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CHALLENGES TO VALUATION OF BIODIVERSITY AND THE WAY FORWARD A CASE STUDY OF ADAMAWA STATE, NIGERIA

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Abstract
The study was conducted to investigate the Challenges to valuation of Biodiversity in Adamawa State and the way forward. Data collection involved the use of multi-stage technique and random sampling method. It was conducted in the three ecological zones of the state (southern guinea, northern guinea and Sudan Savanah zones). Being a purposive study, 210 respondents were selected from the 7 randomly selected Local government area in the state. Structured questionnaires were used to obtain primary data while journal, proceedings, text, brochure and manuals were used to elicit information for secondary data. The Data generated were analyzed using descriptive statistics such as, tables, mean, percentages and charts. The result on challenges to valuation of biodiversity were as follows indicated by the respondents. complexity of the ecosystem top the list with 21.9 % of the respondents followed by government attitude towards conservation with 18.3 % then anthropological activities 16.6 %, data limitation 12.3 %, missing market 10.1 %, early stage of valuation 7.2 %, budget constraint 5.0 %, population growth 4.1 %, poverty 3.1 % and the least is human-wildlife conflict at 1.4 %. The anthropological activities detrimental to the conservation of biodiversity in the state according to respondents were as follows: hunting (26.4 %), farming (18.3 %), logging (14.0 %), grazing (9.8 %), wildfire (8.0 %), settlement (5.2 %), poverty (4.7 %), population increase (4.2 %), insecurity (3.2 %), infrastructure (2.7 %), fishing (2.4 %) and invasive species (1.2 %). The study recommended that, local communities should be trained to acquire skills in areas such as craft making, motor mechanic, carpentry, mason, modern agricultural practices etc. as a sustainable means of livelihood. Adequate policy and institutional frame work should be put in place for the purpose of management and conservation of biodiversity at the grass root. Implement community conservation education programs to strengthen outreach and education campaigns targeting all age groups and literacy levels to promote conservation ethics and ecological knowledge. There should be international cooperation in enhancing domestic capacities because most expertise in valuation are located in developed countries. Further studies for the development of appropriate models for valuation of biodiversity in the state and Nigeria at large should be carried out without delay.

Keywords: Challenges, valuation, biodiversity, ecosystem, extinction

Introduction

Biodiversity is the variety of all life forms, the different plants, animals and micro-organisms their genes and the ecosystem of which they are part. It is not static but constantly changing. The concept emphasizes the interrelatedness of the biological world. It covers the terrestrial, marine and other aquatic environments (Nunes and Van den berg 2010). The authors further stated that Biodiversity can be classified at four levels as follows. Genetic diversity: the variation in the information represented by the gene of individual plants and animals; Species diversity: the variety within and between species, subspecies and population; Ecosystem diversity: the variety of communities of plants and animals within particular habitats at scale ranging from individual habitat to landscapes and bioregions; Functional diversity: The range of functions generated by ecosystems including ecosystem life support functions such as regulating water, carbon cycle and photosynthesis.

The term *value* is used in various ways across different academic disciplines. Jacobsen and Hanley (2019) identified three primary types of value: exchange value, which refers to the relative price

of a good or service in the market; utility, which describes the use value of a good or service, which can be substantially different from its market price (for example, water, despite its low market price, has a very high utility value, while diamonds, often expensive, may hold low practical utility for many); and importance, which refers to the emotional or intrinsic value people assign to a good or service. This can include experiences such as the emotional or spiritual connection some people feel when viewing wildlife or natural landscapes, as well as ethical considerations regarding the *existence value* of biodiversity—its inherent worth, independent of human use (Tisdell, 2021).

