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TREE SPECIES DENSITY AND DIVERSITY IN JEMAA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

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ABSTRACT
Vegetation is one of the living components of the environment that provides food for man and shelter for wildlife. This paper assesses tree species density and diversity in Jema'a Local Government, Kaduna State, Nigeria with a view to providing information for sustainable natural resource management. Stratified sampling design was used to group the study area into four land use types, namely: forests, woodlands, farmlands and built-up Areas. Data for this study were collected from 48 sample plots of 20 × 20m laid out systematically across the study land use types. The establishment of plots was done by the use of measuring tape, ranging poles and GPS. Within each plot, tree species density and diversity, height, and dbh were obtained. Descriptive statistics was used to analyze the data. Result indicates that a total of 556 individual stands of woody species were identified and enumerated in the study area through the field survey. These belong to 50 species, 48 genera and 26 families. Species which recorded the highest representation are *Sterculia setigera* (10.6%), *Terminalia macroptera* (8.55%), *Anona senegalensis* and *Lophira alata* had (7.82%) each. While, the families combretaceae and fabaceae had the highest number of tree species of five each. It is recommended that a sustainable forest management be urgently adopted that involves indigenous people participation and the government.

Keywords- Conservation, Management, Tree Species Density and Diversity

INTRODUCTION

Biodiversity, which is the totality of living things, varies from one place to another (Mohammed, 2014). Plants are key part of the living environment. Vegetation provides food and oxygen for man, shelter for wildlife, increase soil nutrient, and also controls erosion, drought, and desertification. Trees also sequester carbon, which is a beneficial service to humans because excess of carbon in our surrounding is dangerous to human's health (Agbelade et al, 2016). Life on earth cannot exist without trees. Increase in population as well as intense agriculture in the recent years in Nigeria has caused people to remove vegetation in a manner that exceeds their re-growth (Badamasi, 2014). Removal of vegetation leads to deforestation, loss of valuable species creating open spaces which results to different environmental problems. This affects the density and diversity of woody resources. That is why Ikyaagba *et al* (2015) noted that species which are known to be abundant in a place might actually be endangered while those previously perceived as endangered might be nearing extinction. Zankan *et al* (2019) reported that many families of tree species in KSCOE, Gidan Waya recorded one species due to over-exploitation for woodfuel production, farming, timber production, erection of buildings and overgrazing and those families are under threat of becoming extinct. That is why International Renewable Energy Agency [IRENA], (2015) reported that continuous trends of deforestation in many African countries over the past two decades, on the one side, and a growing woodfuel demand on the other, point to an unsustainable level of forest management. Keenan *et al* (2015) reported that the highest net losses in forest area between 2010 and 2015 in Africa were in Nigeria (410K ha y^{-1}), Tanzania (372K ha y^{-1}), Zimbabwe (312K ha y^{-1}) and Democratic Republic of Congo (311K ha y^{-1}).

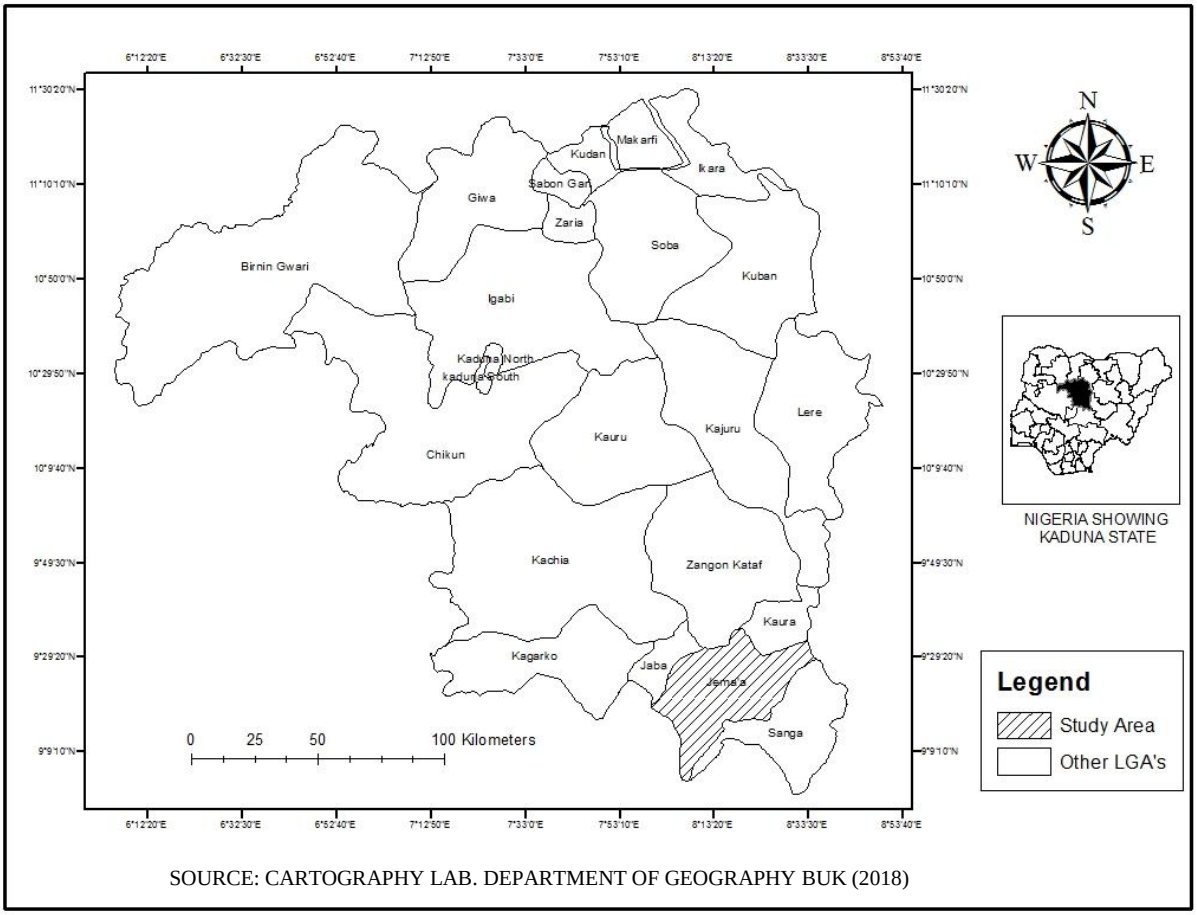
There is need for the management and conservation of the vegetation resources by adopting sustainable means of exploiting them to avoid further degradation. Adequate information about the state of vegetation is required for sustainable management in Nigeria. In the case of Jema'a local government, no detailed information is available to know the state of the woody species, so as to provide the means for the management and conservation of the woody resources especially that the local government serves as the heart of southern Kaduna coupled with its high population which suffers too much pressure from resource depletion. Therefore, this paper assesses tree species density and diversity in Jema'a local government area of Kaduna State, Nigeria with a view to

