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TREE COMPOSITION AND DISTRIBUTION IN FEDERAL UNIVERSITY OF AGRICULTUREMA KURDI, NIGERIA

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ABSTRACT

Savannah ecosystem plays an important role in the welfare and economy of man. It is at the center of human activities which greatly influence the structure, composition and abundance of all plants life forms. In recent time, there is upsurge of interest in conservation of African Savannah; however, there is dearth of accurate data on conservation and distribution of tree species in many part of Africa, of which Federal University of Agriculture Makurdi is not left out. This study therefore assessed tree species composition and distribution in Federal University of Agriculture Makurdi. Stratified and systematic sampling technique were applied in the laying of transects and plots. Four transects of 2km were laid in four land use types of Undisturbed area, Plantation, Wildlife Park and Residential Area. On each transects 4 plots of 50 x 50m were laid at regular interval of 500m. Species composition, species richness, evenness, diversity and similarity were estimated across the land use types. Data were analyzed using descriptive statistics. A total of 52 tree species in 48 genera and 22 families were recorded, with undisturbed area having the highest number of species of 26. Forty five percent families were represented by only one species. Species richness, evenness and diversity decreases from undisturbed area to residential area (D= 6.091-2.695), (J= 0.821-0.671), (H^1= 3.39-2.24). Undisturbed area and Wildlife Park were closely related. Even though, undisturbed area had the highest number of species, most of the species were juvenile species. It was recommended that Federal University of Agriculture Makurdi authority conservation effort be stepped up on the campus.

Key words: Abundance, conservation, distribution, Species composition, Structure,

INTRODUCTION

Savannas occupy sixty percent vegetation cover of sub-Saharan Africa and they are typified by the coexistence of woody plants and grasses (Sankaran *et al.,* 2005).The relative proportions of each of these species are being influenced predominantly by water availability, fire, nutrients, herbivory and people (Sankaran *et al.,* 2005).

Savannah ecosystem plays important roles in the welfare and economy of man. It is at the center of human activities that greatly influence the structure, composition and abundance of all plants life forms, but during the last century fragmentation and disturbance have accelerated (Lykke 1998).

Today there is an urgent need for conservation measures and adoption of sustainable use methods throughout Africa to avoid further degradation of the natural resources. According to Lykke (1998) scientific long-term data on vegetation changes are generally lacking for most savanna areas.

InNigeria, for instance there is limited accurate dataon flora composition. Thus species currently perceived as abundant

might actually be endangered while those previously perceived as endangered might be nearing extinction.

Therefore, this study was aimed at assessing the tree diversity, distribution and composition at theFederal University of Agriculture Makurdi, Nigeria. Because the patterns in tree species composition and structure are valuable parameters for vegetation monitoring (Zisadza-Gandiwa *et al.,* 2013); the woody vegetation component is suggested to provide a more reliable index on habitat status. It is believed that the study would contribute to the management and conservation of trees on the campus of the Federal University of Agriculture Makurdi.

Study Areas

This study was carried out at the Federal University of Agriculture Makurdi, which is located within the Southern Guinea Savanna zone on 8°35'E 8°41'E and 7°45'N, 7°52'N. The university is boarded by the river Benue to the south, close to River Guma in the East and to the west of the (Route A3) Makurdi to Lafia. The area is characterized by two distinct seasons; wet and dry season. The wet season occur between April to October, and dry season between November. Rain fall distribution is bimodal with the areas occurring in June and September. Mean annual rainfall is between 1000mm and 1500mm. Mean annual temperature is 30°c relative humidity i**s** between 60% and 80% wet but decreases in the early months of dry season (Jimoh*et al.,* 2009). The campus is divided into two: North core and south core.

The vegetation of the University of AgricultureMakurdi is open savannah woodland, characterized by predominantly fewer trees, more shrubs and predominantly tall grasses up to 2m tall. Forest formations are found in low land areas and river banks. Some of the species found in the area includes:*Danielliaoliveri, Vitelleriaparadoxa, Vitexdoniana, Hymenocordiaacida , Burkiaafricana, Khayasenegslensis,* and *Parkiabiglobosa*among others (Ikyaagba, 2008).

