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BIODIVERSITY AS A TOOL FOR SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT IN NIGERIA

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ABSTRACT

This article reviews the important of biodiversity in Nigeria; Nigeria is enriched with large natural resources which include non-agricultural and agricultural resources. Each resource has its own peculiarities. In agricultural resource, its role on economic growth and nation development cannot be over-emphasized. Apart from production of food crop, wildlife also plays some important roles in any nation's growth. Man has been known to be depended on plants and animals for food. A good inter-bio-relationship between animals and plants in the same ecosystem yields robust and better diversity. Nigeria has being place of high importance on biodiversity in a variety of ways. Food, raw materials, a wide range of goods and services, genetic information for agroforestry, medicines and health-care assistance, household and commercial items, aesthetics and cultural values all come from the country's biodiversity. It also delivers green ecosystem services that help to improve the environment and educate people about the natural world. Biodiversity values within Nigeria were directly tied to a diverse range of ecosystems which exist in multiple ecological zones. The use of biodiversity and the amount of protection are both influenced by different cultural varieties.

KEY WORDS

Ecosystem, biodiversity, agriculture, food, animals, Nigeria.

Biodiversity refers to the variety of life that includes all interactions between plants, animals, and microorganisms living in the same habitat. This applies to all levels and kinds of biological organization that coexist in the same environment, including genetic diversity, diversity of species, and ecological diversity (CBD, 2012). Biodiversity on the planet is a rich natural resource in terms of economics, culture, aesthetics, science, and education, providing huge monetary and non-monetary advantages to humanity (Leverington *et al.*, 2010). It also supplies essential bio resources that allow humanity to continue to survive on our planet (Aguilera 2019). The term biodiversity refers to the diversity of living creatures' species, or the number of distinct animal, plant, and microbial species present. Long-term evolution determines the species makeup of a particular environment (Pimbert, 1993). Each species has evolved to its own niche, which is defined by particular characteristics (temperature range, food availability, or light), allowing this to breed and maintain its population (Mann, 1991). The extinction of one species seems to have repercussions on many others, causing an imbalance. Any species that fills the void left by extinct species will definitely not be able to satisfy all duties it once did. When a species becomes extinct, its services to the global biosphere are irrevocably lost, and it is extinct (Mann, 1991).

Over exploitation, pollution, and habitat conversion are the greatest risks to species diversity. They result in the slow extinction of species on a local, regional, and global scale. Furthermore, introducing species into new environments disrupts natural equilibrium. It should have been obvious that the extinction of species is followed by a performance



degradation, some of which have serious consequences for human life, such as the diminution of economically exploited fish populations and soil and sediment erosion.

Ecological diversity, which explains the current variance in both terrestrial and aquatic environments, is another significant aspect of biodiversity (Purdy, 2012). This includes differences in a biological community's complexity, such as the number of various niches, trophic levels, and other ecological processes (Brenda, 2009). Ecosystem diversity includes things like deserts, forests, grasslands, wetlands, and seas. Ecological variety is the broadest scale of biodiversity, and within each ecosystem, there is a vast quantity of both species and genetic variation (Cunningham, 2015). Ecosystem diversity refers to the diversity of ecosystems within a given geographic area and their overall influence on human life and the environment (Brenda, 2009). For a multitude of reasons, ecological diversity is essential to human survival. Ecosystem approach enhances oxygen levels by enhancing photosynthesis among the habitat's plant organisms. Diversity in an aquatic setting aids in the purification of water for human use by vegetation. Plant variations expand as a result of diversity, making them useful source of medications as well as herbal products for human use. People alter the nature of biological communities by a variety of acts that increase the rates of species invasions and extinctions at all scales (Naveh, 1994). Agreements were established in the international community by the 21st century that highlighted environmental conservation as one of the top goals of sustaining and conserving biodiversity for the growth of mankind (Kolahi *et al.*, 2012). Many protected areas are also known to play key roles in preserving biodiversity with vital services supplied by natural systems, which ensure highly sustainable and balanced eco-world (Borrie *et al.*, 1998).

