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ASSESSMENT OF WOODY VEGETATION DIVERSITY IN BABURA AREA, NORTHWESTERN NIGERIA

Please did I use the correct surnames?

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Abstract

Biodiversity ensures how well a natural system will remain. In Nigeria many studies have reported threats to biodiversity resulting from both natural and human perturbations. This study assessed species diversity in Babura area with a view to providing recommendations for sustainable management of indigenous plant species. A quadrat of 30m x 30m was used to sample vegetation in two landuse types in the area. Species diversity was calculated using Shannon index (H^I) while species evenness was measured using Pielou's index (J^I). Results of the study shows that both diversity (H^I=0.98) and evenness (J^I =0.269) are low. These low values may be attributed to human disturbances through fuelwood exploitations and erratic rainfall experienced in the area. This study recommended that regulation to curb the exploitation of forest resource should be made stricter in the study area through proper legislations. Also recommended is provision of affordable and energy efficient cooking stoves to people of the area.

Key words: Woody vegetation, diversity, Babura, Nigeria

INTRODUCTION

Vegetation diversity is critical to maintaining the health of any ecosystem, and essential ecosystem functions are better when species diversity is higher. Many ecologists are convinced that species diversity is important for the stability and proper functioning of ecosystems (Schlapfer *et al*., 1999). Species diversity is the identity and variety of elements in a population, including species lists and measures of species diversity and genetic diversity (Noss, 1990). Diversity concept relies on the

apportionment of abundances (or some related quantities such as biomass or coverage) into a number of animal or plant categories forming the ecological community under study (Pielou, 1977).
Since the 1990s, the global loss of biological diversity has become a major concern, not only to ecologists but also to the general public. Vegetation diversity decrease is a normal process but often human activities (especially in the last two centuries) have greatly accelerated the rate at which losses occur. The rate of forest loss by natural disturbances and human interventions has increased dramatically at both global and local levels (Janzen, 1988).

Assessment of vegetation diversity is vital for planning conservation action. Vegetation diversity assessment allows land managers to place local assessments into regional or national perspectives, which facilitate the prioritization of limited resources available to managers (Ingerson and Loya, 2008). Accurate estimates of the spatial distribution of plant diversity are needed to support policies that are designed to maintain terrestrial biodiversity and tropical forest carbon stocks (Sanchez-Azofeifa, Castro-Esau, Kurz, Joyce, (2005).Stohlgren, (1994) reported that long-term vegetation inventory and monitoring programs (especially at large-scale) are rare but valuable for regional and national condition assessments.

In Nigeria, plant diversity is lost especially along dry forests, which are important sources of natural products such as fruits, foods and resources for medicine. Additionally, natural and man-made threats as well as direct and indirect consequences of socio-economic development have contributed to the erosion of biodiversity at all levels in the country. It is believed that within the last 25 years, about 43% of the forest ecosystem has been lost through human activities in Nigeria (Federal Government of Nigeria, 2001).

Due to the importance of trees and its lineages with the environment and human activities, geographers have long been interested in the study of diversity and density of species, and structure of vegetation over global, regional, and local spatial scales (MacDonald and Edwards 2003). The literature is also replete with researches on vegetation diversity in northern Nigeria. Some notable ones are Danjuma (2010); Daura, (2011); Dikko (2012); Ezeobi, (2014); Zakari (2015); and Danjuma (2017). The aim of this study is to assess woody vegetation diversity with a view to providing information for successful management of species in the area.

DESCRIPTION OF THE STUDY AREA

Babura lies on latitude on latitude $12^{0}38^{I}$N and $12^{0}46^{I}$ as well as longitude $8^{0}58^{I}$E and 9.01^{I}E. The area has a total of 992km^{2} and located north of Jigawa State Nigeria near the Niger Republic border. Babura is about 103.8 kilometres southeast of Kantche, Zinder, Niger Republic.