providing information for sustainable management of natural resources.

MATERIAL AND METHODS

The Study Area

This study was carried out in Jema'a local government area of Kaduna State, Nigeria. Jema'a local government lies between latitudes 9˚ 11′ to 9º 30′ N and longitudes 8º00′ to 8º 30′ east of the Greenwich Meridian, situated in the southern part of the state. The 2006 census report shows that Jema'a local government had a population of 278,735 people, comprising of 133,068 females and 145667 males (National Population Commission [NPC], 2006). The study area, just as all areas in the middle belt of Nigeria, has AW type of climate as classified by Koppen. It is characterized by two distinct seasons: wet and dry. The wet season occurs between April to October with a peak of rainfall in August, and dry season occurs from November to March. These seasons are influenced by the tropical maritime and tropical continental air masses. The mean annual rainfall is about 1800mm and the mean monthly temperature is 25^0C, while relative humidity is about 62% (Abaje and Giwa 2007, as cited in Ishaya and Abaje 2008). The orographic effects of Jos Plateau and the Kagoro hills have positive influence on the climate of the study area, influencing rainfall, temperature, and relative humidity (Ishaya and Abaje, 2008). It lies within the Guinea savanna region of Nigeria.



SOURCE: CARTOGRAPHY LAB. DEPARTMENT OF GEOGRAPHY BUK (2018)

Fig. 1: Kaduna State showing the study area

DATA COLLECTION

Stratified sampling design was used to group the study area into four land use types, namely: Forests, Woodlands, Farmlands and Built-up Areas. Data for this study were collected from 48 sample plots of 20 × 20m, laid out systematically across the study land use types. The laying of the sample plots was based on the extent of the land use type in the study area. The establishment of quadrat was done by the use of measuring tape, ranging poles and GPS. Within each plot, tree species density and diversity, height, dbh were obtained. Trees with diameter at breast height (dbh) ≥ 10 cm were identified and their dbh measured.

PROCEDURE FOR DATA ANALYSIS

Species Density (SD): Species density which is the total number of individual trees in a unit area (Peterson, 2009), was determined by summing up the number of individuals of respective species in the study area and expressing it on per hectare basis (Hundera and Deboch, 2008 as cited by Dangulla, 2013). (1)

Relative Density (RD)

Species relative density (RD), which is an index for assessing species relative distribution, was computed with equation

RD= (ni/N) x 100 (2)

Where: RD (%) = species relative density; ni = number of individuals of species i; N = total number of all individual trees of all species in the entire community.

Basal Area (BA)

Basal area (BA) which measured the cross-sectional area of tree trunk at DBH was calculated by the formular:

BA= (л/4 x 10,000) x DBH^2 (Larsen, 1999) (3)

Where BA= Basal area in square metres (m^2), DBH= Diametre at breast height, л = 3.1415

Species relative dominance

Species relative dominanc**e** (RDo) used in assessing relative space occupancy, was estimated using:

RDo= $\sum Bai\ x100 / \sum Ban$ (4)

Where: Ba_i = basal area of all trees belonging to a particular species i^{th}

Ba_n = basal area of all trees in the study area.

