Conservation and Utilization of Biodiversity- Implications to the Nigerian Environment

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Abstract

Biodiversity has faced a series of threat in different terrains/countries. The deforestation rate in Nigeria is still being ranked highest in the world, despite having some conservation strategies in place, including both in situ and ex situ conservation measures. The study aimed at a critical appraisal of the status of biodiversity conservation and utilization pattern in Nigeria. The review was carried out using published materials and personal interactions with stakeholders. Poverty, population growth, invasive alien species, habitat fragmentation are some of the militating factors depleting biodiversity in Nigeria. The IUCN Red list assessment reports that 148 animal and 146 plant native species of Nigeria are currently in its Threatened category. With these assessments been carried out on the global level, we hypothesized that such global assessment might be biased based on the various identified peculiar threats faced by different species in their local environment. The study has identified these threats in Nigeria and proffers ways of conserving the country's biodiversity. We recommend the development of a National red List for Nigeria as obtainable in other developed Nations.

Keywords: Biodiversity conservation; IUCN; Red List; Sustainable utilization

Abbreviations: IUCN: International Union for Conservation of Nation; CBD: Convention on biological Diversity; LC: Listed as Least Concern; IITA: Institute of Tropical Agriculture; NACGRAB: National Centre for Genetic Resources and Biotechnology; NHRI: National Horticultural Research NNPS: Institute Nigeria National Park Service

Introduction

Biodiversity is the variability among living organisms from all sources including, inter alia, terrestrial, aquatic and the ecological complexes of which they are part, this includes diversity within species, between species and of an ecosystem. The strategic position of Nigeria in West Africa that lies between longitudes 30E and 150E and latitudes 40N and 140N has endowed it with very rich biodiversity, distributed within different ecological zones, comprising mangrove, rainforest, montane, and the savanna- Guinea, Sudan and Sahel [1]. These different eco-geographical zones support different plants and animal species, including endemic ones. Biodiversity provides valuable bioresources that support the existence of man on earth. In addition, biodiversity also provides unquantifiable services to human. 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. Information on the status of biodiversity in Nigeria is currently not up to date.

Although many estimated data on the status of biodiversity exist, none of these have proved convincing in the face of current reality. According to the most recent survey on biodiversity assessment [1], Nigeria has over 7,895 plant species, identified into 338 families and 2215 genera, including a significant number of them being endemic species [2]. However, there exist a lot of factors militating against the conservation of these resources, triggering alterations at different ecosystems that make up biodiversity. In as much as humans cannot live without developmental activities which to a great extent are dependent on resources from biodiversity pool, lack of prudent use can result in total loss or extinction of some valuable portion of it. Therefore, the need to harmonize developmental activities in such a way that the impact on biodiversity would be least must be advocated.

The primary goal of biodiversity conservation is to maintain all species and population of species for present and future use. Conservation of biodiversity can either be carried out in-situ

which implies the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species or *ex-situ* (entails protecting an endangered species of plant or animal outside its natural habitat [3,4] The effective conservation of biodiversity in Nigeria has been hampered by factors, such as population growth, habitat fragmentation; high poverty index perception, overexploitation, and pollution. Also, the lack of biodiversity data has hindered conservation efforts, making it almost impossible to track species extinction. Consequently, there is a need to reassess the level of Biodiversity conservation in Nigeria. Hence, the current review, therefore, investigates the current status of biodiversity, factors militating against biodiversity conservation and management in Nigeria and proffer recommendations for its sustainable Conservation

Measurement of Biodiversity

Biodiversity is a contraction of "biological diversity" and refers to the number, variety and, variability of a living organism [5,6]. It is synonymous with "life on earth" and embraces two different concepts: one is a measure of how many different living things there are and the other is the measure of how different they are. Although many definitions of biodiversity exist, the most often cited was defined on the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, when the Convention on Biological Diversity (CBD) was initiated. It is stated as follows "Biodiversity is defined as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of an ecosystem [7]. The definition recognizes the different dimensions of biodiversity genetic, species and ecosystems and how these different aspects vary over space and time. To better understand and conserve biodiversity, it is important to identify indices by which biodiversity can be measured. At present, there are 3 basic ways we can measure biodiversity, these include genetic diversity, species diversity, and ecosystem diversity.