Sampling Design

The study used stratified sampling design to group the University land into four land use types:

Undisturbed area (UP), Plantation (PT), University of agriculture Makurdi Wildlife Park (WP) and Residential area (RT).The inventory was conducted on 4 transects of 2-km length x2m width. One transect was laid in each of the four land use types.

Systematic cluster sampling technique was used to establish plots on each of the 4 transects for Tree species enumeration. Each of the 4 transects consists of four 50x50m plots which were systematically located at a regular interval of 500m along the main transect (Brearley*et al*., 2004). Each of these plots was sub-divided into nine (9) subplots of 10 x 10m (8 located at the edge of the quadrants and one 1 at the centre).

Within the 50 x50 m plots, trees with DBH ≥ 10 cm were enumerated. Trees with DBH of ≤ 10 cm were also considered as tree and were enumerated within the 10 x10 m subplots. Each of the trees encountered was assigned a class based on DBH (Sullivan *et al.,* 2005, Turyahabwe and Tweheyo, 2010). Diameters of trees were measured using a diameter tape in case of larger trees. The identification of plants samples was carried out using flora Field guides (Keay, 1989).

Identified tree species were grouped into species and families and presented in tables, chats and percentages, relative frequency, relative density and Importance Value Index (IVI).

Importance Value Index(IVI) was calculated for tree species by summing relative frequency and relative density values for all

the tree species. IVI was used to identify dominant species in the study area.

The following formulas were used for each calculation (Maingi and Marsh, 2006; Adam *et al.,* 2007).

Frequency

$$\text{Frequency}(\text{F}) = \frac{\text{number of plots in which species occur}}{\text{Total number of plots sampled}}$$

Relative frequency

The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\text{Relative Frequency}(\text{R F}) = \frac{\text{species frequency of individual species}}{\text{Total of frequency value of all species}} \times 100$$

Density

$$\text{Density}(\text{D}) = \frac{\text{Number of individual species}}{\text{Area sampled}}$$

Relative density

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\text{Relative Density}(\text{RD}) = \frac{\text{species density of individual species}}{\text{Total density for all species}} \times 100$$

$$\text{Importance value index(IVI)} = \text{relative frequency} + \text{relative density}$$

Floristic composition in the various land use types were estimated using diversity indices such as species richness, diversity and evenness. Species richness was computed using Margalef (1951) as cited by Spellerberg (1991) and Magurran (2004) as follows:

$$D = \frac{(S-1)}{\ln N}$$

Where, D = species richness index (Margalef index), S = number of species and N = the total number of individuals.

Species diversity was estimated using Shannon- wiener diversity index as cited by Spellerberg (1991); Turyahabwe and Tweheyo (2010). Shannon- wiener diversity index equation is stated as:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Where H' = species diversity index, pi = the proportion of individuals or the abundance of the i^{th} species expressed as a proportion of the total abundance. The use of natural logs is usual because this gives information in binary digits.

Species evenness was estimated usingPielou's evenness (equitability) index (Pielou, 1975) as cited by Turyahabwe and Tweheyo (2010) as followed:

$$J' = \frac{H'(observed)}{H_{\max}}$$

J' = Pielou's evenness index. Where H' (observed) / H_{max}, where $H_{max}$is the maximum possible diversity, which would be achieved if all species were equally abundant (=Log S)

The indices were computed for all tree species in (trees, in each plot and land use type.

Jaccard similarity coefficient:

$$S_J = \frac{a}{(a + b + c)}$$

S_J = Jaccard similarity coefficient,

a = number of species common to (shared by) quadrats,

b = number of species unique to the first quadrat, and

c = number of species unique to the second quadrate

Result

Tree Species Composition in the Study Area

A total of 52 tree species in 48 genera and in 22 families were recorded. Thirty six (36) species were recorded in the undisturbed area with the least number of species recorded in residential area 14 (Table 1 and 2). *Maranthespolyandra* (benth) Prance was the most important tree species in the undisturbed area with IVI value of (10.44). *Hymenocradiaacidia* had *IVI* value of (18.63) in plantation, in wildlife park it was *Afzeliaafricana*with IVI value of (11.41) while *Leucaenaleucocephala* hadthe highest IVI value (36.33) in residential area (table I) for the abundant the table shows that *Maranthespolyandra*had the highest RD value (7.5) undisturbed area, for Wild life Park it was *Afzeliaafricana* (8.33). *Leucaenaleucocephala* was the highest in residential area (16.33) with *Hymenocadiaacida* was the most abundant special plantation with RD value of (13.22).

