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A PRELIMINARY SURVEY OF TREE SPECIES DIVERSITY: A CASE STUDY OF FEDERAL UNIVERSITY WUKARI

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ABSTRACT
The impact of anthropogenic activities on tree species diversity of a selected sub-sample of the Federal University Wukari Campus comprising of four sampling Sites (A, B, C and D) was investigated using the Shannon-Wiener, Margalefs and Menhinik diversity indices. Tree felling is the commonest human activity. The infrastructural developments and anthropogenic activities among the four sampling sites ranges from low to high. A total of 203 individual tree species of 20 species from 15 families was encountered in the study area. The dominant families were Arecaceace, Fabaceae, Anacardiaceae, Lamiaceae and Moraceae. *Elaies guineensis* (80) was the most dominant tree species with the highest relative density (RD) of 39.4% at Site D while the lowest RD of 0.49 were encountered at Sites A, B and C. The most abundant tree species were *Elaies guineensis* and *Mangifera indica* due to their economic importance. About 35% of the trees were exotic while 65% were native. A high Shannon-Wiener index value of 0.78 and Margalefs index value of 14.869 were observed. Analysis of the diversity indices of the 20 species reveals the sensitivity of the Shannon-Wiener index than the Margalefs index, though the two indices shows relative diversity of tree species according to their ranges. The high population size of the indigenous trees with higher economic uses is a strong indicator of loss of tree genetic resources that play critical roles in local diversification of the ecosystems to make them more resilient for what is to come with respect to climate change regulation.

Keywords: Arecaceae, Elaies guineensis, Fabaceae, Mangifera indica, Margalefs richness index, Mehinik index, Shannon-Weiner index, Relative Density, Tree diversity

INTRODUCTION
Over the years trees have undergone different levels of disturbance due to unprecedented increase in human population, which have led to cutting of trees for firewood collection, charcoal production, urbanization and infrastructural developments (Omoro *et al.*, 2010; Anongo, 2012). This has impacted tree diversity, abundance, species composition, indigenous knowledge of tree flora and conservation. The XXI century is experiencing a dramatic decline of global biological diversity, which is more evident in tropical regions (Cazzolla, 2016a), and it is mainly due to increasing anthropogenic impacts (Battipaglia *et al*., 2015; Cazzolla, 2016b; Cazzolla, 2016c). The result is a fragmented landscape from Guinea to Nigeria, composed of patches of forest interspersed in a rural environment (VaglioLaurin *et al.*, 2013). Understanding tree composition and structure is a vital instrument in assessing the sustainability of the local biotic community species conservation and management of disturbed ecosystem. An understanding of the diversity and stand structure of trees is critical for climate change regulation, because their manipulation can allow creation of trees that absorbed more carbon-dioxide. Biological diversity has become a widely recognized descriptor of the status of communities and ecosystems for its role in community stability (Ogwu *et al*., 2016).
Trees provide immeasurable services to man and to the environment generally (Ogwu *et al*., 2016). The tree floras of the Federal University Wukari are mostly indigenous and dispersed by man, and recently there have been cases of tree felling. Therefore, the focus of this research is to identify the tree flora in a sub-section of the Federal University Wukari Campus, to document and assess their diversity and usefulness so as to promote their proper utilization and safe keeping. To also enlighten them on the benefits of conserving these trees so as to encourage their sustainable utilization and preservation.
Therefore, it is important that trees are constantly monitored in other to determine whether diversity is been maintained or not. This research is a preliminary data monitoring survey which could be used as a baseline for future studies aimed at the analysis of environmental changes. A university campus should be promoted and was also used as a model environment for sustainable development.