Genetic diversity: this is the variation of the set of genes carried by different organisms: it occurs on a small scale among organisms of the same species, among closely related species such as those in the same genus, and among more distantly related species, in different families, orders, or kingdoms. It could be characterized by a range of techniques: by observation of inherited genetic traits [8,9] studying the chromosomes and their species-specific karyotype and analyzing the DNA information using molecular technology [10,11]. The number of possible combinations of gene-sequence variants in a population is so great that it cannot even be expressed in a meaningful way. This amazing variation in the genetic code offers opportunities for evolutionary change, the survival of species, adaptations to a changing environment, and the formation of new species [12,8-9] Species diversity is a function of the distribution and abundance of species. Often, species richness, which is the number of species within a region or given area, is used almost synonymously with species diversity

[13]. However, technically, species diversity includes some consideration of evenness of species abundance. In its ideal form, species richness would consist of a complete catalog of all species occurring in the area under consideration, but this is not usually possible unless it is a very small area.

Species richness measures in practice, therefore, tend to be based on samples. Such samples consist of a complete catalog of all organisms within taxa found in a particular area or of a measure of species density in a given sample plot or a numerical species richness defined as the number of species per specified number of individuals [14,15].Ecosystem diversity: is the variation in ecosystems found in a region or the variation in ecosystems over the whole planet [16]. There are several generic measures of ecosystem-level diversity, such as biogeographical realms or provinces [17], based on the distribution of species, and ecoregions or ecozones, and based on physical attributes such as soils and climate [18]. Ecological diversity is the largest scale of biodiversity, and within each ecosystem, there is a great deal of both species and genetic diversity.

Monitoring Biodiversity Loss

Recent data which indicates current annual rate of species extinction to be at least 100 to 1000 times the background rate of about 0.0001 %; amounting to extinction rate of 0.001 % to 0.1 % a year [19,20] have raised serious concerns especially for developing countries like Nigeria. In addition to local threats, deforestation and climate change have been identified as the two major drivers of species" extinction [21]. This has necessitated the need to regulate and monitor the loss of biodiversity which ultimately leads to the extinction of species, The International Union for conservation of nature (IUCN) Red list provides a tool used to assess and measure the likelihood of a species becoming extinct. The purpose of the IUCN red list is to provide information and analysis on the status, trends, and threats to species in order to inform policymakers and scientist on identifying species requiring the urgent need for protection. At present, IUCN reveals that a total of 28,338 different species, which accounts for 27% of the more than 105,000species the organization has analyzed are at risk of extinction [22]. Comparing the number of species already assessed to the total number of species yet to be assessed, only a fraction of the 1.8 million species known species have been assessed, so there is a need for more urgency of the assessment process. More so, such global assessments are likely to underestimate current high threat levels of plants and animals' species in Nigeria. Many species that make up the country's biodiversity has either been over-exploited or are victims of the many other factors that deplete biodiversity.

According to the IUCN Red list 2013 report, Nigeria has a total of 309 threatened species in the following taxonomic categories: Mammals (26), Birds (19), Reptiles (8), Amphibians (13), Fishes(60), Molluscs (1), other Invertebrates (14) and Plants (168) (FME 2015). These figures indicate a warning signal of an

impending consequence of the continuous escalation of extinction rates. There are some concerns in solely adopting the global IUCN assessment. The IUCN red list categories and criteria were developed to assess risk at the global level. Therefore, the outcome of such an assessment can either be overestimated or underestimated at the local level. It is important to understand the trend of species in different parts of its range. For instance, species with a wide range of distribution may have a low risk of becoming extinct globally and hence may be listed as Least Concern (LC) on the Red List. But it may locally be declining in parts of its range. If this trend is not recognized and reversed, the species could disappear from the locality. To mitigate this challenge, IUCN developed criteria to enable assessment at the regional and national level [23]. The guideline for applying the Red list criteria at the national and regional level are available to download from the IUCN web site: www.iucnredlist.org.