The study area

S/N	Species	Family	UP	PT	RP	WP
1	*Acacia seyal* Del.	Mimosaceae	6	0	0	0
2	*Afzeliaafricana*	Caesalpinioideae	19	0	0	17
3	*Albizialabbeck*	Mimosoideae	0	0	22	0
4	*Allophylusspicatus* (Poir.) Radlk.	Sapindaceae	0	0	25	0
5	*Anacardiumoccidentale* L.	Anacardiaceae	0	0	6	0
6	*Annonasenegalensis*Pers	Annonaceae	12	0	0	8
7	*Anogeissusleiocarpa* (DC.) Guill. &Perr.)	Combretaceae	10	4	0	6
8	*Azadirachtaindica*A. Juss	Meliaceae	0	0	10	0
9	*Brideliaferruginea*Benth.	Euphorbiaceae	7	2	0	1
10	*Burkiaafricana*Hook L	Caesalpiniaceae.	22	0	0	7
11	*Combretummolle*	Combretaceae	0	0	0	0
12	*Combretumnigricans*	Combretaceae	1	0	0	1
13	*Crossopteryxfebrifuga*	Euphorbiaceae	9	0	0	2
14	*Danielliaoliveri*	Caesalpinioideae	7	10	0	11
15	*Delonixregia*	Caesalpinioideae	0	0	13	0
16	*Entadaafricana*Guill. &Perr	Mimosoideae	2	0	0	1
17	*Ficussur*Forssk	Moraceae	8	0	0	7
18	Ficussycomorus L	Moraceae	5	0	0	2
19	*Gardenia aqualla*Stapf& Hutch	Rubeaceae	4	3	0	1
20	*Gardenia erubescens*Stapf& Hutch.	Rubeaceae	0	0	3	0
21	*Gmelinaarborea*Roxb.	Verbenaceae	0	8	0	0
22	*Huracrepitans*Linn	Euphorbiaceae	0	0	7	0

23	*Hymenocardiaacida*Tul	Euphorbiaceae	5	16	0	8
24	*Khayasenegalensis*	Meliaceae	5	0	2	3
25	*Kigeliaafricana* (Lam.) Beneth	Bignoniaceae	16	1	0	12
26	*Lanneaschimeriana*	Anacardiaceae	0	0	0	1
27	*Leucaenaleucocephala* (Lam.) de Wit	Mimosaceae	0	0	24	0
28	*Lophiralanceolata*Tiegh. ex Keay	Ochnaceae	20	13	5	4
29	*Maranthespolyandra* (Benth.) Prance	Chrysobalanaceae	24	3	0	10
30	*Maytenussenegalensis* (Lam.) Exell,	Celastraceae	11	7	0	99
31	*Parkiabiglobosa*(Jack.) G. Don.	Mimosaceae	8	5	0	4
32	*Pericopsislaxiflora* (Baker) Meeuwen	Papilionoideae	10	0	0	8
33	*Piliostigmathonningii*Schum	Caesalpinioideae	8	0	0	2
34	*Proposisafricana*(Guill. & Perr.) Taub.	Mimosoideae	4	3	0	10
35	*Pseudocedrelakotschyi* (Schweinf.) Harms	Meliaceae	1	0	0	4
36	*Psidiumguajava*L	Myrtaceae	0	0	1	0
37	*Pterocarpuserinaceus*Poir.	Papilionoideae	10	8	0	4
38	*SarcocephalusLatifolius*	Rubeaceae	0	2	0	0
39	*Seminiasemana*		0	0	1	0
40	*Steculiasetigera (J.E. Smith) E.A. Bruce*	Rubeaceae	10	1	0	7
41	*Stereospermumkunthianum* Cham	Bignoniaceae	10	0	0	8
42	*Strychnosspinosa* Lam.	Loganiaceae	4	0	0	2
43	*Syzygiumguineense* (Willd.) DC	Myrtaceae	9	0	0	5
44	*Tectonaglandis*L	Lamiaceae	0	7	0	0
45	*Terminaliaglaucescens*. Planch. ex Benth	Combretaceae	5	5	0	12
46	*Terminaliaschimperiana*Hochst.	Combretaceae	4	10	0	5
47	*Thevetianeriifolia*Juss	Apocynaceae	0	0	26	0
48	*Trichiliaemetica*Vahl		2	0	0	1
49	*Uvariachamae* P. Beauv	Annonaceae	8	0	0	0
50	*Vitellariaparadoxa*G. Don	Sapotaceae.	5	0	2	2
51	*Vitexdoniana*Sweet	Verbenaceae	14	7	0	8
52	*Zanthoxylumzanthoxyloides* (Linn.) Waterman,	Rutaceae	8	0	0	8

