0.4 in 2003. Kenya and Cameroon have lower figures of 0.4, 0.3 and 0.2 respectively - showing that they performed better than Nigeria concerning CO_2emissions. Nigeria's CO_2emissions figure for 2004 (0.5) in 1990 was higher than that of 2003 (0.4).

3.5 Access to Improved Water Sources, Urban and Rural (Target 10, Indicator 30 of the MDGs)

Among the countries of the world, 26 countries have 100% score in providing access to improved water sources in urban and rural areas. These countries include Australia, Austria, Belarus, Belgium, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Israel, Japan, DR Korea, Lebanon, Mauritius, Netherlands, Singapore, Slovak Republic, Spain, Switzerland, United Arab Emirate, United Kingdom, United States and Uruguay.

When the performance of five selected countries of SSA (including Nigeria) were compared, South Africa is in the lead with a figure of (88) and is followed by Ghana (75), Cameroon (66), Kenya (61) and Nigeria (48). Whereas other countries in this group made improvements between 1990 and 2004, it was only Nigeria that retrogressed.

Table 1. Access to water (Urban and Rural) in selected countries of SSA

SN	Country	1990	2004
5	South Africa	83	88
2	Ghana	55	75
4	Cameroon	50	66
3	Kenya	45	61
1	Nigeria	49	48

Source: The World Bank (2007). World Development Indicators. Washington DC, USA. Pp 22 -24

Access to Improved Sanitation Facilities (% of Population): (Target 10, Indicator 31) i.e. Proportion of population with Access to improved sanitation, urban and rural (1990 and 2004).

Countries that have attained the 100% target include Australia, Austria, Belgium, Canada, Croatia, Denmark, France, Germany, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, Trinidad and Tobago, United States and Uruguay.

Among some selected countries in SSA, Kenya's score (72) is the highest in 2004 and closely followed by South Africa (65), Cameroon (51) and Nigeria (44). Ghana's figure (18) was lower than that of Nigeria. While comparing figures for 1990 and 2004, four of the five countries in have recorded progress in providing access to improved sanitation. Kenya's high figure (72) of 1990 was the same as that of 2004.

Table 2. Access to improved sanitation facilities in selected SSA

SN	Country	1990	2004
3	Kenya	72	72
5	South Africa	69	65
4	Cameroon	48	51
1	Nigeria	39	44
2	Ghana	15	18

Source: The World Bank (2007). World Development Indicators. Washington DC, USA. (Pages 22 -24)

Concerning the first stage of this appraisal, it can be seen that Nigeria performed poorly on all the indicators used for ensuring environmental sustainability. These include:

(i) The land area covered by forest and annual deforestation rate.
(ii) Natural protected areas (Deforestation and Biodiversity).
(iii) CO_2emission in MT per capita.
(iv) Access to improved water (urban and rural).
(v) Access to improved sanitation facilities.

The second stage of this appraisal used data presented in the 2010 Environmental Performance Index (EPI) of the Yale Centre of Environmental Law and Policy. The performance of Nigeria was examined among the following four categories:

(i) All the 163 countries in the EPI analysis.
(ii) African Union (AU) member countries.
(iii) Countries of SSA
(iv) Cluster Analysis Groupings of Nigeria.

3.6 Nigeria's Ranking among 163 Countries in the EPI Analysis

Out of the 163 countries covered by the data analyzed by Emerson et al. [12], Nigeria with an EPI score of 40.2 was ranked in the 153rd position. Nigeria is among the last eleven countries with low EPI scores. Ten countries with low EPI scores include Benin (39.6), Haiti (39.5), Mali (39.4), Turkmenistan (38.4), Niger (37.6), Togo (36.4), Angola (36.3), Mauritania (33.7), Central African Republic (33.3) and Sierra Leone (32.1). The top ten performing countries are Iceland (93.5), Switzerland (89.1), Costa Rica (86.4), Sweden (86.0), Norway (81.1), Mauritius (80.6), France (78.1), Austria (78.1), Cuba (78.1) and Columbia (76.8) Details are show in Appendix 4 (page 8 of the 2010 EPI Report) [13].