Nigeria is one of the world's most biologically diverse countries. The country homes have high comparative broad degrees of rich endemism and species due to the complicated topography and large diversity of habitats found in them. The Niger Delta's coastal creeks, the Cross River Basin's rainforests, and the mountains along Cameroon's border are just a few examples. There is an inland pattern of an assortment of different forest and woodland habitats that finish up in Sudan Savannah and Sahel/semi-desert zone in the northern section of the nation (Figure 1). Each ecosystem has its own wild fauna, higher and lower floral species, and a diverse collection of marine and freshwater aquatic animals. Nigeria is rich in endemic flora, with 91 species belonging to 44 groups, with *Rubiaceae* family having the most members (Borokini, 2014).

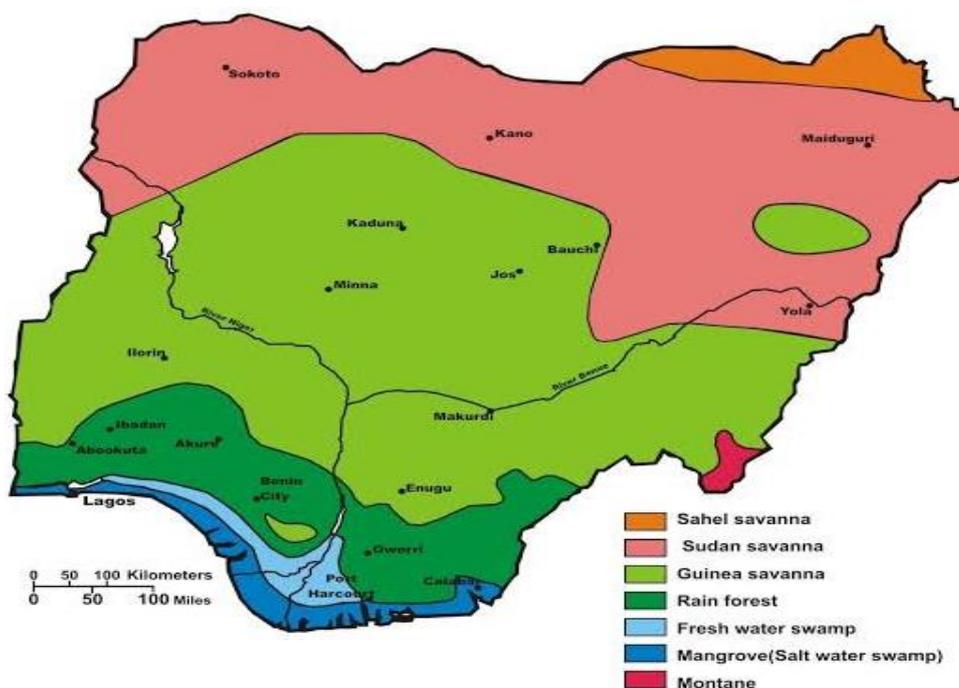


Figure 1 – Nigeria vegetation map (Source: Ibenebgu, 2018)



However, land use changes from agriculture and overgrazing, over exploitation of natural resources by extractive players, invasive species, and environmental degradation are all threatening Nigeria's biodiversity. Nigeria has a total of 7895 plant species divided into 338 families and 2215 genera (NFNB, 2001). There are around 22,000 species of vertebrates and invertebrates. There are around 20,000 insects, 1,000 birds, 1,000 fishes, 247 mammals, and 123 reptiles among these species. All of these animals and plant species are found in varying numbers across the country's vegetation, as shown in (Table 1). Majority of these variations helped to keep the country's agricultural economy afloat.