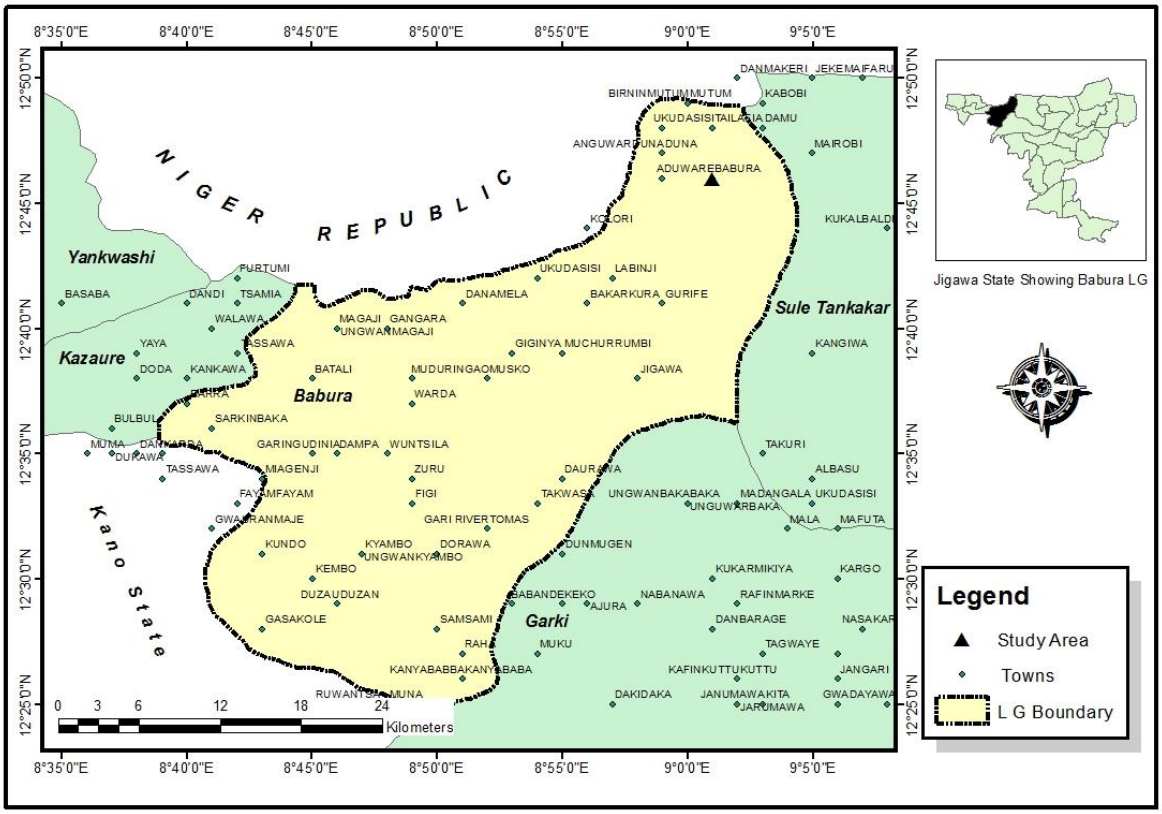

Figure 1: Babura Area, northwestern Nigeria

The study area which has a population of 20,8101 people (NPC, 2006) lies in a climatic zone described as semi-arid, hot, tropical zone with high temperatures (average daily maximum more than 33.5°C). The highest mean maximum temperature (40°) is recorded during the period March to May, whereas, the lowest mean maximum temperature is recorded in January (33.1°C). The annual average rainfall is between 600mm to 1000mm while the natural vegetation of the study area is the Sudan Savanna type. Vegetation of the area is typically sparse, comprised of annual and perennial grasses, other herbaceous plants, shrubs, and small trees.

Babura area is home of farming and livestock breeding. These two livelihood activities are the major economic activities in the area. The dominant crops grown are staple ones including guinea corn and millet.

RESEARCH METHODS

Data Collection

This study employed quadrat sampling to survey vegetation in the study area. Quadrat sampling here was done using 30m x 30m tool. It involved: laying, inventorying, identification and recording of species was done in two land use types. Samples of unknown species were collected on plant pressers and transported to herbarium of Department of Biological Sciences of Bayero University Kano for identification.

Data Analysis

Woody vegetation diversity was analysed in this study using Shannon and Pielou Indexes as follows:

Shannon Index

Species diversity is measured using indices. Some of the common diversity indices are the Shannon, Simpson, and log series alpha diversity indices. However, this study used Shannon's index (written as H^I) for its suitability in measuring order within a community (Shannon and Weiner, 1963).

Shannon's index (H^I)= $\mathbf{-\Sigma\ (Ni/N)\ log_2\ (Ni/N)\ I=1,}$ where; **Ni**= Total number of individuals of a species, **N**= Total number of individuals of all species.

Shannon index used for the assessment of plant diversity (H^I) is sensitive to rare and abundant species; sensitivity to rare species increases as one decrease from 1 (Shannon, 1948). The choice of Shannon index (H^I) for diversity assessment of species is because of its suitability in measuring order within a community. Additionally, it is sensitive to the number of rare species in a community, which is why it is used to study random samples from a larger community. According to Kent and Coker (1992), Shannon index allows analysis of not only the number of species but how the abundance of the species is distributed among all the species in the community. Typical values are generally between 1.5 and 3.5 in most ecological studies and the index is rarely greater than 4 (Kent and Coker, 1992).

Pielou Index

Species evenness was also measured using Pielou's index (J^I) = $\mathbf{H^I/H^I_{max}}$, where $\mathbf{H^I}$ is the number derived from the Shannon diversity index, $\mathbf{H^I_{max}}$ is the maximum possible value of H^I= ln(S) and S is the total number of species.