3.6.1 Nigeria's ranking among 46 AU member countries

The five top performing countries are Mauritius (80.6), Algeria (60.6), Egypt (62.0), Tunisia (60.6) and Djibouti (60.5). Nigeria is ranked in the 38th position among the AU member countries. Nigeria has managed to outscore only eight (8) countries. However, Nigeria is still among the ten (10) lowest ranked countries (See Appendix 5 and page 28 of the 2010 EPI Report) [13].

3.6.2 Nigeria's ranking among countries of SSA

Out of the 41 countries in SSA, Nigeria is ranked in the 33rd position. This implies that Nigeria is also among the ten lowest ranked countries in SSA as shown in Appendix 6. The high fliers are Mauritius (80.6), Djibouti (60.5), Namibia (59.3) and Sao Tome and Principe (57.3). Apart from Nigeria, the other non-performing countries include Benin (39.6), Mali (39.4), Niger (37.6), Togo (36.4), Angola (36.3), Mauritania (33.7), Central African Republic (33.3) and Sierra Leone (32.1). Details are found in page 26 of the 2010 EPI report.

3.6.3 Nigeria's ranking among Cluster 3 countries

Emerson et al. [12.] used seven cluster groups to performing analysis for the 2010 EPI. Each of the Cluster Groups had special attributes. Nigeria was included among Cluster 3 Countries which are mostly poorly underdeveloped African nations which performed poorly on environmental indicators but have done well on climate change indicators due to their low greenhouse gas per capita. Their low income helps to explain poor health infrastructure and limited fossil fuel-based development. The Cluster 3 countries are 24 in number as shown in Appendix 7.

It can be seen from the above results that Nigeria is among the ten countries with very low EPI ranking among 163 countries of the world.

She has also not done well among AU members and countries of SSA. As a member of Cluster 3 Countries, Nigeria is among countries that are mostly underdeveloped, with poor performance on environmental indicators. Other negative attributes of this group include poor health infrastructure and limited fossil based development.

It can be seen from this appraisal that Nigeria has not been performing well in matters concerned with environmental sustainability. She did poorly in the all the targets and indicators used in evaluating the data from the World Bank Development Indicator Report [11]. These include the land area covered by forest and the annual deforestation rate, natural protected areas, access to improved water in urban and rural areas and access to improved sanitation facilities. Although the CO_2 emission figures during the period of appraisal were low, many African countries in SSA performed better than Nigeria [13].

Based on the ranking, Nigeria is among the ten non-performers in the world and among African Union members [13]. Even among countries of SSA, Nigeria did not fare better. Cluster analysis was also done in the EPI study. Nigeria was grouped among Cluster 3 countries with many negative attributes. It was categorically any asserted that countries in this group performed poorly on environmental indicators but has done well on climate change indicators due to their low greenhouse gas per capita. Group 3 Cluster members also have poor health infrastructure and limited fossil-based development.

Guidelines on how to improve environmental sustainability of the countries of the world can be inferred from a 2-page Summary Fact Sheet prepared for each country [12,14]. One of the most useful information to assist us in this assignment is contained in the first sheet which deals with policy categories. The first page of the Summary Fact Sheet on Nigeria is shown in Table 4.

The scores for Nigeria on the 9 policy categories are also compared with other countries having similar income and geographic grouping with Nigeria. After sorting the policy category data on Nigeria, it can be seen that high marks were recorded for Nigeria in Climate Change (75.8), Biodiversity (74.7), Fisheries (65.6) and Agriculture (59.1). Nigeria had low marks in air pollution impact on ecosystem (40.6), air pollution impact on humans (37.2), forestry (22.1), water impact on humans (15) and environmental burden of diseases (9.17). These scores suggest the policy areas that Nigeria should concentrate on in order to improve her performance on how to ensure environmental sustainability. However, these policy directions have to be localized based on economic and social conditions in country.

In order to improve the performance of Nigeria about ensuring environmental sustainability, Nigeria needs to work hard on policy issues related to environmental burden of disease, the impact of water on humans, forestry, air pollution on humans and air pollution on ecosystem. Nigeria needs to increase its growing stock in forestry. There is need for massive planting of trees throughout the country. The forested areas should be well-managed. Deforestation should be discouraged. Timber and other resources of the forests appear to be free to anyone interested in their removal. Sustainable forest management is not being practiced in the country. Clearing of forest for slash and burn agriculture has continued unabated.

