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ASSESSMENT OF THE DIVERSITY AND CONSERVATION STATUS OF TREE SPECIES IN FEDERAL UNIVERSITY GASHUA, YOBE STATE NIGERIA

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Abstract

Trees play a critical role in maintaining ecological balance, supporting biodiversity, and delivering socio-economic and environmental benefits within university settings. This study evaluates the diversity and conservation status of tree species at Federal University Gashua by examining species richness, composition, abundance, and conservation status across the campus. In total, 28 plant species from 9 families were identified. The most dominant tree species were *Ixora coccinea*, *Syzygium guineense*, *Terminalia catappa*, and *Azadirachta indica*, with Importance Value Index (IVI) values of 8.26, 7.26, 6.49, and 5.30, respectively. The IVI values offer a comprehensive assessment of the phytosociological characteristics of each species within the community. Tree species diversity indices, based on the Shannon-Weiner index, were 2.67, 3.38, 2.65, and 2.70 for plots 1, 2, 3, and 4, respectively. Corresponding Simpson diversity index values were 0.83, 0.71, 0.72, and 0.68. These findings suggest that tree diversity at Federal University Gashua is high, and the structural composition of these species supports ongoing growth and ecological stability.

Keywords: Diversity, Conservation, Plant, Gashua
Paper type: Research paper

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Tree species diversity and composition within a given area are influenced by environmental factors, including temperature, humidity, nutrient availability, sunlight, topography, bedrock geology, soil characteristics, canopy structure, and land-use history (Myers *et al.,* 2020). Tropical rainforests represent the primary centers of plant species diversity globally (Turner, 2024). These forests constitute some of the richest biological communities on Earth and are recognized for supporting a significant proportion of global biodiversity (Baraloto *et al.,* 2023). Tropical forests provide essential ecosystem services, such as species conservation, soil erosion prevention, and habitat preservation for both plants and animals (Armenteras *et al.,* 2019). The diversity of tropical forests is notable; they contain the majority of the world's plant and animal species and possess extensive genetic resources due to variations in elevation, climate, and soil, ranging from humid rainforests to dry forests and savannas. Over 2.5 million people reside in areas adjacent to forests and depend on these ecosystems for water, fuelwood, and other resources (Gebrehiwot, 2023).

Tropical forests are declining rapidly worldwide, with approximately 4% of their current area lost annually (Isango, 2020). Major pressures on forest reserves stem from anthropogenic activities, including overexploitation of resources, grazing, and conversion of forest land to residential, educational, industrial, and infrastructural uses, as well as unstable climate conditions. These pressures result in reduction, fragmentation, and impaired ecosystem functions. There is an urgent need for conservation measures and the implementation of sustainable land-use practices across Africa to prevent further degradation of natural resources. Lykke (2018) notes that long-term scientific data on vegetation changes are generally lacking in most savanna regions. Changes in flora and fauna species composition have become a global issue in the latter half of the twentieth century due to intensive anthropogenic activities. Effective management of both disturbed and undisturbed stands, as well as understanding the provision of non-timber ecosystem services, requires detailed descriptions of species composition patterns (Neelo *et al.,* 2025). In Nigeria, for example, accurate data on flora composition remain limited.

Forest resources in Nigeria serve multiple purposes, including the provision of wood fuel for domestic cooking and heating in rural areas and among urban populations; materials for housing, fencing, and furniture; construction and joinery; weaving fibers for baskets, nets, and furnishings; and medicinal trees for drugs, incense, and carving (Oriola, 2019). Additional uses encompass watershed protection to control runoff and maintain soil nutrients, atmospheric regulation through evapotranspiration and carbon dioxide sequestration, and erosion control via shelter belts, dune stabilization, and rehabilitation of degraded terrain. Forest resources are also essential for industrial and export purposes, such as pulpwood for newsprint, paper, containers, textiles, veneer logs for plywood and furniture, sawn timber for lumber, joinery, construction, and transmission poles (Aribisala, 2023).