Understanding the diverse ways in which biodiversity contributes to human welfare and ecological balance is crucial for effective conservation and economic valuation. As the recognition of these contributions grows, there is increasing interest in valuing biodiversity not only as a resource for consumption but also as a key component of tourism and cultural heritage. Economic valuation plays a pivotal role in creating markets for biodiversity conservation and ecosystem services, such as through mechanisms like payments for ecosystem services (Engel *et al*., 2019). The process of market creation involves three key stages: demonstration of values, appropriation of values, and sharing the benefits from conservation (Kontoleon and Pascual, 2014). Demonstration entails identifying and measuring the flow of ecosystem services and their values, highlighting the importance of biodiversity, which is often undervalued in traditional markets. Appropriation involves capturing these values and internalizing them into market systems, potentially correcting market failures or creating new markets, such as carbon credit markets. Finally, benefit-sharing mechanisms ensure that the rewards from ecosystem services are fairly distributed to those who bear the costs of conservation, such as local communities or landowners (Rowcroft *et al*., 2017; Bateman *et al*., 2015; Lantz and Slanny, 2016).

Economics, which focuses on the allocation of limited resources, relies on valuation to provide essential information about the scarcity of resources, including biodiversity and ecosystem services. These resources reflect society's willingness to trade off certain benefits to conserve them (Lantz and Slanny, 2016). Without proper valuation, the value of ecosystems and biodiversity may be overlooked, leading to their degradation and the associated social costs. Economic valuation helps policymakers understand that these resources are finite, and their depletion can result in significant community costs if not properly accounted for in decision-making (Barbier *et al*., 2019). Environmental economists have expanded demand theory to include goods not traded in markets, such as ecosystem services, which are often considered public goods—goods that are non-excludable and, therefore, do not develop market prices, making their value largely invisible in traditional economic frameworks (Aylward, 2016).

The absence of market prices for ecosystem services and biodiversity can distort public decision-making and the allocation of funds, especially when the impacts of government actions on these resources are not properly considered (Postel and Thompson, 2018). This can lead to inefficient policies that fail to protect these vital resources. Philip and Macmillan (2015) highlight several reasons for conducting valuation studies, including the lack of formal markets for many ecosystem services, the presence of imperfect markets, and the failure of existing markets to capture the full value of these resources. Valuation studies are also crucial for understanding alternatives and assessing future uncertainties in supply and demand. Additionally, these studies help governments design more effective conservation programs and enable natural resource accounting methods, such as Net Present Value

(NPV), to better evaluate long-term benefits and costs. The challenge of valuing biodiversity becomes evident in rural economies where biodiversity provides critical resources for survival. Biodiversity plays a significant role in providing food through hunting, bush meat consumption, and other cultural practices. Furthermore, biodiversity contributes to income generation through tourism and ecosystem services. In these rural areas, where economic opportunities may be limited, wildlife is a crucial component of local livelihoods (Karanth *et al*., 2018; Naughton-Treves *et al*., 2017). Valuation techniques attempt to quantify the benefits provided by biodiversity and ecosystems, which often remain unaccounted for in traditional market-based economic systems. These benefits extend beyond direct consumption (e.g., bushmeat trade) to the provisioning of ecosystem services such as pollination, water purification, and carbon sequestration. By placing an economic value on these services, valuation studies provide essential data that can guide policy decisions and create market-based incentives for biodiversity conservation (TEEB, 2010; Costanza *et al*., 2017). Various methods are employed in the economic valuation of biodiversity, including market-based approaches, revealed preference methods, and stated preference techniques. Market-based methods often rely on the direct pricing of biodiversity products, such as bush meat or wildlife-based tourism services, through local or regional markets. Revealed preference techniques, such as the travel cost method, assess the economic value of biodiversity by studying how people's travel behaviors reflect their willingness to pay for access to wildlife-based resources, like national parks or biodiversity reserves (Walsh *et al*., 2017). Stated preference techniques, such as contingent valuation, involve surveys to determine individuals' willingness to pay for specific conservation outcomes. These methodologies collectively provide a comprehensive understanding of biodiversity's economic significance, especially in areas where market-based transactions do not fully capture the scope of benefits provided by biodiversity species and ecosystems (Mugisha *et al.*, 2021; Mitchell and Carson, 2014).