Conservation of Biodiversity

Conservation of biodiversity involves the conservation of essential ecological diversity to preserve the continuity of food chains and in so doing the genetic diversity of plants and animals is preserved. There are two major approaches to conserving biodiversity; single-species and ecosystem approach. The single-species approach involves the maintenance of the variable population of select species [24]. These select species are used as indicators of the health of the environment, the welfare of other species, the value of the protected area, and the impact of habitat alteration. The ecosystem approach involves the protection and conservation of a particular ecosystem, designated as protected areas. It encapsulates many species, enabling numerous species to bene-

fit from the conservation process [25,26]. To effectively carry out ecosystem-oriented research, key management priorities must be put in place to ensure many species benefit simultaneously. Both approaches have their own merits and limitations, however, a synergistic and complementary application of both approaches while taking cognizance of the limited resources available is recommended [27]. Basically, Biodiversity can either be conserved in-situ or by ex-situ methods.

In Situ Conservation

In situ conservation is on-site conservation or the conservation of genetic resources in natural populations of plant or animal species such as forest genetic resources in natural populations of tree species [3]. *In situ* conservation maintains not only the genetic diversity of species but also the evolutionary adaptations that enable them to adapt continually to shifting environmental conditions, such as changes in past populations and climate. It ensures that along with target species, hosts of other interlinked species are also preserved as a by-product. It is generally cheaper than ex-situ methods (although not cheap). It may often be the only conservation option, for example for species of plants with recalcitrant seeds. In Nigeria, conservation of the diversity of wildlife species is maintained at the optimum level commensurate with other forms of land use in order to ensure the continued existence of wildlife for the purpose of their sustainable utilization for benefit of the people [28]. The natural tranquility of these protected areas along with communities of animals and birds in them, combine to make each a niche destination [29]. National parks, forest reserves, and sacred grooves constitute the major hallmark of *In situ* conservation of biodiversity in Nigeria (Table 1).

Table 1: Categories of Organisms and Their Recorded Number of Species in Nigeria (FME 2015).

Group	No of Species
Mammals	274
Birds	941
Amphibians	109
Reptiles	135
Fish	338
Orchids	145
Algae	1335
Lichens	17
Fungi	134
Mosses	16
Liverworts	6
Pteridophytes	165
Gymnosperms	5
Flowering plants	5209

National Parks

Nigeria has a total of 8 National Parks, covering 20,156 km², or about 3% of Nigeria's total land area [28]. These conserved areas

are monitored by the Federal Government of Nigeria, under the jurisdiction of the Nigeria National Park Service (NNPS). National parks play a vital role in the conservation of Nigeria's wildlife,

housing an abundant diversity of wild faunas like buffaloes, roan antelopes, chimpanzees, crocodiles, hippopotamuses, hyenas, giant forest hogs, lions and leopards, as well as flora. These animals and plants found to occur in different numbers within the country's vegetation that ranges from the mangrove along the coast in the south to the Sahel in the North1. It is worthy to note that the strict method of operations by the park staff has ensured some level of protection of the national parks and the species therein.

In addition to performing conservation activities, the national parks offer local and international visitors the best opportunities to sample Nigeria's natural habitats as well as biodiversity. Also, it has enabled researchers to carryout fieldwork in a natural ecosystem devoid of negative external factors. National Parks have been invaluable in boosting the country's lucrative tourism sector [30] (Table 2).

Table 2: Size, Locations and Period of Establishment of National Parks in Nigeria.

