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Woody Species Composition and Diversity of Wawa-Zange Forest, Gombe State, Nigeria

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ABSTRACT

According to recent research, severe human-induced deforestation is causing 65 percent of the thirty Forest Reserves spread over Gombe State to progressively transform into the desert. The research was done in the Wawa-Zange Forest Reserve in Gombe State, Nigeria, to assess the richness of woody species and biodiversity preservation. The vegetation was sampled with the Point Centered Quarter technique. A complete enumeration of Woody (Trees and Shrubs) with (Diameter at Breast Height or DBH) ≥10 and ≥5cm was carried out. Using Simpson's Diversity and the Shannon-Wiener index, alpha diversity was evaluated. A total of 51 woody species from 16 families and 41 genera were discovered. 34 were trees while 17 were shrubs. Most species were found in the Fabaceae family. Ceasalpinoidae (10), Mimosoideae (4), Papilionoideae (3), Combretaceae (7), Rubiaceae (5), Anacardiaceae, Burseraceae, Capparaceae , Moraceae, Tiliaceae had two species each. The other families are namely Apocynaceae, Ebanaceae, Loganiaceae, Meliaceae, Rhamnaceae, Sapotaceae, Zygophyllaceae with one species each. Simpson index of Diversity was (0.55) and the Shannon-Wiener index was (2.07). This study concluded that plants with low Importance Value Index or IVI such as *Pterocarpus erinaceous, Capparis mitchelli, and Pericopsis laxiflora* need urgent conservation measures. Therefore, it is important to properly adopt conservation and sustainable management measures.

INTRODUCTION

One of the most urgent global issues currently facing human survival, welfare, and development is deforestation [1]. It is one of Africa's two biggest annual losses of natural forests [2]. Primary forests are being destroyed at the greatest rate in the world in Nigeria. At 55 percent, it will soon lose almost all of its primary forests [3]. Natural forests covered 10.9Mha of Nigeria's land in 2010, accounting for almost 12% of the country's total area. It lost 97.8Kha of natural forests in 2020, which is equal to 59.5 Mt of CO2 emissions [4]. There are numerous factors, including biotic, climatic, and human activity, that contribute to deforestation in Nigeria. The main contributors to deforestation in Nigeria include human activities like logging, farming, oil exploration, urban migration, wood burning, grazing, etc. The problem is worse in Nigeria's dryland regions, which are more susceptible to desertification. According to estimates, between 50 and 75 percent of the states of Adamawa, Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara are at risk of wind erosion. In Gombe State, the Wawa-Zange Forest reserve is equally seriously affected by deforestation. The demand for fuelwood outstrips supply and new trees are not replanted. Even the existing ones are not allowed to regenerate. Consequently, the rate of deforestation increases by 1 kilometre each year. [1]. As reported [1] hundreds of tree species are cut from nearby forests and the Wawa-Zange reserve. The amount of fuel wood transported to the local market in Gombe each day is reportedly around one kilotonne. This is true since the 1996 founding of Gombe State and the ongoing security issues posed by the Boko Haram insurgency in the country's northeast put extra strain on the state's resources, even though Gombe is a more tranquil state than the other states nearby.

The Forests of Wawa-Zange are deteriorating. What was once an area of thick forests is turning into open woodland. Due to the aforementioned issues, this study was done to determine the woody species composition of the Wawa-Zange Forest Reserve. The data collected would be used as a baseline to disclose the vegetation's state in the study region, which will aid in the development of the forest's regeneration process.