Importance Value Index (IVI) for each species was calculated using

RD + RDo/2 (Brashears *et al*, 2004 as cited by Agbelade *et al*, 2016) (5)

Species Diversity (D)

Shannon–Weiner (1949) diversity index as cited by Abagai (2011) was employed to determine the diversity of plant species in the sample plots

$H^1 = -\sum_{i-1}^{s} pi \text{ In } (pi)$ (6)

Where H^1 = Shannon – wiener diversity index

S = Total number of Species in the Community

P1 = Proportion of S made up of the 1^{th} species

In = Natural Logarithm.

Species richness (d)

Species richness (d) which is a count of the number of different species in a given area was calculated by the formula

$d= S/\sqrt{N}$ (Margalef, 1958). (7)

Where S = Number of Species

N = Number of Individuals of all species.

Shannon's maximum diversity index was calculated using the formula:

$H_{max} = \ln (s)$ (8)

S=Total number of species in the community

Species evenness (*EH*)

Evenness (EH) as a measure of equitability of spread of available species in the community, was obtained using Shannon's equitability.

$$EH = \frac{Hi}{\text{Hmax}} = \sum_{i=1}^{s} \text{pi In(p1)/in(S)} \quad (9)$$

Where H^1= Shannon-wiener diversity index

P1= Proportion of S made up of the 1^{th} species

In= Natural logarithm

S=Total number of species in the community

RESULTS AND DISCUSSION

COMPOSITION AND DISTRIBUTION OF WOODY SPECIES IN JEMA'A LGA

A total of 556 individual stands of woody species were identified and enumerated in the study area through the field survey. These belong to 50 species, 48 genera and 26 families (Table 1). Families Combretaceae and Fabaceae had the highest number of species in eight genera, followed by Mimosoideae, Caesalpinaceae and Rubiaceae with four species each belonging to twelve genera. Anacardiacea had three species belonging to three genera. Families Moraceae, Euphorbiaceae, Arecaceae, Rutaceae, and Myrtaceae had two species each belonging to ten genera and families Tiliaceae, Bignoniaceae, Loganiaceae, Leguminosae, Lamiaceae, Meliaceae, Leguminoceae, Annonaceae, Araliaceae, Verbenaceae, Sterculiaceae, Ochnaceae, Phyllanthaceae, Moringaceae and polygalaceae had one species each belonging to different genus.

The composition of woody species in the study area is typical of West African Guinea Savanna ((Abbey, 2006 as cited in

Ikyaagba *et al*, 2015). Most of the tree species found in the study area have the capacity to withstand fire. A total number of 50 species, belonging to 48 genera and 26 families were recorded in this study which is higher than the 29 species recorded by Ahmad (2012) in Kogo Forest Reserve, Katsina State, Nigeria and also higher than that of Abagai (2011) who recorded a total of (36) species in a neighbouring Kagoro/Tsonje Reserve, Kaduna State. The representation of most families by one or two species is a peculiar feature of savanna vegetation. The study identified Combretaceae and Fabaceae as the most common families (Table 1 and Figure 2). This is similar to the findings of Ikyaagba et al (2015) on Tree Composition and Distribution in Federal University of Agriculture Makurdi, Nigeria but it is contrary to the work of Zakari (2015) in Baturiya Wetland, Jigawa State in a different ecological zone, which identified families Fabaceae and Apocynaceae as having the highest representation. These differences may be as a result of variability in terms of weather and climate between the two ecological zones or the level of exploitation of the woody species for woodfuel, timber, and farming, or overgrazing done by people in the two areas. Seven (7) species recorded one (1) stand and this shows that most of these families have suffered severe exploitation by human activities such as woodfuel collection, timber extraction, bush burning, farming and overgrazing. They are said to be under threat of becoming extinct or disappear in the ecological system if severe exploitations continue. These species are *Afzelia africana*, *Erythrophleum suaveonlens*, *Daniellia oliveri*, *Pterocarpus erinaceus*, *Ficus syscomorus Prosopis africana and Securidaca longepedunculata*. There is need for restoration of these species in this study area in order to ensure their continuity.

