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Towards Sustainable Mitigation of Environmental Degradation in Nigeria

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Abstract
Our world is naturally blessed with dynamic resources such as vegetation, waters, air and soils. In the natural settings; vegetation change, rivers are polluted, sea levels rise, soil erodes and climate changes and yet human activities are on the increase and potentially more potent and dynamic activities on top of these already dynamic natural processes are surging up. Humankind has dramatically transformed much of nature and its natural environment through a process which is not new because it has been on for millennia. One significant dilemma is that transformation of nature has accelerated sharply over the last two centuries, and especially in the last several decades. Today, the natural environment is being progressively destroyed, bulldozed, and felled by saws or handheld axes, until only small remnants of its original extent survives. To substantiate this, by mid-1970s (after the drought that caused starvation in West Africa), humans had drastically increased the rate at which world's forest cover is destroyed and over the last century development has claimed almost all fringes of major towns. If we have observed one thing common between human interaction and dynamic resources, it is that our inability to sustainably and effectively manage those resources is often quite clear. Efforts to stop further deterioration are never late because as Myers pointed out, "we still have half of all tropical forests that ever existed" (Myers, 1992). Although this paper is theoretically sounded, its aim is to review some salient issues on environmental degradation in Nigeria which mostly hinders the development of sustainable mitigation and provide options to alleviate the escalating rate of degradation. Success in fighting environmental degradation requires an improved understanding of its causes, impact, degree, methods and acquaintance with climate, soil, water, land cover and socio-economic factors. Considering this all, it is recommended that hybrid options combining indigenous and current externally developed approaches (which are mostly incompatible with the environment and cultures of Nigeria) should be produced and utilised to combat degradation in the country.
Keywords: environmental degradation, mitigation options, resources, Nigeria

1.0 INTRODUCTION

Environmental degradation according to Yiran et al. (2012) would remain an important global issue for the 21st century because of its adverse impact on agronomic productivity, food security and quality of life. Getachew and Demele (2000) holds the most pressing environmental problems in the least developed countries are prevalent in rural areas, where the bulk of the populations live and whose livelihood depends on agriculture and related activities. Izibili (2005) stated that no doubt, damage to the environment is no respecter of frontiers, and damage done to one generation has the consequence of affecting the future generation. Based on this and many salient issues within the context of environmental degradation, Reynolds Stafford-Smith and Lambin (2007) stated that a major environmental challenge of the 21st century is environmental degradation; it adversely affects the sustainable relationship between ecosystems and the livelihoods of people worldwide. These are no doubt pointer to the escalating debates on environmental degradation/combat measures dilemma and which serious work has to be done before degradation is laid to rest.

The United Nations, UN (1997) refers to environmental degradation as the deterioration of the natural environment through human activities and natural disasters. The term environmental degradation implies that environmental resources such as land, soils and vegetation are reduced to a lower rank taking into account the fulfilment of given demands (Blaikie and Brookfield, 1987). Environmental degradation is not a new thing, it has been happening all over the world for centuries. The problem is that it is now occurring at a much faster rate, therefore not leaving enough time for the environment to recover and regenerate (Nicholson, 1990). Environmental degradation is composite phenomenon that has no single, readily identifiable attribute. Perhaps this is why there are so many conflicting and confusing definitions (Reynolds, 2001), as well as terminologies. It is far worst in Africa than in other continents because as noted McCann (1999) that African landscapes are anthropogenic and are subject to constant changes as a result of human interferences. The greatest strengths of African landscapes are their ability to support diverse vegetation resources (woody and herbaceous layers) and their resilience to natural calamities and climate change. It is however widely reported that this ecological zone because of certain natural, socio-economic and political constraints is the one of the most degraded parts of the World (Solbrig and Young, 1992). Dregne et al. (1991) and Solbrig and Young (1992) mentioned that regions worldwide face unprecedented environmental degradation particularly in savannah environments of the

developing countries where the natural environment is perceived to be under greatest threat. Reed (2007) noted that environmental degradation is the reduction in value of the environment to meet its ecological and socio-economic needs. It includes issues such as land degradation, deforestation, desertification, loss of biodiversity, land, water and air pollution, climate change, sea level rise and ozone depletion.

Environmental degradation is leading to more severe natural disasters which have already cost the world over $608 billion in the last decade, killed and displaced over 8 million people, mainly poor people in most developing countries in 1998-1999 alone (Worldwatch, 2001). Statistical evidence of the state of the environment by the United Nations have estimated that, of the 8.7 billion hectares of arable land, pastures and forests worldwide, nearly 2 billion of them have been degraded over the past 50 years, of which 18% are of forest land, 21% are of pasture land and 37% are of arable land (Haaften et al., 2004). Nearly 216 million hectares of rain-fed croplands or about 47% of their total area in the world's dry lands (457 million hectares) are affected by various processes of environmental degradation and about 3.3 million hectares of rangeland or nearly 73% of its total area in the world's dry lands (4.5 million hectares) are affected by degradation of vegetation. Each year a total of 6 million hectares of productive dry lands is turned into worthless desert (The World Commission on Environment and Development, WCED, 1987).

With the dangers of further deterioration before us, assessment of environmental degradation has therefore become a global issue for the long-term management of the earth bountiful natural resources and the sustenance of livelihood that depend on them (William, 1998). The problem which warranted the study is that many environmental degradation mitigation approaches and programmes have been organised and implemented in isolation in Nigeria, yet negligible progress in fights against degradation and desertification is recorded other than hike in deterioration of the environment. The argument is perhaps the approaches are not suitable for the cases (site specific degradation in Nigeria) or that they are not properly articulated for the purpose of mitigation. Hence there is need for understanding some environmental issues properly for a shift in the Nigeria's efforts to combat degradation. To ensure this, review of the concept and approaches of environmental degradation assessment are very vital and therefore elaborated in this work. The hope is that with discussions such as this, better mitigation measures can be produced and tailored workable options that reflect the environment and people of Nigeria.

2.0 CONCEPT OF DEGRADATION

Degradation is simply the deterioration of land, soils and loss of bio-productivity of vegetation due to varying causes. The concept has been discussed to refer to all forms of reduction in quality and quantity of ecosystem resources such as lands and forests. Degradation plagues almost all areas of the world but more severe in arid, semi-arid and sub-humid areas and presents a global challenge that requires urgent attention (Reynolds Stamford-Smith and Lambin, 2007; UNCCD, 2008).