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METHODOLOGY

The study Area

In Gombe State's Wawa-Zange Forest Reserve, this research was conducted (**Fig. 1**). The Forest Reserve, which was gazetted in 1962, is located between latitudes 10^0 49' 22"N and 10^0 46' 23"E, at an altitude of 411 m above sea level, and it takes up a total of 1536.57km2, or 153,657 hectares, between the Dukku and Funakaye Local Government Areas. The two main communities in the forest, Wawa (now in Funakaye LGA) in the north and Zange (currently in Dukku LGA) in the south inspired the name Wawa-Zange. The forest reserve has seven major settlements: Zange, Bozonshulwa, Nappe, Shuwe, Dile, Peshere, and Wawa. This settlement was selected as the study site. The Climate is generally warm, exceeding 40^0 C during the hottest months (March-May). It has two main seasons dry and wet with an average annual rainfall of 850mm. The landscape is primarily mountainous, undulating, and hilly to the southeast and flat open plains to the north, north-east, west, and north-west. The Sudan Savannah ecological zone's woodland dominates the reserve, with a concentration of woodlands in the south-east and south-western regions. These woodlands have a light-closed canopy made up of stunted shrubs and trees that are 4.87 m to 6.09 m high, along with sparse growth of grasses. In the reserve, the native flora, fauna, notable birds, and wildlife have deteriorated and are in danger of going extinct entirely.

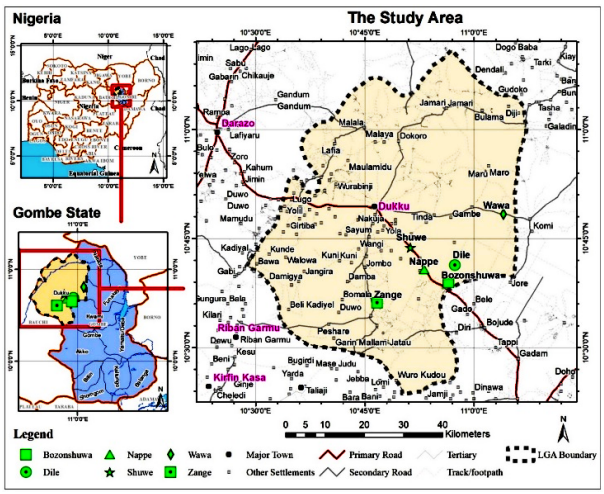

Fig 1. Wawa-Zange forest reserve map identifying the research sites Source: (Field Work, 2022).

Data Collection

Data were collected across the whole Forest reserve, which was sampled using Point Centered Quarter (PCQ) Sampling method according to [7]. Using the PCQ method, a steel pin was inserted into the ground to serve as a marker after a starting location was randomly chosen [7, 8]. This sampling point had a tape affixed to it, and four quarters were marked off, with the nearest plant (trees and bushes) measured in meters (m) in each quarter. Each transect's sampling points were treated in this manner. Each of the four transects per hectare has 10 sampling locations. Additionally, 40 sampling points with 160 species per hectare were taken, resulting in 4 species at each sample point. Furthermore, the separation between the sampling site and the trunk's or base's center was measured. In each quadrant, the distances between the sampling location and the adjacent tree's midpoint were measured and noted. Within the quadrats, single-stem woody perennials up to 5m tall and 10cm in diameter at breast height (DBH) were counted and classified to the species level. However, with a measuring tape, the diameter at breast height of trees and shrubs (DBH $\leq$ 10 cm, $\geq$ 4.5 cm) was measured in each quarter and recorded. For trees with flutes or buttresses, the diameter was measured 30 cm above the spot where the flute or buttress vanished into the stem.

Identification of species

All species encountered were recorded at each sampling point. Field guides and Floras, as well as literature featuring coloured images, were used to identify species on-site [9, 10, 11] and as done by (Abba HM, 2014, unpublished data). Those individuals that could not be identified were brought to the Department of Botany at Gombe State University in Gombe, where they were identified by an expert, and also compared with herbarium specimens. Hutchinson and Dalziel's [12] nomenclature was used.

Data analyses

$$Mean\ point-to\ plant-distance = \frac{Total\ point-to-plant\ distance}{4\ x\ Number\ of\ points\ sampled.}$$

The distance from the quadrant's centre to each of the four plants per station was added up to get the Plant Species Point to Point distance (m), D_1, D_2, D_3 and D_4 are summed. This gives the species Point Point Distance.