NOTE: UP=Undisturbed area, PT= Plantation, WP= University of agriculture Makurdi Wildlife Park and RT = Residential area

Table 2: Tree species important value index in the study area

Species	Undisturbed			Plantation			Residential			WildlifE Park		
	RF	RD	IVI	RF	RD	IVI	RF	RD	IVI	RF	RD	IVI
Acacia sayal	1.47	1.88	3.35	0	0	0	0	0	0	0	0	0
Afzelia Africana	2.94	5.94	8.89	0	0	0	0	0	0	3.08	8.33	11.41
Albizia labbeck	0	0	0	0	0	0	0	14.97	14.97	0	0	0
Allophyluss picatus	0	0	0	0	0	0	0	17.01	17.01	0	0	0
Anacardium occidentale	0	0	0	0	0	0	10	4.082	14.08	0	0	0
Annona sengalensis	2.94	3.75	6.69	2.7	0	2.70	0	0	0	3.8	3.92	7.00
Anogeissus leiocarpa	1.47	3.13	4.60	5.41	3.31	8.71	0	0	0	3.83	2.94	6.02
Azadirachta indica A. Juss	0	0	0	0	0	0	0	6.80	6.801	1.54	0	1.54
Bridelia ferruginea	1.47	2.19	3.66	2.70	1.65	4.36	0	0	0	1.54	0.49	2.03
Burkia Africana	2.94	6.88	9.82	0	0	0	0	0	0	3.08	3.43	6.51
Combretum molle	0	0	0	0	0	0	0	0	0	3.08	1.47	4.55
Combretum nigricans	1.47	0.31	1.78	0	0	0	0	0	0	1.54	0.49	2.03
Crossopteryx febrifuga	2.94	2.81	5.75	0	0	0	0	0	0	1.54	0.98	2.52
Daniellia oliveri	2.94	2.19	5.13	5.41	8.26	13.67	0	0	0	3.08	5.39	8.47
Delonix regia	0	0	0	0	0	0	0	8.84	8.84	3.08	0	3.08
Entada Africana	2.94	0.63	3.57	0	0	0	0	0	0	1.54	0.49	2.03
Ficus sur	2.94	2.5	5.44	2.70	0	2.70	0	0	0	3.08	3.43	6.51
Ficus sycomorus	2.94	1.56	4.50	2.70	0	2.70	0	0	0	1.54	0.98	2.52
Gardenia aqualla	2.94	1.25	4.19	5.41	2.48	7.884	0	0	0	1.54	0.49	2.03
Gardenia erubescens	0	0	0	0	0	0	0	2.04	2.04	1.54	0	1.54
Gmelina arborea	0	0	0	5.41	6.61	12.02	0	0	0	0	0	0
Hura crepitans	0	0	0	0	0	0	20	4.76	24.76	0	0	0
Hymenocardia acida	2.94	1.56	4.50	5.41	13.22	18.63	0	0	0	3.08	3.92	7.00
Khaya senegalensis	2.94	1.56	4.50	0	0	0	10	1.36	11.36	3.08	1.47	4.55
Kigelia Africana	2.94	5	7.94	2.70	0.83	3.53	0	0	0	3.08	5.88	8.96
Lanneaschimeriana	2.94	2.19	5.13	2.70	0	2.70	0	0	0	1.54	0.49	2.03
Leucaenaleucocephala	0	0	0	0	0	0	20	16.33	36.33	0	0	0
Lophiralanceolata	2.94	6.25	9.19	5.41	10.74	16.15	0	3.40	3.40	3.8	1.96	5.04
Maranthespolyandra	2.94	7.5	10.44	5.41	7.44	12.84	0	0	0	3.8	4.9	7.98
Maytenussenegalensis	2.94	3.44	6.38	5.41	5.79	11.19	0	0	0	3.08	4.4	7.49
Parkia biglobosa	2.94	2.5	5.44	5.41	4.13	9.54	0	0	0	3.08	1.96	5.04
Pericopsis laxiflora	2.94	3.13	6.07	0	0	0	0	0	0	3.08	3.92	7.00
Pilliostigma thonnigii	2.94	2.5	5.44	0	0	0	0	0	0	1.54	0.98	2.52
Proposis Africana	2.94	1.25	4.19	5.41	2.48	7.88	0	0	0	3.08	4.90	7.98
Psedocedrelakotschyii	1.47	0.31	1.78	0	0	0	10	0	10	3.08	1.96	5.04
Psidiumguajava	0	0	0	0	0	0	10	0.68	10.68	0	0	0