Rank	National Park	Geographic Area km^2	Established	Coordinates	Location [State(s)]
1	Gashaka Gumti	6,731	1991	7.5424°N, 11.6158°E	Taraba, Adamawa
2	Kainji	5382	1979	10.3683°N, 4.5547°E	Niger, Kwara
3	Cross River	4,000	1991	5.5804°N, 8.7483°E	Cross River
4	Old Oyo	2,512	1991	8.3781°N, 3.8248°E	Oyo, Kwara
5	Chad Basin	2,258	1991	11.7426°N, 14.0349°E	Borno, Yobe
6	Yankari	2,244	1962	9.8543°N, 10.3030°E	Bauchi
7	Kamuku	71,121	1999	10.7500°N, 6.5000°E	Kaduna

Forest Reserves

Forest reserves are portions of lands, controlled by the state government, where commercial harvesting of wood products is prohibited in order to capture elements of biodiversity that can be missing from sustainably harvested sites. Initially, the system was designed in a way that deforestation rates due to logging activities are balanced with a recurrent afforestation plan. But a different scenario exists. A significant portion of various forest reserves in Nigeria has been converted to farmlands. Forest reserves in Nigeria are in great danger as an increase in population and an economic activity has brought about an uncontrolled mass encroachment into these protected sites (Table 3).

Table 3: Size and location of Forest Reserves in Nigeria.

Rank	Forest	Reserve Geographic area Km^2	Coordinates	Location (State)
1	Oluwa	829 6.8230°N	4.6738°E	Ondo
2	Idanre	561 6.8577°N	5.1055°E	Ondo
3	Afi	312 6.1980°N	8.9766°E	Cross River
4	Okeluse	144 6.7893°N	5.6908°E	Ondo
5	Ise	142 7.3841°N	5.3804°E	Ekiti
6	Edumanom	93 4.4150° N	6.4502°E	Bayelsa
7	Oba Hills	52 7.7500°N	4.1166°E	Osun
8	Ngel Nyaki	46 7.0833°N	11.0666°E	Taraba
9	Omo	1,305 6.8500°N	4.3800°E	Ogun
10	Shasha	7.0858°N	4.5000°E	Ogun

Sacred Groves

According to the IUCN guideline on protected area management categories, sacred groves are considered as Sacred Natural Sites. They are relics forest patches preserved in the name of religion and culture [30]. Sacred groves comprise stands of trees that are of special religious importance to a particular culture and based on its relevance, the conservation of species in the grove is guaranteed. Scared groves are well distributed among various cultures in Nigeria owing to the fact that a preponderance of the Nigerian population still practices traditional religion. For example, The Osun-Osogbo sacred grove, Osun State, a registered UNESCO World Heritage Site, is highly revered by the local people and in so doing help to protect and conserve the biotic species that are inherent in it.

Ex-situ Conservation in Nigeria

Ex-situ conservation entails protecting an endangered species of plant or animal outside its natural habitat, through colony relocation where part of the population is taken to a less threatened location or human care methods such as zoos and botanical gardens. *Ex-situ* conservation, while helpful in man's efforts to sustain and protect our environment, is rarely enough to save a species from extinction. It is to be used as a last resort or as a supplement to in-situ conservation because it cannot recreate the habitat as a

whole: the entire genetic variation of a species, its symbiotic counterparts, or those elements which, over time, might help a species adapt to its changing surroundings.

Home Gardens

A home garden is an agricultural production system that involves the cultivation of a small portion of land which may be around the household or within walking distance from the family home. Home gardens are normally located adjacent to homes, close association with family activities and a wide diversity of crop and livestock species to meet family needs. In the rural parts of Nigeria, Home gardens play a central role in household security for food, fuel, fibre, materials, and even land ownership. However, in the urban environment, population pressures and increased demand for housing has reduced the potentially available lands required for home garden cultivation. The practice of home garden system has contributed immensely to the stability and sustainability of the ecosystem especially in the rural parts of Nigeria, where home gardens are a customary practice. It offers a steady harvest of fresh produce all year round, with low input and high output. In addition to biodiversity conservation [31,32] home gardens could also serve as important sites for on-farm experiments [33]. According to [34] home garden system habours the greatest species diversity in mixed culture.

