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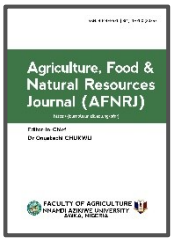

Original Article

Ecological assessment of tree species composition and diversity in Federal University Dutsin-Ma campus, Nigeria

OPEN ACCESS

Zara MUSA[1], Khadijatu Abba ANGO[2] & Sufiyanu SANI[3]

[1]*Department of Forestry and Wildlife Management, Ahmadu Bello University, Zaria, Nigeria*
[2]*Department of Forestry and Wildlife Management, Federal University Dutsin-Ma, Katsina, Nigeria*
[3]*Department of Forestry and Soil Science, Federal University Dutsin-Ma, Katsina, Nigeria*

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ABSTRACT

The study assessed tree species diversity in the Federal University Dutsin-Ma Take-off campus (FUDMA), Katsina state, Nigeria. The purposive sampling technique was employed for the study, with five locations within the study area purposively selected due to the presence of higher number of trees around them. One Plot each of 20 x 20m was laid across sample sites. All trees within the five different plots were recorded with their Diameter at Breast Height (DBH) measured. One hundred and sixty-one (161) individual trees belonging to seven (7) families were encountered in the study area. Azadirachta indica (RA = 48.45 %) was the most abundant species. Out of the recorded number of tree species, second gate, clinic, mosque and sport complex areas had the highest number of trees, each having 46(29%), 35(22%), 31(19%), 30(19%) respectively, while senate building recorded the lowest number of tree species, having 19 (11%). The local status of tree species revealed that majority (33.33%) were abundant and 25% were threatened/endangered. The pooled mean for DBH of the trees in the study area was 0.50m. The Shannon-Wienner and Simpson indices was 1.72 -0.72 respectively. The record of rare and threatened indigenous tree species in the study suggests that little attention had been given to regeneration and management of these species. The need to raise more seedlings especially for threatened and endangered species for both enrichment planting and increased afforestation of the campus is opined in this study. Likewise, that existing tree species within the campus be further protected from various forms of threats.

KEYWORDS: *Inventory, Management, Tree species composition, Relative abundance*

INTRODUCTION

Plants are crucial to life on earth because they provide oxygen, important raw materials, and form the basis for food webs (Osawaru & Ogwu,2014). Products and services provided by trees in the ecosystem support needs and promote the wellbeing of millions of people on earth. Increased urbanization has caused significant changes along urban-rural gradient, leading to variety of landscapes that are mainly shaped by human activities (Jiang *et al*., 2025). Among such human activities is the indiscriminate felling of trees for commercial and household use benefits. The adverse impacts of urbanization have been documented in various studies. For example, Sun *et al*. (2019) observed a decline in tree carbon density with increasing urbanization intensity. Despite the challenging effects of urbanization, trees can be strategically planted and managed to optimize desired ecosystem services using knowledge of

*Corresponding author: zmusa1@fudutsinma.edu.ng

heterogeneous urban landscapes and human demographics (Cabaraban *et al.,* 2013).

Urban trees are necessities in urban planning, because of their economic, ecological and social benefits. Trees in urban and peri-urban environment contribute to urban resilience by mitigating heat islands, managing storm water and offering recreational spaces that improve resident's mental health (Abgaogun et al., 2024). The university campus is a center of daily beehive activities for both staff and students and is a place of recurring patterns and organized social activities. A dose of nature, especially green space, plays a critical role in improving attention restoration, stress reduction, and academic performance for students (Li & Sullivan, 2016; Amicone *et al.,* 2018). Biodiversity on university campuses has the potential to connect directly to the public. For example, biodiversity on university campuses influences perceived attractiveness of urban areas to students (Lindemann-Matthies & Brieger, 2016) and promotes appreciation of the natural environment of local people (Colding & Barthel, 2017).

