

BIODIVERSITY CONSERVATION IN NIGERIA: CONTEMPORARY CHALLENGES FOR ECOLOGIST

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ABSTRACT: This paper discusses biodiversity and its significance. It looked at the status of Nigeria's biodiversity and why it is important to conserve it. Importance of biodiversity in Nigeria includes the provision of food, medicines and industrial materials. It highlights the aim and types of biodiversity conservation. The text examines some approaches that in the author's opinion, will contribute significantly in complimenting the already existing approaches to biodiversity conservation in Nigeria. Among the factors that contribute to biodiversity loss are poverty, population growth, deforestation and habitat degradation. A brief review of the methods of biodiversity conservation shows that protected-area system is the main method of biodiversity conservation in Nigeria, although in some cases it is been supported by community-based conservation approach. Amidst this effort, biodiversity continued to be eroded; this called for ecologist working to conserve Nigeria's biodiversity to be involved more directly to augment the already existing conservation efforts. Priorities for ecologist thus include understanding the causal relationships between people and biodiversity, placing economic value on biodiversity and prioritizing target outcomes and indicators.

KEYWORDS: Biodiversity conservation; Food production; Deforestation; Agricultural expansion; Invasive species; Poverty.

1 INTRODUCTION

Biodiversity comprises all species of plants, animals and microorganisms, the ecosystems and the ecological processes of which they are parts. It is the term used to describe nature's variety, including both the number and frequency of ecosystems, species or genes in a given assemblage [50]. Biodiversity is considered by some to be the same as species richness; some consider it as species diversity, while many consider it to be the complete variety of life on this planet [70]. According to the International Convention on Biological Diversity [72], "Biodiversity"(biological diversity) means the variability among living organisms from all sources, including among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part including within species-diversity, between-species diversity and ecosystem diversity. Biodiversity is fundamentally and categorically divided into three related levels of biological organization which are: Genetic diversity which means variability in genetic composition among the populations and individuals of the same species: Species diversity which means variability among species in ecosystem and ecosystem diversity which means habitat diversity per unit area [23].

Biodiversity serve as the very bases of human existence and economic development because it plays a significant role in the way ecosystems function and in the many services they provide [17]. These services include nutrient and water cycling, soil formation and retention, resistance against invasive species, pollination of plants, and regulation of climates as well as pest and pollution control by ecosystems [17].

Conserving of biodiversity is the use of biological resources in ways that do not diminish or destroy the variety of genes and species or important habitats and ecosystems [1]. Conservation of biodiversity could be *in situ* (protection, maintenance

and management of variety of life forms in their real habitat) or *ex situ* (collection of some species or their populations and communities in areas away from their real habitat) [52].

2 STATUS OF BIODIVERSITY IN NIGERIA

Nigeria covers 923,000 km² with a human population of 140 million growing at an annual rate of about 2.8% according to The Report of the Nigeria's Population Commission on the 2006 Census [58]. A total of about 7895 plant species identified in 338 families and 2,215 genera have been recorded in Nigeria. There are about 22, 000 vertebrates and invertebrates species. Of these, about 20, 000 are insects, 1, 000 are fishes, 247 are mammals, 123 are reptiles [26] and 894 are birds [19]. Also about 1,489 species of micro-organisms have been recorded. This ranks Nigeria as one of the richest countries of Africa in terms of biodiversity. All these species of animal and plant are distributed differently within the country's vegetation ranging from the mangrove along the coast in the South to the Sahel in the North [26].

Most Nigerians are not aware that most of our biodiversity are threatened by intense pressure from various human related activities such as farming, building of infrastructures and industries, drainage and filling of wetlands, human settlements among others [5]. The consequences of these activities are loss of biodiversity. Presently, among the biological resources the world may loss as a result of threat from these activities is about 37 species of birds [18]. The population of Nile crocodile (*Crocodylus niloticus*) once present in Nigeria waters right up to Lake Chad is fast declining due to habitat destruction and hunting [33]. About 65 of 560 species of trees in Nigeria forestry are now faced with extinction while many are at different stage of risk [33]. These are all conservation issues to the country.