MATERIALS AND METHODS

Study Area

Federal University Gashua, a community is in the Bade Local Government Area of Yobe State. Yobe State, Nigeria, falls between 12 ° 86'N and 11° 04'E. The area is landlocked, and artisanal fishery is predominant (Sule and Sotolu, 2016). The area is characterized by two distinct seasons: the wet and dry seasons. The wet season is from April to October, while the dry season is from November to March. Rainfall is bimodal, with the maximum between June and September. Mean annual rainfall is between 1000 mm and 1500 mm, mean annual temperature is 30℃, and relative humidity is about 80% but decreases in the early months of dry season (Ikyaabga, 2008).

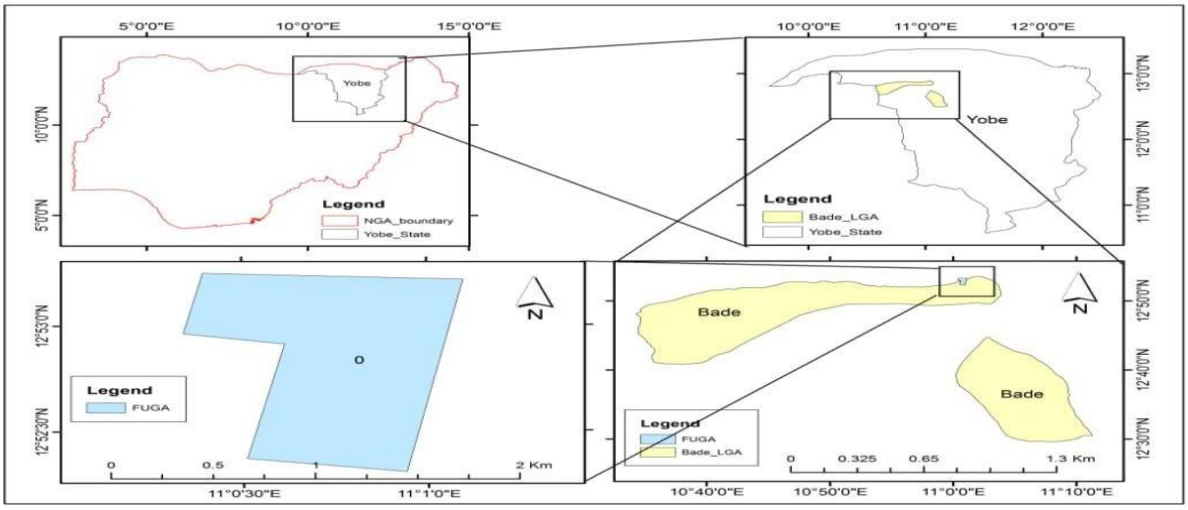


Fig1. This map indicates the study area.

Identification of Plant Species

Floral parts of plant species were collected, processed according to herbarium techniques, and identified in the field with the assistance of an ethno botanist who provided local names (Hausa). Names of identified plants were compared with those in Blench 2017. To obtain their botanical translations. Family taxon of each plant was verified using the Global Biodiversity Information Facility (GBIF) website (http://www.gbif.org). Unidentified plant samples were taken to the Herbarium of the Department of Biological Sciences, Federal University Gashua, for authentication and identification.

Species Relative Density (RD %)

Relative density of species was calculated using the formula;

$$RD = \frac{ni \times 100}{N}$$

Where ni is the number of individual species (i); N is the total number of all species in the entire community (Iyagin, 2017).

Basal Area Computation (BA (cm2))

$$BA = \frac{\pi D^2}{4}$$

Where D is the breast height diameter and $\pi = 3.14$ (Iyagin, 2017).

Species Relative Dominance (RDo)

$$RD = \frac{\sum Bai \times 100}{\sum Ban}$$

Where The Basal Area of Individual (Bai) is Plant belonging to species i and Ban is the Stand Basal Area (Fatem, 2020).