Seed Banks

Seed banks are ex-situ storage facilities use to store seeds in order to forestall the loss of genetic diversity in rare and threatened plant species [35] (Table 4). In seed bank, seed collections are stored at constant low temperature and low moisture to guard against loss of genetic resources that are otherwise maintained in situ or in field collections, which could be damaged by diseases outbreaks or as a result of any other natural disasters. There are different methods used for seed storage based on tolerance to low temperature and dry environment, hence, seeds are further divided into storable (orthodox) and non-storable (recalcitrant). The orthodox types include small-seeded grains crops and vegetables. They can be stored for a long time under low-temperature and low humidity environment. This storage could be done on a long, medium or short-term period in accordance to the purpose of storage and the viability of the germ plam are important. The recalcitrant type is classified as non-storable and therefore cannot be stored under low temperature and humidity conditions, examples are certain vegetables, cocoa, mango and so on. Such seeds may be stored in low temperature ranges ($0 – 10^0C$) for short periods such as 1-5 years [36]. Research institutes in Nigeria such as International Institute of Tropical Agriculture (IITA), National Centre for Genetic Resources and Biotechnology (NACGRAB), and National Horticultural Research Institute (NHRI), are directly involved in germplasm collections, storage, and preservation. Over 25,000 accessions of major seed crops (Cowpea, soya bean, Bambara groundnut, maize, African yam beans, and miscellaneous Legumes) persevere in these facilities. These collections are made available for plant breeders and researchers for crop improvement and food security.

Table 4: Some Selected Threatened Plant Species in Nigeria and Their Main Uses.

Species	Main uses	Threat status
Cassia nigricans	Medicine	Endangered
Cola nigerica	Medicine	Endangered
Diospyros mespiliformis	Carving	Endangered
Hymenocardia acida	General	Endangered
Kigelia africana	General	Endangered
Mansonia altissima	Timber	Endangered
Milicia excelsa	Timber	Near Threatened
Nesogordonia papaverifera	Medicine	Endangered
Nigella sativa	Medicine	Endangered
Okoubaka aubrevillei	Medicine	Endangered
Tieghemella heckelii	Medicine	Endangered
Triplochiduiton scleroxylon	Timber	Endangered

Botanical and Zoological Gardens

Living collections of plant and animal species are housed in botanical and zoological gardens respectively. There is approximately a total of 16 botanical gardens in Nigeria with an approximate 10, 000 - 20, 000 living plant accession. In addition, there are several notable zoological gardens in Nigeria, namely Abuja Zoo Abuja, Audu bako zoo, Kano; Enugu zoo, Enugu; Ibadan University zoo, Ibadan; Jos Wildlife Park, Jos; Port Harcourt zoo, Port Harcourt, Ogba zoo, Benin; Sanda kyarimi zoo, Maiduguri. Botanic and Zoological gardens do not only conservation of the living specimens of plants and animals' species, but they also serve as resort centers for Nigerians and foreign tourists, thereby generating income for the country and also aid to decrease unemployment (Table 5).

Table 5: Some Selected Threatened Fauna and Their Uses.

Species	Main Uses	Threat Status
Crocodylus nilotitus	Food/Medicine/Leather	Endangered
Osteolaemus tetraspis	Food/Medicine	Endangered
Psittacus erithacus	Medicine	Endangered
Cercopithecus erythrogaster	Medicine	Endangered
Loxodonta africana	Food (Ivory)	Endangered
Trichecus senegalensis	Food/Medicine	Endangered
Giraffa camelopedalus	Food	Endangered
Python sabae	Bay	Endangered
Struthio camelus	Food/Medicine	Endangered
Gazela dorcas	Food	Endangered

Why Conserve Biodiversity?