Table 1 – Nigeria Vegetation Type

S/N	Vegetation type	Name of reserve	Locations (State)
1	Guinea Savannah	Ebbazikampe, Ibi and upper Ogun	Kwara, Taraba, and Oyo
2	Rainforest	Okpara, Anambra	Oyo, Anambra
3	Lowland Rainforest	Ohosu, Ologbo, Iri-Ada-Obi, Ologbolo-Emu-Urho, Orle River, and Gilli-Gilli; Uddi/Nsukka, and Akpaka; Obudu	Edo, Anambra and Cross River
4	Mangrove/Swamp Forest	Stubbs creek	Akwa-Ibom
5	Sudan Savannah	Wase Sanctuary, wase Rock Bird Sanctuary, Pandam Wildlife Park and Pai River; Dampar Sanctuary and Nasarawa; Lama/Bura, Kogin Kano, Dagida, Alawa and Kwiambana	Plateau; Nasarawa; Bauchi; Kano, Niger and Zamfara
6	Sahel Savannah	Lake Chad	Borno

Source: NFNB (2001).

Poverty. Poverty is a basic violation of human dignity since it denies people options and chances. It refers to a person's inability to engage successfully in society on a fundamental level (Good, 1991). It includes not having enough to feed and house a family, not having a school or clinic in the town or area, not having property on which to produce one's food or a work to earn one's livelihood, and not having access to credit. Poverty involves being vulnerable to violence, and it frequently entails living in marginal or vulnerable locations with no access to safe drinking water or sanitation (Cardinale, 2012). According to the reports UNDP 2008, 2009 that high number of impoverished people lives in Nigeria. It increased from 27.2 % to 65.6 % in 1996, representing an annual growth of 8.83 % during a 16-year period. However, from 1996 and 2004, the poverty rate fell by 2.1 percent each year on average, to 54.4 percent (UNDP 2008, 2009).

Poverty, to a considerable extent, leads to a serious danger for biodiversity and, in other ways, continues to increase poverty in most rural regions. It serves as a vital connection between alleviating poverty, job creation, and long-term economic viability (WCED 1987). This demonstrates how biodiversity and poverty frequently coexist at different sizes (Fisher and Christopher, 2007). As seen in (Figure 2), the Sudan, Guinea, and Sahel savannah have higher poverty levels than the rest of the vegetation. Natural protection in ecological vegetation zones contributes to the socioeconomic growth of the areas. According to Ola-Adams *et al.*, (2004), conservation is viewed both as a restraint to development and a strategy for poverty alleviation. Many results show insufficient information to tell policymakers about the importance of conservation in a country's economic growth.

Poverty, as an underlying element of biodiversity loss can endanger species diversity in two ways. First, the rich elite drives poor to damage their own source of living for little financial return, and second, owing to deprivation, they find it impossible to secure any other alternative than eroding the fundamental base of their own long-term existence (Iment and Adebola, 2001). Biodiversity is always on the receiving end, as it is the most immediately available source of food, fiber, shelter, medicine, and limited commercial gain for rural people (Adebayo and Uyi, 2010).

Food supply and food security. Food is vital to people's everyday activities; it nourishes and aids in the growth of human bodily systems, as well as utilizing biodiversity directly (Power and Jetz, 2019, Steffen *et al.*, 2015, Bardgett and Van der Putten, 2014, Wardle, *et al.*, 2014). Vegetables, fruits, nuts, grains, meat, honey, and food additives such as food



colorants, flavorings, and preservatives are examples of nutrition (Bardgett and Wardle, 2010, Fausto *et al.*, 2018, Hill *et al.*, 2018). Only 12,500 flowering plant species are considered edible by humans, out of an estimated 300,000 species. It has long been recognized that wild food sources continue to play an important role in providing people's nutritional needs in many countries (Babigumira *et al.*, 2014, Pereira *et al.*, 2020, Jetz *et al.*, 2012, Faurby and Svenning, 2015).