The significance of biodiversity conservation and its associated economic benefits cannot be overstated, especially in Adamawa state, where local communities depend on biodiversity for food security and income generation. The valuation of wildlife species will provide crucial data to guide policy decisions related to sustainable management, conservation efforts, and ecotourism development. Understanding the economic value of biodiversity in both food and tourism contexts will help identify opportunities for the local population to derive long-term benefits without depleting the natural resources. Additionally, promoting ecotourism based on wildlife could contribute to job creation, enhance community development, and increase awareness of environmental sustainability. The findings of this study will be useful for policymakers, conservation organizations, and stakeholders involved in the management and protection of biodiversity. Moreover, the research will contribute to broader efforts in promoting biodiversity conservation and supporting the sustainable development goals (SDGs) of poverty reduction, responsible consumption, and the protection of ecosystems.

Materials and Methods

The Study Area

Location

Adamawa is a state in northeastern Nigeria, with its capital at Yola. It lies between latitude 9° 12^{1} and 12.59^{11} N of the equator and between longitude 12° 29^{1} 43.40^{11} E of the Greenwich meridian (Figure 1). The study covered three eclogical zones namely: Northern (Michika and Mubi South), Central (Yola South and Fufore) and the Southern (Mayo-belwa, Shelleng and Toungo) as shown in Figure 2, It is one of the largest states of Nigeria and occupies about 36,917 square kilometres. Adamawa was created out of Gongola State on 27th August, 1991 as one of the nine new states created by the Federal Military Government. Prior to its creation in 1991, it was part of the North Eastern States from 1967 to February 1976 and Gongola State 1976 – 1991 (Bdliya and Tukur, 1993).

The State shares border with Gombe State to the North, and Borno State to the North East, while to the West it is bordered with Taraba State as well as the Republic of Cameroon to the East. There are over 80 ethnic groups found in Adamawa State. Some of the ethnic groups include: Fulani, Verre, Chamba, Kwah, Waja, Tambo, Libo Mwama, Kilba, Viengo and others (Adamawa State Diary, 2015). The people of Adamawa, are noted for its rich cultural heritage which reflects in its history. The three main religions are Islam, Christianity and Traditionalism. There are 21 local government areas in the state; namely, Fufore, Ganye, Gombi, Guyuk, Hong, Jada, Shelleng, Demsa, Madagali, Maiha, Mayo-Belwa, Michika, Mubi, Numan, Song, Yola, Mubi-South, Jimeta, Girei, Toungo and Lamurde. The author further stated that the major occupation of the people is farming. Their cash crops are cotton and groundnuts while food crops include maize, yam, cassava, guinea corn, millet and rice. The village communities living on the banks of the rivers engage in fishing while the Fulanis are cattle rearers. The state has a network of roads linking all parts of the country. The development of many communities in the state can be traced to the colonial era when the Germans ruled a swath of territory known as the Northern and Southern Camerouns from Dikwa in the North to Victoria (Limbe) on the Atlantic coast in the 19th century (Omar,1996).