Many Universities worldwide have green spaces as an integral part of their campuses because of significant benefits for ecological function and urban communities (Susilowati *et al.*, 2022). Despite all of these benefits of trees in urban environment, including campuses, the rate of their removal had been on the increase for various reasons especially for infrastructural development. Although tree removal is sometimes necessary due to factors like old age, disease and conflict with infrastructure (Nowak et al., 2018), the primary consequences of this removal lead to devastating negative impacts such as soil erosion, increase temperatures, storms and flooding as reported by Agbaogun *et al*. (2024). Tree planting programs and their retention during development of areas are the possible ways of averting the consequences of tree removal in the environment.

Federal University Dutsin-Ma Take-off campus is located in Dutsin-Ma town, Katsina State. The campus offers a kind of micro climate for academic activities, sports, resting space and other due to relative abundance of woody tree species. It also offers important benefits like improving air quality and supporting biodiversity in the ecosystem especially serving as a safe haven for free ranging urban wildlife species such as birds. The campus has become a place for tree species preservation as both students and staff of several Departments associated with green environment and climate change mitigation are constantly creating awareness on the need to preserve trees. Although the campus is known to harbor different woody tree species, scientific evidence of past inventory is scanty while information is also lacking on their relative abundance as well as threat status. This gap in information justified the study. Understanding the distribution and woody tree species diversity in the campus will further support informed decision making in building plans, conservation strategies and sustainable management practices in the campus.

MATERIALS AND METHOD

Study area

Federal University Dutsin-ma, situated in Dutsin-Ma Local Government Area of Katsina State, Nigeria has two campuses, namely; main campus and the take-off campus. This study is however limited to the take-off campus. The Campus lies between Latitude $12^0$28'24''N and Longitude $7^0$29'0''E (FUDMA GIS Lab). The study area experiences moderately high relative humidity year-round, with temperatures ranging from 21°C to 35°C. The soil in the area belongs to the sandy clay loam textural class. The area receives an annual rainfall of 700mm (Abaje *et al*., 2014) and high temperature in most parts of the year, with maximum day temperature of about 38^0C or higher in the months of March (Ruma & Sheikh, 2010). The area lies within the Sudan Savannah zone which combines the characteristics of both Sahel and Guinea savannah, the vegetation of the area is typically a grassland type.

Sampling procedure and data collection

The purposive sampling technique was adopted in the study by selecting five locations due to higher presence of trees in those areas. They included: Senate Building Area (SBA), Mosque Area (MA), Second Gate Area (SGA), Sport Complex Area (SCA) and the Clinic Area (CA). For each site, plot of 20m x 20m was established and all trees observed were recorded and identified to species level. Individual tree species in each of the plots whose diameter at breast height (DBH) were greater than or equal to 10 cm were identified, counted, recorded and their DBH measured using a girth tape.

Data Analysis

Data collected were analyzed using Descriptive statistics (mean and percentages) for tree species abundance while the Shannon Weiner diversity index was used in evaluating the diversity of tree species in the study area as illustrated below:

Relative Frequency (RF) for individual species in the study area was calculated using the formula below:

$$\text{Relative Abundance (RA) \%} = \frac{\text{Freuency of a specie}}{\text{Total frequency of all species}} \times 100 \quad (1)$$

Using the PAST Program, the Shannon-Wienner diversity (Shannon and Weaver, 1949) was computed to evaluate tree species diversity. Shannon-Wiener index is a measure of diversity that takes into account the species richness (number of species in a given area) and their relative abundances. It is given by the formula:

$$H = -\sum_{i=1}^{s} Pi\ lnPi \quad (2)$$

Where, H= Diversity index; S= Total number of species, P_i= Proportion of each individual (i^{th}) species in the sample, ln P_i= Natural logarithm of the species proportion, Values are generally between 1.5 and 3.5 in most ecological studies.