The performance of Nigeria on each of the 25 indicators used for the EPI is shown in Table 5 below. Nigeria is doing quite well on eight (8) of the 25 indicators. In order to make substantial progress, concerted efforts need to be made in addressing problems related to poor performance on eighteen (18) indicators. Nigeria appears to be doing fairly well (79 - 100) on indicators concerned with marine trophic index, greenhouse gas emission and biome protection. Her performance on indicators concerned with industrial greenhouse gas emission intensity, agricultural subsidies, critical habitat protection and water scarcity index is excellent (100). Nigeria scored above 50% of target in trawling and dredging intensity, $S0_2$emissions, outdoor pollution and water stress index. The table shows that Nigeria performed below 50% of target among thirteen indicators namely NOX emissions, water quality index, growing stock change, non-methane volatile organic emission (VOE), access to sanitation, pesticide regulation, CO_2 emissions, indoor air pollution, environmental burden of diseases, access to water, ecosystem ozone, marine protection and forest change.

Table 3. (Summary Fact Sheet 1) - EPI score and rank score and policy category

Values for Nigeria

Country: Nigeria
Region: Sub-Saharan Africa
EPI Rank: 153
EPI Score: 40.2
GDP/Capita est. (PPP):
Environmental Objectives:

- Environmental Health: 17.64
- Ecosystem Vitality: 62.74

Policy categories

SN	Policy category	Country	Income group	Geographic group
9	Climate Change	75.8	60.8	67.2
5	Biodiversity	74.7	37.2	64.0
7	Fisheries	65.6	72.2	79.7
8	Agriculture	59.1	61.7	67.6
4	Air pollution (impact on ecosystem)	40.6	59.4	52.4
2	Air pollution (impact on humans)	37.2	45.6	39.8
6	Forestry	22.1	70.6	75.7
3	Water (impact on human)	15.0	50.8	34.1
1	Environmental Burden of Disease (DALY)	9.17	32.7	19.1

Source: 2010 Environmental performance index

Table 4. Performance of Nigeria on 25 EPI indicators

SN	Indicators	Value		Proximity to target
11	Water scarcity index	0.0	0	100
15	Critical habitat protection (%)	100	100	100
20	Agricultural water intensity (%)	1.9	<=10	100
21	Agricultural subsidies (NRA)	0.0	a	100
24	Industrial greenhouse gas emission intensity (t CO_2 per mill US$)	13.2	36.3	100.0
13	Biome protection (%)	9.9	<=10	99.3
23	Greenhouse gas emissions/capita (Mt CO_2eqiv.)	3.2	2.5	92.8
18	Marine trophic index (slope)	-0.01	>=0	79.0
12	Water stress index	4.7	a	58.7
3	Outdoor air pollution (%)	45.0	100	57.3
6	S02 Emissions (Gg/lOOO sq. km)	0.9	<=.01	53.2
19	Trawling and dredging intensity (%)	47.8	0	52.2
7	NOX emissions (Gg/lOOO sq. km)	1.2	<=0.01	49.6
10	Water quality index	44.8	100	44.8
16	Growing stock change (ratio)	0.9	>=1	44.1
8	Non methane volatile organic emissions (Gg/lOOO sq. km)	4.6	<=0.01	32.5
4	Access to Sanitation (%)	30.0	100	21.44
22	Pesticide regulation	4.0	22	18.2
25	CO_2emissions per electricity generation (CO_2 per kWh)	413.5	0	17.8
2	Indoor air pollution (%)	78.8	100	17.1
1	Environmental Burden of Diseases	160.5	a	9.2
5	Access to water (%)	47.0	100	8.6
9	Ecosystem ozone (ppb)		a	2.0
14	Marine Protection (%)	0.0	>=10	0.0
17	Forest cover change (%)	-3.3	>=0	0.0

