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BIO-RESOURCES CONSERVATION AND ANTHROPOGENIC DRIVERS OF BIODIVERSITY DEPLETION IN ISIALA NGWA, SOUTHEASTERN, NIGERIA.

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ABSTRACT: *The study examined the conservation of biological resources in Isiala Ngwa, Southeastern, Nigeria with a view to assessing its implications for the achievement of the sustainable development goals. Also the anthropogenic drivers of biodiversity depletion in the study area were studied. The study utilized primary data obtained from field observation, focus group discussion and key informants' interviews. Secondary data were also used in the study. Diversity indices of species were obtained from Quadrat Analysis using the Shannon Wiener's Diversity Index. Data were analyzed using Principal Component Analysis and Descriptive Statistics. The study found that anthropogenic activities that drive biodiversity depletion in the study area were mainly agricultural land use practices such as deforestation, bush burning, crop farming, mixed farming, bush fallowing, and plantation agriculture, intercropping and hunting. Agricultural land use practices had negative impacts on biodiversity which resulted in the low diversity indices (0.02- 0.44).The results of the PCA on the impact of agricultural practices on biodiversity isolated three components explaining 64.29% of the variance. Legislation against indiscriminate bush burning, unauthorized hunting, bush fallowing with a longer fallow period were measures adopted in the paper to manage ecosystem biodiversity conservation*.

KEYWORDS: Anthropogenic drivers, bio-resources conservation, biodiversity, sustainable development, diversity indices

INTRODUCTION

The ongoing loss of biodiversity associated with increasing human populations and unsustainable use of natural resources poses a major challenge in the world today (Rockstrom et al, 2009, Ohl et al, 2009 and Sterling et al, 2010). Biodiversity is complex and dynamic (Gaston, 1996; Sterling et al, 2010). Phil-Eze (2003) stated that biodiversity can be seen as firm acclamation that the earth we live in is occupied by diverse forms of living things, which may vary from place to place. There are multiple definitions of biodiversity by many scholars and organizations, but the ones that are relevant to our discourse are the definitions given by Phil-Eze (2003); WWF (1989); and Sterling, et al (2010). Phil-Ezeh (2003) defines biodiversity as the variety and variability of plant and animal genes and species and ecosystems found on the surface of the earth. Also, World Wide Fund for Nature (1989) defines biodiversity as the wealth of life on earth, the millions of plants, animals and micro-organisms, the genes they contain and the intricate ecosystems they help to build into living environment. In the light of these definitions of biodiversity, Sterling, et al (2010) define it as all life on earth across all levels (genes, populations, and species including humans, assemblages, ecosystems/ landscapes, and the ecosphere) and the ecological, cultural, and evolutionary processes that sustain it. Biodiversity conservation requires an understanding of

multiple issues including causes, effects, and unintended impacts. As a source of life, biodiversity is our life wire (Phil-Ezeh, 2003). Yet, despite the fact that entire Nigeria population depends on Nigeria's biological resources which are diverse in nature for survival, the destruction of such resources in most rural localities which are dependent on more than 70% of the bio-resources is quite alarming. Spangenberg (2007) identifies anthropogenic pressures as human interference by over exploitation (logging, hunting, gathering, farming and grazing), from habitat disturbance and fragmentation to full habitat destruction.

The bio-resources in Nigeria are many folds and include: wildlife (products and wild animals), vegetation (food, timber and medicines), bamboo, ratan, resins, gums, latexes, tannins, dyes, spices etc (Phil-Ezeh, 2003). Because of the richness of the biological resources in our local communities, there is great increase in a culture of waste amongst our people who think that the bio-resources are inexhaustible since they are free gift from God (Phil-Ezeh, 2003). This culture of waste enhances the depletion of bio-resources in Nigeria. Garrod and Willis (1994) state that successful biodiversity conservation should aim to sustain ecological, evolutionary and cultural diversity, and their underlying processes. There is a broad consensus among the scientific community that anthropogenic factors relating to unsustainable production and consumption are the primary causes that lead to biodiversity loss, depletion of the foundation for ecosystem resources and services provisioning as well as cause deterioration in human well-being (Kendall, 1996; MEA, 2005; EEA, 2006, EC, 2008; King, 2009). Moreover, Sala et al. (2000) in reporting results of a scenario analysis, point out that "Land-use change is the most severe driver of changes in biodiversity depletion among five major drivers of change in terrestrial ecosystems (i.e. land-use change, climate change, nitrogen deposition, biotic exchange and elevated carbon dioxide concentration) and it is basically human induced…"

There are many human induced factors of bio-resources depletion in Nigeria all of which are land-use changes and practices. Factors such as agricultural practices of bush burning, farming practices, animal rearing/ hunting, industrialization, land degradation, deforestation and road/ housing construction enhance the depletion of bio-resources and hinder proper bio-resources conservation (NEST, 1991, Madu, 2003, Phil-Ezeh, 2003; Ayadiuno, 2011).