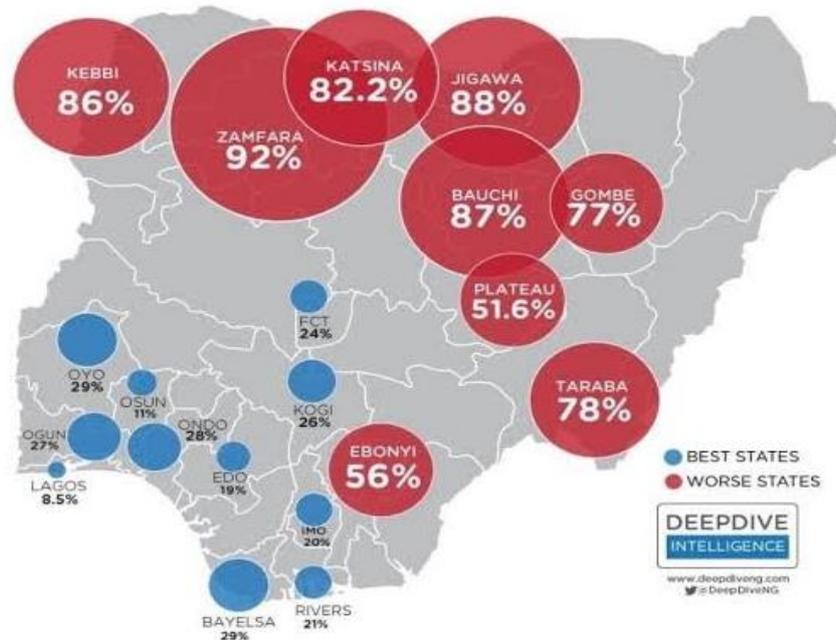


Figure 2 – Poverty rate in each State across Nigeria (Source: OPHI, 2017)

Previous research has shown that diversification protects crops from production fluctuation and ultimate crop failure (FAO, 2019). It is well known that the majority of foods consumed in industrialized nations originate from domesticated species that are heavily reliant on wild populations, with a considerable portion of it foraged from the wild (Ravenga and Mock, 2015). In comparison to general variation, the diversity of organisms exploited for food supply remains modest, leaving plenty of space for more exploitation (Roe *et al.*, 2005, Butchart *et al.*, 2010). The utilization of wild species and variations to provide genes for improved yields, tolerances, vigour, pest and disease resistance in cultivated and domesticated species, however, decreasing this gap indirectly (Hills *et al.*, 2018, Adams *et al.*, 2014). Thus, wild animal and plant species provide a vast reservoir of genetic variety, which is essential for food security (Adams *et al.*, 2014). Forests, savannah woodlands, and coastal mangroves all contribute directly to the nutrition of Nigerians living in rural communities (Usman and Adefalu, 2010). In Nigeria, biodiversity and human food are inextricably linked. Nigerians rely heavily on biodiversity for food and other supplements (Igu *et al.*, 2017). Nature has provided 70-80 percent of food for rural Nigerians, while 20-30 percent is being used to sustain the essential benefits of urban and peri-urban groups (Ajao, 2012). Bush meat, snails, periwinkles, fish, wild fruits like bush mango, edible kola, nuts, various types of vegetables, and also condiments and nutrition foods like hot leaves, various species of spices, honey from bee hives, mushrooms, and scent leaves are all examples of foods derived from the forests (Meduna *et al.*, 2009). The bush meat trade has helped many Nigerian households in rural regions by providing work for numerous men and women. The distinctiveness of Nigeria's food supply from biodiversity rests in the country's broad-based ecological variety spanning the length and breadth of the country (Nataniel and Nathaniel, 2001). The Niger Delta's coastline region, with its mangrove habitat, offers a unique range of sea-food sources. Nigeria boasts the most diverse range of swamp forest vegetables, fruits, wild nuts, and dietary supplements of any country (USAID, 2008). The tropical rainforest belt



that runs through the southern portion of Nigeria contains a great number of fruit trees that may be used for both commercial and residential purposes, as well as raw material for the wood industry. Previous research on the Okwangwo sector of Cross River National Park in northern Cross River State found the existence of 15 distinct types of seeds, 3 oil seeds, 44 different fruit types, and 25 different fungus species.

The demand for *Gnetum africanum* as a food source has outstripped the availability, affecting millions of Nigerians in the Cross River and Akwa-Ibom states. The Guinea Savannah forests of Nigeria are rich in animals and also supply a variety of unusual fruit trees and vegetables. The Sudan savannah supplies food fodder for grazing animals and is also home to a diverse range of species. The diversity of animals, plants, and trees that make up biodiversity may be valued and maintained for long-term sustainability.