Source: 2010 Environmental performance index

Table 5. Countries with forest areas more than 500,000 km^2

SN	Country	Forest area (Thousand K2)	Average annual deforestation
12	Russian Federation	8,088	0.0
4	Brazil	4,777	0.5
5	Canada	3,101	0.0
14	United States	3,031	-0.1
6	China	1,973	-1.7
2	Australia	1,637	0.2
7	Congo, DR	1,336	0.3
9	Indonesia	885	1.6
11	Peru	687	0.1
8	India	677	-0.4
13	Sudan	675	0.8
10	Mexico	642	0.5
1	Angola	591	0.2
3	Bolivia	587	0.4
17	Cameroon	212	0.9
15	Nigeria	111	2.4
19	South Africa	92	0.0
16	Ghana	55	1.7
18	Kenya	35	0.3

Source: The World Bank (2007). World Development Indicators. Washington DC, USA. Pp 138 - 140

Table 6. $C0_2$ emission (Metric Tons per capita) (Target 9, Indicator 28). Selected countries

SN	Country	1990	2003
24	United A. E.	30.8	33.4
13	Kuwait	21.3	32.7
22	Trinidad&Tob	13.9	22.1
18	United States	19.3	19.9
1	Australia	15.9	19.8
4	Canada	15.0	17.9
17	South Africa	8.1	7.9
23	Ukraine	13.2	6.6
2	Belarus	10.6	6.3
12	Korea,DR	12.4	3.5
14	Nigeria	0.5	0.4
10	Ghana	0.2	0.4
16	Kenya	0.2	0.3
15	Cameroon	0.1	0.2

Source: The World Bank (2007). World Development Indicators, Washington DC, USA. Pp 22 -24

The EPI is a very useful indicator for determining the performance of Nigeria and other countries of the world on environmental sustainability. All stakeholders in environmental management, particularly the 3-tiers of government, policy makers, the private sector, non- governmental organizations, community-based organizations, academics, researchers and concerned citizens should be aware of the performance of Nigeria on environmental matters through workshops, seminars and training. There is an urgent need to draw up action plans to redress the unenviable position of Nigeria concerning the targets and indicators for ensuring environmental sustainability. Application of modem technology, especially satellite technology should greatly assist us monitoring resources of our environment. For example, satellite technology was used in the recent EPI study to track deforestation in 129 countries of the world (2010 EPI, rages 49 -51). Nigeria with a score of 0.8% Annual Change in forest was ranked in the 45th position. Seventeen countries had greater than 1% change in their forest. The five top countries with high rates are Nicaragua (1.57%), Cambodia (1.56%), Brazil (1.54%), Argentina (1.45) and Brunei Darussalam (1.38%). This shows that Nigeria is not one of the bad performers concerning annual deforestation rates.

Table 7. EPI score ten top countries of the world

Rank	Country	Score
I	Iceland	93.5
2	Switzerland	89
3	Costa Rica	86.6
4	Sweden	86.0
5	Norway	81.1
6	Mauritius	80.6
7	France	78.1
8	Austria	78.1
9	Cuba	78.1
10	Columbia	76.8
108	Kenya	51.4
109	Ghana	51.3
liS	South Africa	50.8
133	Cameroon	44.6
153	Nigeria	40.2

Source: Extracted from 2010 Environmental Performance Index (page 8)

Table 8. EPI score- Top performance and selected AU numbers

Rank	Country	Score
1	Mauritius	80.6
2	Algeria	67.4
3	Egypt	62.0
4	Tunisia	60.6
5	Djibouti	60.5
15	Kenya	51.4
16	Ghana	51.3
18	South Africa	50.8
29	Cameroon	44.6
38	Nigeria	40.2
42	Togo	36.4
43	Angola	36.3
44	Mauritania	33.7
45	Central African Republic	33.3
46	Sierra Leone	32.1

Source: Extracted from 2010 Environmental Performance Index (page 28)