There are two well-known approaches to bio-resources/biodiversity conservation, viz; protecting the habitat by adopting in-situ conservation and protecting individual species outside the habitat (ex situ) (King 2009). The conservation of biodiversity is a complex process and could be achieved through protection of habitats, and it requires in-depth analysis of available bio-resources. (Kendall, 1996) .

Proper conservation measures/ practices are necessary to control the depletion of bio-resources in our local communities in Nigeria. To this end, Maiti and Sarkar (2017) note that bio-resources (plants, crops and animals) are life savers of mankind and animal kingdom. They also added that increasing global warming associated with increased emission of green house gases has direct impact on these prestigious resources. According to Maiti and Sarkar (2017), this urges a great necessity of the preservation of environments, management and conservation of bio-resources

sustainably and transmits the knowledge to the public for awareness. This if done, will checkmate the destruction/ wastage of bio-resources and probably conserve the Nigeria's ecosystem.
The study examined the conservation of biological resources and anthropogenic drivers of biodiversity depletion in Isiala Ngwa North LGA, Abia State Nigeria with a view to assessing their implications for sustainable management of the bio-resources in the study area.

The study Area

The area of study is Isiala Ngwa North L.G.A of Abia State Nigeria, which has an area of about 83.5km^2. The area is located between latitudes 05^{0}21'N and 05^{0}29'N and longitudes 07^{0}18'E and 07^{0}22' E (Fig.1).Its climate falls under the Af climate of Koppen's classification, with two major different seasons namely the rainy and dry seasons. The rainy season comes between the months of April and October while from November to March marks the period of dry season in some parts of the study area. Isiala Ngwa North experiences a total annual rainfall of 2250mm – 2500mm, with a relative humidity that ranges from 75 – 100% and temperature range of 25^{0}C to 32^{0}C (Anyadike, 2002). The study area is made up of a rural populace with a population of about 154,083 people by the 2006 population census (FGN, 2007). If this population figure is projected to 2018; it will then be 210,775 people. Given their rural setting, the people rely mainly on agriculture which involves farming, hunting and grazing as their major economic activity and source of livelihood.