Species diversity can be partitioned into two components: *richness* and *evenness* (Chiarucci, Maccherini, and De Dominicis, 2001). Species evenness is a measure of the relative abundance of species that make up the richness of an area, with evenness being maximum (J=1) when all species have similar population size. The higher the values of J, the more even the species are in their distribution within quadrat (Kent and Coker, 1992). Mayden (1997) noted that species richness and species evenness are probably the most frequently used measures of the total biodiversity of a region. Species evenness (E) is a measure of equitability of spread.

RESULT AND DISCUSSION

WOODY VEGETATION DIVERSITY

Shannon index value (H^I) for 13 species encountered in parkland of Babura is 0.98 (Table 1). As it appears the value is well below 1.5 and this indicates low diversity. By this value, low species richness and evenness as well as apparent lack of order (entropy) can be concluded in the study area. Likely factors for the low Shannon index value in Babura are climate and ecological conditions of the area. However, rainfall is believed to be the dominant factor responsible for the low diversity and evenness

of species in the area perhaps due to the scientific evidences suggesting it to be a limiting factor in the drylands.

Table 1: Diversity Index for Woody Vegetation on Parkland in the Study Area

Botanical Names	Local Names	Shannon
Adansonia digitata	Kuka	0.11
Eucalyptus camaldulensis	Turare	0.11
Acacia sieberina	Farar kaya	0.11
Azadirachta indica	Darbejiya	0.10
Butyrespermum pakii	Kade	0.08
Balanite aegyptiaca	Aduwa	0.08
Anogeissus leiocarpus	Marke	0.05
Parkia biglobosa	Dorowa	0.05
Piliostigma reticulatum	Kalgo	0.05
Ziziphus spina-christii	Kurna	0.05
Fadherbia albida	Gawo	0.05
Diosphyros mespiliformis	Kanya	0.05
Tamarindus indica	Tsamiya	0.04
		H^I=0.98

Findings of this study on low diversity index corroborates Dikko (2012) with H^I (1.45) who found that that lack of evenness in Dabagi Forest Reserve resulted to low H^I value in the area studied and Danjuma (2017) which reported Shannon index of 1.225 parklands of dryland of northwestern Nigeria. It however disagrees with Ahmad (2012) with H^I (2.62) in Kogo Forest Reserve in Katsina State as well as Zakari (2015) with H^I (3.769), (3.767) and (2.628) in three sampled plots in Baturiya Wetlands in Jigawa State were high richness and evenness are observed.

WOODY VEGETATION EVENNESS

Species evenness for species in Babura area was calculated using Pielou's index. The J value for species in the area is 0.269 (Table 2). Being an indicator of evenness, this value is relatively low. It indicates high unevenness in the distribution of species in the area.

Table 2: Evenness Index for Woody Vegetation in Babura

Shannon Index	0.98
Total No. of Species	38
Evenness	**0.269**

Finding of this study on low J value of the study area confirms Danjibo (2015) who reported J value of 0.12091 in Kuwanka Banza Forest Reserve, Kebbi. It also corroborates Ndah, Andrew and Becham (2013) with J (0.90) for trees and J (0.87) for shrubs in Takamanda Rainforest in Cameroon.

Variations in J values may be connected to disproportionate human activities in the area which directly impinge on the evenness of plants especially on farmed parklands of the area. There are no limits to destruction of bushes for fuelwood and other uses in most villages studied. This agrees with Soulé (1991) that human activities though not limited to the direct destruction, conversion, or degradation of ecosystems can result to loss of entire assemblages of species.

CONCLUSION

Woody vegetation forms the basis of livelihood of many in Nigeria and developing countries at large. Severe losses of these resources especially in Nigeria have been reported in many studies including Nichol, 1989; Federal Government of Nigeria 2001; David 2008; Danjuma, 2010; Daura, 2011; Dikko, 2012. In both parkland and forest reserve, this study reveals that multipurpose woody species such *Butyreospermum parkii, Anoigeissus leiocarpus, Parkia biglobosa, Balanite aegyptiaca*, and *Diosphyros mespiliformis* are in severe state despite long term management. Our result indicated that the diversity index of the species (H^I 0.98) is low and well below 1.5 which is the threshold even in drier ecological zones of the world.

Although many drivers can be responsible for species depletion in the marginal north of Nigeria, this study therefore concluded that over exploitation is perhaps the most important factor responsible for the low diversity and evenness of species in the study area. However, persistent erratic rainfall in the study area may slow regenerative capacity of most plants in the study area.

RECOMMENDATIONS

1. Control of massive local exploitation of forest resources (particularly wood fuel) is recommended by this study. To achieve this, highly restrictive protected area management policies of the past should be complemented by new ones. Options with a minimal risk of increasing land conflicts such agroforestry should be encouraged in the surrounding areas.

2. Alternative sources of energy such as the clean and energy efficient stoves should be provided to local people to reduce the over-exploitation of woody vegetation in the study area.

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