Domestic and commercial products. Biodiversity provides enormous industrial value with a wide range of industrial materials or templates obtained directly from biological resources (FSIN, 2018, Wardle *et al.*, 2014, Babigumira *et al.*, 2014). Some of the building materials found in biodiversity were fibers, dyes, resins, gums, adhesives, rubber, oils and waxes, and scents (Pereira *et al.*, 2020). Herbicides, fungicides and insecticides are among agrochemicals derived from natural sources or synthesized using natural compounds as templates (Aktar *et al.*, 2009). As for food and medicine, the full potential of biodiversity for exploitation has significantly higher range of species for industrial uses, raw materials from biodiversity are tremendous, and as a result, biological resources must not be allowed becoming extinct. The bulk of rural people living in various regions of Nigeria obtained greater proportion of their income from the wild bio-resources. Biodiversity provides firm foundation for better rural life with improved economy. Many rural people mostly men and teenagers live by collecting unprocessed wild resources, while bulks of their women are involved in processing the natural resources to add value for distribution and commercialization (FEPA, 2003).

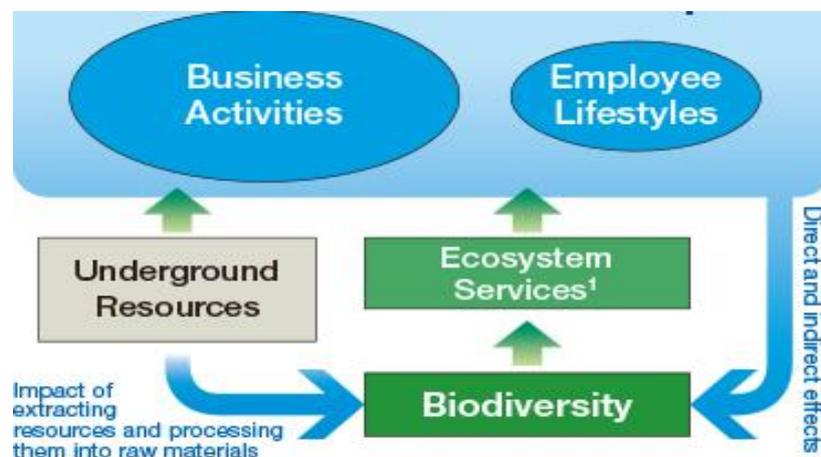


Figure 3 – Ecosystem structures and functions (Source: Epson Group Sustainability Report, 2021)

In communal ties with biodiversity, many rural Nigerians' lives may be seen in the trading and acquisition of food resources. Leaves, vegetables, ropes, seeds, fruits, nuts, gum Arabic, firewood, bamboo, rattan, chewing sticks, cattle sticks, logs, snails, bush meat, and fish) and their products (medicines, oils, fats, wines, thatches, sponges) are gotten through communal relationship with biodiversity. As reported by (FGN, 2010) that massive communal network involves in biodiversity, market exchanges and job opportunities for about 20 % of Nigeria's population living in both rural and urban areas. Wood carving, canoe construction, furniture manufacturing, basket weaving, local dye industry, honey production, fish smoking, food processing, oil palm processing, fruit processing, and herbs medicine processing are occupations involved with biodiversity in Nigeria. The domestication of both plant and animal species can benefit from genetic preservation through the assistance from the wild. Many developing countries of the world have to learn from Nigerians in relation to biodiversity as an



important source of livelihood support, and economic development of the people living in both rural and urban places.

Ecosystem functioning and ecological services. Over the time, changes occurred in ecosystem structure and functions which are often caused by biodiversity loss (Figure 3). If these changes are not well addressed, it may lead to loss or degradation of essential services, as well as having negative impact on human civilizations, aesthetic, ethical, and cultural values. Presence of natural resource scarcity for livelihood support is seen today in many Nigerian communities that formerly had an abundance of items and services for life support systems. Abundance of life and life support systems was witnessed through inter relationship with biodiversity but when human population is rapidly increasing, the significance of biodiversity in supporting ecosystem functioning is critical falling for long-term development.