The concept of degradation/desertification was discussed earlier than Aubreville (1949) by European and American scientists in terms of increased sand movements, desiccation, desert and Sahara encroachment and man-made deserts (Stebbing 1935), (Lowdermilk 1935 and Jones 1938 in Helldén, 2003). The two terms are interchangeably used by researchers to refer to deterioration in environmental quality and services. However, the word "desertification" was introduced by the French forester Aubreville in 1949 when he suggests that desertification meant the spreading of deserts or desert-like conditions. Aubreville (1949) also stated that there are real deserts being born today, under our very eyes, in the 700-1500 mm annual rainfall areas. Since then, different concepts of desertification have developed and been discussed over and over again by scientists, politicians and the international community.

The term desertification (advance degradation) evokes an image of the "advancing desert," a living environment becoming sterile and barren. But this is not an accurate picture (Nicholson, 1994). As summarised by Johnson et al. (1997), degradation is "a term whose meaning reflects our perceptions, viewpoints, timeframes, and value attachments". **T**he words degradation and desertification are used interchangeably in this work. When degradation is used it is ours while desertification remains as obtained from the literature.

3.0 CAUSES OF ENVIRONMENTAL DEGRADATION

The causes of degradation also referred to as desertification, remain controversial (Helldén 1991, Geist and Lambin, 2001). It's now thirty seven (37) years after the United Nations Conference on Desertification (UNCOD) in 1977 which has gone and prompted an on-going and still unresolved debate about the causes and effects of degradation and desertification (Gray, 1999). Recent analysis by Geist and Lambin (2004) suggests that claims that desertification is either a human-made or a purely natural (i.e. climate-driven) process should be more nuanced. They carried out a worldwide review of the causes of desertification, and from 132 case studies identified four major categories of proximal causal agents: (1) increased aridity; (2) agricultural impacts, including livestock production and crop production; (3) wood extraction, and other economic plant removal; and (4) infrastructure extension, which could be separated into irrigation, roads, settlements, and extractive industry

(e.g. mining, oil, gas). They concluded that only about 10% of the case studies were driven by a single cause (with about 5% due to increased aridity and 5% to agricultural impacts). About 30% of the case studies were attributable to a combination of two causes (primarily increased aridity and agricultural impacts), while the remaining cases were combinations of three or all four proximal causal factors.

In Nigeria erosion constitutes a major form of environmental degradation. NEST (1991), identified five principal types of soil erosion in Nigeria, namely, sheet erosion, rill erosion, gully erosion, coastal erosion and wind erosion.

4.0 THE STUDY AREA

4.1 Location, Position and Population of Nigeria

Nigeria is located in West Africa. It lies between 04 16^0 and 13 53^0 North of Latitude and 02 40^0 and 14 41^0 East of longitude. Nigeria is bordered in the West, North, East and South by the Republic of Benin, Niger, Chad and Cameroon and Atlantic Ocean respectively (Figure 1). It has a land area of 923, 850 km^2 (Idowu et al 2011). It has 36 administrative states, a Federal Capital Territory (FCT). It has 774 Local Government Authorities (LGAs). It stretches for about 1,200 km in the N-S and E-W directions and has a coastline of about 853 km long. It is bordered to the north by the Niger Republic; to the north-east, by the Chad Republic, to the east by the Cameroun Republic, to the South, by the Atlantic Ocean and to the west, by the Republics of Benin and Togo.

Nigeria accounts for about one in every five Africans, 60% of West Africa population and 14% of the regional landmass. The 2006 Population and Housing Census puts the population of Nigeria at 140,431,790 consisting of 71,345,488 Males and 69,086,302 Females (NPC, 2006). The estimated average growth rate of the population is put at 2.8%, implying an estimated population for Nigeria of 168 million in 2010. Nigerian Economy is dominated by Agriculture. Over 70% of Nigeria's population is engaged in agriculture as their primary occupation and means of livelihood with an average of 41% contribution to the GDP.

Nigeria is rich in biodiversity as the country is well endowed with a variety of plant and animal species. There are about 7,895 plant species identified in 338 families and 2,215 genera (Federal Government of Nigeria, FGN, 2010). The vegetation ranges from the mangrove and thick forests in the South, followed by Savannah and the Sahel in the middle belt and the North respectively. The country is punctuated by the Obudu and Udi Hills in the East, the Jos plateau in the North Central and the Adamawa highlands in the North East. Nigeria is drained by two main rivers – Niger and Benue**.**

4.2 Consequences of Environmental Degradation in Nigeria

Environmental degradation is an increasing problem in many parts of the world. The phenomenon is most pronounced in the drylands, which cover more than 40% of the earth's surface (Dobie, 2001). Environmental degradation of varying types and degree are generally un-evenly distributed in Nigeria. Ranging from the less devastating such as sheet erosion and mild gullies, to highly dangerous types such as loss of biodiversity, drought and loss of soil bio-physical characteristics, a typical environment in Nigeria may be occupied with one or overlapping sets of degradation consequences. While it is vivid, though arguably, that coastal erosion and water pollution and marine biodiversity loss are typical in the southern coastal areas of Nigeria, the central states suffers from salinization and acidification of soils and sediment discharge on lower Niger-Benue catchments. Loss of biodiversity of plants and pockets of reserved areas and well as reduction in soil fertility are quite alarming in Nigeria (David, 2008) and this is moving at alarming rate in Northern Nigeria because of deforestation and fuel wood consumption (Naibbi, 2013).

On regional basis, the southern areas of the country, in the lowland rain forest and derived Savanna ecological zones, where population pressures have resulted in degradation of the forests, severe gullies (in the Enugu and Edo States) continue to develop and erode massive areas of farmlands and settlements. Many of these areas have erosion prone, shallow or sandy soils but yet continue to remove surface cover to plant one or two seasonal crops thus exposing the soils for the rest of the off-farm period of the year to splash and heavy downpours of the tropical continental climate of southern Nigeria. Along the coastline, issues of saltwater inundation are evident. Specifically, new areas of saltmarshes/tidal flats were identified over extensive areas that were not affected before. The coastal area has also witnessed a reduction in the area of freshwater swamp. These areas are being converted to intensive agriculture (Titilola and Jeje, 2008).

The north is prominent with aridity and drought, wind erosion and change in vegetation. In the north, a process of desertification is evident as sand dunes that were stable in the past are now exposed. Large areas of gully erosion are clearly visible, and denuded areas can be identified in many agricultural regions (FORMECU, 1998). Generally deforestation, salinization and loss of plant diversity are most widespread in all parts of Northern Nigeria. The increasing intensity of agricultural activity due to population growth may be the most important factor influencing this process. Other influential factors may be climate change or the establishment of major water works projects (i.e. construction of dams).