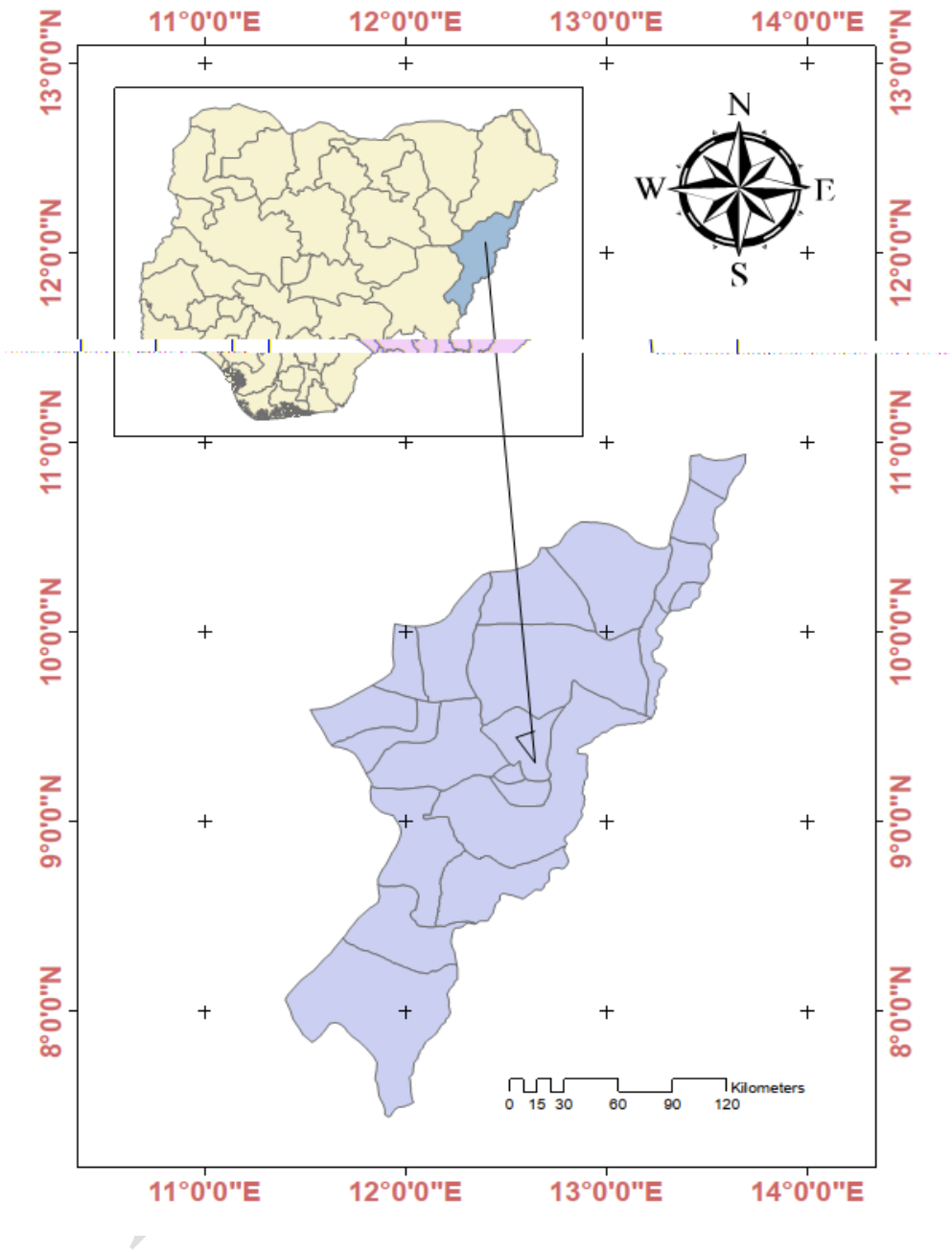

Figure 1: Map of Nigeria Showing Adamawa State
Source: Adebayo and Tukur (2020)