Nigeria used to have 8 National Parks, however, with the reversion of the Yankari National Park to a State game reserve , the present network of protected areas include 7 national Parks, 15 game reserves [74] and 36 forest reserves [19]. Other protected areas include sanctuaries and game reserves meant to conserve wild life and to supplement protein from domestic sources [26]. Tables 1 and 2 show the threatened biodiversity species and National Parks in Nigeria respectively.

Table 1. Threatened biodiversity species in Nigeria

A SPECIES (PLANT)	COMMON NAME	MAIN USES	STATUS
<i>Milicea excelsia</i>	African teak	Timber	Endangered
<i>Diospyros ellioti</i>	Red fruited ebony	Carving	Endangered
<i>Triplochiduiton scleroxylon</i>	African white wood	Timber	Endangered
<i>Mansoiea altissinia</i>	Mansonia	Timber	Endangered
<i>Masilania acumminata</i>	-	Chewing stick	Endangered
<i>Garcina manri</i>	Ofun	Chewing stick	Endangered
<i>Oucunbaca aubrevillei</i>	-	Medicine	Almost extinct
<i>Erythrina Senegalensis</i>	Coral flower	Medicine	Endangered
<i>Cassia nigricans</i>	Black grain olive	Medicine	Endangered
<i>Nigelle sativa</i>	Black cumin	General	Endangered
<i>Hymenocardia acida</i>	Large red heart	General	Endangered
<i>Kigelia Africana</i>	Sausage tree	General	Endangered
B ANIMAL			
<i>Crocodylus nitoticus</i>	Slender snouted crocodile	Food/Medicine/bags	Endangered
<i>Osteolaemus tetraspis</i>	African dwarf crocodile	Food/Medicine	Endangered
<i>Struthio camelus</i>	Ostrich	Food/Medicine	Endangered
<i>Psittacus erithacus</i>	African gray parrot	Medicine/Pet	Endangered
<i>Cercopithecus erythrogaster</i>	white throated monkey	Food	Endangered
<i>Loxodonta Africana</i>	African bush Elephant	Food/Ivory	Endangered
<i>Trichecus senegalensis</i>	Manatee	Food/Medicine	Endangered
<i>Giraffa camelopedalus</i>	Giraffe	Food/Medicine	Endangered
<i>Python sabae</i>	Royal python	Bags	Endangered
<i>Gazella dorcas</i>	Dorcace gazelle	Food	Endangered

Source – Federal Government of Nigeria 2001

Table 2. National Parks.

NAME OF PARK	AREA	LOCATION	VEGETATION TYPE
1a Kanji National Park (Borgu sector) 1b Kanji National Park (Zurguma sector)	532,000 ha	Niger State	Guinea Savanna
2 Kamuku National Park	121,130 ha	Kaduna State	Guinea Savanna
3 Old Oyo National Park	253,000 ha	Oyo State	DryForest/Guinea savannah
4 Okomu National Park	200 ha	Edo State	Lowland Rainforest
5a Cross-River National Park (Oban Division) 5b Cross-River National Park (Okwango Division)	400,000 ha	Cross-River State	Lowland Rainforest
6 Gashka Gumti National Park	6, 402, 480 ha	Taraba State	Guinea Savannah/Montane
7 Chad Basin National Park 7a(Hadejia-Nguru Wetlands/oasis Sector) Chad Basin National Park 7b (Sambisa Sector) Chad Basin National Park (Chingurme-Duguma Sector)	230,000 ha	Borno State	Sahel Savannah

Source-Federal Government of Nigeria 2001.