Pterocarpuserinaceus	2.94	3.13	6.07	5.41	6.61	12.02	0	0	0	3.08	1.96	5.04
SarcocephalusLatifolius	0	0	0	2.70	1.65	4.36	0	0	0	0	0	0
Seminiasemana	0	0	0	0	0	0	10	0.68	10.68	0	0	0
Steculiasetigera	2.94	3.13	6.07	0	0.83	0.83	0	0	0	3.08	3.43	6.51
Stereospermumkunthianum	2.94	3.13	6.07	0	0	0	0	0	0	3.08	3.92	7.00
Strychnosspinosa	2.94	1.25	4.19	0	0	0	0	0	0	1.54	0.98	2.52
Syzygiumguineense	2.94	2.81	5.75	0	0	0	0	0	0	3.08	2.45	5.53
Tectonaglandis	0	0	0	5.41	5.79	11.19	0	0	0	0	0	0
Terminaliaglaucescens	2.94	1.56	4.50	5.41	4.13	9.54	0	0	0	3.08	5.88	8.96
Terminaliaschimperiana	2.94	1.25	4.20	5.41	8.26	13.67	0	0	0	3.08	2.45	5.53
Thevetianerifolia	0	0	0	0	0	0	10	17.69	27.69	0	0	0
Trichiliaemetica	1.47	0.63	2.10	0	0	0	0	0	0	1.54	0.49	2.03
Uvariachamae	2.94	2.5	5.44	0	0	0	0	0	0	0	0	0
Vitellariaparadoxa	2.94	1.56	4.50	0	0	0	0	1.36	1.36	1.54	0.98	2.52
Vitexdoniana	2.94	4.38	7.32	5.41	5.79	11.19	0	0	0	3.08	3.92	7.00
Zanthoxylumzanthoxyloides	2.94	2.5	5.44	0	0	0	0	0	0	3.08	3.92	7.00

Tree familyrepresentation

A total of plant 22 families were recorded in the study are (Figure 1) the result in Figure 1reveals that 30(45%) of the families were represented by one species each. The dominant family was *mimosoideae* with 7 species this was followed by *combretaceae* and *Caesalpinoideae* with 5 species each.