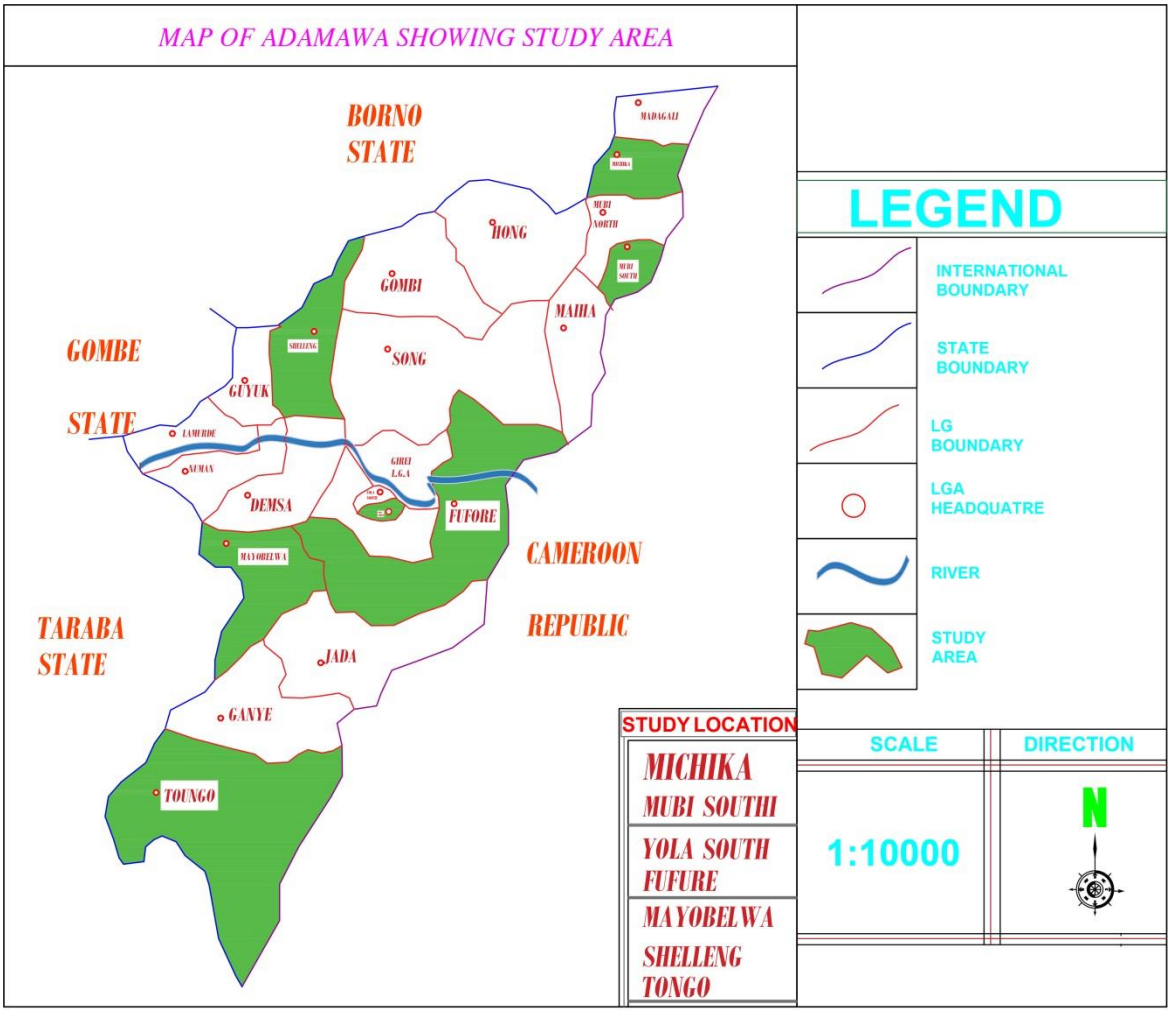

Figure 2: Map of Adamawa State Showing the Study Area
Source: Adebayo and Tukur (2020)

These were however handed over, as UN Trustee Territories, to the British at the end of the first World War with the signing of the Versailles Treaty. After a series of plebiscites, the Northern Kameruns joined Nigeria to form the then Sardauna Province, and the Southern Kameruns formed a Confederation with French speaking Cameroon (Bdliya.and Tukur, 1993).

Sampling Method/Technique

For the purpose of this study, data collection involved the use of multi-stage technique and random sampling method. First, the state was stratified into three blocks. Secondly, 30% of the Local Government Area in each block were randomly selected. Thirdly, Thirty respondents were selected in each Local Government Area (Babies, 1975).

Valuation of biodiversity was conducted in the three ecological zones of the state (southern guinea, northern guinea and Sudan Savanah zones). In view of the fact that there are significant differences in

socio-economic and cultural characteristics of the people among the three senatorial zones as observed during the reconnaissance survey of the state (Conducted prior to the main study), and the three ecological zones (southern guinea, northern guinea and Sudan Savanah zones) which coincides with the three senatorial zones hence, the state was stratified into three blocks based on the ecological zones.

Data `collection

Interview guide/structured questionnaire were used to obtain primary data while Journals, Proceedings, Texts, Brochure, and Manuals were used to elicit information for secondary data. The structured questionnaire was used to collect data from thirty respondents in each of the randomly selected local Government area making a total of two hundred and ten (210) respondents being a purposive study.

The Focus group was constituted at each Local Government Area (LGA). The membership was constituted based on the following prerequisites (a) environmental awareness, (b) knowledge of the wildlife resources of the area, (c) involvement in bush meat trading, (d) broadened horizon through education and (e) Men and women of authority. On the bases of the above prerequisites the Focus group was composed of Wildlife/Forest officers, traditional leaders, civil servants, hunters, bushmeat traders, farmers, women leaders and artisans (Kontoleon and Pascual, 2014).