MATERIALS AND METHODS
Taraba is bordered to the north by Bauchi and Gombe States, to the east by Adamawa state, to the south by Cameroon, and to the west by Benue, Nassarawa, and Plateau States and with wooded savannah in the northern region and derived Guinea savannah in the southern region of the State.
The study site is the Federal University Wukari located in the north –eastern region of Wukari Taraba State between latitude (7°50'37"N) and longitude (9°46'30''E). Geo-politically,Wukari is located in the southern region of the state on longitude 9°7ˋ83''E and latitude 7°8ˋ50''N. Wukari is bounded to the north-west by Benue state, to the South-east Takum local government area, and north-east by Bali, Karim-Lamido and Gassol Local Government areas of Taraba State and characterised by river valley systems and lowlands.
Data for the preliminary survey was collected in the early wet season of June 2018. Wet season occurs in Nigeria between April and October in the south while in the North, the start of rainy season is often delayed till June.
Global positioning system device was used to record the coordinates of the four sampling sites as shown in table 1. Field inventory of tree flora was adopted for data collection.

Four sampling sites were selected within the study area representing maximum (Sites C = Administrative block and D = FUW Staff School) and minimum (Sites A = Female student's hostel and B = Male student's hostel) anthropogenic activities for accurate recording of different tree species. Perimeter fence was used as transect for Sites A and B while Sites C data was collected from the administrative block through the Faculty of Humanities down to Cafeteria using the main road as transect. The main road towards the school was used as transect for the FUW Staff School. Throughout the survey, all the tree species encountered within the sampling sites were recorded. Tree species identification were identified with the aid of tree identification guide books, including Tropical Tree Crops (Okpeke, 1987), Trees of Nigeria (Keay, 1989), Flora of West Tropical Africa (Hutchinson and Dalziel, 1958-1968), Useful Plants of West Tropical African (Burkill, 1985; 1994; 1995; 1997 and 2000). Identification of taxonomic species was also aided with the use of local names.

Table 1: GPS Readings of the Sampling Sites

Sampling Sites	Latitude	Longitude
Site A	7°50'35''N	9°46'32''E
Site B	7°50'36''N	9°46'30''E
Site C	7°50'36''N	9°46'36''E
Site D	7°50'48''N	9°46'34''E

Three species diversity indices were used to determine the diversity of tree species in the study area. They include:
Margalef species richness index (d), which is used as a simple measure of species richness according to Margalef (1958).

$$\mathbf{d} = \frac{(S-1)}{InN}$$

Where S = total number of species; N = total number of individuals in the site and In = natural logarithm.
Shannon-Weiner index (H), which is the measure of diversity within a site according to Shannon and Wiener (1949).

$$H' = -\sum_{i}^{s} pi \ln(pi)$$

Where Pi = S / N, S = number of individuals of one species; N = total number of all individuals in the site and In = logarithm to base e

Sørensen similarity coefficient (CS), which measures similarity in species composition for two sites, according to Sørensen (1948).

$$\mathbf{Cs} = \frac{2a}{(2a+b+c} X\ 100$$

Where a = number of species found in both sites; b = number of species found only in site A and c = number of species found only in site B. Expressed as a percentage of similarity or dissimilarity.

Relative density of species (RD)

$$\mathbf{RD} = \frac{number\ of\ individual\ species}{total\ number\ of\ trees} X\ 100$$

Relative abundance of species (Pi)

$$\mathbf{Pi} = \frac{relative\ density\ of\ species}{100}$$

RESULTS AND DISCUSSION

Various studies on tree composition and usefulness have been carried out in similar environments (Iheyen *et al*., 2009; Kankara *et al*., 2015; Ogwu *et al*., 2016). Tree diversity portrays the number and variety of different species in a given area. Loss of tree diversity contributes to loss of diversity of animal life that depends on these trees for survival. Despite the relative diversity of the tree flora recorded from a sub-section of the University community, their diverse services to man have reveals that each tree has its own notable usefulness. A total of 203 trees belonging to 20 species were recorded as shown in table 2. Among the four sampling Sites A,B,C and D, Site D (Staff School area) has the highest population size (146) of trees and highest species diversity while site B recorded a population size of one tree (*Mangifera indica*) (Table 2). Among the tree species, *Elaeis guineensis* had the highest population size of 80 individual species than followed by *Mangifera indica* (Site B)(Table 2, Figure 1. Site C was next to site D in tree spp and population size of 44(Table 2). *Mangifera indica* was the commonest tree observed on all the sampling sites with the least number found on Site B. (Table 2). Figure 1 shows the distribution of tree species diversity among the four sampling sites (Sites A, B, C and D). In contrast to this study, Abdullahi and Abba, 2021, remarked that *Azadirachta indica* was the most abundant tree in Kumo town Gombe State. This is due to the reafforestation measures by the Federal Government to curb the menace of desertification in the early 1970s/1980s.