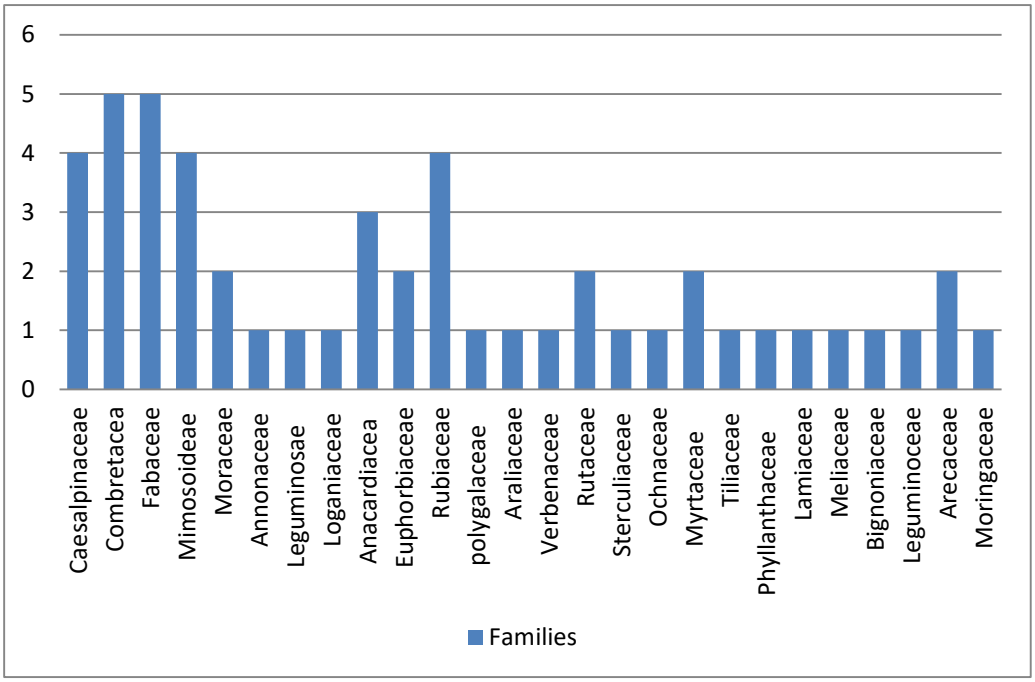


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Fig. 2: Family Distribution of Woody Species in Jema'a LGA