Data Analysis

Descriptive statistics was employed in the analysis of data. The descriptive statistics used are: Tables, means, frequency distribution, percentages and charts.

Results

The respondents in the study area mentioned the challenges to Valuation of biodiversity as indicated in table 1. Complexity of the ecosystem top the list with 91 (21.9 %) of the respondents followed by Government attitude towards conservation with 76 (18.3 %) then Anthropological activities 69 (16.6 %), Data limitation 51 (12.3 %), Missing market 42 (10.1 %), Early stage of valuation 30 (7.2 %), Budget constraint 21(5.0 %), Population growth 17 (4.1 %), Poverty 13 (3.1 %) and the least is Human-wildlife conflict at 6 (1.4 %).

Table 1 Challenges to valuation of biodiversity

SN	Factors	Frequency	Percentage
1	Complexity of the ecosystem	91	21.9
2	Government attitude towards conservation	76	18.3
3	Anthropological activities	69	16.6
4	Data limitation	51	12.3
5	Missing market	42	10.1
6	Early stage in valuation	30	7.2
7	Budget constraint	21	5.0
8	Population growth	17	4.1

9	Poverty	13	3.1
10	Human-wildlife conflict	6	1.4
	Total	416	100

Discussion

The result in table 1 on Complexity of the ecosystem is in consonance with the report of (Figge, 2015) whom stated that even amongst the specialist community, there is much uncertainty about the range and scale of the species within ecosystems, as well as the functions and services provided. In such circumstance, it is difficult to correctly value these resources. Similarly, Veisten, (2017) stated that there is limited understanding of the concept and worth of biodiversity amongst non-specialists, which could lead to its being undervalued by individuals. He further stated that if in order to reasonably respond to the survey questions, participants must first be educated about the concept of biodiversity, then it could be argued that the resultant values are not representative of the general population who have not had such education. Conversely, it could be argued that it is pointless to ask people to value something about which they have little or no knowledge. *The result on* government attitude towards conservation issues in these study coincide with the observations of Ijiomah and Akosin (2000) stating that in some countries, there is a complete absence of policies, strategies and appropriate institutional frame work required to prosecute conservation matters and even where they exist, most governments show lukewarm attitude and lack pragmatic approach in their dealings with issues concerning conservation of natural resources. The authors further stated that this situation manifest in poor funding of conservation projects and programmes that can create the awareness among its citizenry, and change their negative attitude toward conservation issues. Similarly, John *et al*., (2012) shows that it is a sad fact that biodiversity are still generally undervalued even when the economic return alone is comparable to or better than those obtained from other patterns of land use. They added that too frequently there is a lack of understanding of environmental problems on the part of decision makers and priority is often given to short-term financial gain from logging or other forms of exploitation even where this conflict with long term environmental consideration. Similarly also in the report of NBR, (2019) which stated that corruption is another major factor to blame for creating a threatened future for Nigeria's biodiversity. The collapse of logging controls in Nigeria is traced to corruption of forestry officials and this indirectly affects all other natural resource based products. Corrupt politicians have aided the de-reservation of many biodiversity rich areas for non-productive reasons, thereby jeopardizing all past efforts at saving and protecting biodiversity. Also in the words of Perrings and Gadgil, (2003) Nigerian government established several forest reserves for conservation of forest resources, these forest reserves have been seriously neglected and received little or no improvement in terms of investment and management, the implication of these loses is that many plants and animals, including many potentially valuable species are on the fast track to extinction. The result obtained in the study area on anthropological activities is in consonance with what was obtain by Fada *et al.,* (2023) whom stated that in spite of innumerable pleasure mankind derive from biodiversity, man´s inhumanity to biodiversity remain unceasing and unabated. Various human activities such as bush burning, Logging, Illegal grazing, damming rivers, draining swamps, environmental pollution, hunting and poaching are threatening their existence. Invariably, many more are faced with extinction and classified as threatened species. Breakdown of