3 IMPORTANCE OF BIODIVERSITY IN NIGERIA

3.1 FOOD

One of the importance of biodiversity conservation is the gene pool of wild plants which is available to support the narrow genetic base of these established food crops, providing disease resistance, improve productivity and different environmental tolerances [58]. During times of food insecurity, particularly during times of low agricultural production or cyclical food gaps or periods of climate induced vulnerability, biodiversity provides an important safety-net [36]. People around the world mostly depend on these species for their food, shelter, and clothing [43]. In Nigeria, forests serves as a source of ripe fruits, vegetables, and different types of leaves that can be used as dietary supplements. For instance, the leaves of baobab tree (*Adansonia digitata*) are used in the preparation of soup. The flower is eaten raw, the seed also provide flour which is very rich in vitamin B and protein and can be used as baby food [29], while the seeds of *Pakia biglobosa* are used for making delicious sauce in Northern part of the country. Also, wild animals such as antelope, hippopotamus, and bird are hunted for their meat as source of protein and other nutrients [19].

3.2 MEDICINE

People have long used biological resources for medicinal purposes. Biodiversity provides an important source of medicinal resources and play a vital role in the discovery of drugs [46]. About 80% of human population globally, depends on medicines from nature for primary healthcare [13]. The World Health Organization estimates that in many developing countries up to 80% of the population depends on biodiversity for primary health care and the loss of biodiversity has been linked to the increased emergence and transmission of infectious diseases with deleterious impacts on human health [38]. In Nigeria, the bark of *Faidherbia albida*/ *Acacia albida* tree is used to cure diseases such as cough, pneumonia, vomiting and diarrhea while the leaves and the gum are used for the treatment of haemorrhage and ophthalmia. Various parts such as the roots, flowers, pods and the seeds are used in the treatment of influenza, toothache, and rheumatism. Some other known medicinal plants in Nigeria includes Mango (*Mangifera indica*), Hogplum (*Spondias monbin*), Arrow poison (*Strophantus hispidus*), Goatweed (*Ageratum conyzoides*), Pawpaw (*Carica papaya*), Siam weed (*Eupatorium odoratum*) [7].

3.3 INDUSTRIAL MATERIAL

Biodiversity provides a wide variety of species used by many industries [9].For instance, wood, a commodity used globally is still largely gotten from the wild. It is used for construction and as raw materials for timber and paper industries. Nigerian

native plants such as *Terminalia superba* (Afara), *Nauclea diderrichi* (Opepe), Mahogany and Iroko have been of continued importance as raw materials for timber industries. They are also used for the construction of buildings and furniture. Latex, which is produced by rubber tree, also serves as a raw material for rubber industries for the production of plastics, gums, cables etc.

3.4 AGRICULTURE

Biodiversity provides the “natural capital” for ecosystem services, ecological processes such as the maintenance of watershed services, soil fertility, pollination, seed dispersal, nutrient cycling, natural pest and disease control [35]. All these rely to a greater or lesser extent on biodiversity, or components of it processes that are critical to the maintenance of agricultural systems [10]. Greater plant species diversity increases soil nutrient remineralization, usage and efficient retention which leads to greater productivity and minimizes nutrient loss through leaching in the ecosystem [73]. Variety of soil microorganisms play an important role in the process of nutrient recycling which is also necessary for the maintenance of soil productivity [41]. The soil’s nutrient status is further improved and made readily available by species such as earthworms which mix and aerate it. Increased plant species diversity decreases disease prevalence on plants and improve pest control by increasing the number of predators such as lizards, birds and certain insects [64]. In Nigeria, insects like bees play a vital role in agriculture as pollinators of crops, aside the production of honey.

3.5 RESEARCH, EDUCATION AND MONITORING

The available knowledge of biodiversity is still inadequate to ensure proper management, and only by further scientific research are we likely to learn new and improved methods for managing it [65]. Natural habitats serve as living laboratories to learn how to get better use from biological resources, how to maintain the gene pool of biological resources, and how to renew dilapidated ecosystem. In Nigeria, ecologically and culturally important sites like National parks and Game reserves are used for research into ecology and for comparisons with other areas under different system of use [19].