Relative Frequency (RF)

It shows the number of occurrences of a particular species of plant in a given area and was calculated using the following:

$$RF = \frac{\sum Fi \times 100}{Fn}$$

Where Fi is the number of plots where species i was encountered and Fn is the total frequency of all species (Okechalu, 2021).

The Importance Value Index (IVI)

Importance Value Index shows the ecological significance of tree species in community structure. It was determined using the formula below:

$$IVI = RD + RDo + RF$$

Where: IVI = Importance Value Index, RD = relative density, RDo = Species relative dominance and RF = relative frequency (Rayhanur-Rahman, 2019).

Species Richness

A mathematical method that takes into account the species richness and abundance of each species in the vegetation was used to determine community composition in each of the study plots. The Margalef (Dmg) index was used to calculate the number of species (Okechalu, 2021).

The Margalef index formula is as follows:

$$Dmg = \frac{-1}{LnN}$$

Where: S is the number of different species in the community, N is the total number of all individuals in the community and Ln is Natural Logarithm.

Plant Diversity Indices

Shannon-Weiner Index of Diversity (H')

This index was calculated using the formula:

$$H' = -\sum PiLnPi$$

Where: Pi is the proportion of species i and Ln Pi is the natural logarithm of the proportion of species i according to (Rayhanur-Rahman, 2019).

Simpson's Diversity Index (D)

$$D = 1 - \sum \left(\frac{n_i(n_i - 1)}{N(N - 1)} \right)$$

Where ni is the number of individual species; N is the total number of individuals in the plot (Iyagin, F, 2017)

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Assessment of the Conservation Status of Tree Species at Federal University Gashua

Each tree species was assessed for its global conservation status using the Global Biodiversity Information Facility (GBIF) and the International Union for Conservation of Nature (IUCN) Red List Version 2022-1. The IUCN Red List is widely regarded as the primary tool for conservation decision-making, as it provides information that informs biodiversity conservation policy and practice. In contrast, GBIF is an open-data research infrastructure, funded by national governments worldwide, that aims to make data on all forms of life on Earth accessible globally (Bello, 2019).

Results and Interpretation

Tree Species Composition and Species Richness in Federal University Gashua

Analysis of species richness identified 38 tree species distributed among 9 families across all study plots. The Margalef's index of richness was 4.08, 8.31, 4.85, and 4.70 for study plots 1, 2, 3, and 4, respectively (Tables 1-3).

Table 1 presents the tree species composition in Federal University Gashua. Plot 1 contained

Table 1: Tree Species Composition in Federal University Gashua.

S/N	Species Names	P1 BG	P2 VCC	P3 AC	P4 FAS	Total
1.	*Abutilon theophrasti*	0	0	0	1	1
2.	*Adansonia digitata*	1	0	0	0	1
3.	*Aloe barbadences miller*	4	0	0	0	4
4.	*Arachis hypogaea*	0	0	0	1	1
5.	*Azadirachta indica*	10	10	2	7	29
6.	*Calotropis procera*	0	10	8	15	33
7.	*Canchrus gliaririas*	0	5	0	11	15
8.	*Chamaerops humidis*	0	20	0	9	29
9.	*Citrullus lanatus*	0	0	0	2	2
10.	*Citrus aurantifolia*	11	0	0	0	11
11.	*Cleome gynandra*	0	0	0	2	2
12.	*Corymbia citriodora*	0	0	7	0	7
13.	*Cucumis melo*	0	0	0	6	6
14.	*Delonix regia*	8	0	0	0	8
15.	*Dicliptera brachiate*	9	0	0	0	9
16.	*Duranta erecta*	0	9	0	10	19
17.	*Emperia cylindrical*	0	0	0	15	15
18.	*Euphorbia mili*	3	0	0	0	3
19.	*Ficus platyphylla*	0	2	0	0	2
20.	*Ficus macrocarpa*	0	20	0	0	20
21.	*Peruvian passionfruit*	0	2	0	0	2
22.	*Ixoca coccinea*	0	4	30	0	34
23.	*Moringa oliefera*	4	4	5	0	13
24.	*Oryza sativa*	7	0	0	0	7
25.	*Piecilia fructescens*	0	3	0	0	3
26.	*Rehmannia glutinosa*	0	3	0	0	3
27.	*Senna obtusifolia*	0	0	0	8	8
28.	*Sesbania herbacca*	5	0	0	0	5
29.	*Sida rhombifolia*	0	7	0	0	7
30.	*Tithonia diversifolia*	0	2	0	0	2
31.	*Solanum lycopersicum*	7	0	0	0	7
32.	*Sonchus arvensis*	0	2	0	0	2
33.	*Syzygium cumini*	9	5	7	5	36
34.	*Tabernaemorium spp*	0	20	0	0	20
35.	*Terminalia catappa*	8	8	6	0	22
36.	*Thespesia popuinea*	0	7	5	5	12
37.	*Vachellia farnesiana*	16	12	18	7	53
38.	*Ziziphus mauritiana*	0	4	0	0	4
	Total	**111**	**170**	**118**	**113**	**512**
P = 0.001		**Df= 49**			**P < 0.05**	