Mathematically,
$D_{1+}\ D_{2,+}\ D_3+D_4$= Species distance (Spd) per station.
then, $Spd_1 + Spd_2 + \ldots\ldots\ldots\ldots + Spd_{20}$ = Point to Point Distance
D = Distance (m)

Spd = Species distance
Spd_{20} = The Species Point to Point Distance in the 20th station.

Species Plant Mean Point to Point distance was calculated by averaging Mean Point to Point Distance (m).

Mean area per plant (ma) = (Mean Point to-Plant Distance) ^{2}

$$\text{Total density for all species} = \frac{\text{Unit area} = 10000}{\text{Mean area per plant}} \quad (\text{Mean area per plant})^2$$

The mean area/tree (M.A.) = D2

Where D= the mean distance of 4 points to the nearest tree distances taken in each of four quarters i.e. D1, D2, D3 and D4.

For the woody species the following relation stands. The vegetation was evaluated quantitatively using total, relative, and absolute densities, frequency, relative frequencies, dominance, relative dominance, and important value [7].

Absolute density and Relative density by species

$$\text{Absolute density of a species} = \frac{\text{Relative density of a species}}{\text{Total density}} \times 100$$

$$\text{Relative density of a species} = \frac{\text{Number of Individuals of a species}}{\text{Total number of Individuals of all species}} \times 100$$

Frequency and Relative Frequency of a species.

$$Frequency = \frac{No\ of\ points\ at\ which\ a\ species\ occurs}{Total\ number\ of\ points\ sampled}$$

$$Relative\ frequency = \frac{Frequency\ of\ a\ species\ x\ 100}{Total\ frequencies\ of\ all\ species}$$

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Basal area, Absolute and Relative dominance by species.
The Diameter at Breast Height (DBH) measurements were converted into basal area by the formula

$b = (d/2)^2 \times \pi)$,

where b = basal area, $\pi = 3.1416$, and d = diameter.

Absolute dominance (per unit area) of a species = Absolute density of a species x mean basal area of a species.

$$\text{Relative Dominance of a species} = \frac{\text{Absolute Dominance of a species}}{\text{Total number of Absolute Dominance of all species}} \times 100$$

Importance Value Index (IVI) and relative importance value (RIV) for each species.

Importance values calculated is of significance in Savanna vegetation [8]. The IVI from the woodland data was calculated by summing relative frequency, density and dominance values for each species.

IVI = Relative Density + Relative Dominance + Relative Frequency

$$\text{Relative importance value} = \frac{\text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}}{3}$$

Species diversity index
Measurement of alpha diversity. Two common approaches for measuring alpha diversity are species richness and evenness/ heterogeneity [13].

Simpson's diversity index
The formula used for calculating D is:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where:
D = diversity index
N = Total number of organisms of all species found
n = number of individuals of a particular species
The value of D ranges between 0 and 1 [14].

Shannon-Wiener index
The Shannon index was used to calculate the community diversity using the formula:

$$H' = {}^{s}\sum_{i=1} pi\ (pi)$$

Where H= the Shannon –Weiner index and pi = the proportion of individuals of the total sample belonging to the i_{th} species. $\sum$ = Sum. [15].

RESULTS AND DISCUSSION

In Wawa-Zange Forest Reserve, fifty-one species from 16 families and 41 genera were discovered. Out of this number 34 were trees and 17 were shrub species. The species obtained showed characteristics of Sudan Savanna plants (**Table 1**). The fact that the study area is designated as Sudan Savanna and the area's species diversity suggest that this is a significant conservation site. The amount of woody (tree and shrub) plants discovered is comparable to that found in the Kanawa Forest Reserve, which has 25 tree species and 35 shrub species, as reported by [16]; (Abdullah MB, 2010, unpublished data) in Yankari Game Reserve in 2003 with 38 tree species, in 2004 with 42 tree species, and 2005 with 43 tree species; [17] reported 37 tree and shrub species belonging to 17 families in the Falgore wildlife reserve in Kano state, and also [18] collected 16 woody species in Girei forest reserve in Adamawa State. Direct comparisons with other studies of a comparable nature are challenging such as [19], which collected 50 woody species in the Ipinu-Igede sacred forest in Benue State, North-Central Nigeria and [20] obtained 14 species in North-Eastern Nigeria. Due to the fact that the floristic data that are now accessible are either site-specific or span a wide range of vegetation zones. While biological factors and the presence of adequate environmental gradients seem to have a greater influence on diversity at the site level, climate and topography appear to have broad effects on diversity across the landscape.