anthropological activities is shown in figure 3. The result in this study on *Data limitations* is also in line with the findings of Eshet (*et al.,* (2017) whom stated that it is inevitable that some of the data required for an economic evaluation will not be readily available. Where data are limited, this should be acknowledged and the measures taken in response to this limitation clearly specified. The results and recommendations should be made explicitly conditional on these limitations. In the same vein NBR, (2019) mention that the general lack in systematic environmental data collection and management in Nigeria, impacts negatively on biodiversity data and their application. Although University faculties and other specialized institutions have conducted a number of research works, the results are widely disseminated and often not accessible. In addition, faulty and incomplete information is gathered and cited in various documents, leading to unrealistic assessment of biodiversity related problems and solutions to address them. The result on missing market also resonate the findings of *NBR*, (2019) whom stated that Market prices do not take into account all values of biodiversity. For example, the value of the different services provided by forests (such as watershed protection, the production of clean water and air, or offering recreation possibilities) is not necessarily reflected in the price of the marketed products (such as timber), which are in fact underpriced. This applies especially to ecosystem functions and services and is also referred to as the absence of economic markets for such ecosystem assets. Since the latter cannot compete in the market place with types of use that deliver a direct economic benefit they are simply ignored in decision taking. Non-existent or missing markets are seen by some as the most common reason for environmental degradation.

The result on early stage in valuation in this study coincide with other authors report because in recent years, many studies have examined how people value biodiversity. However, the majority of these research work has been conducted in the developed world with only limited application in developing countries, in spite of the abundant biodiversity of the region as reported by Georgiou *et al.*, (2016); and Van Beukering *et al*., 2017). In the same vein Christie *et al*. (2018) identified some studies that aimed to value biodiversity in developing countries. This number represented approximately one-tenth of all published biodiversity valuation studies at the time. It is therefore evident that there is great variability in the application of valuation in developing countries, with the poorest countries and some regions having little or no coverage the authors further stated that the application of economic valuation in developing countries is clearly in its infancy stage.

Result on Budget constraints also coincide with the finding of Edward *et al.,* (2015) in which the authors stressed that Budgets for parks and green spaces are already constrained and are likely to come under further pressure. Continued financial pressures are also likely to affect the quality of green spaces. Although biodiversity provide broad benefits across a range of spheres, their budgets remain narrowly derived from one source. It may be more appropriate to draw funds from across local authority budgets in a way that better reflects the spread of benefits from investing in parks, especially including current and future environmental and health benefits.

The result of these studies on population growth rate coincide with the findings of Ijomah and Akosim (2000) whom stated that as population grows the demands for all human necessities also increase. Those demands include food, which consumes large size of land area and timber to build more houses for the growing population. These demand results in clearing of bush and felling of trees, a situation which

leads to destruction of ecosystems and the extinction of plants and animals. In the same vein Edward *et al.*, (2015) mentioned that the use of biodiversity by mankind has grown over the last few centuries to unprecedented level and simultaneously there has been a sharp reduction in biodiversity suggesting an impact of human population on biodiversity and consequently a possible threat to mankind himself. The findings of this study on Poverty is similar to the result of Osunsina, (2019) stating that to a large extent, poverty contributes a major threat to biodiversity and in other ways continues to further deepen the level of poverty in most rural areas. The poor are pushed by the affluent and influential majority to destroy their own source of livelihoods for meagre financial returns, and the poor, due to deprivation find it difficult to secure any other alternative than to erode the very foundation of their own long term survival. Similarly NBR, (2019) noted that biodiversity is always at the receiving end being the readily available option for food, fibre and minimal commercial gain by the rural poor. The need for protection of these resources is therefore seen as elitist by the rural poor whose deprivation in terms of food and domestic needs have been pushed to the wall.

The result on Human-wildlife conflict mirrows the observation of Institute of Policy Analysis and Research, IPAR, (2015) stating that Competition between man and wildlife has been reported in various parts of the world. The nature and intensity of the problem varies from country to country depending on human population growth rates, conservation methods and scarcity of critical natural resources, especially land and water. It also resonate the work of Chardonnet *et al*., (2016) noting that Human-wildlife conflicts arise from direct and indirect negative interactions, leading to economic losses in agriculture through destruction of crops, human fatalities and injuries, depredation of livestock and retaliatory killings of wildlife. These conflicts hamper the peaceful habitation of human and wildlife and also constitute major threats to the survival of many wildlife species.