5.0 METHODOLOGICAL FRAMEWORKS FOR ASSESSING ENVIRONMENTAL DEGRADATION

Because of the complex nature of environmental degradation it was argue that global assessments of degradation lack the appropriate methodologies to deal with the complexity of the issue (Convention to Combat Desertification, CCD, 1997), however, these frameworks provide basic methodological underpinnings for the assessment of degradation and therefore valuable tools for its mitigation. They are discussed in consonance with the concept of degradation as it is discussed earlier on.

5.1 Stress-Response Framework

The United Nations Statistical Office in the mid-1970s developed a general framework of environmental statistics through a joint initiative with Canada that led to the development of the Stress-Response. The framework considers the stress on the natural environment beyond its carrying capacity and its effects on human beings. The focus of the stress-response framework is on the effects of human activities on the natural environment. The stress-response approach has had a major impact on environmental reporting around the world (Hodge, 1991). The exclusion of the major causes of the stress on the natural environment is, but, one of several serious limitations to current expressions of the stress-response concept, one that reduces significantly its usefulness for assessing environmental degradation holistically (Hodge, 1991).

5.2 Pressure-State-Response Framework

The Pressure-State-Response (PSR) assessment framework of Organisation for Economic Cooperation and Development (OECD) (1994) was a step further of the stress-response framework. The PSR framework is based on a concept of causality: human activities exert pressures on the environment and change its quality and the quantity of natural resources. Society responds to these changes through environmental, general economic and sectoral policies ('sectoral response') (OECD, 1993). The assessment framework takes into consideration, the 'pressures' which describe the intensity and extent of human activities acting directly on the environment beyond its carrying capacity. The 'state' refers to the baseline state of the environment as judged from areas relatively unaffected by direct human activities (Pinter et al., 1999). The 'responses' deal with the impacts of stresses on the environment and assess human actions, such as legislation, new technology, economic instrument, economic expenditures, changing consumer preferences and international conventions, undertaken to protect the environment (Gallopin, 1997).

The PSR framework is the most widely accepted of the many frameworks advocated, having been adopted by the OECD for its analysis of the degradation and pollution of the natural environment. The European Environmental Agency of the European Commission also used the PSR approach in assessing various environmental problems within member states (Jesinghaus, 1998). The PSR is also used in the methodology of the World Bank's Land Quality Indicator programmes (World Bank, 2001). In most developing countries, one cannot examine critically environmental degradation without considering the indirect causes of degradation, hence the limitation of PSR in this study.

5.3 Driving Force-State-Response Framework

The Driving force-State-Response (DSR) framework was first initiated by United Nations Commission for Sustainable Development, UNCSD (1997) to consider the shortcomings of both the stress-response and the PSR framework. The framework, instead, considered the driving forces of environmental problems that did not feature in both the stress-response and PSR frameworks. The replacement of the term 'pressure' in the PSR framework by the term 'driving force' was motivated by the desire to include economic, social and institutional aspects of environmental problems (European Environmental Agency (EEA), 1999). The World Bank adopted the DSR framework in its work on indicators of environmentally sustainable development (World Bank, 1995), even though in 1997 it published World Development Indicators (World Bank, 1997) which used the PSR framework.

A major advantage of the DSR framework is that it organizes information on sustainable development systematically in a way that guides the user of the framework through all aspects of sustainability. In distinguishing between the social, economic and environmental aspects of sustainable development, the framework ensures that no aspects of sustainability indicators are automatically excluded. The inclusion of the economic and social aspects is particularly important for developing countries with economies in transition, for which an equal balance between the developmental and environmental aspects of sustainability is important in order to ensure future sustainable growth patterns (United Nations Commission for Sustainable Development, UNCSD, 1997). The DSR works perfectly when an environmental stress has been identified and linked to a causative set of human activities as perceived in most developing countries.

5.4 Driving Force-Pressure-State-Impact-Response Framework

The European Environmental Agency (EEA), within the legal basis of the European Union Environmental Policy Acts 95, 174, 175 and 176 of the consolidated version of the Treaty on European Union and under the auspices of the European Commission, in their effort to introduce environmental issues in their developmental agenda, further improved the existing assessment frameworks into a five indicator framework (which includes PSR and DSR as special cases) dubbed as the 'DPSIR assessment framework' (EEA, 1999). Each indicator

conveys its own distinctive meaning and application. The framework is seen as giving a structure within which to present the indicators needed to enable feedback to policy makers on environmental quality and the resulting impact of the political choices made, or to be made in the future (Kristensen, 2004).

According to the DPSIR framework there is a chain of causal links starting with '*driving forces*' (economic sectors, human activities) through '*pressures*' (emissions, waste) to '*states*' (physical, chemical and biological) and '*impacts*' on ecosystems, human health and functions, eventually leading to political '*responses*' (prioritisation, target setting, indicators). A 'driving force' is a need. Examples of primary driving forces for an individual are the need for shelter, food and water, while examples of secondary driving forces are the need for mobility, entertainment and culture. Pressures on the environment, according to Geist and Lambin (2002) are human activities or actions, usually at the spatial level, that originate from intended land-use and directly impact negatively on the natural environment. As the driving forces, the 'pressures' of degradation are usually multivariate. Driving forces lead to human activities such as transportation or food production, i.e. result in meeting a need. As a result of pressures, the 'state' of the environment is affected; that is, the quality of the various environmental compartments (air, water, soil, etc.) in relation to the functions that these compartments fulfil. The 'state of the environment' is thus the combination of the physical (air, soil and water quality), chemical and biological conditions (ecosystems-biodiversity, vegetation, soil organisms, water organisms etc.). Environmental 'impacts' are the changes in environmental parameters, over a specific period of time and within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initialised. In other words changes in the state may have environmental or economic 'impacts' on the functioning of ecosystems, their life supporting abilities, and ultimately on human health and society. A 'response' by society or policy makers is the result of an undesired impact and can affect any part of the chain between driving forces and impacts.

The components of the DPSIR framework are explained in the following way by (see Kristensen, 2004 for the framework).