Source: Field Survey September, 2018

Table 1: Composition and Distribution of woody species found in Jema'a LGA

S/N	Tree Species	Family	F	B. A	MDbh	MHt	D/ Ha	RD%	RDo	IVI
1	*Tectona grandis*	Lamiaceae	10	0.04	21.8	7.1	40	1.82	2.14	1.98
2	*Khaya senegalensis*	Meliaceae	2	0.02	16.5	15	8	0.36	1.07	0.76
3	*Grewia bicolour*	Tiliaceae	3	0.01	13.0	4.2	12	0.55	0.53	0.54
4	*Neubouldia laevis*	Bignoniaceae	3	0.02	15.0	8.0	12	0.55	1.07	0.81
5	*Afzelia Africana*	Leguminoceae	1	0.04	23.0	13.3	4	0.18	2.14	1.16
6	*Erythrophleum suaveonlens*	Caesalpinaceae	1	0.02	17.0	18.0	4	0.18	1.07	0.63
7	*Piliostigma recticulatum*	Caesalpinaceae	16	0.03	20.3	7.8	64	2.91	1.60	2.26
8	*Daniellia oliveri*	Caesalpinaceae	1	0.06	28.0	13.1	4	0.18	3.21	1.69
9	*Anogeissus leiocarpus*	Combretaceae	8	0.03	18.3	24.6	32	1.46	1.60	1.53
10	*Combretum micranthum*	Combretaceae	2	0.03	19.6	9.2	8	0.36	1.60	0.98
11	*Terminalia avicenioides*	Combretaceae	21	0.02	15.5	11.5	84	3.82	1.07	2.45
12	*Terminalia macroptera*	Combretaceae	47	0.01	11.7	6.1	188	8.55	0.53	4.54
13	*Terminalia catapa*	Combretaceae	23	0.04	22.3	14.2	92	4.18	2.14	3.16
14	*Dichrotachya cinera*	Fabaceae	2	0.01	13.3	5.7	8	0.36	0.53	0.45
15	*Pericopsis laxiflora*	Fabaceae	29	0.02	14.4	8.3	116	5.27	1.07	3.17
16	*Pterocarpus erinaceus*	Fabaceae	1	0.03	20.0	15.4	4	0.18	1.60	0.89
17	*Cassia fistula*	Fabaceae	4	0.04	21.9	17.4	16	0.73	2.14	1.44
18	*Delonix regia*	Fabaceae	7	0.03	19.2	16.3	28	1.27	1.60	1.44
19	*Parkia biglobosa*	Mimosoideae	5	0.05	24.7	17.0	20	0.91	2.67	1.79
20	*Entada africana*	Mimosoideae	2	0.02	16.4	7.2	8	0.36	1.07	0.72
21	*Prosopis africana*	Mimosoideae	1	0.03	19.0	14	4	0.18	1.60	0.89
22	*Albizzia lebbeck*	Mimosoideae	6	0.03	18.6	19.3	24	1.09	1.60	1.35
23	*Ficus syscomorus*	Moraceae	1	0.03	21.0	10.7	4	0.18	1.60	0.89
24	*Chlorophora excelsa*	Moraceae	3	0.02	17.0	16.2	12	0.55	1.07	0.81
25	*Anona senegalensis*	Annonaceae	43	0.01	10.4	3.7	172	7.82	0.53	4.18
26	*Cassia arereh*	Leguminosae	6	0.01	13.8	4.3	24	1.09	0.53	0.81
27	*Strychnos spinosis*	Loganiaceae	4	0.01	10.0	3.1	16	0.73	0.53	0.63
28	*Bridella farruginea*	Anacardiacea	8	0.05	24.8	13.8	32	1.46	2.67	2.07
29	*Vitex doniana*	Anacardiacea	4	0.06	28.3	12.3	16	0.73	3.21	1.97
30	*Mangifera indica*	Anacardiacea	6	0.40	71.8	13.3	24	1.09	21.4	11.2
31	*Hymenocardia acida*	Euphorbiaceae	35	0.02	17.6	3.8	140	6.36	1.07	3.72
32	*Euphorbia convolvuloides*	Euphorbiaceae	14	0.03	19.3	10.6	24	2.52	1.60	1.35
33	*Breonadia salicina*	Rubiaceae	2	0.03	21.1	12.5	8	0.36	1.60	0.98
34	*Hallea stipulosa*	Rubiaceae	8	0.03	19.7	14.4	32	1.46	1.60	1.53
35	*Nauclea latifolia*	Rubiaceae	6	0.02	14.6	8.4	24	1.09	1.07	1.08
36	*Crossopteryx febrifuga*	Rubiaceae	19	0.04	22.8	11.9	76	3.45	2.14	2.79
37	*Securidaca longepedunculata*	Polygalaceae	1	0.07	29.2	14	4	0.18	3.74	1.96
38	*Cussonia barteri*	Araliaceae	5	0.03	18.7	6.3	20	0.91	1.60	1.26
39	*Gmelina arborea*	Verbenaceae	5	0.04	23.1	15.2	20	0.91	2.14	1.53
40	*Zanthocylum zanthozyloides*	Rutaceae	4	0.03	19.2	10.1	16	0.72	1.60	1.16
41	*Citrus sinensis*	Rutaceae	5	0.02	17.3	14.3	20	0.91	1.07	0.99
42	*Sterculia setigera*	Sterculiaceae	58	0.01	12.6	3.2	232	10.6	0.53	5.57
43	*Lophira alata*	Ochnaceae	43	0.05	25.5	12.7	172	7.82	2.67	5.25
44	*Syzygium cuminii*	Myrtaceae	7	0.02	17.2	6.3	28	1.27	1.07	1.17
45	*Psidium guajava*	Myrtaceae	5	0.05	24.0	4.1	20	0.91	2.67	1.79
46	*Uapaca togoensis*	Phyllanthaceae	13	0.06	26.8	9.6	52	2.360	3.21	2.79
47	*Eleis guineensis*	Arecaceae	11	0.03	20.4	22.3	44	2.0	1.60	1.8
48	*Phoenix reclinata*	Arecaceae	19	0.02	17.8	11.2	76	3.45	1.07	2.26
49	*Moringa oloifera*	Moringaceae	12	0.01	13.4	7.4	48	2.18	0.53	1.36
50	*Isoberlinia doka*	Caeslpiniaceae	16	0.04	21.2	18.3	64	2.91	2.14	2.53
			556	**1.87**		**2232**				

Note: F=Frequency, B.A=Basal Area, MDbh=Mean Diameter at Breast Height, MHt= Mean Height, D/Ha= Per Hectare Density, RD=Relative Density, RDo= Relative Dominance, IVI=Important Value Index.

Result indicates *Sterculia setigera* (Nkwar), *Terminalia macroptera* (Mbon-sit) as having the highest frequency of 58, 47 respectively and account for 10.6% and 8.55%. *Anona senegalensis* (Mburm) and *Lophira alata* (Mben) had a frequency of 43 each, and account for 15.64%. *Afzelia africana, Erythrophleum suaveonlens, Daniellia oliveri, Pterocarpus erinaceus, Ficus syscomorus, Prosopis africana and Securidaca longepedunculata* on the other hand had the lowest frequency of one, representing 0.18% each, which was not in conformity with Danjibo (2015) who documented that *Detarium microcepum* having the highest frequency of 63, followed by *Terminalia avicennioides* with a frequency of 60 in Kuwanka banza Forest Reserve and species with lower frequency include *Gardenia aqulla, Lannea acida*. The variations may largely be due to anthropogenic disturbances, differences in climatic conditions of the two areas as well as edaphic factors. The implication of this is that, there is the disappearance of tree species that are being replaced by shrubs and herbs in the study area. These changes will lead to extinction of most of the indigenous tree species such as *Daniellia oliveri, Khaya senegalensis* and *Pterocarpus erinaceus* which also create open surfaces that allows direct rain splash that detaches the soil, leading to erosion, loss of soil nutrient, drought and desertification and flooding.