Watershed protection and resource recycling. Watershed conservation is directly influenced by biodiversity. The large network of river systems, as well as its related wetlands and flood plains, rely on the continued operation of these watersheds, support a diverse range of flora and animals. The two main major rivers found in Nigeria (Niger and Benue), play a critical role in Nigeria's ecosystem and economy. The foliage of tropical crops, rocks of savannah and woods safeguards the headwaters of numerous rivers. Gallery forests provide a buffer zone of cover for water sources that support humans, animals, and cattle (Miller *et al.*, 1995). When the trees and its accompanies biodiversity elements are lost, siltation and degradation of water supplies occurs, thereby creating immense miseries for human populations, animals, and livestock. Watersheds and their associated biodiversity also play very critical roles in protecting much-needed freshwater for domestic and agricultural purposes, and providing good habitat for a diverse range of wildlife. Watershed protection also provides a better platform for nutrient circulation and resource recycling for complex ecosystem and species interaction, generic renewal, and ecosystem productivity (Nataniel and Nathaniel, 2001).

Health and traditional medicine for human welfare. The World Health Organization defines human health as a condition of entire physical, mental, and social well-being, rather than simply the absence of sickness or infirmity (Manoharachary and Nagaraju, 2016). Biodiversity, in addition supply nutrition which performs direct and indirect responsibilities in sustaining the health of the human population (Johnson *et al.*, 2013). There are two key ways in which biodiversity might help impoverished people manage their health risks (Christian, 2021). The first is related to biodiversity's role in reducing the risk of infectious illnesses, while the second is related to biodiversity's role as a source of accessible medical regimens that are not only curative but also preventative, hence lowering health risks (Diaz *et al.*, 2019). For decades, biodiversity had benefited millions of Nigerians in meeting their health need and requirements. Traditional medicine uses plants which are mostly found in the wild. This practice has recently received formal acknowledgment and attention for health improvement (Diaz *et al.*, 2006). Biodiversity minimizes the danger of spreading illnesses within an ecosystem and among its human populations, as well as the chances of invasive diseases entering the system (Sandifier *et al.*, 2015). Almost every local community has vast collections of plants and animals for treatment of various ailments. Plants and animals provide helps and solutions to many health-related problems associated to reproduction system services such as prenatal care, birthing, anti-infection medicines, and sexual drive enhancement (Wittebolle *et al.*, 2009). Hundreds of different kinds of plants are useful for healing various ailments in different locations in Nigeria (Will *et al.*, 2012). As a result, trading in medicinal plants and animal parts has expanded. Today, traditional medicine practice has constitutes a major category of commodities at local markets in rural and peri-urban areas. Recently, people are now becoming more reliant on herbs, animal parts, fruits and other natural resources. It has now being shown that conservation and sustainable management of biodiversity is critical to ensure better health delivery to millions of Nigerians (Kala, 2017). Domestication of these therapeutic plants and animals are currently being attempted in various places like homes, research institutes, tertiary institutions and Non-governmental organisations in Nigeria. The country has being able to achieve results through the



involvement of research institution like National Agency for Genetic Resources and Biotechnology (NAGRAB) and Forestry Research Institute of Nigeria (FRIN), these institutes have preserve key genetic biodiversity resources in Nigeria. The National Institute for Pharmaceutical Research and Development also has accurate information on the medicinal and patent worth of Nigeria's plant resources. Apart from direct use of biodiversity in traditional medicine, diversity likewise contributes ecosystem services such as environment welfare activities with biological scavengers and decomposers (Figure 4).