The study found 10 different species in the Fabaceae (Caesalpinoidae) family, which has the most species overall. This is due to the fact that these families are well-known as native species in the majority of Savanna-Woodland Mosaics in Africa, and they are more characteristic of Sudano Sahelian zones [21, 22]. Also, Fabaceae's ecology and reproductive biology may also play a role because of its effective and successful dispersal capacities and better adaption to a variety of ecological settings. In Nigeria apart from Poaceae, Fabaceae is known to dominate the angiosperm biodiversity of both the Southern and Northern Savanna of Nigeria [21]. According to Harris [23], no family has a wider worldwide spread in a wider variety of ecosystems than the Fabaceae, with the possible exception of the Poaceae. Also [24, 19] identified Fabaceae as the dominant family in Benue State, Nigeria.

Table 1. Species Composition of Woody Species In Wawa-Zange Forest Reserve, Gombe State, Nigeria.

Family	Species	Habit	Genera	Common Names	Hausa Names
Anacardiaceae	*Sclerocarya birrea* (CA Rich)	Tree	*Sclerocarya*	Marulon (Jelly plum)	Danya
	Haematostophis barteri (Hook-F)	Shrub	*Haematostophis*	Blood plum	Jar danya, Bashau,Tursahi
	Lannea microcarpua (ENGL.S.K Krause	Tree	*Lannea*	African grapes	Faru
Apocynaceae	*Hollarhena floribunda* (G.Don) Durand & Schinz	Tree	*Hollarhena*	Rubber tree	Bakin mayu,Sandan mayu.
Burseraceae	*Commiphora africana* (A.Rich.) Engl.	Tree	*Commiphora*	African Myrrh	Dashi,Ba-zara,Bizana
	Boswellia dalzeilli (Hutch)	Tree	*Boswellia*	Elephant tree	Arrarrabi
Capparaceae	*Maerua angolensis* (DC)	Shrub	*Maerua*	Bead-bean tree	Chichiwa, gazare
	Capparis mitchelle Lindl	Shrub	*Capparis*	Caper bushes/Bush tucker	Lemon Daji
Combretaceae	*Combretum glutinosum* (Per & dc)	Shrub	*Combretum*	French khat	Ciriri,Tarauniya,Dao,Dagora
	Combretum molle R.Br.Ex Cx-Don	Tree	*Combretum*	Velvet Bush	Wuyan damo
	Combretum nigricans (RP.ex Guill & Perrot)	Tree	*Combretum*	Bushwillow	Ciriri,Dagara,Dagera
	Combretum collinum Fresen	Tree	*Combretum*	Weeping Bushwillow, Variable bushwillow	Tarauniya, Kantakara
	Combretum hypopillinum (Diels)	Tree	*Combretum*	White taramniya	Farar taramniya