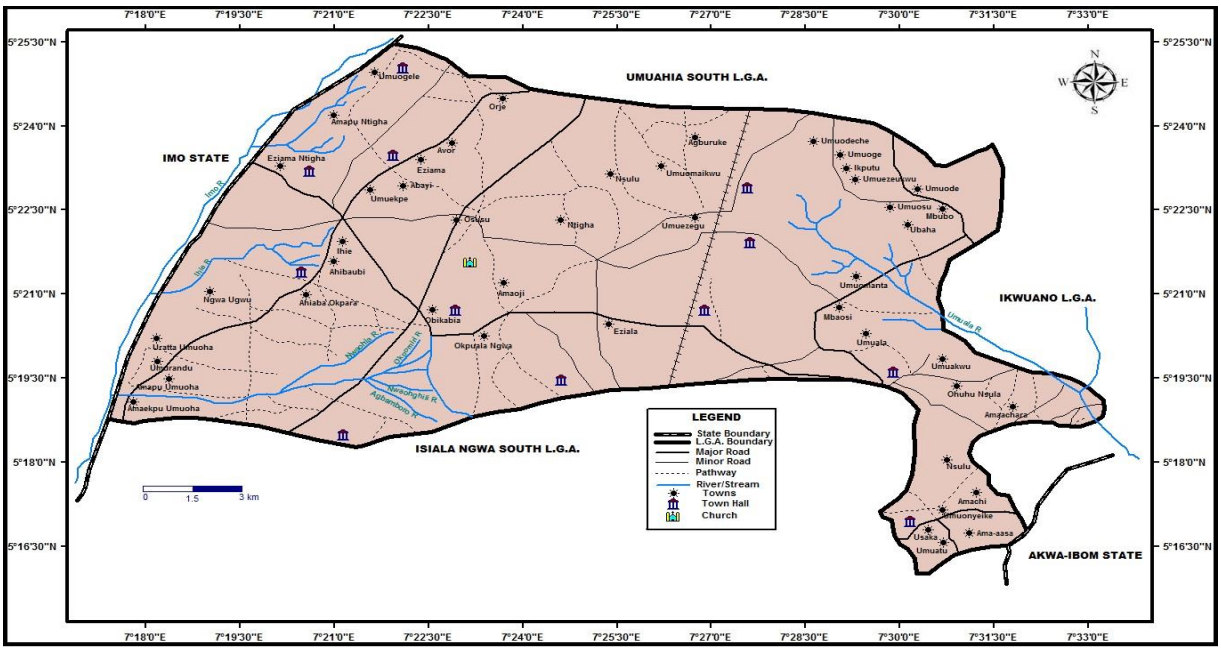

Fig.1: Isiala Ngwa North LGA showing the communities

MATERIALS AND METHODS

Data collection

The study area is made up of forty (40) communities (Fig 1). For data collection a 20m x 20m square quadrat was laid on purposively sampled sites of identified agricultural land use practices in the area. The practices were intercropping, mixed farming, plantation farming, bush fallowing and animal husbandry. A reconnaissance survey of the area was done while a checklist of the plant and animal species was drawn. The inventory of biodiversity in the mapped quadrants was taken, after Sutherland (1996)**.** In each of the quadrants, enumeration and recording of biodiversity in the area in terms of species richness and diversity were undertaken. For the plants, direct count was adopted to estimate number while diversity index was used to determine the species abundance. This enabled the determination of the pattern and distribution of the species diversity by noting the number of species in each quadrant. For the wildlife, the study was limited to mammals, birds, reptiles and amphibians since these are the major indicators of biodiversity in an area. For mammals direct count was also adopted. We equally used the number of animals caught by hunters as a measure of animal population (Sutherland, 1996). Such information was made available through Focus Group Discussions with experienced hunters in the area. To estimate the population of birds, a number of techniques were combined. Such included point counts, counting of flocks and counting of occupied nests on tree colonies. We also used the carcass of some animals like skulls, bones, evidence of molted skin, feather, droppings, although aided with some hunters, to determine the presence of certain animal species in the quadrants. Some elders were also engaged in key informant interviews on the composition of biodiversity in the area. The method of selection was purposive sampling while selection criteria were availability at the time of the fieldwork, knowledge of the subject and willingness to participate in both the FGD as well as Key Informant Interviews (KIIs).

Data Analysis

Descriptive statistics such as tables and charts as well as percentages were used to analyze the inventory of biodiversity indices. Shannon Wiener's Diversity index (DI) after Ian and Peter (2003) was used to obtain the diversity indices of the species. The value of Shannon diversity index usually falls between 1.5 and 3.5 and only rarely does it surpass 4.5 (Khan, 2013). The value of the DI is a reflection of species diversity in the area. The Shannon-Wiener's Diversity Index is given as:

$$Hi = \frac{NInN-\Sigma(28il\ n\ ni)}{N} \quad - - - - - - - (i)$$

Where N is the total number of individuals of all species, ni is the number of individuals of species I, and ln is natural logarithm

The calculation of biodiversity indices for the species in Isiala Ngwa was done using the formula after Hill (1973), which gives Biodiversity index is as:

$$\text{Biodiversity Index} = \frac{\text{the number of species in the area}}{\text{the number of individuals in the area}} \quad - - - -(2)$$

The biodiversity indices (BI) from agricultural land use practice sites were very low; ranging from 0.02 – 0.44.The highest BI of 0.44 was obtained from a crop farm site in Umurandu; while the least BI of 0.02 was obtained from a grazing sites for Animal husbandry in Amapu Ntigha.

RESULTS AND DISCUSSION

The results of the study show that crop farming and mixed farming are not friendly to biodiversity. Hence there is a very low relationship between the agricultural land use practices and biodiversity. Thus, the raw data was subjected to P.C.A to find out the underlying factors in the observed variation. The P.C.A. is shown in Table 1.