Key: P1BG: Plot 1 Biological Garden, **P2VCC:** Plot 2 VC Complex, **P3AC:** Plot 3 Area Class, **P4FAS:** Plot 5 Faculty of Agricultural Sciences

Importance Value Index of tree species in Federal University Gashua and their conservation status according to International Union for Conservation of Nature (IUCN).

Table 2 presents the Importance Value Index (IVI) of tree species at Federal University Gashua, along with their conservation status as classified by the International Union for Conservation of Nature (IUCN). Ixora coccinea exhibited the highest IVI (8.26), whereas Sonchus arvenis had the lowest IVI (0.44).

S/N	TREE SPECIES	LOCAL NAMES (HAUSA)	RF	RD (%)	RDO	IVI	RANK	IUCN RLS
1.	*Abutrian theophroshi*	Kauchi mai gashi	0.01	0.19	0.02	0.77	29	LC
2.	*Adansonia digtata*	Kuka	0.06	0.19	0.12	0.44	34	LC
3.	*Arachis hypogaea*	Gyada	0.01	0.19	0.01	0.33	37	LC
4.	*Azadirachta indica*	Dogoyaro	0.04	5.66	0.11	5.30	4	DD
5.	*barbadiences miller*	Alobera	0.04	0.78	0.09	0.88	27	LC
6.	*Calotropis procera*	Tumfafiya	0.04	0.97	0.12	0.88	28	LC
7.	*Canchrus gliaririas*	Gambu	0.02	2.15	0.14	2.44	12	LC
8.	*Cenchrus ciliaris*	gambattafo	0.06	0.97	0.15	2.43	13	LC
9.	*Chamaerop humlis*	Kaba	0.06	5.66	0.15	5.30	5	LC
10.	*Citrullus lanatus*	Kankana	0.01	0.39	0.00	0.44	35	LC
11.	*Citrus aurantifolia*	Karimi lamu	0.06	2.15	0.13	2.33	14	LC
12.	*Cleome gynandra*	Gasaya	0.01	0.39	0.16	0.66	30	LC
13.	*Corymbia citriodora*	Turare	0.02	1.37	0.11	1.66	17	LC
14.	*Delonix regia*	Plamboyan	0.04	1.56	0.11	1.78	15	LC
15.	*Duranta erecta*	Furen zinariya	0.04	2.73	0.13	4.43	6	EN
16.	*Emperata cylindrical*	Tsakuwa	0.02	2.92	0.11	3.07	10	LC
17.	*Euphorbia mili*	madagascar	0.05	0.58	0.09	0.77	29	LC
18.	*Fieus plat*	Gabanuou	0.05	0.39	0.06	0.45	32	LC
19.	*Ficus microcarpa*	Chadiya	0.03	3.91	0.11	4.12	8	LC
20.	*Ineuctia peruviana*	Giye giye	0.02	0.39	0.05	0.45	33	VU