6.0 ENVIRONMENTAL DEGRADATION ISSUES IN NIGERIA

6.1 National Environmental Policies of Nigeria

As part of the Federal Government of Nigeria's overall framework of protecting the environment, policy issues have given prominence to the twin environmental problems of drought and desertification (Federal Government of Nigeria, FGN, 2006). This part evaluates the past and present efforts of governments with a view to highlight on current efforts which require review of approach and identifying new initiatives that are considered needful. Emphasis of this review is on constituent elements to combat desertification within the framework of the National Policy on Environment to include the following:

1. Development of a National Action Programme to Combat Desertification and mitigate the effects of drought towards the implementation of the Convention to Combat Desertification (CCD) in Nigeria,
2. Integrating public awareness and education on causes and dangers associated with drought and desertification, as well as the constraints of the CCD,
3. Strengthening of national and state institutions involved in drought and desertification control programme,
4. Promoting sustainable agricultural practices and management of water resources including water harvesting and inter-basin transfers,
5. Encouraging individual and community participation in viable afforestation and reforestation programmes using tested pest and drought-resistant and/or economic tree species,
6. Encouraging the development and adoption of efficient wood stoves and alternative sources of energy,
7. Establishing drought early warning systems,
8. Involvement of the local people in the designing, implementation and management of natural resources conservation programmes for combating desertification and ameliorating the effects of drought,
9. Intensifying international cooperation and partnership arrangements in the areas of training, research, development and transfer of affordable and acceptable environmentally sound technology and provision of new and additional technical and financial resources,
10. Inventorying degraded lands, and implementing preventive measures for lands that are not yet degraded or which are slightly degraded,
11. Adopting an integrated approach to address physical, biological and socio-economic aspects of desertification and drought,
12. Intensifying cooperation with relevant inter and non-governmental organizations in combating desertification and mitigating the effects of drought,
13. Strengthening the nation's food security system,
14. Establishing, reviewing and enforcing cattle routes and grazing reserves,

6.2 National Programmes to Combat Degradation in Nigeria

Nigeria signed the Desertification Convention on the 31st October, 1994 and ratified same on the 8th July, 1997

thereby qualifying the country as a Party to the convention with effect from 6th October, 1997. Part of the fulfilment of the convention's objectives is setting up a number of National programmes to combat degradation (FGN, 2006). These are broadly reviewed into the following headings;

6.2.1 Forestry Programmes

The country has made several attempts at putting in place programmes that would ensure the efficient management of her Forest resources. These include:

The establishment of Industrial Plantations from 1978, Land Use and Vegetation survey between 1975 and 1978, Production of perspective plan for the period 1990 - 2005 and formulation of a Nigerian Forest Action Program in 1997. However, most of these initiatives have had limited impact in turning around the precarious state of the Forest estates.

An Arid Zone Afforestation Project (AZAP) was instituted by the Federal Government in 1976 to tackle the problems of desertification through the establishment of woodlots, shelterbelts and windbreaks. Over 10 million seedlings were raised annually between 1978 and 1984. About 150 kilometers of shelterbelts, 3,680 hectares of woodlots, 24 boreholes, 70 tree nurseries, and Forestry Vocational Schools were established (FGN, 2012).

The EEC supported a pilot project in Katsina State covering a total area of 1.6 million hectares involving the establishment of shelterbelts, windbreaks, woodlots and trees on farmlands. In addition, the World Bank also financed a similar project in the five arid zone states (World Bank, 1989). Areas of focus of the Forestry Programme include the following: Land Use Policy, Fuel Energy, Mass Tree Planting Campaign, Prevention of Bush Fire, Silvo-Pastoral System and Sand Dune Fixation.

6.2.2 Energy Resources

Draft National Energy Policy was formulated in 2001 (FGN, 2001). In it was stated that Nigeria consumes well over 50 million metric tonnes of fuelwood annually; a rate that far exceeds the replenishment rate through various afforestation programmes. Sourcing of fuel wood for domestic and commercial uses is a major cause of desertification in the arid zone states of Nigeria. In other to reduce deforestation associated with fuelwood sourcing, the Federal Government, through the Energy Commission of Nigeria (ECN), has put in place the following programmes for the purpose of promoting optimal utilization of renewable energy resources by Nigerians: 1. training programmes on renewable energy technology, 2. biogas and biomass utilization projects, 3. solar photovoltaic electrification projects for remote rural areas.

6.2.3. Integrated Programmes Targeted at Poverty Alleviation

The Federal Government of Nigeria realises that poverty alleviation is a major weapon for combating desertification. Consequently, a number of poverty alleviation programmes have been put in place and notable amongst these are; the Northeast Arid Zone Development Programme (NEAZDP), the FMENV/UNIMAID Linkage model village project, the Katsina State Agricultural and Community Development Project (KSACDP), the Sokoto Environmental Protection Programme (SEPP) (FGN, 2012) and these are reviewed as follows;

The North East Arid Zone Development Programme (NEAZDP), funded by the Federal Government of Nigeria with European Union assistance, commenced in February 1990 with the main objective of motivating and assisting the rural population to improve their standard of living through proper resource use and management. The major components of this programme include water resources development and management (including irrigated agriculture), provision of micro-credit for off season economic activities, cottage industries, livestock fattening, rural banking and popularisation of animal traction for land preparation for agricultural activities.

The Federal Ministry of Environment/University of Maiduguri Linkage Centre on Drought and Desertification Control, based at the University of Maiduguri, initiated a model village project at Sabon garin Nangere, Yobe State in 1995. Activities carried out at the model village include establishment of community woodlots and roadside tree planting, provision of energy efficient wood stoves, provision of biogas for domestic cooking, provision of Ventilated Improved Pit (VIP) latrines and provision of solar powered water pump for the community boreholes (Gadzama, 1995). The model village project, though presently constrained by lack of funds, is no doubt a major success that deserves replication in other parts of the drylands of Nigeria.

The Katsina State Agricultural and Community Development Project (KSACDP) was conceived as the first stage of an IFAD strategy to speed up and intensify rural development in the drylands of Nigeria. The rationale was to improve resource management through community participatory processes, principally in group mobilisation for credit supply and joint action against the serious degradation threatening the agricultural productive capacity of the land. Achievements recorded include improvement in farming practices (in both uplands and fadamas) to make their more sustainable, investments in community and amenity development in the villages and in off-farm income generating activities for groups of poor and landless households with emphasis on those headed by women.

The Sokoto Environmental Protection Programme covers an area of about 17,500 km2 in the north-eastern part of Sokoto State. The objective of Programme was to improve the utilisation of resources to achieve long-term sustainable growth and environmental protection. The Programme is jointly financed by the Federal Government of Nigeria, Sokoto State Government and the European Union under the Sixth European Development Fund

(Lome III). The programme components include Afforestation, Livestock and Rangeland management, and development of rural infrastructures, Irrigation, Women development and Adult literacy.