A total of 15 families from the 20 tree species were observed from the four sampling sites of the study area (Table 3). *Elaies guineensis* and *Mangifera indica* had the highest relative density (RD) of 39.4 and 15.76 respectively, while *Eucalyptus, Afromosia*, Teak, Wild syringe, Fig tree, fan palm had the least RD(0.49)(Table 4). This indicate abundance and high utilization of these species for great economic benefits for timber, medicinal, fuelwood, commercial purposes, except the fan palm that is an exotic tree newly introduced for beautification of the University premises. The high RD of Oil palm and Mango is also related to their ecological/economic uses, like curbing erosion, shade, food, fodder, fuelwood, income , medicinal thereby resulting to the unconscious and genuine sustainable management by the community. Low RD reflects endangerment or vulnerability of such tree species. However, aggressive conservation measures needs to be taken for sustainable management of indigenous species for local resilient to climate change regulation (Anongo, 2012). Site D has the highest number of indigenous /native trees while site B had only one tree (Table 4).

Table 2: Total count of Tree flora within the Sampling Sites

COMMON NAME	BOTANICAL NAME	SITE A (Female Hostel)	SITE B (Male Hostel)	SITE C (Admin Area)	SITE D (Staff School)	TOTAL
African Peach Plant	*Nauclea latifolia*	0	0	0	2	2
African plum tree	*Vitex doniana*	0	0	1	7	8
Afromosia	*Pericopsis elata*	1	0	0	0	1
Bouldia	*Newbouldia laevis*	0	0	9	1	10
Cashew	*Anacardium occidentale*	0	0	0	3	3
Daniella	*Danielli olivieri*	0	0	2	1	3
Fan Palm	*Livistona chinensis*	0	0	0	1	1
Ficus	*Ficus* spp.	0	0	2	8	10
Fig Tree	*Ficus carica*	0	0	0	1	1
Gmelina	*Gmelina arborea*	0	0	0	4	4
Guava	*Psidium guajava*	2	0	0	1	3
Gum tree	*Eucalyptus spp.*	0	0	1	0	1
Mango	*Mangifera indica*	9	1	16	6	32
Moringa	*Moringa oleifera*	0	0	1	7	8
Neem	*Azadirachta indica*	0	0	3	15	18
Oil Palm	*Elaeis guineensis*	0	0	0	80	80
Orange	*Citrus sinensis*	0	0	2	0	2
Shea Butter	*Vitelleria paradoxa*	0	0	5	9	14
Teak	*Tectona grandis*	0	0	1	0	1
Wild Syringe	*Burkea africana*	0	0	1	0	1
TOTAL		12	1	44	146	203