4. POLICY RECOMMENDATIONS

4.1 Strategies for Climate Change Mitigation towards Sustainable Environmental Management in Nigeria

4.1.1 Joint implementation

Under this arrangement the developed or industrialised countries facilitate the implementation mechanism of projects that will reduce green-house gas (GHG) emissions in developing countries. Such Emission Reduction Units (ERU) is counted in favour of the investing (developed) nation. Thus, the joint implementation project is mutually agreed upon by both the investing and host (developing) nation. Reforestation schemes are included under the joint implementation mechanism. This strategy thus corroborates one of the submissions made by Intergovernmental Panel on Climate Change; IPCC, for carbon-dioxide stabilization, which is the enhancement or expansion of greenhouse gas sink or reservoirs such as forests [15]. The on-going "Building Nigeria's Response to Climate Change" (BNRCC), a Canadian International Development Agency (CIDA) funded project being executed by Nigerian Environment Study/Action Team (NEST) and the new programme on climate change training by the Osun State University's Centre for Climate Change and Environmental Research are good examples of the joint implementation mechanism being undertaken in Nigeria. The Greenwatch Initiative, a Non-Governmental Organization, based in Makurdi, Benue state is also co-implementing the CIDA funded project of NEST on BNRCC in Daudu communities in Benue State and Falgore communities in Kano state.

The effect of the joint implementation mechanism is that it will facilitate the establishment of artificial forest in many places and thus reduce pressure on the Natural Forest. The natural forest with less human interference will therefore regenerate naturally; and coupled with good and sustainable management practices, it may attain stability. Like the ongoing Green-watch Initiative/Canadian Government Joint Implementation Committee on Climate Change Mitigation Project at Daudu, the project identified among others, climate change-induced activities such as poor farming practices, excessive exploitation of trees for fuelwood and or charcoal production, destruction of water catchments/watersheds leading to the pre-mature drying of the down steams and rivers, and removal of vegetation cover and etc. To address these issues, the project adopted the following strategies [16,17]

- Massive awareness campaign on the dangers of indiscriminate and unwholesome utilization of forest and environmental resources. Followed by training the people on the best harvesting and sustainable forest management practices.

- Developing the entrepreneurial skills of the people in these communities to improve their livelihood capabilities and reduce poverty.
- Provision of forest tree seedlings for planting around watersheds and water courses
- Establishment offorest nurseries, and planting forest trees and other plants on marginal lands.
- Provision of alternative water (example rain harvesting reservoirs) and energy sources.

4.1.2 Pricing emissions/carbon trading

Carbon trading is an outcome of decision made under the United Nations Framework Convention on Climate Change (UNFCCC) at a meeting held in Kyoto in 1997. The agreements paved way for the clean Development Mechanisms to harness emerging markets in forest carbon trading. The process allows industries in developed countries to offset their emissions of carbondioxide by investing in reforestation and clean energy projects. Forest carbon projects are one of the least expensive ways for companies to off-set their carbon emission [18,19]. Here, every emitter is charged a price per unit emission equal to the amount of carbon content emitted.

If Nigeria embarks on Carbon Trading, the effects on forest resources would be that afforestation and use of clean energy will reduce pressure on the natural forest and hence the degraded forests would be able to be restored to its original state. The regeneration of the forest to its natural state will encourage biodiversity development and thus their sustainability. More forest cover will be established and biodiversity enhanced.

4.1.3 Mass communication/ awareness creation

Mass awareness creation using effective communication media will significantly assist in transmitting knowledge to people on the dangers of climate change. Until one comes to term with realities of a problem, formidable actions may not be taken. When one appreciates the enormity of a problem, more serious actions are then taken to put a stop to it. It is in line with this principle that awareness creation is imperative in the fight against climate change. There are many mitigation measures on climate change effects, education of the masses on these methods is an imperative for success to be recorded [20] Awareness creation will ensure mass action towards the fight against climate change, and this will certainly be more effective than 'one-man show' kind of arrangement.

The sensitization of the public on the consequences of climate change on natural resources and human/societal welfare will garner more concern towards reversing climate change and hence its effects. Since forestry is at the centre of any climate change mitigation strategy, its development and that of biodiversity will be fostered through the relevant activities.