6.2.4. Building Partnerships

Government has recognised that the hydra-headed problem of desertification cannot be tackled by itself alone so it facilitated the involvement of other actors including the Private Sector, Non- Governmental Organizations (NGOs) Community based Organizations (CBOs) and Donors. At present, a number of NGOs are actively involved in the implementation of CCD in Nigeria. Some of them participated very actively in the negotiation process as follows: 1. Action Programmes, Co-ordination Mechanisms and Partnerships, 2. Capacity Building, Education and Public Awareness, 3. Financial Resources and Mechanisms, (FGN, 2006).

Some of the NGOs in Nigeria are actively participating in the activities of the Global NGO network on Desertification. As a matter of fact, the Nigerian Environmental Study/Action Team (NEST) is the sub-regional focal point of this network for Anglophone West Africa. Other prominent national and international NGOs that are actively involved in the implementation of CCD include the Nigerian Conservation Foundation (NCF), Forestry Association of Nigeria (FAN), and International Union for Conservation of Nature (IUCN) (Nigerian Environmental Study/Action Team, NEST, 1991).

6.5 Challenges of Combating Environmental Degradation in Nigeria

Despite the various national efforts and achievements recorded, desertification and general environmental degradation remain a major challenge to Nigeria's sustainable development. The problem continues to reduce the natural resource base and complicate efforts to reduce the pervasive poverty of the affected regions (FGN, 2006). Of the major challenges is the inability to domesticate the Nigeria's UNCCD framework to state levels and redress the escalating poverty which mostly cited as the leading driver of environmental degradation in Nigeria.

Other major challenges faced in attempts to combat environmental degradation and desertification in Nigeria include (1) the poor maintenance of irrigation and drainage networks, and over abstraction of groundwater; (2) conversion of land from forestry and agriculture to other land uses (e.g. energy, transportation development, etc.) without compensatory conservation measures on the new non-forest land; (3) excessive grazing in forest lands in the absence of adequate pastureland and a viable policy of fodder development; (4) incessant bush burning during land clearing for agriculture, hunting for games, and the cattle herdsmen desirous of stimulating re-growth of dormant grass buds and (5) sand mining (FGN, 2012).

7.0 SALIENT LIMITATIONS ON ENVIRONMENTAL DEGRADATION MITIGATION INITIATIVES IN NIGERIA

The capacity of the Nigerian Government to mitigate environmental degradation is limping because certain noticeable issues are left in the development and implementation of programmes. These are presented and discussed with respect to obvious reports obtained from evaluation of the programmes over the years.

7.1 Adoption of Externally Developed Approaches to Combat Degradation

Unlike the new shift, in the past natural resource management in the world over has reflected a belief that the top-down application of science to predict and control the natural world is the best practice of management. This has led to the widely accepted approaches even though some are not evaluated to have any advantage over the indigenous practices such as natural regeneration in the Maradi area. Many authors have contended that conventional approaches has not accomplished what it promised; it has not been able to sustain both the healthy functioning of natural systems and humans' use of their resources (Bart, 2006). Instead, ecosystem health is steadily declining: biodiversity continues to decrease and landscapes are degraded, while conflict and litigation frequently overwhelm combat decisions

Nigeria has been a country that unarguably utilises approaches that are externally driven to manage its environment to the detriment of others that are indigenous without necessarily proving their capabilities. These and practical evidences have led (over the past last two decades) to growing number of critics, including many scientists, who challenged the technocratic optimism of this 'conventional approaches' (Chamber, 1993; Mortimore, 2006; Shepherd, 2008) as substitute to the local intuitive practices that spans generation. This process has been a bad one even though the technocrats would want it that way; it has been yielding limited achievement.

7.2 Non-decentralisation of Nigeria's UNCCDD Objectives to States

Nigeria is a Federal entity, it's the system of governance of natural resources has been centralised mostly and managed by the federal government from the centre. Although the states and local governments are vital organs of the governments, centralised initiatives form a bed rock upon which all other measures lies on because even the desertification charter that was ratified and domesticated by Nigeria till now is owned and utilised by the federal government agencies. This development has resulted to failure in most programmes aimed at combating degradation and desertification in Nigeria. Decentralisation will help spread development to the rural stakeholder easily and implementation will then reach all without heavy work.

7.3 Not to the hands of the poor (programmes, subsidies and incentives)

The global scope of sustainable development issues leads to calls for initiatives that are transferable, inclusive and scientifically valid, to provide good governance of resources together with local actors. However, such initiatives, generally defined by experts at high levels, can be lacking legitimacy in the eyes of rural poor always respond to the specific circumstances at local site. This has always led to the top-bottom dichotomy and resulted to more destruction than cohesion in a matter that requires bonding such as natural resource management and environmental degradation mitigation. As has been argued by Chambers (1997) and Anderson et al. (2006) and many others that a main source of management problems is the centralised means of resources sharing that unfairly allocate environment management funds to the central agencies and in consonance with the reality of continued economic alienation of the rural poor, Chambers, Saxena, and Shah (1991) 'to the hands of the poor' and what Leach and Mearns (1996) and Mortimore et al. (2006) have advocated that, environmental degradation and mitigation should be done with local people inclusive, rural poor are always successful. In their arguments they cited various examples from Machakos and Makueni Districts of Kenya, Maradi in Niger Republic as well as Kano region in Nigeria were local natural management was done by people and was found to be resilient more than in other areas that operate the conventional approaches.

Of the impediments to mitigation of environmental degradation in Nigeria, withdrawal of incentives due to short fall of foreign funds (owing to donor fatigue), privatisation policies which shatter subsidies and bureaucratic involve in accessing loans are posing serious challenges that often lead to the failure of most mitigation initiatives of the rural people. Rural people have intuitive practices of managing their environment which are more resilient, cost effective and friendly but because they lack certain take up capital cannot fully realise most dreams. Today growing numbers of private sector operatives are willing to invest in natural resources management and these offers can be utilised so that their invest can help augment national programmes that cannot continue as a result of economic crunch.