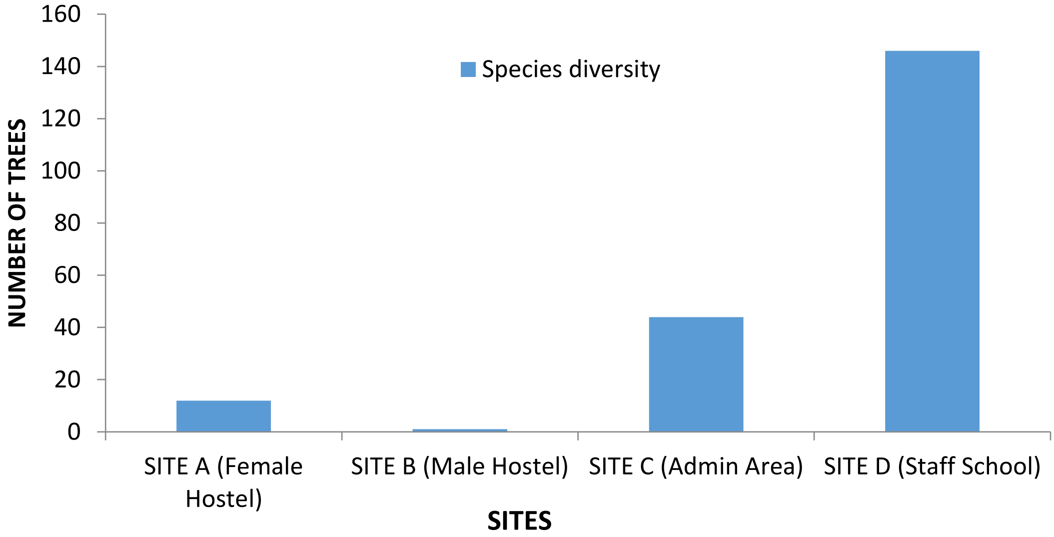

Figure 1: Total Tree Flora Count among the Sampling Sites

Dicotyledonous species was the most abundant plant group recorded from the 20 species observed (Table 4). All the trees observed in the sub-section of the study area were 100% Angiosperm from the 203 trees recorded (Table 4) and about 35% were exotic while 65% were native. In contrast, Ogwu *et al*., 2016 reported that 73.41% of the trees encountered in the Ugbowo Campus of the University of Benin were exotic and 26.59% were native trees. The families Anacardiaceae, Aracaceae, Fabaceae, Lamiaceae and Moraceae were the most abundance in the study area (Figure 2). Iheyen *et al*. (2009) reported the Fabaceae family as the most abundant family in Ehor Forest Reserve, Edo State while Ogwu *et al.*, (2016) recorded the Aracaceae and Fabaceae families as the most abundant in University of Benin Ugbowo campus.

Predominance of these families may be as a result of their efficient seed dispersal mechanism. Most members of the Fabaceae family are wind dispersed, hence may account for their widespread occurrence and they could compete and displace the native trees. In addition, the high occurrence of the family Fabaceae could be explained by the fact that most species belonging to the Fabaceae family are mostly found throughout the seasons because they are adapted to withstand the adverse effects of Sahel regions (Kankara *et al*., 2015). Also, the high occurrence of Fabaceae, Moraceae and Anacardiaceae in this research are related to their many economic uses like income generation, varied medicinal purposes (Ahmed *et al*., 2017), food/condiments, fodder, shade, etc resulting to sustainable conservation by the community. This agrees with the findings of Garba *et al*., 2021, with regard to the economic uses of the tree flora from the different biotic zones of Nigeria.

Also according Ogwu *et al*., 2016, the seven species out of the 20 species encountered in the study area with a RD of less than 1 could be considered vulnerable or endangered within the study area. However, only a sub-sample of the tree flora on the University Campus have been identified and recorded. Further studies in the other sections yet to be investigated need to be conducted.

Table 3: Families and their number of Tree Species recorded at the Study Sites.

Family	Number of trees species
Anacardiaceae	2
Aracaceae	2
Bignoniaceae	1
Caesalpiniaceae	1
Fabaceae	2
Lamiaceae	2
Maliaceae	1
Moraceae	2
Moringaceae	1
Myrtaceae	1
Rosaceae	1
Rubiaceae	1
Rutaceae	1
Salicaceae	1
Sapotaceae	1