21.	*Ixoca coccinea*	Furenja	0.04	6.64	0.08	8.26	1	LC
22.	*Moringa oliefera*	Zogale	0.07	2.54	0.07	2.67	11	DD
23.	*Oryza sativa*	Shinkafa	0.07	1.37	0.10	1.34	22	LC
24.	*Piecilia fructescens*	Baadade dashe	0.05	0.58	0.07	1.55	19	DD
25.	*Rehmannia glutinosa*	Dajin giya	0.06	0.58	0.06	1.55	20	VU
26.	*Senna obtusifolia*	Tafasu	0.02	1.56	0.17	1.77	16	LC
27.	*Sansercviena trifasciata*	Guru moodaa	0.03	0.97	0.06	1.05	26	DD
28.	*Sesbania herbacca*	Kyerno	0.06	0.97	0.12	1.07	25	LC
29.	*Sida rhombifera*	Kauchi	0.05	1.37	0.13	1.34	23	VU
30.	*Sobania granditurs*	Agunmiya	0.05	0.39	0.04	1.34	24	VU
31.	*Solanum lycopersicum*	Tumatir	0.08	1.37	0.17	1.66	18	LC
32.	*Sonchus arvensis*	Ciyawa mairon	0.04	0.39	0.08	0.44	36	LC
33.	*Syzygium guineense*	Malmo	0.04	7.03	0.11	7.26	2	VU
34.	*Tabernaemorium spp*	Furen far	0.02	3.90	0.09	3.44	9	LC
35.	*Terminalia catappa*	Farin baushe	0.03	4.29	0.11	6.49	3	EN
36.	*Thespesia popuinea*	Majidadi	0.03	1.37	0.05	1.55	20	DD
37.	*Vachellia farnesiana*	Bagaruwa	0.05	4.49	0.03	4.22	7	LC
38.	*Zizphia mauritiana*	Magama	0.05	0.78	0.07	0.63	31	LC

P = 0.014 **Df= 43** **P < 0.05**

Table 2: RF; Relative Frequency, RD; Relative Density, RDo; Relative Dominance, IVI; Importance Value Index, IUCN; Union for Conservation of Nature, RLS; Red List Status, EN; Endangered, VU; Vulnerable, NT; Near Threatened, LC; le DD; Data Deficient.

Table 3: Diversity Indices of trees species in Federal University Gashua

This table shows the Diversity Indices of trees species in Federal University Gashua in which the following parameters are observed; Species Composition (S), Total number of individuals (N), Shannon-Weiner Diversity Index (H'), Species Evenness, Simpson Diversity Index (D) and Margalef's Richness Index (Dmg) respectively.

S/N	Tree species Diversity Parameters	P1 BG	P2 VCC	P3 AC	P4 FAS
1.	Margalef's Richness Index (Dmg)	4.08	8.3	4.85	4.70
2.	Shannon-Weiner Diversity Index (H')	2.67	3.38	2.65	2.70
3.	Simpson Diversity Index (D)	0.83	0.71	0.72	0.68
4.	Species Composition (S)	18	27	10	16
5.	Species Evenness	0.92	0.71	0.72	0.68
6.	Total number of individuals (N)	111	170	118	113

P = 0.002 Df = 5 P < 0.05

DISCUSSION

The present study recorded a total of 38 tree species across the four plots of Federal University Gashua, with a combined abundance of 512 individuals. The variations observed in species counts across the plots indicate differences in disturbance levels, human activities, and micro-environmental conditions. Similar findings were reported by Khera *et al.,* (2021) and Attua & Pabi (2023), who observed that areas closer to human settlements tend to experience higher levels of disturbance, leading to reduced woody species composition. Plots with lower disturbance (such as Plot 2 with higher richness index of 8.31) showed greater species abundance than more disturbed plots. This pattern agrees with studies in tropical and savanna ecosystems where woody species richness reduces with increasing anthropogenic pressure (Naidu & Kumar, 2016; Markum *et al.,* 2023). Likewise, Akinsoji *et al.,* (2016) reported similar declines in tree communities within Gashaka-Gumti National Park due to exploitation by nearby communities.