PER HECTARE DENSITY OF TREE SPECIES IN JEMA'A LGA

The overall density of tree species in the study area was 2232 (Table 1). However, species per hectare density of trees found in the study area indicates that *Steculia setigera* has the highest (232/ha), followed by *Terminalia macroptera* (188), but at neighbouring Kagoro-Tsonje forest, *Gmelina arborea* had the highest followed by *Albizzia zygia* and *Adenodolichos paniculatus,* which may be occurred as a result of intervention by man, since *Gmelina arborea* is an exotic species or over-exploitation of the woody genetic resources as reported by Abagai (2011) in her study on the Assessment of the Current Ecological Status of Kagoro/Tsonje Riparian Forest, Kaduna State. *Steculia setigera* is taking the lead in per hectare density in the study area may be due to the fact that the species is not used for commercial woodfuel, timber extraction or as a result of heavy or excessive exploitation suffered by other species such as *Pterocarpus erinaceus, Terminalia avicenioides and Khaya senegalensis* due to their high demand and economic value. *Afzelia africana, Erythrophleum suaveonlens, Daniellia oliveri, Pterocarpus erinaceus, Ficus syscomorus , Prosopis africana and Securidaca longepedunculata* recorded one stand each with the least per hectare density of four. This signifies that they are at the top of the list of vulnerable tree species under threat of extinction from the study area, which occured as result of over-exploitation (woodfuel and timber), competition, and clearing of forest land for crop production or by herdsmen to feed their livestock, climatic and edaphic factors.

The highest basal area of trees within the study area ($0.40m^2$) was contributed by *Mangifera indica*. This was followed by *Securidaca longepedunculata* ($0.07m^2$), *Daniellia oliveri,Vitex doniana, Uapaca togensis* with basal area of (0.06) each. The least basal area ($0.01m^2$) was recorded by *Anona senegalensis, Grewia bicolar, Terminalia macroptera, Dichrotachya cinera, Cassia arereh, Strychnos spinosis, sterculia setigera and moringa oleifera*. However, *Mangifera indica* had the highest species importance with an IVI of 11.2%. This was followed by *Sterculia setigera* 5.57, and *Lophira alata,* with IVI of 5.25. Species with the highest mean dbh (71.8cm) was *Mangifera indica*. Mangifera indica also had the highest relative dominance of 21.4% followed by *Securidaca longepedunculata* with relative dominance of 3.74%.

With regards to height, the tallest species in the study area was *Anogeissus leiocarpus* which had a mean height of 24.6m which was followed by, *Eleis guinensis* (22.3), *Albezia lebbeck* (19.3m), *Erythrophleum suaveonlens* (18.0m) and Casssia fistula (17.4m). The shortest species on the other hand are *Hymenocardia acida* (3.8m), *Sterculia setigera* (3.2m), *Annona senegalensis* (3.2m) and *Strychnos spinosis* (3.1). This shows that most of the bigger trees have been removed either for woodfuel, charcoal, timber, grazing of livestock by herdsmen or farming. Too much pressure exerted on these vegetation resources does not only affect their density and diversity but even their height as there is disappearance of trees which are replaced by shrubs and herbs in the study area. This has created open surfaces in the ecological system which allows direct rain splash that detaches the soil, causing erosion, drought and desertification.

DISTRIBUTION OF WOODY SPECIES OVER THE LAND USE TYPES

The distribution of woody species is not even over different land use types. In the study area, though forest has been influenced by human activities, but it recorded the highest number of individual tree species 286 (50.9%), followed by woodland with a total of 154 (28%) species. Farmland recorded a total of 77 (14%). Built-up area recorded the least tree species in the study area 39 (7.1%) (Figure 2). *Sterculia setigera* was the most encountered tree species in the forest with a frequency of 57 and in the woodland *lophira alata* had the highest frequency of 23. For farmland, it was *Terminalia macroptera* that had the highest frequency of 47. In the built-up areas, exotic tree species such as *Tectona grandis, Mangifera indica, Citrus sinensis* and *Psidium gujava* are more prominent which most of them were planted by their owners. Though forest recorded the highest number of species in the study area, but most of them are not matured due to over-exploitation for timber, commercial woodfuel production and bush burning or grazing of livestock. The removal of woody species for farmland and settlement also result in the depletion and disappearance of our indigenous species that are been replaced by exotic species.