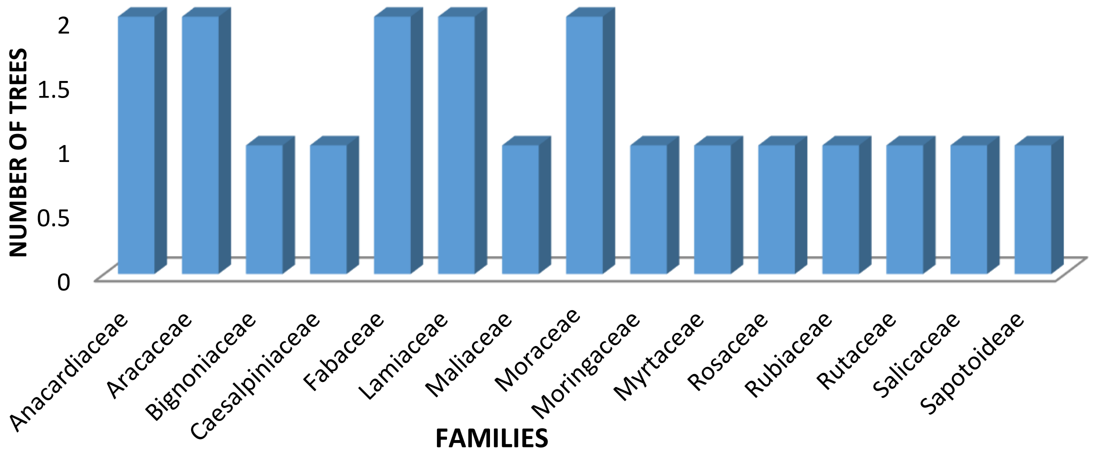

Figure 2: Graphical illustration of total trees species among Families

Table 4: Trees species, their relative density, relative abundance, Margalef species richness and Shannon-Wiener diversity indices.

Common / Botanical Names	RD	Pi	Origin	Plant Group	HPC	D	H	Total Count of Tree Flora on Sampling Sites				
								A	B	C	D	(TOTAL)
African Peach Plant (*Nauclea latifolia)*	0.98	0.01	N	D	A	0.188	0.034	0	0	0	2	2
African plum tree (*Vitex doniana)*	3.94	0.04	N	D	A	1.317	0.088	0	0	1	7	8
Afromosia (*Pericopsis elata)*	0.49	0.005	N	D	A	*0*	0.02	*9*	*0*	*0*	1	1
Fence Tree/Bouldia (*Newbouldia laevis)*	4.93	0.05	N	D	A	1.694	0.1	*0*	*0*	*9*	*1*	10
Cashew (*Anacardium occidentale)*	1.48	0.015	E	D	A	0.376	0.046	*0*	*0*	*0*	*3*	3
Daniella (*Danielli olivieri)*	1.48	0.015	N	D	A	0.376	0.046	*0*	*0*	*2*	*1*	3
Fan Palm (*Livistona chinensis)*	0.49	0.005	E	M	A	*0*	0.02	*0*	*0*	*0*	*q*	1
Fig tree (*Ficus* spp)	4.93	0.05	N	D	A	1.694	0.1	*0*	*0*	*2*	*8*	10
Fig Tree (*Ficus carica*)	0.49	0.005	N	D	A	0	0.02	*0*	*0*	*0*	*1*	1
Gmelina (*Gmelina arborea)*	1.97	0.02	E	D	A	0.565	0.056	*0*	*0*	*0*	*4*	4
Guava (*Psidium guajava*)	1.48	0.015	E	D	A	0.376	0.046	*2*	*0*	*0*	*1*	3
Eucalyptus spp	0.49	0.005	E	D	A	0	0.02	0	0	1	0	1
Mango (*Mangifera indica*)	15.76	0.16	N	D	A	5.835	0.159	*9*	*1*	*16*	*6*	32
Moringa (*Moringa oleifera*)	3.9	0.039	N	D	A	.317	0.088	*0*	*0*	*1*	*7*	8
Neem (*Azadirachta indica*)	8.89	0.089	E	D	A	3.199	0.134	*0*	*0*	*3*	*15*	18
Oil Palm (*Elaeis guineensis)*	39.4	0.39	N	M	A	14.869	0.78	*0*	*0*	*0*	*80*	80
Orange (*Citrus sinensis)*	0.99	0.01	N	D	A	0.188	0.03	*0*	*0*	*2*	*0*	2
Shea Butter (*Vitelleria paradoxa*)	6.70	0.067	N	D	A	2.477	0.120	*0*	*0*	*5*	*9*	14
Teak (*Tectona grandis*)	0.49	0.005	N	D	A	0	0.02	*0*	*0*	*1*	*0*	1
Wild Syringe (*Burkea Africana)*	0.49	0.005	N	D	A	0	0.02	0	0	1	0	1
												203