Table 1: The Rotated Component Matrix of the Impact of Agricultural Land Use Practices on Biodiversity in the Study Area

		Component		
	Variables	I	II	III
XI	Intercropping	-.775*	.060	.227
X2	Mixed farming	.511	.156	.430
X3	Plantation agriculture	.208	.841*	.040
X4	Bush fallowing	.618*	-.053	-.174
X5	Animal husbandry	-.008	-.053	.923*
	Eigenvalue	1.380	1.355	1.123
	% of variance	22.996	22.577	18.723
	Cumulative %	22.996	45.573	64.296

*significant loadings $\geq +/-0.60$

The results of the P.C.A in Table 1 show that out of the five variables, three components were extracted explaining a total variance of 64.296%. Component I has significant loadings on two variables (X_1, and X_4). The variables are X_I (crop farming (-0.775), meaning that it impacts negatively on biodiversity. The second variable is X_4 (bush fallowing (0.618) which implies that bush fallowing with long fallow periods leads to the capability of plants to regenerate after being burnt or cleared for farming. Variable X_1 and X_4 explain 22.996% of the total variance. The underlying factor therefore becomes the impact of plant clearance on biodiversity. The eigen value is 1.380.

Component II has significant loading on only one variable. The variable is X_3 (Plantation Agriculture), which means that increase in the rate of Plantation Agriculture, increases the depletion of biodiversity and diminishes the chances of regeneration of the vegetal cover. This also affects the entire elements of biodiversity. The eigen value is 1.355 and it accounts for 22.577% of the total variance. Thus, the underlying dimension becomes effect of mono cropping on biodiversity.

Component III has significant loading on one variable, and contributes 18.723%. The variable is X_5 (Animal Husbandry). This indicates that with a high frequency of animal husbandry, there will be an increase in the destruction of biodiversity. As the farmers allow animals to graze in the area, it will eventually lead to the death of plant species. This in turn causes the exposure of the animal species living there to either death or other hazards or both. When these animals are exposed to such threats, they either die or migrate to other areas that may not be conducive for them. The underlying component here becomes "effect of habitat disturbance on biodiversity".

The results of the Focus Group Discussions and Key Informant Interviews with farmers and hunters in the area are summarized in Table 2

Table 2: Responses from the FGD and key informants' interview with farmers and hunters in the area

Questions Raised	**Responses from Respondents**	**Researchers' comments**
Concerning the farming systems practiced	Farming system is mainly peasant or subsistence farming. The major practice is bush fallowing, with fallow period 2 – 3 years	Short fallow periods do not favour biodiversity conservation.
About farm tools used and type of crops planted	Farm tools are hoes, machetes, and spades. The type of crops planted are cassava, yam, garden eggs and vegetables, yield determined by soil fertility	Farming systems determine the tools used. Hence simple farm tools used for subsistence farming.
What type of animals are kept in the area	They include ruminants e.g. goats, sheep, cows and cattle. Some livestock roam about on free range while others are on semi-free range –	Leaving the livestock to roam about leads to biodiversity depletion.

	partially housed and sometimes left on their own.	
Concerning the effect of constant bush clearing on biodiversity	They agreed that it has negative impacts on wildlife and plant species in the area	Most mammals that require forest areas for habitation are now absent. Hence this practice causes loss of habitat.
As to whether there are protected areas in the area	There are informal protected areas. E.g. waste lands around shrines, along ancestral bush tracks.	More of these protected areas are advocated
Concerning sustainable agricultural production and biodiversity conservation	They suggested controlled burning i.e. gathering the grasses together and burning them. So, organic farming is advised.	If organic farming is practiced, biodiversity conservation is rest assured.
In terms of the use of inorganic fertilizers	It was not obtainable in the past due to long fallow periods. But population growth has resulted in land scarcity, leading to short fallow periods and use of organic fertilizers	This does not aid biodiversity recuperation.
About continuous cropping	This is mostly done at the back of people's houses, school farms etc.	Over time, this may lead to perpetual loss of soil fertility
About hunting and bush burning in relation to biodiversity	Some hunters set the bush ablaze so as to catch some animals. Some widows do same in order to clear their land for farming as they have nobody to help them.	Bush burning is very detrimental to the wildlife and vegetation and should be discouraged.
About the number of animals caught per day	They kill an average of 35 different species of animal on each hunting expedition	Unauthorized hunting should be discouraged in the area.
Concerning whether they consider the age and sex of animals during hunting	They shoot the animals at sight; no room for such consideration.	Indiscriminate hunting can lead to extinction of some animal species.