From an anthropocentric point of view, humans should only be concerned about biodiversity conservation because of the direct benefits it provides us. In addition to these direct benefits, biodiversity provides much more, including ecosystem services, social and spiritual benefits as well. Biological Resources Biological resources are those products that we harvest from nature. These resources fall into several categories: food, medicine, fibers, wood products, and more. For example, over 7,000 species of plants are used for food, although we rely heavily on only 12 major food crops. A significant part of population in Nigeria, especially those in the rural areas depend on plants for medicine [37]. For example, Alstonia boonei, Morinda Lucida, and Enantia chlorantha are used to cure Malaria In the developed world, where synthetic drugs use predominates, such medicines originally produced from formulas derived from plants. Fibers for clothing, ropes, sacking, webbing, netting, and other materials are provided by a large number of plants, including cotton plants, flax plants (linen), hemp (cordage and sail canvas), Agave plants (sisal), Corchorus plants (jute), bamboo and palms. Trees provide wood products used in making homes, furniture, and paper products. In addition, living organisms provide inspiration for engineers seeking better and more efficient products. The field known as Biomimicry is the study of natural products that provide solutions to human needs. For example, shark skin provided the model for hydrodynamic swimming suits. The glue used by Sandcastle worms (Phragmatopoma californica) to cement together their sand particle shells was the inspiration for the glue that mends fractured bones in the aqueous internal environment of the body.

Ecosystem Services

Ecosystem services are processes provided by nature that support human life. These services include the decomposition of waste, pollination, water purification, moderation of floods, and renewal of soil fertility. Often time, these ecosystem processes are often overlooked and are not valued as part of the economy. When the economic value is assigned to these services, it is often startlingly high. For example, insect pollinators help produce many commercially important fruits such as almonds, melons, blueberries, and apples. The global economic value of pollination services performed by insects has been valued at $217 billion per year 39.

Social and Spiritual Benefits Throughout most of human history, conservation has involved protecting nature for the spiritual gifts it provides and protecting sacred places in the local landscape. Stories of indigenous people incorporate detailed knowledge of the animals and plants that make up their world. The heterogeneity of the world's mythology, folk art, and folk dances show the effects of biodiversity on cultural development and contribute to the richness of global arts and literature. Different cultures developed in different landscapes that influenced activities, occupations, diet, language, and architectures.

Intrinsic Value

Biodiversity has an intrinsic value that is worth protecting regardless of its value to humans. The first argument for the intrinsic value of biodiversity is the idea that humans are part of nature. The argument for conservation of biodiversity often emphasizes the need to facilitate the continued evolution of evolution as humans are and were part of nature, they benefited from the evolutionary process. The tenet that humans are part of nature questions whether humans should endanger their own milieu and the process from which they stem. Major Causes of Biodiversity Loss in Nigeria Although biodiversity, in essence, has to do with genes, species, and ecosystems, it is also related to issues far beyond the confines of biology. Understanding the threats to biodiversity and offering solutions to them necessitates insights from the socio-economic and applied sciences. The effectiveness and success of protection in any part of the world normally depends on many local factors of economic, social and political nature [38]. Some of the main factors militating against biodiversity conservation in Nigeria include:

Population Growth

Population is recognized as an indirect driver of biodiversity loss, as human demands for bioresources, such as food and fuel

play a key role in driving biodiversity degradation. It exacerbates every other factor having an impact on the ecosystem [39]. The Nigeria National Bureau of Statistics, 2012, estimated the population of the citizens in Nigeria to average around 166.2 million people and it is projected that by 2050, the population of Nigeria is expected to surpass that of the US; thereby making it the world's third most populous [40].The high rate of population increase in Nigeria has led to an unceasing search for more arable land for food production and livestock grazing, and for wood for fuel, construction, and energy. Humans have tended to settle in areas of high biodiversity, which often have relatively rich soils and other attractions for human activities. This constitutes a great threat to biodiversity, especially since many of these areas have numerous endemic species [41]. The consequence of such high population pressure has resulted in the high intensity of logging, poaching, illegal exploitation, agricultural expansion and collection of fuel wood has continued to pose serious threats to the country's forest resources [42].