Keys: RD = Relative Density, Pi = Relative abundance, D = Margalef species richness index, H = Shannon-Wiener diversity**.**

According to the Shannon-Wiener index ranges of high scores (close to 1) indicate high diversity while low scores (close to 0) indicate low diversity (https://www.bhangarmahavidyalaya.in>), the Shannon-Wiener diversity index in this study reveals low species diversity. The value of the Shannon-Wiener diversity index usually ranges from 1.5 to 3.5 and only rarely exceeds 4.5 (Ortiz-Burgos, 2015).
However, the Margalefs species richness index reveals a high species richness for Oil palm(14.869) followed by Mango, Neem, Sheabutter, African plum tree, *Newbouldia laevis, Ficus* spp and *Moringa* (5.835; 3.199; 2.447; 1.317; 1.694;1.694; 1.317) (Table 4). Values of Margalefs index ranges from 0 to 8 and the higher values indicate a higher diversity of species (https://www.ecologycenter.us>margalefsindex 2008). A value of 0 indicates a very low diversity of species while a value of 8 or greater indicates a very high diversity of species. The phytosociological characteristics of tree flora in the sub-sample of the study area are shown in Table 5 and Table 6.
In comparison of the three species diversity Indices (Shannon-Wiener, Margalefs and Menhinik), sites C and D had high species diversity for Margalefs, Menhinik and Shannon-Wiener indices with Margalefs recording the highest values (Table 5). However, despite the high values, the indices do not fall within the ranges indicating a low species diversity of trees observed in the study area.

Table 5: Comparison of the Margalefs richness, Menhinik's and Shannon-Weiner Diversity Indices.

SITE	Margalefs	Menhinik	Shannon-Weiner
A	0.805	0.866	0.148
B	0	1	0.02
C	2.907	1.809	0.534
D	3.812	1.655	1.2459

KEY: A = Female hostel, B = Male hostel, C = Admin Area D = Staff School

Comparison of the level of diversity among the four sampling sites using Sorenson's Similarity coefficient reveals Sites A and B with Sorenson Similarity Coefficient of 50% and a less than 50% Sorenson Similarity Coefficient with other sampling sites (C and D) as shown in Table 6. This shows that only site A and B had similar diversity of species reflecting different human activities, Sites A and B being the female and male student's hostels respectively of the Federal University Wukari Campus. Others were dissimilar when compared also reflecting different human activities.

Table 6: Sorenson Similarity Coefficient between Sites A, B, C and D.

SITES	SORENSON'S COEFFICIENT 50%			
	A	B	C	D
A	-			
B	50%	-		
C	33%	25%	-	
D	30%	31%	22%	-

CONCLUSION

The results reveal that Site D recorded the highest number of trees while site A had the least number of tree flora. The relative diversity of tree flora in the sub-section of the study area reflects low diversity and species richness due to high tree felling for anthropogenic activities and infrastructural developments. The most dominant tree species such as *Elaeis guineensis, Mangifera indica, Daniella olivieri, Tectona grandis, Vitex doniana, Pericopsis elata* have great economic uses in providing crucial services for the University community such as *Elaeis guineensis* and *Mangifera indica* provides shade, palm oil and mango for food and income generation; shade, fruits and timber or fuelwood from *Daniella olivieri, Tectona grandis, Vitex doniana, Pericopsis elata*. In addition, all of the trees observed are mostly utilized for Biology practicals and researches by students. Re-afforestation through silviculture and tree-planting strategies should be adopted and embarked upon by members of the University community which on the long run may serve as shelterbelts and windbreaks to protect the entire University Environment from any unforeseen environmental/castrophic events.

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