Source: *Field work, 2016*

From the inventory of plant species their frequency of occurrence indicates that they are two thousand seven hundred and sixty-six (2766) in number. In terms of abundance, there are sixty-seven (67) ferns, representing 2.64% of the total population. The climbers are one hundred and seventy-two (172), which is 6.79% of the population. The grasses are three hundred and three (303) representing 11.96%; the herbs are seven hundred and fifty-five (755) (29.79%). The shrubs are four hundred and one (401) which is 15.82% of the population of the plant species. Finally, there are eight hundred and thirty-six (836) tree species representing 32.99% of the population. The biodiversity indices in the area were very low, ranging from 0.02 to 0.44.This was due to agricultural activities together with over harvesting of forest products like logging, firewood gathering and hunting among others. The classification of the components of flora in the study area is shown in Fig.3.

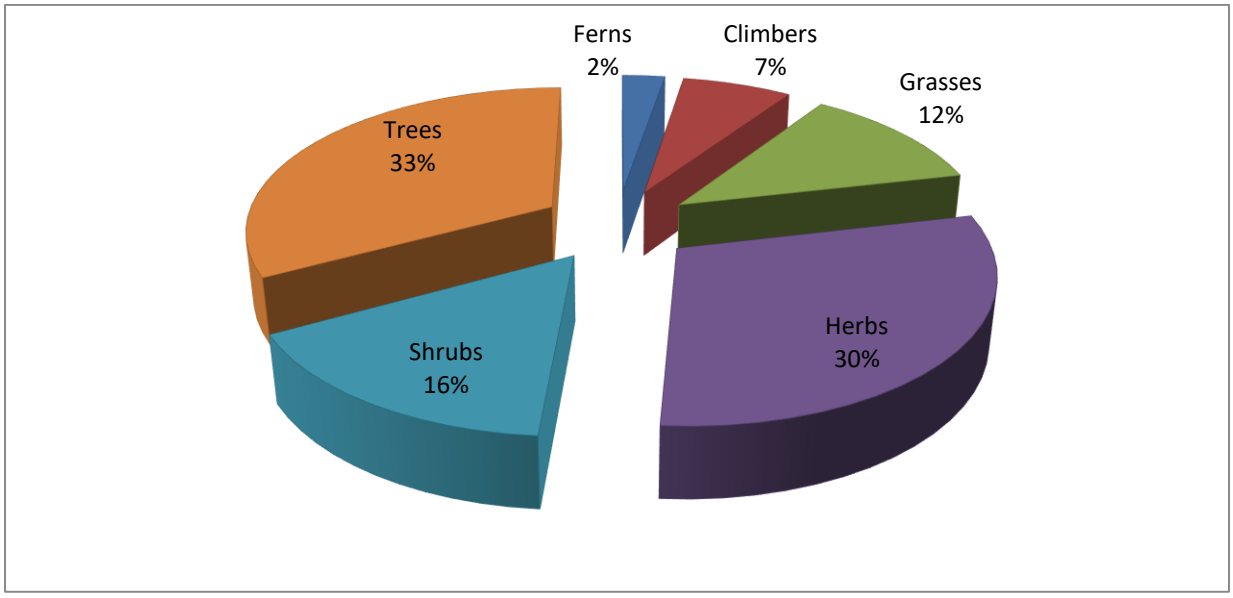

Fig 3: Percentage of the plant species in the area.

On the part of the fauna, we saw a great diversity of animal species. They range from the reptiles (R), amphibians (A), birds (B), other lower animals to large mammals (M) and others (O) that do not fall under any of the categories above. From the study, it is evident that Isiala Ngwa has a total of about sixty-two (62) species of animals. They are classified under forty-eight (48) families and sixty (60) genera as can be seen on the checklist (table not included). They are divided into four main groups viz birds, reptiles, amphibians, mammals and others. From the findings, there are twenty-six (26) species of birds, eleven (11) species of reptiles, fifteen (15) species of mammals, and four (4) species of amphibians.

In terms of their frequency of occurrence, there are four hundred and sixty-nine (469) birds (42.75%), one hundred and fifty-eight (158) reptiles (14.40%), three hundred and four (304) mammals (27.72%) and ninety two (92) others (8.39%). The composition of fauna in the study area is presented in Fig.4.