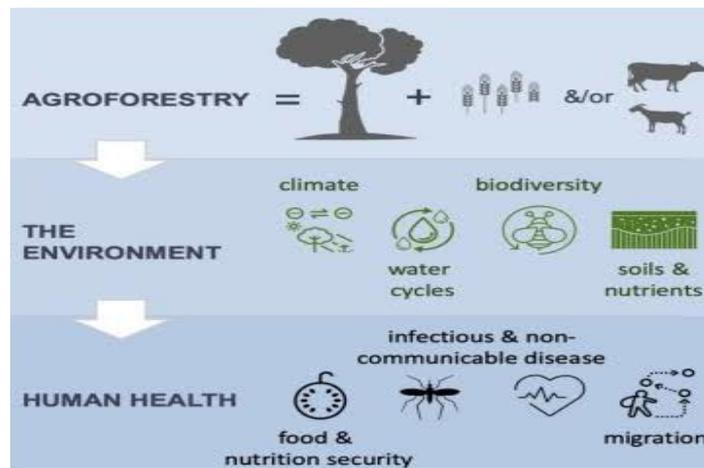


Figure 4 – Ecosystem to biodiversity and health delivery (Source: FAO, 2020)

Culture, heritage, arts and crafts

Many ethnic groups found in Nigeria have their own traditions and expertise employed to interact with the environment. It has been seen that conservation of natural environments and species is crucial to Nigerian cultures. Biodiversity plays vital resource endowment for Nigerian cultures. The two worlds of culture, heritage and biodiversity are inextricably linked in Nigeria. The lifestyles, customs, and conventions of Nigerians, as well as the arts, crafts, music, and folklore reflects the ecosystem and natural resources found in each group and culture. As an example, the Niger Delta's, Ijaws, Itsekiris, and Ilajes, are found in the riverine areas and the people are comfortable with coastal environments. They swim, make canoes, do fishing, compete in water regattas, and prepare seafood. Another example is the people living in the Lake Superior, an inland body of water such people are in the Benue flood plains and around Lake Kainji, Hadejia-Nguru lake, Lake Chad, and Oguta Lake. The Benue flood plains are experienced with freshwater fishing, freshwater fish processing, and water resource management (Nigeria Biodiversity Report, 2014).

Recently, several regions in Nigeria gives significant attention during ancient times to areas with high conservation of biodiversity in support of worship, availability of vital herbs, and consultation with deities. Some tribes still have fetish and holy forests where spiritual consultations and harvest of plants for traditional medicines are made for the benefit of the community. The inter relationship of biodiversity with culture, and natural heritage intertwined in Nigeria to gained international acclamation, Osun-Osogbo forest in Osun State has being designated as a UNESCO World Heritage Site. The link between culture and biodiversity has also aided in the conservation of some endangered animal species, such as the *Sclaters guenon* (*Cercopithecus sclateri*), which can be found not only in the wild of Taylor Creek and Stubbs Creek forest reserves, but also in holy woods found in Akpugoeze community in Anambra State and Langwa community in Imo State (Onyekwelu *et al.*, 2008).

Ecotourism and aesthetic values. Tourism and aesthetic resources are part of the benefit of biodiversity places such as coastal sandy beaches, barrier islands, sparkling landscapes; biodiversity hotspots, incredible cultural variety, and pleasant temperature are among Nigeria's natural resources (William *et al.*, 2020). Nigeria's diverse ecosystems make it potentially high-tourism destination. In recent times, there has been some favourable



emphasis given to the benefits of biodiversity for tourism. The world renowned mountain race has began and held in Nigeria's Obudu Plateau in recognition of the Plateau's distinctive topography and semi-temperate climate. The Arugungu Fishing Festival is also a popular tourist attraction in Nigeria, and the Hadejia Nguru Wetlands in northern part of Nigeria. Many notable sites in Nigeria has huge potential for receiving millions of migratory birds, that could provide huge resource for seasonal bird watching if well developed (Crawley, 1997). However, owing to social instability, aging infrastructure, corruption, and poor policies has made social and environmental insignificance of these resources, Nigeria has not being receiving much tourism attention. Nigeria is known to be home of famous big animals like Cross River gorilla (*Gorilla diehli*), African elephant (*Loxadonta africana*), lion (*Panthera leo*), and Nigerian-Cameroon chimpanzee. The nation is also a center for primate variety; it is among the highest in Africa for avian richness with a record of 940 species. Surprisingly, Nigeria's incredible biodiversity is little known to the world and even areas like the Niger Delta are understudied and underappreciated (Hillebrand, 2004).