Habitat Fragmentation

Habitat fragmentation refers to the discontinuity or „break down" of large contiguous habitats into smaller, isolated patches of habitats. The consequences of such fragmentation impact negatively on the species interactions, community structure and the general ecosystem of those fragments. Habitat fragmentation is currently the main threat to terrestrial biodiversity. When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines. In Nigeria, habitat degradation or forest degradation occurs in an immeasurable and uncontrollable rate. Government agencies saddled with the responsibility of checking these menaces are either complacent or are simply just corrupt.

Introduction of Alien Invasive Species

According to IUCN definition of „alien species": An alien species is a species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity [22]. These species can cause damage to the environment by modifying ecosystem processes which could potentially lead to the extinction of native species. A species is invasive if it can successfully establish and spread to new habitats after its introduction, seemingly without further assistance from humans. Invasive species can spread into new areas already occupied by native flora and displace those species [43]. Such invasions from the intentional or Unintentional transport of plants to new regions now seriously threaten the Biodiversity, structure, and function of many of the world's ecosystems the problems caused by invasive species have potentially large economic consequences. Threats from invasive alien species include direct predation of native wildlife, competition for resources and ecosystem damage (e.g. through the removal of a key species such as a pollinator). Apart from the impact on wildlife, invasive species can have a huge economic impact if they target commercial crop species, or indirectly influence them through effects such as soil destabilization [44]. The problems that invasive alien species cause have been shown to cost the global economy hundreds of billions of dollars a year and the environmental harm caused is considered one of the greatest threats to the ecological well-being of the planet [45]. In Nigeria, much work needs to prevent and control the impact of invasive alien species. Preliminary studies to ascertain the number of alien species competing with the native species of plants in Nigeria is a major prerequisite to controlling the occurrence of invasive alien species.

Poverty

Poverty remains a big threat to Biodiversity conservation in Nigeria. When people who reside in a rural environment which harbors a large chunk of its biodiversity, are extremely poor, Biodiversity becomes their resort [45] reported a significant direct relationship between poverty and environmental degradation. The potentials for Nigeria to become one of the leading economies in the world is not in dispute. This is so due to the abundant human capital and natural resources the country is blessed with. But it is shocking to note that, the reality conveys the opposite. Nigeria has overtaken India as the country with the largest number of people living in extreme poverty, with an estimated 87 million Nigerians, or around half of the country's population, thought to be living on less than $1.90 a day. Therefore, in order to ensure a proper system of biodiversity conservation, the level of poverty needs to be reduced.

Over-Exploitation

According to the National Biodiversity Strategy and Action Plan, more than 80 % of forest cover in Nigeria has been lost since 1990, with only 5.04 % now remaining [46]. Most protected areas lack adequate protection because illegal logging, encroachment by farmers and cattle herders, firewood gatherers and poaching still continue in most areas. Large areas of the natural forests are being exploited for tree species such as the mahoganies, *Nauclea diderrichii* (opepe), *Terminalia ivorensis* (Odigbo), *Terminalia superba*, (Afara), *Triplochiton sceleroxylon* (Obeche) and others known in the international market. High intensity of logging and illegal exploitation of these and other species has continued to pose serious threats to the country's forest resources (FME, 2015). Other Lesser-known causes of overexploitation of forest resources are due to "knock-on" effects which occur when species that are co-evolved with another, such as plants with specialized insect.

Pollinators. A negative impact on one of such species will have a negative ripple effect on the other go. For example, Moabi (*Baillonella toxisperma*) used to be a common tree in West-Africa. The fruits are eaten, cooking oil is extracted from the seeds (karite) and the bark is used for medicinal purposes. For its reproduction, the plant depends on the gastrointestinal tract of elephants to disperse and help initiate germination of the Moabi seeds. The

impressive reduction of elephants has impacted negatively on the distribution of Moabi. The locals in some instances have rendered little assistance to conserving species especially the very rare ones. Recently, some local inhabitants of the Brass community, Bayelsa State, Nigeria, butchering a stranded whale on the sea-shore, believing it was God-sent [46] (Figure 1).