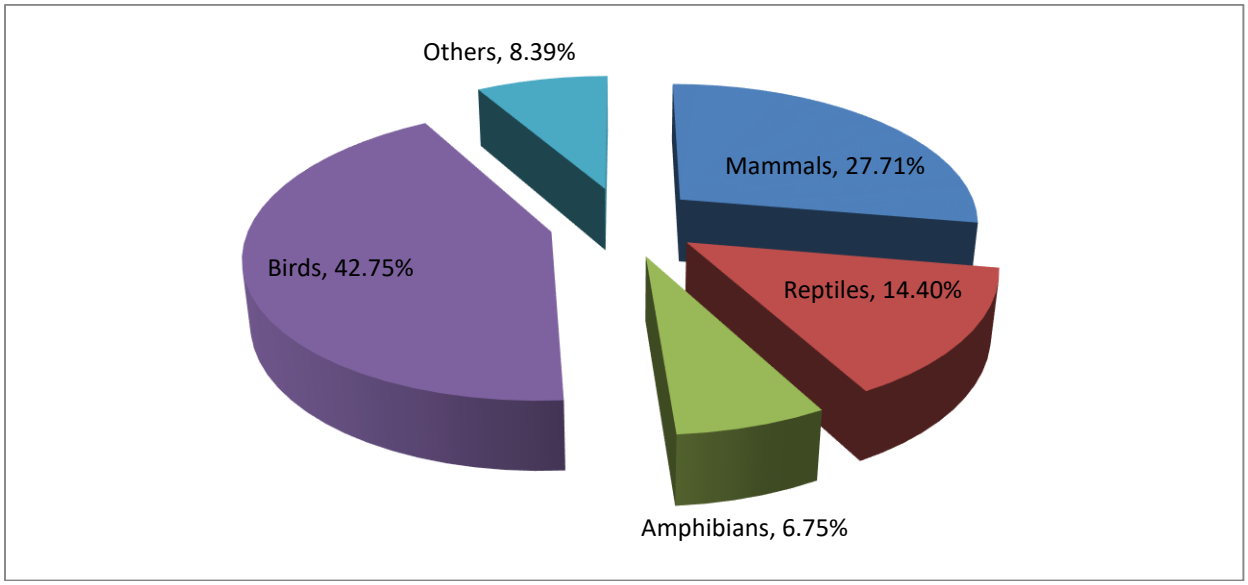

Fig 4: Percentage of different wildlife of the area

The species inventory shows that across the forty communities, some plant and animal species are not evenly distributed. In some areas, a particular species is predominant while elsewhere it may be scarce or totally absent. There are some plant species that are found in all the communities like the *Elaeis guineensis* (oil palm), *Synedrella nodiflora* (Yellow starwrt), *Palisota hirsuta, Aspilia africana, Chromolaena odorata* among others.

Also there are some plants species though present in the area, they are found in few communities. Examples include *Centrum species*, found in only nine communities, *Combretum dolichopetalum* was found in just one community, *Cocos nucifera* only found in seven communities.

From the study, some animal species were found in large numbers. Others were found to be one (1) or two (2) in some communities as at the time of the inventory. For instance, *Milvus migrans* was present in just one community (Umuezeukwu); *Sphenodon punctatus* was present in nine (9) communities. However, there are some species that were present in almost all the communities – examples include *Agama agama, Emberiza citrinella* among others. The reason for the low population of some of the plant and animal species could be bush burning and uncontrolled hunting. The hunters confessed to getting as many as 35 different animal species during some of their hunting expeditions which took place thrice a week. Even some women set their farmlands ablaze in order to clear them for farming. Hence demonstrated efforts should be made to avoid driving these species to extinction especially those that are very scarce. This is in line with the United Nations Sustainable Development Goals which Goals 14 & 15 cover biodiversity conservation. To ensure this, there should be a sustainable management of the biodiversity resources in the area.

CONCLUSIONS

From the findings of this study, it is evident that there is a great diversity of biodiversity in Isiala Ngwa. Even though there is a diversity of plant and animal species, there is also a number of anthropogenic driving forces that exert negative impacts on biodiversity across the area. It therefore follows that in some parts of the area, certain species are dominant whereas they are very few or even totally absent in other parts. It therefore implies that there should be a control in the management of these anthropogenic activities in favour of bio-resources conservation. This can be done by adopting the farming systems that can improve the distribution of biodiversity in the area. Such include bush fallowing with long fallow period, land rotation, intercropping, agroforestry etc. There should also be a rule guiding the harvest of forest resources especially logging and indiscriminate hunting to allow for sustainability.

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