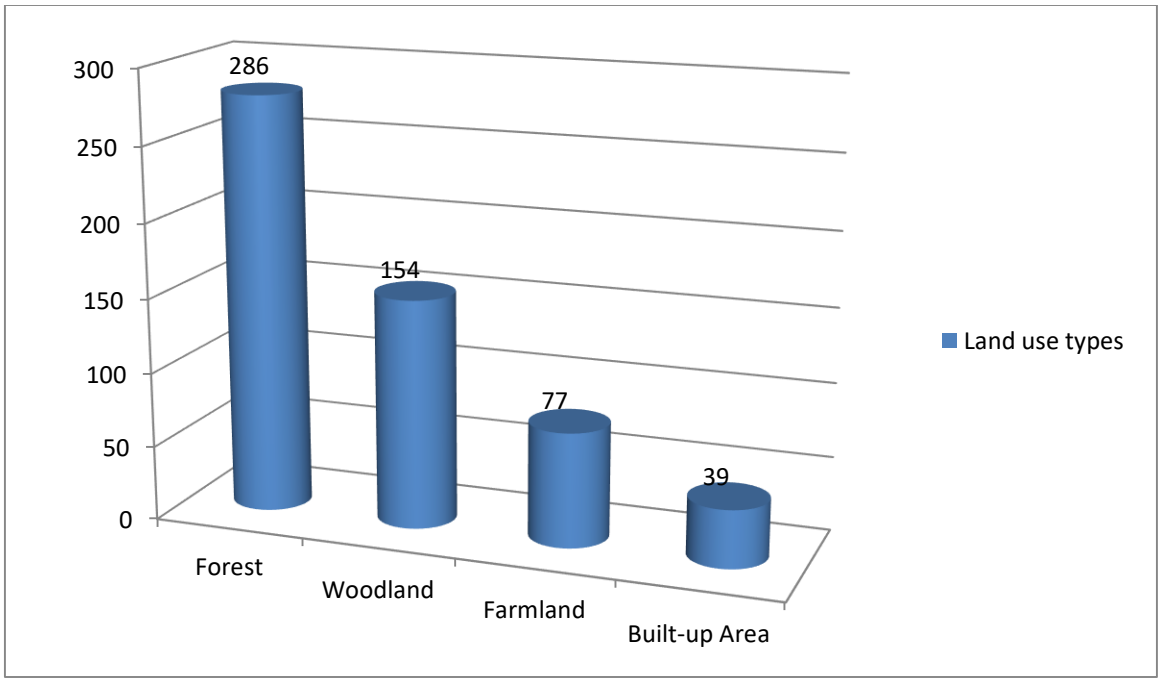

Fig 3: Distribution of Woody Species over the Land use Types

SHANNON INDEX (H) OF DIVERSITY

Shannon-Weiner diversity index (H) was used to compute woody species diversity. The more species a place may have, the more diverse it stands to be and the less species, the less diverse it may be. In this study, it was found that the total species diversity for the study was 3.23 (table 2). However, the diversity of species varied remarkably among the species with *Sterculia setigera* (Nkwar), *Terminalia macroptera* (Mbon-sit), *Anona senegalensis* (Mburm) *and Lophira alata (*Mben) being the most diverse species in the study area with the H value of 0.24, 0.21, 0.19 and 0.19 respectively. On the other hand, *Ficus syscomorus, Daniellia oliveri, Prosopis africana, Securidaca longepedunculata, Pterocarpus erinaceus, Erythrophleum suaveonlens, and Afzelia africana had* H value of 0.01 each. They therefore, have the least diversity of species and they are at the top of the list of becoming extinction.

Table 2: Shannon index (H) value table

Nindem Name	Species	Ni	Pi	Inpi	-(Pi) x (Inpi)
Tik	*Tectona grandis*	10	0.018	-4.178	0.075
Nset	*Khaya senegalensis*	2	0.003	-5.809	0.017
Agap	*Grewia bicolour*	3	0.005	-5.298	0.026
Duruku	*Neubouldia laevis*	3	0.005	-5.298	0.026
Gorgo	*Afzelia africana*	1	0.002	-6.215	0.012
Iler	*Erythrophleum suaveonlens*	1	0.002	-6.215	0.012
Iderng	*Piliostigma recticulatum*	16	0.029	-3.540	0.103
Ndam	*Daniellia oliveri*	1	0.002	-6.215	0.012
Ndam Ilon	*Isoberlina doka*	16	0.029	-3.540	0.103
Iyirr	*Anogeissus leiocarpus*	8	0.015	-4.199	0.063
Nsha-tuk	*Combretum micranthum*	2	0.003	-5.809	0.017
Nkok	*Terminalia avicenioides*	21	0.038	-3.270	0.119
Mbon-sit	*Terminalia macroptera*	47	0.085	-2.465	0.209
Ikon Lema	*Terminalia catapa*	23	0.042	-3.170	0.013
Nton-sit	*Dichrotachya cinera*	2	0.003	-5.809	0.017
Inkiring	*Pericopsis laxiflora*	29	0.053	-2.937	0.156