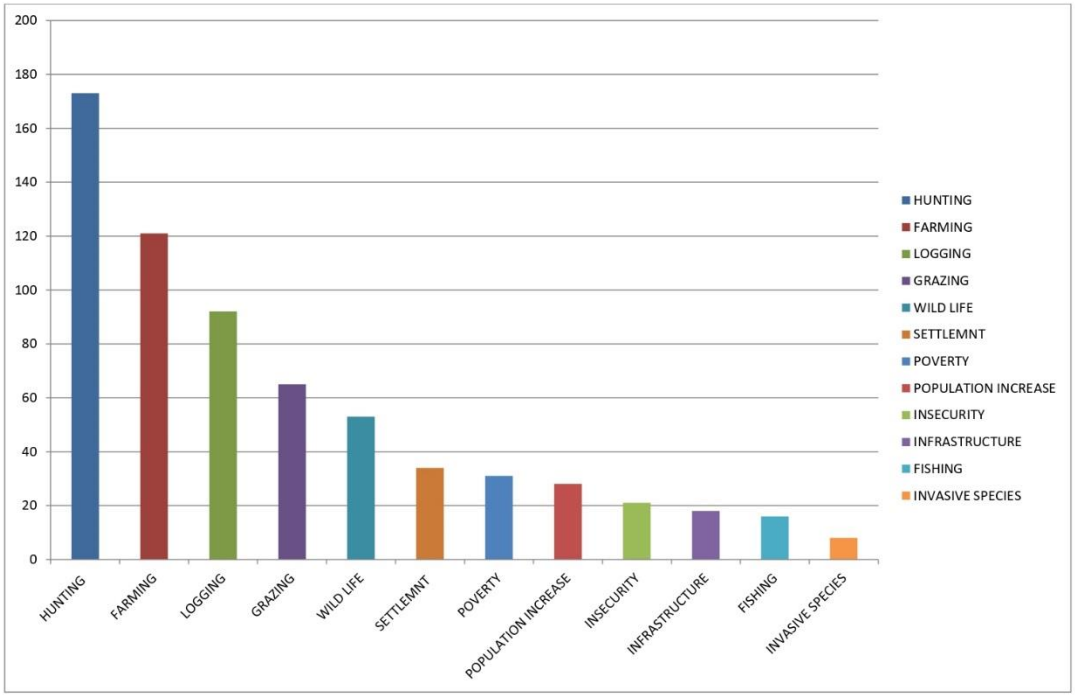

Figure 3: Anthropological activities

Conclusion

In conclusion the study revealed the challenges to valuation of biodiversity and the threat factors that militate against biodiversity conservation for sustainable use were also identified. It also proffered solution to the current challenges to biodiversity valuation in the study area. Maintaining biodiversity requires more than just protecting them and their habitats. It also entails the sustainable use and management of all biodiversity and their support systems. The Society needs a mechanism for determining the appropriate trade-off between biodiversity protection and the human activities that create value for people but result in biodiversity loss. There is need for enlightening decision makers and the general public to increased their understanding of the range of values and benefits that biodiversity offer to the welfare of mankind.

Recommendations

In view of the finding of this study the following recommendation were made.

1. To prevent the local dwellers from hunting, indiscriminate expansion of agricultural land areas, illegal logging, grazing and wild fires, local communities should be trained to acquire skills in areas such as craft making, tailoring, shoe and bag making, motor mechanic, carpentry, mason and modern agricultural practices.

2. Adequate policy and institutional frame work should be put in place for the purpose of management and conservation of biodiversity at the grass root.
3. Awareness creation on the role of integrated efforts by local government, NGO's and the communities for the development of eco-tourism sites and projects in the rural areas is highly recommended
4. Implement community conservation education programs, to strengthen outreach and education campaigns targeting all age groups and literacy levels to promote conservation ethics and ecological knowledge.
5. There should be international cooperation in enhancing domestic capacities because most expertise in valuation are located in developed countries.
6. Further studies for the development of appropriate models for valuation of wildlife species in the state and Nigeria at large should be carried out without delay.

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