3.6 RECREATION

Most people derived recreational value from biodiversity through leisure activities such as bird watching, hiking in the country side, natural history study, hunting and fishing for pleasure rather than necessity. People also value such areas for films, photographs or literature based on or using wildlife, natural habitats and natural features, tourism, ecological field study and other scientific features [50]. Many people from other parts of the world are attracted by the terrain and wildlife of Africa, and this is a major foreign exchange earner for many countries, most notably Kenya [65]. In Nigeria, National parks, wild life parks and bird sanctuary are also used for recreational purposes such as tourism and birdwatching [19]. Although, touristic activities must also be carefully regulated to ensure that they do not undermine the biodiversity on which they are based [65].

3.7 CULTURAL VALUES

Most of the areas with the highest biological diversity on the planet are inhabited by indigenous and traditional people, providing a strong link between biological and cultural diversity [54]. Indigenous people use a very wide range of lesser-known species and often possess deep ecological knowledge that helps maintain the ecosystems in which they live [48]. Most cultures view themselves as an integral part of the natural environment therefore have respects for other living organisms. Some forests areas in Nigeria are set aside and protected by rural communities mostly in the south for cultural purposes [19].

4 CAUSES OF BIODIVERSITY LOSS

Biodiversity is important to human development as a result of the goods and services it provides. However, it is being lost due to a number of factors, including uncontrolled conversion of land, pollution, unsustainable harvest of biological resources and introduction of invasive species [15]. In Nigeria, factors responsible for the loss of biodiversity include but not limited to the following:

4.1 HABITAT DEGRADATION

Increased rate of biodiversity loss and environmental degradation are clearly attributed to human activities [16]. Based on the Millennium Ecosystem Assessment, major habitats including forests, grasslands and coastal zones have been heavily impacted by human activities leading to their degradation [44]. Farming, which covers about 36% of the potentially suitable land surface of the globe, is the major cause of habitat degradation and loss [20]. Habitat degradation is caused by human activities such as mining, clear-cut, logging, trawling, urban sprawl and introduction of invasive species or by natural environmental change due to factors such as volcanic eruption and climate change [66]. With more than half of the world's population now dwelling in urban centers, urban sprawl has also contributed to the degradation and loss of many habitats [74]. Agricultural expansion is a primary cause of habitat destruction in Nigeria as it is associated to vegetation destruction and short fallow period. For instance, most of the montane forest patches of the Cross River National Park-Okwango division are seriously degraded through subsistence agriculture and overgrazing resulting to serious sheet and gully erosion [19].

4.2 POPULATION GROWTH

Human population is expected to grow to nine billion by the year 2050 [53]. Population size; growth and density are often regarded as important factors in explaining the loss of species [14]. Biodiversity is generally threatened most where population density is highest, and regions rich in endemic species have higher-than-average population densities and population growth rates. This is true in many parts of Asia and Africa where humans and threatened species are often concentrated within the same geographical locations [76]. Threat to biodiversity is likely to rapidly increase in regions where human population growth rates are high due to the predicted increase in demands for resources of a growing population in these regions [76]. Many countries in the developing world are facing rapid growth in population, with related pressure on natural habitat and their native fauna and flora [67]. As a result of population pressure, high intensity of logging, illegal exploitation, agricultural expansion and collection of fuel wood has continued to pose serious threats to the country's forest resources [26].

4.3 POVERTY

African livelihoods depend to a great extent on free and accessible variety of biological resources [31]. This direct reliance is associated to the narrow manufacturing or industrial base in Africa [77]. In the event of declining productivity due to environmental degradation, there would be few alternative of income readily available [11]. Huge external debt and low prices for agricultural and primary materials contribute to poverty and almost certainly also have great consequences on the environment [11]. Nigerian national debt increased from \$26 billion to \$70 billion, debt servicing increases from 10% to 50%, unemployment increases from 11.8% to 24%, youth unemployment increases from 9% to 50%, GDP growth decreases from 11% to 6% among others economic woes, hence increasing poverty rate from 54% to 71% in the past six years [70]. Also bribery and corruption are usually additional problems because funds that would have being used to fuel development in the country for all Nigerians were used to fund the lifestyle of a few. The implication of these is negative environmental effect among other consequences.