7.4 Mega Projects

The Nigerian government in its bid to create sustainable solutions to certain natural shocks engage into rapid often untested development projects which tend to fail because of over dependence of expertise advises and reports. Among several, few can be listed which are successful while plenty fail due to disregards to ethics of contracting huge projects. Mega projects such as dam have been considered as vital sources for power, irrigation and domestic water provision and so are given eagerly in search of its potentials. However, responses of the environment to such complex structures are of concern to stakeholders because these dams often pose great consequences such as direct impact to biological, chemical and physical properties of rivers and sediments discharge downstream. In Nigeria the consequences of dam construction are witnessed in Bakalori dam site in Sokoto State as well as Ngadda River project (South Chad basin) in Borno States. Serious environmental calamities were recorded owing largely to the failure of the projects. The valley of the Komadugu Yobe was green throughout the year until the Tiga Dam was constructed. Before the dam, the valley was a major focus of transhumant herds, but now it is only a seasonal grazing resource (FORMECU, 1998).

8.0 HOW CAN WE SHIFT TO SUSTAINABLE MITIGATION?

A sustainable measure can be said to be sustainable, if it is resilient in the face of external shocks and stresses, if it is independent from external support, if it is able to maintain the natural environment and its resources without necessarily degrading any of its parts. In other to sustainably mitigate environment degradation in Nigeria, the study suggested some measures to be taken as they are cost effective and practical. These are presented in (**8.1, 8.2, 8.3 sections of this work**).

8.1 Utilise People Centred Approaches

A people centred approach mitigate environmental degradation should try to increase options and reduce vulnerability. There are several frameworks around which indicators can be developed and organised. There is no unique framework that generates sets of indicators for every purpose. Based on these and many other facts, two frameworks are found to be effectively better in assessing environmental degradation in Nigeria. These frameworks are very vital because unlike others that are reviewed, they have incorporated local stakeholders in their implementation which is the new paradigm in environmental degradation assessment and combat projects. The frameworks are; the Ecosystem Services and Sustainable Livelihoods Frameworks.

8.1.1. Ecosystem Services (ES) Framework

An ecosystem is a self-regulating functional unit in which both non-living and living organisms interact and which has a boundary that distinguishes it from other ecosystems (Leemans 2011). The term ecosystem is often used to describe both a biome and a habitat. The origin of ecosystem as a concept can be traced to 1864 while coining of the terminology has been traced to 1935 (O'Neill, 2001). The concept of ecosystem has emerged with a renewed force when it was mainstreamed in the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, MA, 2005b).This recognition that environmental degradation is scale sensitive and can only be mitigated when people trapped in its impact are involved forced the international community to change thinking

on issues relating to degradation and as well re-focus dimension of management to people centred approach such as the Ecosystem services.

The Ecosystem Services (ES) Framework focuses on the benefits people obtain from ecosystems: ecosystem services. This framework encourages the assessment team to think broadly about the range and scale of impacts of Environmental Degradation/Sustainable Livelihood Management ED/SLM (Millennium Ecosystem Assessment, 2005a). Some impacts are easy to quantify, others not; some are felt locally and very differently according to the socio-economic status of the land-user, others are felt nationally or globally. The importance of ecosystems services for human well-being is articulated by many authors (Boyd and Banzhaf, 2006). Humans depend on ecosystem services and on their benefits for their livelihood needs (Fisher et al. 2009). Whereas people and ecosystems are two independent entities, the human interventions always affect the functions of the ecosystems and consequently the services and benefits derived.

8.1.2. Sustainable Livelihood (SL) Approach and Framework

Out of worrying need of approach that will be best applied that will sustain the environment and together with livelihoods of the people, the sustainable livelihood framework was developed as tool that combines both natural and socio-economic aspects of household livelihood and the environment. The framework is centred on people. Its aim is to help stakeholders with different perspectives to engage in structured and coherent debate about the many factors that affect livelihoods, their relative importance and the way in which they interact (Kollmair and Gamper, 2002). The sustainable livelihoods framework presents the main factors that affect people's livelihoods, and typical relationships between these. The concept of 'sustainable livelihoods' constitute the basis of different Sustainable Livelihood (SL) Framework and has been adapted by different development agencies such as the British Department for International Development (DFID), (DFID, 2000). The livelihoods framework is a tool to improve our understanding of livelihoods particularly the livelihoods of the poor. The Sustainable Livelihoods framework is used for understanding how household livelihood systems interact with the natural, socio-economic and policy environment. Impacts can be in both directions i.e. many pressures leading to land degradation arise from the activities of land-users and ED/SLM causes impacts on land-users' livelihoods. In this assessment the SL approach is used to help understand both: the drivers and pressures leading to ED/SLM and the impacts of ED/SLM on people. Five concepts are crucial for understanding the linkages within the framework (see MA, 2005a for the figure). These are; 1) The vulnerability context, 2) Livelihood assets, 3) Institutions, 4) Livelihood strategies, 5) Livelihood outcomes

However, the SL Approach is not without some limitations. Among which are a differentiated livelihood analysis needs time, financial and human resources (DFID, 2000).

8.1.3 Ecosystem Approach (EA)

The dry environments are facing daunting collection of challenges and faced with the realities of dry environments constraints, the aims of developing an integrated Ecosystem Approach to research for development must include: sharing access to ecosystem goods and services; securing equitable benefits for livelihoods; conserving biodiversity and ecosystem integrity; maintaining or improving biological productivity; and building institutional sustainability (Mortimore, 2006).

The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is the primary framework for action under the Convention on Biological Diversity (CBD) and comprises 12 Principles (for details see Shepherd, 2004). The Approach was developed by the Convention on Biodiversity and recognised that as human beings are ecosystem components, their active roles in achieving sustainable ecosystem management are valued (Shepherd, 2008). In considering how to best implement the Ecosystem Approach, several attempts have been made to rank the principles, either by order of importance or according to theme. The Ecosystem Approach puts people and their natural resource use practices squarely at the centre of decision-making. Because of this, the Ecosystem Approach can be used to seek an appropriate balance between the conservation and use of biological diversity in areas where there are both multiple resource users and important natural values. It is therefore of relevance to professionals and practitioners active in farming, forestry, fisheries, protected areas, urban planning and many other fields (Shepherd, 2004).

The primary methods used in the application of the approach are structured group or individual discussions, supplemented by inventories of biodiversity (as defined by user groups), livelihood and technical options, and some participatory mapping of ecosystem resources or ecosystem areas (Mortimore et al., 2006).