Iher	*Pterocarpus erinaceus*	1	0.002	-6.215	0.012
Ikon oda	*Cassia fistula*	4	0.007	-4.962	0.035
Ilo'on-Arim Uluwas	*Delonix regia*	7	0.013	-4.343	0.056
Ilo'on	*Parkia biglobosa*	5	0.009	-4.711	0.042
Ilo'on-Arim	*Entada africana*	2	0.003	-5.809	0.017
Anger	*Prosopis africana*	1	0.002	-6.215	0.012
Nkwar Karng	*Albizzia lebbeck*	6	0.011	-4.509	0.049
Agwap	*Ficus syscomorus*	1	0.002	-6.215	0.012
Nsan	*Chlorophora excelsa*	3	0.005	-5.298	0.026
mburm	*Anona senegalensis*	43	0.077	-2,564	0.197
Kibon	*Cassia arereh*	6	0.011	-4.509	0.049
Kpakpak/Angurfu	*Strychnos spinosis*	4	0.007	-4.962	0.035
Tutu	*Bridella farruginea*	8	0.014	-4.268	0.059
Intu	*Vitex doniana*	4	0.007	-4.962	0.035
Mangorong	*Mangifera indica*	6	0.011	-4.509	0.049
Nsha	*Hymenocardia acida*	35	0.063	-2.765	0.174
Shanshawa Majeh	*Euphorbia convolvuloides*	14	0.025	-3.689	0.092
Ikon Ituk	*Breonadia salicina*	2	0.003	-5.298	0.017
Ihut	*Hallea stipulosa*	8	0.014	-4.268	0.063
Ntass	*Nauclea latifolia*	6	0.011	-4.509	0.049
Shingai	*Crossopteryx febrifuga*	19	0.034	-3.381	0.115
Manjour	*securidaca longepedunculata*	1	0.002	-6.215	0.012
Ngos	*Cussonia barteri*	5	0.009	-4.711	0.042
Malena	*Gmelina arborea*	5	0.009	-4.711	0.042
Ngboko	*Zanthocylum zanthozyloides*	4	0.007	-4.962	0.035
Lemum	*Citrus sinensis*	5	0.009	-4.711	0.042
Nkwar	*Sterculia setigera*	58	0.104	-2.263	0.235
Mben	*Lophira alata*	43	0.077	-2.564	0.197
Sisip	*Syzygium cuminii*	7	0.013	-4.343	0.056
Gwaiva	Psidium guajava	5	0.009	-4.711	0.042
Bubur	*Uapaca togoensis*	13	0.023	-3.772	0.087
Irek	*Eleis guineensis*	11	0.019	-3.963	0.075
Zizeng	*Phoenix reclinata*	19	0.034	-3.381	0.115
Jangaladi	*Moringa oleifera*	12	0.022	-3.817	0.084
Total		556			3.227

Table 3 shows species evenness (*EH*) value of 0.802**,** species richness or variety (d) 2.120
Shannon Maximum diversity (H_{max}) 4.025

Table 3 species evenness richness and Shannon's Maximum diversity index

Index	Value
Species evenness *(EH)*	**0.802**
Species richness or variety *(d)*	**2.120**
Shannon's Maximum diversity *(Hmax)*	**4.025**

Dangulla (2013) in his study in Yabo Area, Sokoto State, Nigeria found that the major species available in the area were dominated by *Azadirachta indica, Guiera senegalensis, Senna Sieberiana and Combretum micranthum*. The study recorded a diversity index of 2.93 which he reported that the area has moderate woody species diversity. Danjibo (2015) assessed land use/land cover change and floristic composition of kuwanka banza forest reserve, Kebbi state and obtained a diversity index of 2.42, figure which is almost equal to that of Dangulla (2013)

in the same ecological zone. As diversity indices varied with location depending on the species available within an ecological zone, this study recorded high diversity index of 4.03 (Table 3) which is higher than that of (Dangulla, 2013) and Danjibo (2015). When compared with H value of 1.45 recorded by Shamaki *et al.* (2014) at Dabagi forest reserve which is very low.

In terms of evenness of species, the study recorded 0.802 which is higher than that of Kogo forest reserve which stood at 0.779899 as recorded by Ahmed (2012) but lower than 0.84 recorded by Agbelade *et al* (2017) in the southern zone of Nigeria. The result indicates that the available woody species were fairly or evenly distributed within the study area may be as a result of less competition for space and nutrient among the woody species considering the characteristic nature of the ecological zone. The study area had Species richness (d) of 2.12 which is comparatively higher than 1.92, 1.85 but lower than 2.16 recorded in Oluwa, Queen's and Elephant forests of the low-land humid tropical rainforest region of Nigeria as reported by Onyekwelu *et al* (2007). This may be due to high level of exploitation for woodfuel, timber, and farming suffered by the high forest in the south as compared to Guinea savanna ecological zone. Shannon's maximum diversity (H_{max}) index of 4.025 was recorded in this study which indicate that all tree species within the study site do not have equal area abundance may be as a result of more adaptability exhibited by some species or due to preference by exploiters.

CONCLUSION

The density and diversity of tree species in a place is very important because it maintains the stability of the natural ecosystem by controlling erosion, desertification and drought. They also enhance in recycling of nutrients and improving fertile soils. Reduction in density and diversity of tree species in Jema'a LGA is linked to human activities. This study has indicated that there is reduction in density and diversity of tree species in the study area as a result of human activities as many families recorded only single species. For this reason, most of these families are under threat of becoming extinct. It is therefore; important that a sustainable forest management framework is adopted that involves local people and the government. There is need to create more employment opportunities to the populace in order to discourage them from depending on the forest resources.

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