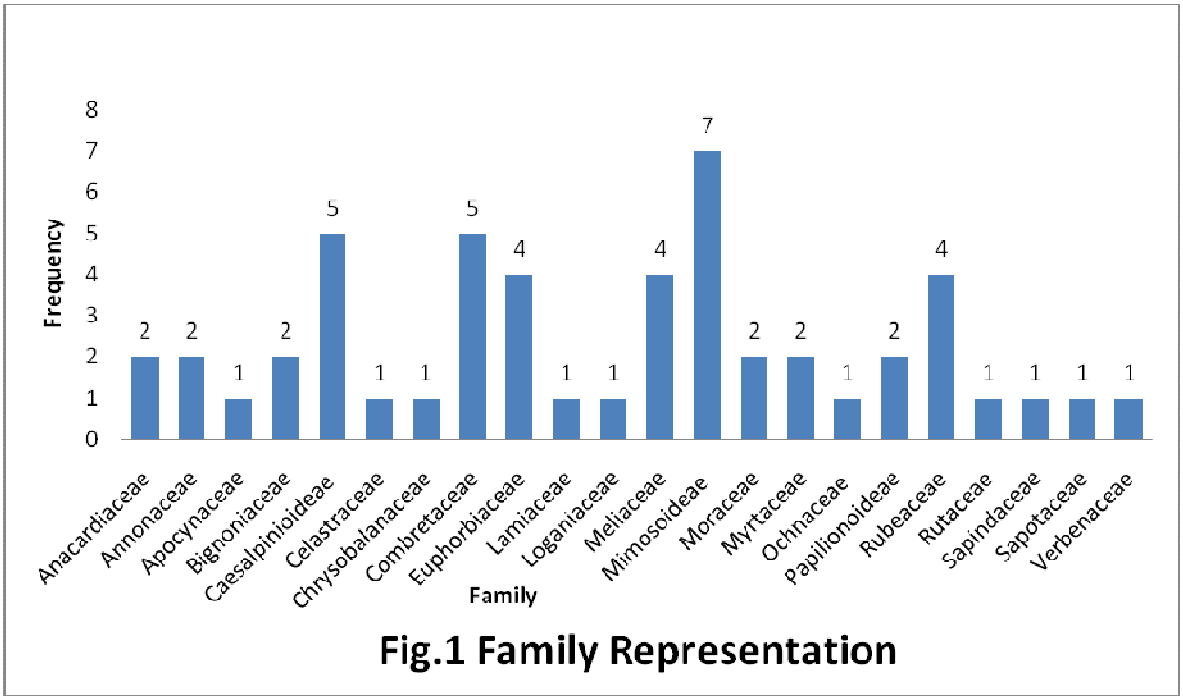

Fig.1 Family Representation

Species Diversity

The undisturbed area had the highest values for tree species richness, evenness and diversity (D =6.091), (J´= 0.82) and (H'= 2.24). This was followed by wildlife park (D =5.993) and (H'= 2.804)(table 3).

Similarity Index

Jaccard similarity index showed high similarity for trees between undisturbed and Wildlife Park 11.3 and the low value between the residential area and plantation 0.03. (Table 4)

DBH Class Distribution

As shown in figure 2. Undisturbed area had the highest number of tree spices in all DBH class with residential area recorded no species in the class below 20, also Wildlife Park recorded the least number in the other classes.

Table 3: Tree Species Diversity Indices across Land Use Types in the Study Area

	UP	PT	RP	WP
Taxa_S	36	19	14	35
Individuals	313	115	147	291
Shannon_H	3.386	2.726	2.24	2.804
Evenness_e^H/S	0.8209	0.8037	0.6709	0.4716
Margalef	6.091	3.794	2.605	5.993

Ikyaagba

Table 4. Tree Species Similarity Index

pairing	index
UP VS PT	0.73
UP VS RP	0.07
UP VS WP	11.3
WP VS RP	0.07
WPVS PT	0.73
RPVS PT	0.03