4.1.4 Reducing emission from eforestation and degradation (REDD)

This represent a long term responsible management of forest resources aimed at avoiding deforestation and degradation activities. Although, REDD was not incorporated in the first commitment phase of the Clean Development Mechanism (CDM), World Conservation Union-IUCN believed that it will be incorporated in the second phase as a mitigation measure for climate change [21]. Avoiding deforestation and forest degradation does not necessarily involve new technologies, and as such it might be cheaper than other measures, especially those involving new technologies. What is important is that the right policies and institutional structures should be put in place for these methods to work. Such structures include: good forest governance, strengthening forest law enforcements, review of property right and stakeholder involvement in decision making as well as fair sharing of benefits and responsibilities. Local circumstances should define or guide implementation strategy and incentives that reflect local concerns should be part of the package. The implication of REDD on forest resources is that it will lead to good forestry practice and the sustainable management of the forest resources.

4.1.5 Extensive practice of Agroforestry

Agroforestry programme as a practice is very useful in sequestrating carbon and could be used on sustainable landscape management principle to address the needs of the stakeholders for food, fibre, fodder and energy as well as other services while still serving as carbon sink. Also, agroforestry has the potential of addressing poverty issues and providing

alternatives and diversified means of livelihoods for both small and large scale investors. Agroforestry practices will reduce human pressure on the natural forest and the resources therein. This is true, because Agroforestry simulates the natural forest outlook; and can provide resources close to what may be obtained from the forest. Agroforestry is a land management strategy, and could be utilized as a farming system to curtail the shifting cultivation farming system common in Nigeria. In the process, the extensive demand for land associated with shifting cultivation, which usually make man to clear more forest land for agriculture, will be eliminated. Thus the forest and the resources therein will be conserved [22].

4.1.6 Establishment of Permanent forest carbon sinks 011 private land

To improve climate change mitigation, the establishment of new permanent forests under private ownership on previously un-forested areas should be encouraged. Land owners should adhere strictly to the sustainable management practices and in so doing so, will have the opportunity o f claiming the Kyoto Protocol complaint carbon credits. There will also be secondary environmental benefits of soil conservation and erosion control, biodiversity conservation, nutrient cycling and cool environment. Other incentives could be added by Government or Non-governmental organizations to foster participation by people. The process will lead to the establishment of more forest cover creating room for biodiversity conservation. About 16 tonnes of CO_2/ha/yr are being sequestered by Plantation of *Pinusradiata* with a 28 years rotation period [23].

4.1.7 Certification mechanism

A mechanism to certify responsible forest management is needed in the country. The principle and criteria for sustainable forest management should be internalized in the forestry system in Nigeria as a tool to demonstrate national commitment to responsible forest management and facilitate greater access to foreign or overseas green market. Collaboration with recognized official development agencies and international NGO will facilitate that process. Adherence to management plans would be an integral part of the process. The nation's forest resources could then be managed to meet the social, economic, and the ecological needs of present and future generations as well as provide climate change mitigating benefits. The implication of this strategy of mitigation on forest resources is that the forest would be managed on sustainable bases, and the resources therein will serve man today and tomorrow.

5. CONCLUSION

Climate change is one of the greatest threats facing the planet. The European manuscript on combating climate change made it clear that if the earth's temperature rises by more than 2℃ above pre-industrial levels, climate change is likely to become irreversible and the long term consequences could be immense [24]. For example, deforestation is one of the major factors of climate change. In the 1980s, about 400 hectares of forest and woodland out of every 1000 hectares suffered deforestation while only 26 hectares were reforested on an annual basis [7], [24]. The remaining forest area in Nigeria will likely disappear by 2020 if the current rate of forests depletion continues unabated. If mitigation strategies are strictly followed, all these expectations will be stopped and some of the damages already done may be reversed [7,25]. It is therefore pertinent that man should proffer useful policies and solutions to the effects of climate change using the mitigation measures. This will make us avert the pending doom spelt out by our own misguided actions of yester years. About 16 tonnes of CO_2/ha/yr are being sequestered by Plantation of *Pinusradiata* with a 28 years rotation period. Going by this, if about 100000 hectares of *Pinusradiata* plantation is raised large amount of CO_2 will be sequestered [23].

COMPETING INTERESTS

Author has declared that no competing interests exist.

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