The ecological significance of each species within the community was assessed using Importance Value Index (IVI). In this study, species such as *Ixora coccinea* (8.26), *Syzygium cumini* (7.26), *Terminalia catappa* (6.49), *Chamaerops humilis* (5.30), *Azadirachta indica* (5.30) and *Vachellia farnesiana* (5.30) recorded high IVI values, indicating that these species are well established and play a major structural and functional role in the ecosystem. *hypogaea* (0.33), *Feus plat* (0.45), *Adansonia digitata* (0.44) and *Sobania grandifloras* (1.34) indicate that these species are poorly represented and may be under threat. Studies by Ayalew (2021) and Adeniji (2021) emphasize that species with IVI values lower than one require conservation attention, since their presence contributes little to ecosystem stability and they are more vulnerable to local extinction. The Shannon-Wiener diversity values obtained in this study (H' = 2.65–3.38) indicate moderate to high diversity. According to Adeniji (2021), H' values greater than 2.5 signify highly diverse and balanced communities. Plot 2 recorded the highest diversity (H' = 3.38), which aligns with its higher Margalef richness index (8.31).Comparable studies also reported similar diversity patterns Okechalu (2021) documented lower H' (1.57) in Pandam Wildlife Park, Plateau State, showing that the Federal University Gashua campus is more diverse.

Rayhanur-Rahman (2019) reported Simpson values (D = 0.07) and evenness 0.79 in Bangladesh forest, which are much lower than the current study (0.68–0.83), indicating stronger species distribution in Federal University Gashua. Magalef richness values (4.08–8.31) obtained in this study are also higher than the 7.57 reported by Rayhanur-Rahman (2019), showing better tree species richness in Plot 2.

Higher values of diversity and richness typically reflect reduced seasonal stress, better habitat conditions, and relatively stable regeneration processes in secondary forest ecosystems (Ayalew, 2021). Lower Simpson's index (0.68–0.83) in some plots also suggests moderate diversity levels consistent with fragmented savanna ecosystems.

The IUCN assessment revealed that 71% of species fall under Least Concern (LC), indicating low risk of extinction. These include *Solanum lycopersicum, Terminalia catappa, Chamaerops humilis, Citrus aurantiifolia, Azadirachta indica*, and others. The presence of many LC species suggests that the ecosystem still maintains a relatively stable and healthy set of woody vegetation.

However, 11% of the species were classified as Vulnerable (VU), and 10% as Endangered (EN)—including *Syzygium spp*., *Calotropis procera*, *Terminalia catappa*, and *Vachellia farnesiana*. This is consistent with findings by Bello (2019), who reported similar vulnerability patterns in Sudan Savanna trees of Katsina State, where key species such as *Pterocarpus erinaceus* and *Prosopis africana* were threatened due to exploitation. The presence of Data Deficient (DD) species such as Thespesia populnea (3% of species) suggests a need for further taxonomic and ecological research to determine their true conservation status, as recommended in IUCN guidelines. The IUCN classification indicates the need for conservation strategies such as controlled harvesting, regeneration programs, and community education to prevent further decline, particularly for species with low IVI values or endangered status.

Conclusion

Tree species were identified, with Fabaceae emerging as the most dominant family. The four most prevalent tree species were *Ixora coccinea, Syzygium guineense, Terminalia catappa, and Azadirachta indica,* exhibiting IVI values of 8.26, 7.26, 6.49, and 5.30, respectively. These IVI values offer a comprehensive assessment of each species' phytosociological role within the community. Additionally, tree species diversity indices based on the Shannon-Weiner index were 2.67, 3.38, 2.65, and 2.70 for plots 1, 2, 3, and 4, respectively, while the Simpson diversity index values were 0.83, 0.71, 0.72, and 0.68 for the corresponding plots. These findings indicate that tree diversity at Federal University Gashua is high, and the structural composition of the tree community demonstrates ongoing growth toward maturity and stability (Dunoma et al., 2026).

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