4.4 DEFORESTATION

Logging and conversion to agriculture or grazing are the main cause of deforestation in the tropics [61]. Of the roughly 16 million km² of tropical rainforest that originally existed worldwide, less than 9 million km² remains today [48]. The current rate of rainforest loss is debated, with different estimates ranging from around 60 000 km² to 130 000 km² per year [21]. In tropical Africa, forest loss is severe in West Africa, montane areas of East Africa, and Madagascar, however, substantial forest still remains in the Congo Basin [41]. According to NEST [51], forest destruction in Nigeria, stood at the rate of about 600,000 hectares per year. Nigeria has one of the highest rates of deforestation in the world, having lost around 410,100 hectare per year over the period 2005 to 2010 [8]. Deforestation, farming and exploitation of forest resources for survival are among the leading causes of the destruction of Nigeria's rain forest. These activities are threatening the existence of species among which is the white-throated monkey (*Cercopithecus erythrogaster*) and Cross River Gorrilla (*Gorilla gorilla diehli*) endemic to Nigeria [52].

4.5 POLLUTION

Pollution can lead to the reduction, and even loss of some keystone species which in turn can result to the destruction of the entire ecosystem [27]. Pesticide and fertilizer effluents from agriculture and forestry, industry including mining and oil or

gas extraction, sewage plants, run-off from urban and suburban areas, and oil spills, are examples of pollutants that harm biodiversity directly through mortality and reduced reproductive success, and also indirectly through habitat degradation [45]. One of the threats to biodiversity in Nigeria is environmental pollution due to oil exploration. In the Niger Delta region of Nigeria, where most of the oil explorations take place, there have been a considerable environmental pollution and forest degradation due to spillage [2]. Other minerals whose mining also caused environmental degradation in Nigeria include tin, coal, iron ore and gemstone.

4.6 DESERTIFICATION

Desertification is a type of land degradation where by a relatively dry land region becomes increasingly arid, typically losing its water bodies as well as vegetation and wildlife [28]. Dry lands occupy approximately 40–41% of Earth's land area and are home to more than 2 billion people [34]. It has been estimated that some 10–20% of dry lands are already degraded, the total area affected by desertification being between 6 and 12 million square kilometers that about 1–6% of the inhabitants of dry lands live in desertified areas, and that a billion people are under threat from further desertification [78]. It is estimated that Nigeria is losing about 35,000 hectares of landmass to desertification annually and that such conditions are expected to be advancing southwards at the rate of about 0.6km per annum threatening the existence of both the terrestrial and aquatic biodiversity in such region. Desertification in northern Nigeria has been evidently linked to greater extent human activities such as large-scale land clearing for agriculture and river damming, but is also exacerbated by periodic drought [30].

4.7 INVASIVE ALIEN SPECIES

Invasive alien species are also considered one of the main threats to biodiversity globally, and are dispersed through poor planned economic introductions, air transport, hull-fouling and ballast water from ships, as well as trade in pets, garden plants and aquarium species [57]. They have infested and affected native species in almost every ecosystem type, in all regions; including marine ecosystems and affect native species mostly through predation, competition and habitat modification with particularly acute effects on the terrestrial biodiversity of small islands [42]. In Africa, almost all countries are affected by invasive alien species. In 2004, the IUCN–World Conservation Union identified 81 invasive alien species in South Africa, 49 in Mauritius, 44 IN Swaziland, 37 in Algeria and Madagascar, 35 in Kenya, 28 in Egypt, 26 in Ghana and Zimbabwe, and 22 in Ethiopia [32]. In Nigeria, alien invasive species such as *Chromolaena odorata* (Linn), a weed species, *Lantana camara*, a multi-taxon hybrid swarm and water hyacinth, *Eichhornia crassipes* (Mart), a fresh water weed are considered as threats to biodiversity due to their effect on native species [39].