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Table 1. Continue

	Anogeissus leiocarpus (DC) (Guill &Perr)	Tree	*Anogeissuss*	African birch	Marke
	Guirea senegalensis (H.F.Guill)	Shrub	*Guirea*	Moshi medicine	Sabara
Ebanaceae	*Diospyros mespiliformis* (Hochst.ex.A.DC).	Tree	*Diospyros*	Jackalberry	Kanya
Fabaceae: Caesalpinoidae	*Isoberlina doka* Craib& Stappf)	Tree	*Isoberlina*	French doka	Doka
	Detarium microcarpum Guill & Perr	Tree	*Detarium*	Sweet Dattack	Taura
	Parkia biglobosa (Jase.) R.B. Exce.Don	Tree	*Parkia*	African locust bean	Dorowa
	Tamarindus indica L	Tree	*Tamarindus*	Tamarind	Tsamiya
	Senna singuena Guill & Perr	Shrub	*Senna*	Wild cassia	Rumfu
	Bauhinia rufescans Lam	Shrub	*Bauhinia*	Silver Butterfly tree	Tsatagi
	Senna tora (L.) Roxb	Shrub	*Senna*	Sickle pod	Tafasa
	Senna seiberiana D.C	Tree	*Senna*	Drumstick, African labumum	Malga
	Senna occidentalis L.	Shrub	*Senna*	Ant bush,Arsenic bush	Tafasan doki.
	Burkea africana Hook	Tree	*Burkea*	Wild syringa	Bakin makarfo,Itacen kudi,Karyar dutse
Fabaceae:Mimosoideae	*Prosopis africana* Guill&Perr	Tree	*Prosopis*	lronwood	Kiriya
	Acacia ataxacantha D.C	Shrub	*Acacia*	Flame thorn	Tsarkakia
	Albizzia chevalieri Durazz	Tree	*Albizzia*	Silk plants	Katsari
	Dichrostachys cineria (L.)Wight et Arn.	Shrub	*Dichrostachys*	Sickle bush,Chinese lantern tree.	Dundu
Fabaceae: Papilionoidae	*Pericopsis laxiflora* (Benth).Van Meeuwen	Tree	*Pericopsis*	Satinwood	Karya gatari
	Pterocarpus erinaceous Perr	Tree	*Pterocarpus*	African kino	Madobia
	Lonchocarpus laxiflorus Guill & Perr	Tree	*Lonchocarpus*	Bamgolobi	
Loganiaceae	*Strychnos spinosa* (Lam)	Tree	*Strychnos*	Elephant orange	Kodarko/ Kokiya
Malvaceae	*Bombax costatum* (Pel &Vuill)	Tree	*Bombax*	Silk cotton tree	Gurjiya
	Ceiba pentandra (L) Gaertn)	Tree	*Ceiba*	White silk cotton	Rimi
	Sterculia setigera Del	Tree	*Sterculia*	Karaya gum	Kukukki
	Adansonia digitata (L.)	Tree	*Adansonia*	African Baobab	Kuka
Meliaceae	*Azadirachta indica* (A.Juss)	Tree	*Azadirachta*	Neem tree	Dogon yaro
Moraceae	*Ficus thonningi* (Blume)	Tree	*Ficus*	Chinese banyan	Chediya
	Ficus platyphyla (Del)	Tree	*Ficus*	Guttan perchan tree	Gamji
Rhamnaceae	*Ziziphus spina-christi* (L.) Desf.	Tree	*Ziziphus*	Christ thorn (Jujube)	Kurna
Rubiaceae	*Feretia apodanthera* Del	Shrub	*Feretia*	Red leaved madler	Lallen suri,Kurukuru
	Randia nilotica (Stapf)	Shrub	*Randia*	Catanaregan	Tsibra
	Gardenia erubescens Stap&Hutch	Shrub	*Gardenia*	Gardenia	Gaude
	Xeromphis nilotica (Stapf) Keay	Shrub	*Xeromphis*		
	Tricalysia chevaleiri K. KRAUSE	Tree	*Ttricalysia*	Scaly bark jakal coffee	Burugali
Sapotaceae	*Vitellaria paradoxa* C.F Gaertn	Tree	*Vitellaria*	Shea butter tree	Kadanya
Tiliaceae	*Grewia mollis* Hochst ex A. Rich	Shrub	*Grewia*	Cannon lettuce	
	Grewia bicolor Hochst ex A. Rich	Shrub	*Grewia*	Bustard Brandy bush	
Zygophyllaceae	*Balanite aegyptiaca* (L.) Del	Tree	*Balanite*	Desert date	Aduwa