8.2 Prioritise stakeholder ship in Environmental Resources Management

Throughout the last decades after the UN summit on sustainable development in 1977, environmental activists now argue that the public should be more deeply engaged in environmental management decision-making and part of the rationale for this argument is based on the growing recognition that Western, scientific approach has discounted the value of local expertise—often to the detriment of the unique social and ecological system being managed (Fischer 2000). Tiffen, Mortimore and Gichuki, (1994) and Mortimore et al. (2006) argued that growing indigenous capabilities to sustain the environment and agro-management of farmlands using local

managers' own initiatives is not harmful to sustainability of the environmental and its resources but only capable of maintaining the base for the future. Site cases such as that of the Machakos (Tiffen, 1993) and Makueni Districts in Kenya showed that between 1932 and 1987, the Akamba people increased the average production per hectare by a factor of >10 while their population grew six-fold. During the latter half of the period, they reserved a crisis in soil erosion, planted trees, extended the cultivated area, and created a landscape of meticulously terraced fields and private pastures. These achievements were sustained during the 1990s even in the dry areas of Makueni District (Tiffen, Mortimore and Gichuki, 1994). Mortimore and Turner (2005) maintained that farmers' capacity to have an impact on the effects of deforestation through conservation of trees on farms should not be under-valued. The surveys in five villages of the Maradi-Kano region have shown that indigenous communities have a capacity to assess their ecosystem resources on the basis of an extensive and detailed knowledge of species, typologies and indicators (Mortimore et al., 2006).

These findings suggest a scenario characterised by strongly held conservation values, and visible in an increasingly wooded landscape, good use of local knowledge in planning and an active search for more sustainable pathways in ecosystem management (Mortimore et al., 2006). Aforementioned findings correlates with the ethos of the study that prioritising local stake holders will ensure the sustainability of resources and redress the effects of most consequences of degradation in Nigeria. This is because about 70% of the population of Nigeria are farmers and more than that are natural resource users, utilising their potentials will only restore the deterioration done to the Nigeria's rich resources as done in Machakos District in Kenya, Yatenga District in Burkina Faso and other areas of Niger Republic.

8.3 Promote Indigenous Environmental Management Practices

The challenges of finding environmentally sound and culturally acceptable natural resources management practices thus lead researchers to consider community-based-knowledge (Berkes et al., 1998). Provided with many thoughts, Grice and Hodgkinson (2002) further stated that an measures that involves the participation of the local community, has proven to be effective in devising proper management system for the sustainable use of landscapes.

A common argument is that local people, in their groups or communities lack the capacity, skills, and expertise to sustainably manage forests and other resources. Often external expertise refer to the big problem of sustainable management is rural illiteracy. These unreasonable arguments produce growing number of outcomes which do not favour the environment and its management. Local organisations can be building block of rural development (USAID, 2002) and key to empowering and amplifying the voices of the rural poor (Anderson et al., 2006). This is because literacy is no guarantee of good management and illiteracy is no guarantee of poor management (Anderson et al., 2006). Some useful techniques worthy of promoting are;

8.3.1 The Farmer Managed Natural Regeneration

Farmer managed natural regeneration is a systematic regeneration and management of desired tree stumps in fields. The FMNR has become a catalyst for large scale people-led environmental restoration and communities and individuals are benefitting through its impact on poverty alleviation and food security. In its three decades since being in practice in Niger, Republic, FMNR has spread to 50% (5 million hectares) of the nation's farmlands with little NGO or government intervention (Rinaudo, 1994). Practices such Farmer Managed Natural Regeneration (FMNR) should be promoted among local resource managers as they are cost effective and still resilient in management of the natural environment and its resources. FMNR helps in meeting the commitments to UN conventions such as the convention on desertification (Rinaudo, 1994). Details of benefits of this practice can be found in Rinaudo (1999, 2005, and 2008), Reij et al. (2009) as well as Mortimore et al. (2006).

When adopted in Nigeria, the technique can recover degraded lands through improved natural resources management and social status of people who can especially women and vulnerable group as seen in Maradi and Zinder of Niger Republic (Reij, 2006).

8.3.2 Agroforestry

Agroforestry is a natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (ICRAF, 2004). Agroforestry would be the integration of trees, plants, and animals in conservative, long-term, productive systems. Every part of the land is considered suitable for useful plants. Emphasis is placed on perennial, multiple purpose crops that are planted once and yield benefits over a long period of time (Boffa, 1999). Nair (1989) has explained that the agroforestry approach to land management offers a viable option to make use of the indigenous knowledge about such underexploited species and integrate them with other preferred species for the production of multiple outputs and services from the same unit of land in a sustainable and socially acceptable manner. Agroforestry practices as suggested Boffa (1999) are indigenous techniques that utilises both crops and trees in association on the same piece of land for a better yield.

Some major advantages of this system are that trees enhance soil fertility in terms of plant-available nitrogen and phosphorus (Rao, Nair and Ong, 1997), there is improved water use efficiency as a result of reduced run-off, soil evaporation and drainage (Ong et al., 2002) and valuable tree products, including fruit, fodder and wood, can be

produced. Agroforestry systems make maximum use of the land. This practice has been in place in farming parklands of Northern Nigeria for decades (Pullan, 1974) and if harnessed it has the propensity of turning around deterioration in degraded farmlands in the area.

8.3.3 Planting Pits Technique (Zai)

Zaï is a traditional soil conservation technique that originated in Mali in the Dogon area. Zaï was adopted and improved by farmers in Burkina Faso after the drought of 1980's. To reclaim severely degraded farmland that water could not penetrate, farmers would dig a grid of planting pits known (also known as Zai) across the rock-hard plots. Zai is an agricultural technique of the Yatenga province of Northern Burkina Faso were gridded pits are made on soils so that it can survive erosion due to run-off (Reij, 1991). The application of the Zaï technique can increase production by about 500 % if well executed (World Bank, 2005). Sawadogo et al. (2001) explained that pits has been used to diversify plants biomass in Burkina Faso and the practice has help improve soil fertility and crop yield in the area.

If Zai is to be promoted farmers in Southern Nigeria would have better possibility of reclaiming their washed away soils and put it into productive use as the technique is perfect in controlling soil erosion by surface run-off.