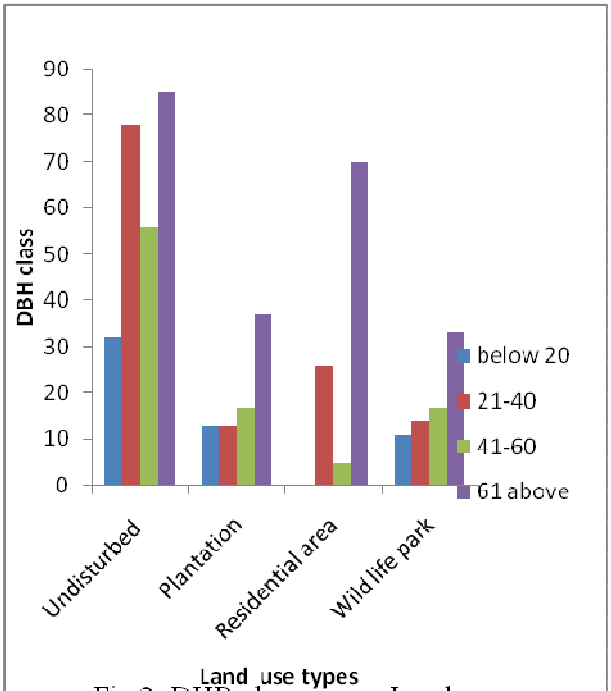

Fig.2 DHB class across Land use types in the study area

Discussion, Conclusion and Recommendation

Tree Composition

The composition of tree at the Federal University of AgricultureMakurdi is typical of West African Guinea Savanna (Abbey, 2006).Most of the tree species found in this area can withstand fire. The number of tree species (52) recorded in this study is higher than the 26 recorded by Iwara*et al*.(2012) in Ugep Cross River state, Nigeria, in a transitional savanna ecosystem.

The representation of most families by one or two species is a peculiar feature of savanna vegetation and also typical of West African Families (Abbey 2006, Richard 2007) however the biological implication of this poor representation is that if urgent steps are not taken, some of these families and species may go extinct. Similar view was expressed by Ikyaagba (2008). The study also identified Mimosoideae, Combretaceae, Eupherbiaceae, as the most represented families, this is similar to the findings of Lykke (1998), Asase and Oteng – Yeboah, (2007),Asase*et al.* (2009) and Attua and Pabi (2013) in Ghana and Ikyaagba (2008) in Nigeria. The high number of leguminous trees (*Parkia biglobosa, Proposis Africana* and others*)* found in the study area could be attributed to their role in rural livelihood and soil fertility which earned then protection (Attua and Pabi 2013)

Species Distribution Density and Diversity

The variation in tree species composition recorded between the land use types in the study area could be linked to disturbance from human activities such as farming, fuel wood collection, Charcoal production and timber exploitation (Hooper *et al*., 2005; Spiegelberger*et al*., 2006). According to Hooper *et al*. (2005) and Spiegelberger*et al*. (2006) land use changes are responsible for decrease species richness and diversity. Ikyaagba (2008) also made similar conclusion.The study also shows that most of the species in the residential area were exotics species; *Albizia labbeck, Delonix regia, Leucaena l*

LophiralanceolataBurkiaafricana, Afzeliaafricana, despite the pressure from the communities,are still thriving in the undisturbed area and Wildlife Park. This implies that if conservation measures are put in place many species would be saved from becoming threaten or extinct in the area.

SimilarityIndex and diameter class distribution

The similarity recorded between undisturbed area and Wildlife Park could be due to reduced human impact compared to plantation and residential area. Giliba *et al.* (2011) reported that human activities play a key role in tree distribution in an ecosystem. The result of the study clearly shows that even though some of the tree species were numerous in

the park, they were not of merchantable size. This could be a sign that human activities are now going on in the protected area. This is a major challenge to protected areas in Africa (Struhsaker*et al*., 2005).

Conclusion and Recommendation

The study of tree species composition and distribution at the Federal University of Agriculture Makurdi concludes that the university has rich and diverse tree species. About 52 tree species in 48 genera and 22 families were recorded. *Maranthes polyandran* and *Hymenocardiaacidia* were striving in the University despite the pressure. Undisturbed area was seen to favour species composition and distribution with high specie in richness, evenness and diversity index. It was clear from the study that there is no discrepancy between undisturbed area and University of Agriculture Wildlife Park. It is therefore, recommends that University of Agriculture Makurdi should stop the grazing and farming in this areas in other to make good and proper implementation of conservation and sustainable management strategies and as a matter of necessity in these areas. Illegal harvesting of resources in the Park and plantation should be checked through proper monitoring and creation of awareness on the value of these reserves.

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