The highest IVI for trees was *Combretum hypopilinum* (9.0) while the lowest IVI for trees was *Pericopsis laxiflora* and *Pterocarpus erinaceous* is 1.06 each. The highest IVI for shrubs was *Guirea senegalensis* (7.49) while lowest IVI is *Capparis mitchelli* (1.17). The highest IVI measures the degree of dominance in a particular species relative to other species in a reserve stand. The species that have the highest important value index are the most prevalent in that particular vegetation, according to [25]. Species management and conservation priorities are established using it as well [26].

Table 2. Importance value index of woody species in Wawa-Zange Forest Reserve, Gombe State.

Species	Relative Density%	Relative Frequency %	Relative Dominance %	Importance Value Index%
Sclerocarya birrea (CA Rich)	3.40	4.00	3.00	3.47
Haematostophis barteri (Hook-F)	4.05	4.18	5.26	4.50
Lannea microcarpua (ENGL.S.K Krause	2.40	2.00	2.00	2.13
Hollarhena floribunda (G.Don) Durand &Schinz	8.00	5.70	6.00	6.56
Commiphora africana (A.Rich) Engl.	2.00	1.46	2.75	2.07
Boswellia dalzeilli (Hutch)	3.59	7.29	4.82	5.23
Maerua angolensis (DC)	2.50	4.56	3.80	3.62
Capparis mitchelle Lindl	0.05	1.00	0.35	1.17
Combretum glutinosum (Per & dc)	4.20	5.92	5.26	5.12
Combretum molle R.Br.Ex Cx-Don	3.94	5.58	6.58	5.36
Combretum nigricans (RP.ex Guill & Perrot)	7.00	4.50	4.35	5.20
Combretum collinum Fresen	8.98	4.50	4.82	6.10
Combretum hypopillinum (Diels)	9.51	10.50	7.01	9.00
Anogeissus leiocarpus (DC) (Guill &Perr)	6.80	5.32	7.45	6.52
Guirea senegalensis (H.F.Guill)	1.80	17.16	3.51	7.49
Diospyros mespiliformis (Hochst.ex.A.DC).	5.61	4.25	7.45	5.77
Isoberlina doka Craib& Stappf)	1.52	1.68	1.75	1.65
Detarium microcarpum Guill & Perr	5.68	5.87	6.14	5.89
Parkia biglobosa (Jase.) R.B. Exce.Don	3.00	2.60	2.00	2.53

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Tamarindus indica L	3.40	2.80	3.00	3.07

Table 2. Continue

Senna singuena Guill & Perr	0.11	0.50	7.01	2.54
Bauhinia rufescans Lam	2.80	3.00	3.50	3.10
Senna tora (L.) Roxb	8.00	7.00	6.00	7.00
Senna occidentalis L.	12.46	0.85	1.32	4.87
Burkea africana Hook	1.53	7.67	3.51	4.23
Prosopis africana Guill &Perr	1.72	2.50	3.95	2.05
Acacia ataxacantha D.C	12.46	4.85	1.32	6.21
Albizzia chevalieri Durazz	1.50	2.30	1.80	1.87
Dichrostachys cineria Weight et Arn	6.48	1.03	3.95	3.82
Pericopsis laxiflora (Benth).Van Meeuwen	1.00	1.20	1.00	1.06
Senna seiberiana D.C	3.36	7.93	3.32	4.87
Pterocarpus erinaceous Perr	1.00	1.20	1.00	1.06
Lonchocarpus laxiflorus Guill & Perr	3.20	2.50	3.00	2.90
Strychnos spinosa (Lam)	1.40	4.70	6.00	4.03
Bombax costatum (Pel &Vuill)	1.17	2.66	1.86	1.90
Ceiba pentandra (L) Gaertn)	0.11	0.50	7.01	2.54
Sterculia setigera Del	6.61	7.00	4.00	5.87
Adansonia digitata (L.)	2.11	1.50	4.01	2.54
Azadirachta indica (A.Juss)	7.50	6.00	6.80	6.80
Ficus thonningi (Blume)	5.60	4.00	3.50	4.37
Ficus platyphyla (Del)	5.80	4.50	4.00	4.77
Ziziphus spina-christi (L.) Desf.	6.05	2.82	2.95	3.94
Feretia apodanthera Del	7.05	5.82	3.95	5.60
*Randia nilotica (*Stapf)	2.70	1.20	5.26	3.53
Gardenia erubescens Stap&Hutch	0.07	1.11	0.43	1.32
Xeromphis nilotica (Stapf) Keay	2.70	1.20	5.26	3.53
Tricalysia chevaleiri K. KRAUSE	11.73	3.50	6.56	7.26
Vitellaria paradoxa C.F Gaertn	5.60	4.00	3.50	4.37
Grewia mollis Hochst ex A. Rich	2.24	0.08	2.19	1.50
Grewia bicolor Hochst ex A. Rich	2.25	1.08	2.23	1.85
Balanite aegyptiaca (L.) Del	0.24	4.69	1.76	2.23