Figure 1: Indigenes of Brass Community in Balyelsa State Devouring a Whale.

Genetic Erosion

The use of improved varieties of crops and complete neglect of local varieties and the landraces lead to loss of biodiversity. Farmers now rely on a few high yielding varieties of a plant at the expense of maintaining previously available genetic diversity. As a result, this, many local varieties of plants have been lost-the use of improved dwarf okra (*Abelmoschus esculentus*) in the place of the native material of the tall okra. Some other the local plant varieties like sword bean (*Canavalia ensiformis*), African yam bean (*Sphenostylis stenocarpa*) and lima beans (*Phaseolus lunatus*) are now becoming extremely rare as only improved cowpea (*Vigna unguiculata*) is being cultivated in many farms. Similarly, *Dioscorea dumetorum*, *Dioscorea bulbfera*, *Trichosanthu*s species (Snake tomato) and Digitaria exiles are no longer in popular cultivation as they were replaced by commercially driven improved varieties thereby causing the loss of important gene resources of all the above plant species [47].

Pollution

The production of toxic chemicals in the environment constitutes a major threat to biodiversity worldwide. Humans have been the major culprit of environmental pollution. Emissions from refineries through gas flaring, industrial processes, plastic waste, burning of liquid and solid waste, oil spillage, Pesticides and inorganic fertilizers from agricultural activities are released into the air, soil and water. And because some of these released chemicals do not degrade easily, they accumulate to a toxic level and affect organisms at the different levels of the food chain. This results in disruption of the ecosystem, affecting the adaptation of species [48] and ultimately resulting in species extinctions. Therefore, proper understanding the many aspects of human influences on biodiversity, and their underlying driving forces, is of crucial importance for setting priorities and counteracting the current negative trends imposed by environmental pollution [49].

Administrative Factor

In Nigeria, various factors militate are against the effective implementation of conservation policies. However, the lack of adequate data on the status of biodiversity remains a fundamental issue [50].The convention on biological diversity requires its member states to report regularly on the status of biodiversity within their countries and implement conservation actions and policies to maintain healthy populations of species within their jurisdiction. Regarding the above mandate, CBD recommends the development of Red list assessment process to effectively assess and maintain the status of species at the country level [51]. This deficiency has made it difficult to design adequate conservation programs for species facing high risks of extinction in Nigeria.

Concluding Remarks

This study has documented the status of biodiversity utilization and conservation in Nigeria. It identifies the current efforts to conserve biodiversity as well as unmask grey areas that need urgent conservation attention. The study will guide scientist, the government and other policymakers to identify and mark out more protected areas in the country and proffer urgent conservation strategies to threatened species. Thus, we advocate for a National Red List of threatened species in Nigeria [52]. To ensure sustainability biodiversity utilization and conservation, two key players must show leadership, first, the Government must integrate principles of sustainable developments into their policies and programs. Second, ecologists seek to make comprehensive data on biodiversity available for policymakers to use. This is currently lacking and there is urgent need to document accurate data that will help track the fluctuation rate of the species population. In addition, there is a need for mass awareness about the impor-

tance of biodiversity conservation, especially in rural areas, where a preponderance of our biodiversity still exists.

Conservation Programme that enables indigenous people to secure their biodiversity in order to give them a sense of belonging should be encouraged. Local people should be trained as guides and in administration, so they could run a profitable ecotourism operation. Monies realized from tourism should enable the local economy to develop, provides the incentive to maintain the habitat, and provides funds for the local health clinic and scholarships for local students. Economic activities are primarily responsible for the depletion of biodiversity and destabilize the natural system, therefore, such biodiversity depletion activities should carry financial penalties and conservation should carry financial incentives. In this way, economic activities that do not destabilize the natural system will be favored and biophysically sustainable economy will gradually develop [53]. Lastly, the majority of degree programs in economics at the undergraduate and graduate level should incorporate courses in Plant Biology and Biotechnology most especially Biodiversity and conservation. This can best enlighten future economists on the consciousness to conserve biodiversity.

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