5 APPROACHES TO CONSERVATION OF BIODIVERSITY IN NIGERIA

Protected-area systems are commonly used globally as a major tool for maintaining biodiversity and key ecosystems services [44]. In Nigeria, protection of habitats and species has long been practice by various cultures, through preservation and other distinctive habitats for religious, ceremonial and or hunting purposes [3]. The protected-area system approach of biodiversity conservation in Nigeria has categorized areas designated for biodiversity conservation into four: National parks, Game reserve, Forest reserve and sacred groves. Nigeria present network of protected areas include 7 national Parks, 15 game reserves [74] and 36 forest reserves which are found in almost every state [19]. Governmental agencies like ministry of environment and National park service in collaboration with non-governmental organizations (NGOs) such as Nigerian conservation foundation, worldwide fund for nature (WWF), and royal society for the protection of birds (RSPB) embarked on various projects to help in the conservation of the nation's biodiversity [19].

This paper outlines the meaning of biodiversity and why it is important in Nigeria. Most importantly, it looks into the status of biodiversity in Nigeria, and the factors impacting on it conservation. We examined some options for ecologist working with Nigerian biodiversity, which, in our own opinion, will compliment the already existing conservation approaches.

In an attempt to improve biodiversity conservation in Nigeria, the following issues should be addressed by ecologists.

- Ecologists working with a conservation authority are advised to become more involved in supplementing local ecological knowledge with modern conservation skills in such a way that it provides timely and related information to resource manager and other resources users [12]. Furthermore, it is also important to take into cognizance the significance of local ecological knowledge and local resource users in effective biodiversity conservation even though they are not fit for the present level of biodiversity degradation [57].
- When the international conservation communities or local authority provide funding for conservation then ecologist should prioritize target results and intermediate indicators such as gorilla surviving in a particular habitat and endemic

bird species found in a particular forest area and describe ways the local community would follow to gain the benefits from the contracted conservation results [25]. Also ecologists should assess the impact of such project on the conservation of biodiversity by at least comparing the situation before and after the contract [36] which in most cases are lacking. This will provide a practical and robust focus for the conservation effort.

- Ecologists working with Nigeria biodiversity are encouraged to justify their commitments for biodiversity conservation by giving biodiversity conservation and sustainable resource use direct economic value [31]. This can be achieved by exploring the potentials of non-consumptive use of biodiversity resources such as nature tourism which can attract large economic gains in some situations [63]. This approach should include benefits for the locals which should be the same or more than the perceived benefits from activities such as logging and fuel wood collection. For instance, in Kenya, according to the World Travel and Tourism Council, in 2014, Travel and Tourism have contributed 4.1% of the GDP of Kenya while in Nigeria, in 2014, estimated revenue related to tourism and travel accounts for approximately 1.7 % of the gross domestic product [78]. Such benefits can only be improved by broadening and placing economic value on the non-consumptive use of biodiversity.
- When working with community-based conservation project, ecologists should devise a way of monitoring and presenting the impact of such approach to the management of biological resources in a statistically robust manner which in most cases is rare [6]. In a situation where such information is available, it takes the form of a case-study approach in which the aims, implementation and outcomes of initiative are described quantitatively, which makes available only the contextual detail and do not allow statistical analysis and the testing of hypothesis about the link between poverty and conservation [62]. This makes it difficult to provide a quantitative evidence to support conclusions on the impact of community-based approach to the conservation of biological resources [67] among other challenges associated with community-based project approach.
- Ecologist should try to understand the interactions between people and nature within complex adaptive systems when looking for solutions to ecological problems, in order to identify and manage threshold of potential concern for a key set of ecologically response variables. In order to determine the thresholds, it is important to understand the causal relationships between people and biodiversity after which adaptive management measures for drivers of biodiversity loss such as wild meat consumption, logging and deforestation should be devised [47].

6 CONCLUSION

Against the background of poverty and poor institutional organization, biodiversity in Nigeria is continued to be threatened by unsustainable human activities. This is placing mounting pressure on ecologist to look for ways to bolster the already existing conservation approaches in a way that are locally feasible and plausible. My opinion is that, even though getting institutions to work in the right track will take a slow political process over time, ecologists working with Nigeria biodiversity must become more engaged directly in the formation of specific approaches to biodiversity conservation. These approaches should work more in complementing the already existing conservation methods with more scientific oriented ways against the threads facing biodiversity in Nigeria.

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