Diversity indices

The richness, variety, and evenness of the species were all measured in the research area at 2.5, 0.55, and 2.07, respectively (**Table 3**). This indicates a moderate level of species variety and variable species distribution in the study area, as well as an old assemblage with diversified and abundant vegetation. When compared to (H'= 3.646) from Ipinu-Igede Sacred Forest as reported [19]; (H'= 3.21) as found by [17], and [18] reported (H' = 2.6). A higher level of anthropogenic disturbance in the studied area could explain the difference in diversity indicators. Based on the focal group discussion and field observations, it is also obvious that the locals' destruction of trees for the purpose of expanding the farmland they currently possess to grow cereals, pulses, and perennial crops has a significant impact on the reserve's cultivated areas. The Shannon-Wiener index typically ranges between 1.5 and 3.5 and is rarely above 5.0 [27]. The values discovered in this study are within the anticipated range.

Table 3. Species diversity Indices in Wawa-Zange Forest Reserve.

Variables	Indices
Number of tree species	51
Shannon Index (H')	2.07
Simpson Index of Diversity (1-D)	0.55
Species richness	2.5

The distribution of trees in circumference classes formed a "J" shape, in accordance with the species composition of the Forest Reserve (**Table 4**). These results were similar to that of [17], who obtained the J-shape diameter distribution Tree stands in the lower DBH class of 6-10cm had higher values (1,300 individuals), followed by shrub stands in the lower DBH class of 1-5cm with (700 individuals) and the higher DBH class of 21.0cm –above with 100 individuals. (**Table 4**). This indicates that the lower class diameter could develop into mature trees if conservation measures are implemented. The diameter class findings in this study back up the claim that Girth –Class frequencies decreased monotonically as girth classes increased.

Table 4. Diameter size class distribution for woody species in Wawa-Zange Forest Reserve (2022).

Diameter Class Interval (cm)	Individuals /Year 2022
A 1.0-5.0	700
B 6.0-10.0	1,3000
C 11.0-15.0	200
D 16.0-20.0	129
E 21.0-Above	100

CONCLUSION

This study concluded that the family Fabaceae: The most prevalent family in the research area is Caesalpinoidae. The densely populated species for trees were (*Acacia ataxacantha* (12.46) while for shrubs was *Senna occidentalis***,** while the frequently populated species for trees were (*Combretum hypopilinum*) while for shrubs was (*Guiera senegalensis*). The dominant trees were *Anogeisus leiocarpus* and *Diospyros mespiliformis* while the dominant shrubs were *Senna singuena*. The tree with the highest importance value index was (*Combretum hypopilinum*) while the tree with the lowest Importance value index was *Pterocarpus erinaceous*, *Pericopsis laxiflora*, and *Capparis mitchelle*. High IVI value species require low priority conservation efforts, and low IVI value species require high conservation efforts.

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