Research and scientific knowledge for development. Nigeria's biodiversity provides inspiration for knowledge, tourism, and enjoyment; it also supports scientific and educational endeavours. Much of Nigeria's significant biodiversity hotspots play home to some of the world's most endangered primates, while many areas are still understudied. Biodiversity provides an outdoor laboratory for researchers as well as limitless opportunities for study in areas such as medical, biotechnology, pest control and management, and ethnography. Nigeria's biodiversity is chronically under-researched and under-documented; this attributes make the contribution of biodiversity to scientific knowledge and sustainable national development falls well short of its inherent potential.

Job creation and occupation. Biodiversity play a major role in job creation in Nigeria. Jobs such as farming, fishing, logging, livestock raising, agricultural and forest resources selling, sawmilling and wood processing, manufacturing in areas like paper making, perfume mixing, food processing, brewery, distilling, garment and shoe making employs more than 65 percents of Nigerians (CBD, 2015). Hunting and gathering is still a popular partime job in the rural regions, while the wood-based industries employ tens of thousands of people directly and indirectly. Most commercial and industrial investments have biodiversity-related activities, oil palm and rubber estates, gum Arabic, kola nut, cocoa and forest plantations, tobacco manufacturing firms, horticulture and commercial fruit tree ventures are biodiversity activities that provide jobs for Nigerians.

Climate change mitigation and adaptation. Biodiversity's importance in global warming has been recognized in Nigeria, although it is not handled comprehensively. Climate change mitigation and adaptation policies in Nigeria need to be improved. Global warming policies and interventions should make a concerted effort to improve biodiversity' adaptive capability. The concept of ecosystem-based adaptation actions for climate change mitigation and adaptation in Nigeria would ensure ecosystem health and optimal contribution to sustainable development. According to the report of National Adaptation Strategy and Plan of Action for Climate Change in Nigeria (NASPA-CCN, 2011) stated that climate change is already having a substantial influence on Nigeria. This report also stated that effect of Climate change may cost Nigeria lost of GDP between 2 % and 11 % by 2020, and if no adaptation is made to climate change, further loss in GDP between 6 % to 30 % will be witnessed by 2050. Climate change is projected to amplify the negative effects of human pressure on biodiversity. This will reduce biodiversity' ability to provide ecosystem services and may result in the invasion of unusual species that are favoured by climate change.

Conclusion. Based on the information provided in this article, it is therefore advice that:

1. Over exploitation of biodiversity must be avoided. Government policy should ensure that the execution of conservation legislation and penalty strictly adherent. Economic activities in the forest should be minimized to avoid primary cause of biodiversity loss and destabilization of the natural ecosystem;
2. Violators of biodiversity loss should be penalized financially and conservation should be rewarded financially;



3. Forest policy should compel rural residents to exercise conservation in order to maintain the biodiversity's long-term viability. This exercise will give the future graduates to be well informed on the importance of biodiversity conservation thereby creating more jobs for the people;
4. Through forestry extension services, sufficient knowledge and adequate information will be known on effects of over-exploitation of biodiversity to the environment and ecosystem;
5. Rural residents should be taught as tour/forest guides with adequate administration to manage a viable ecotourism estate and business. Additionally, revenue generated from ecotourism business should be diverted back to the community to help in the growth of local economy;
6. The government or other international bodies should give an incentive for protecting of the biodiversity hotspots and financial aids should be given to the community to improve their social amenities like medical centre while grants or scholarships should also be given to their children to boost the interest of the rural dwellers to conservation;
7. Based on the information gathered from this article, it is crucial to emphasize that the majority of industrial biodiversity applications have greatly contributed to the deterioration of the earth's biological resources and efforts must be intensified to maintain and manage the resources from being extinction.

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