8.3.4 Promoting Local Energy Alternatives

Woodfuel supports lucrative local trade. Trade in charcoal is a major source of income for many households. For example, in Zambia, the charcoal industry generated about US$30 million in 1998 alone, and in the same year about 60 000 Zambians directly depended on charcoal production for the bulk of their income (Kalumiana, 2000). Globally, energy demand is surging up and with increase in population; the amount needed to sustain households' demands will never reach some. Essentially because four out of five people without electricity live in rural areas in developing countries, mainly South Asia and Sub-Saharan Africa. About 81% of households burn solid fuels, far more than any other region in the world, with about 70% depending on wood-based biomass as their primary cooking fuel. Nearly 60% of urban dwellers also use biomass for cooking (IEA, 2010). While it is predicted that by 2030 energy derived from wood in Africa will still account for an estimated three quarters of total residential energy consumption serving about 1 billion people, it currently only accounts for about 10% of the global energy supply (IEA, 2008). The 2011 UNDP assessment of the MDGs has included Nigeria among those countries requiring further effort to improve their energy situation. Anozie et al. (2007) highlighted some of the efforts of the Nigerian government through its Energy Commission and the numerous other research efforts in addressing the energy situation. They concluded that the majority of the energy targets set by the government remained unmet, due to lack of policy implementation, general lack of awareness from consumers of the compelling need to conserve energy and lack of logistics and proper funding (Naibbi, 2013). All the four impediments to the improvement of the energy situation in Nigeria described by Anozie et al. (2007) focused on the laxity of the policy makers in either not funding the sectors efficiently or not policing the laws that would regulate the proper use of energy in the country.

Nigeria is moving back to the use of traditional cooking energy, which is why the volume of fuelwood collection rose from about 59,095,000 m^3 in 1990 to about 70, 427, 000 m^3 in 2005 (FAO, 2010) thus pro-poor options such promotion and adoption of improved cookstoves (ICS) (Zein-Elabdin, 1997; World Bank, 2011), biomass briquetting technology (see Karekezi, 1994; Freguson, 2012; Danjuma, Maiwada and Tukur, 2013) using local raw materials such as bagasse and municipal waste as well as biogas technology are a must so as to ease stress on biomass and wood.

Energy issues require integrated and interdisciplinary approaches with a sustainable development focus. For example, interventions designed to improve the production of fuelwood such as wood lots and FMNR should be closely coordinated with Environment and Agriculture and Rural Development departments of Ministries and involve community participation. Further, investments in energy sector (to utilise liquefied natural gas presently booming because of discovery crude oil in Niger Republic) should be promoted especially among users of biomass and charcoal so as to move up the twisting energy ladder.

8.4 Improve Rural livelihood Portfolios via local Strategies

Globally, two billion people live on less than US$1/day, about the same number as those lacking access to commercial energy (FAO COFO, 2005). Globally concerns on poverty are glooming in that about 75% of the poor live in rural areas, apparently more in Africa where poverty is predominant (CIFOR, 2005). Africa has the highest percentage of people living on less than a dollar a day (UNDP, 2008). Therefore in order to harness the full potentials of rural areas of Africa and South Asia (next to Africa in terms of poverty) specifically, frameworks and solutions should ensure that future developments options must be geared towards servicing the poor rural resources users. Anderson et al. (2004) maintained that rural natural resource dependant regions should not be treated as mere welfare sinks or 'problem areas'. In reality they present a repository of hopes and recovery when only their livelihood as producers is secured. Although Nigeria is a wealthy country in terms of human and natural resources, its social and economic development is quite slow. This fact can be illustrated by the country's high level of poverty, lack of basic social infrastructure and above all, the indisputable high level of corruption (Kar and Freitas, 2012). About 65 percent of the country's approximate 160 million people are

living below the poverty line (live on less than US$1.25 a day) (United Nations Development Programme UNDP, 2009 and 2010). The UNDP report further confirmed that the poverty figure in Nigeria (over 90 million people), is higher than the combined population of 10 other West African nations excluding Ghana and Cote D'Ivoire.

Aims to provide incentives to local cottage industries; boost people's knowledge of vocations through literacy classes, development of assets (types Sustainable Livelihood Framework section) and provision of infrastructures such as markets and roads should be corner stone of economic projects not technically grounded tools that normally dim peoples' interests to modernity. Local household assets such plough and cart traction, farming implements and local level credit facilities can be organised for the people for loans payable within the limited resources of the community. Typical example is the on-going project in some states of Nigeria through a social development initiative tagged 'Community and Social Development Program (CSDP)' of the Federal Government and Global Environmental Facility (GEF) as well as the IFAD projects in seven north-western States. The projects which have been empowering local technologies to manage the environment is quite a good one in Nigeria.

9.0 CONCLUSION

Natural-resource exploitation is related to crucial sustainability issues. Thus the causes and consequences of unsustainable use of environmental resources cannot be underrated or treated on continental, regional, national even local levels. As collective actions to mitigate environmental degradation are mandatory, every site and case needs its own diagnosis and no isolated measure will suffice unless it is done commensurate to the prior understanding of the phenomena and complete integration of all stake holders.

Significantly, approaches or methods need to be critically selected, taking into account their suitability, applicability and adaptability to local conditions. Fortunately, scientists around the world started long ago to look at the problem of environmental degradation and have developed assessment and monitoring methods. Various assessment methods have been developed at local and scientific scales to determine the status of the land, extent and impact of environmental degradation and to help designing possible conservation activities. It is therefore left to implementers to engage other stakeholder with clear mind and discuss sustainability or otherwise of the approaches and utilise the knowledge for common goal. This has become imperative when we consider Nigeria as the top 4th on list of deforestation countries as reported (FAO, 2010) and other indicators such as soil erosion.

APPENDIX

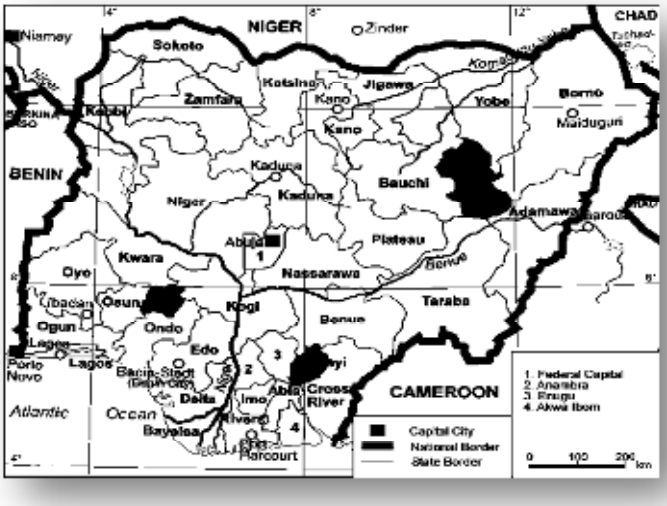

Figure 1: Map of Nigeria

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