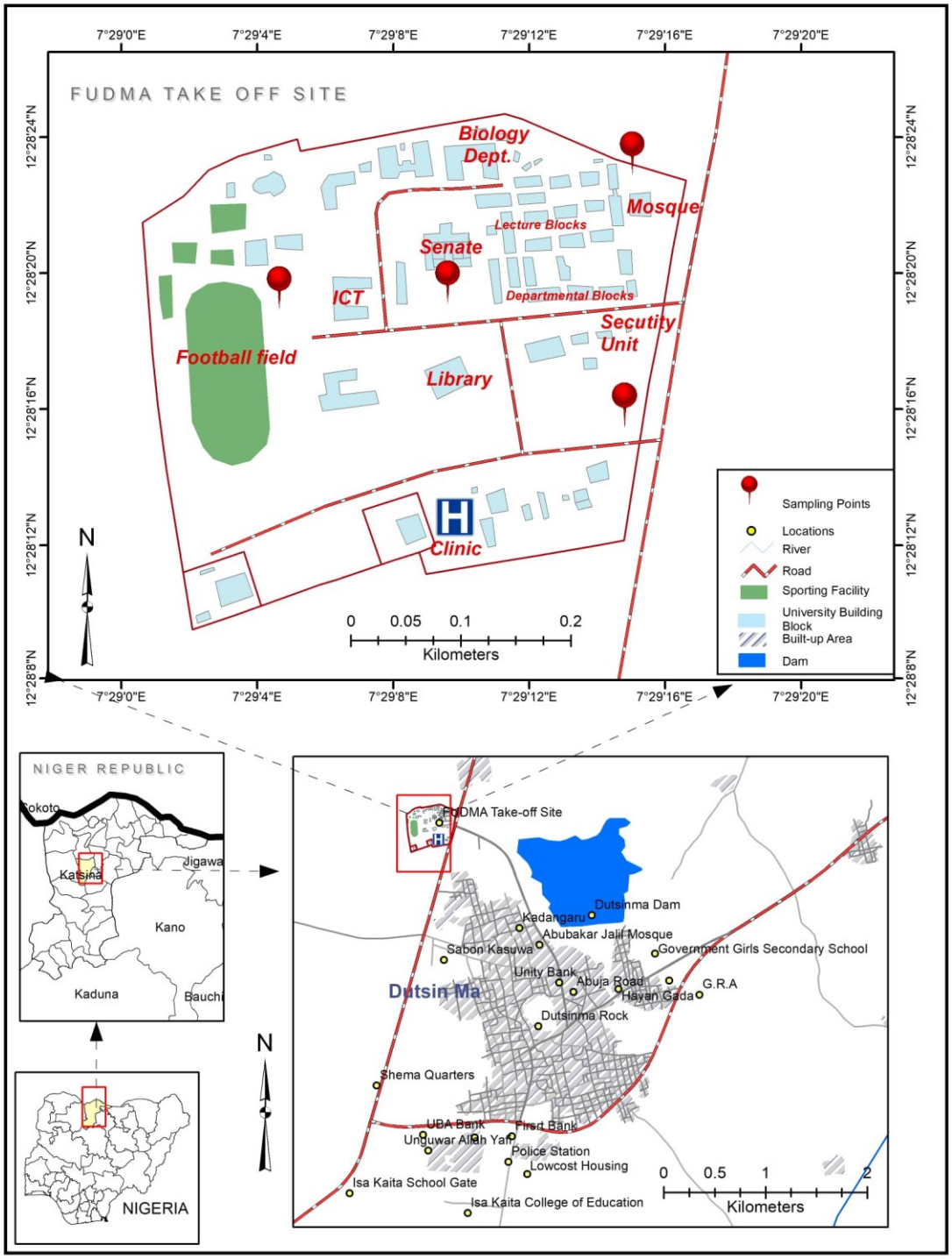

Figure 1: Map of the study area, showing sample site

The Shannon index increases as both the richness and the evenness of the community increases.

The tree species were classified based on the relative Abundance (RA) using the methods in Edet *et al.,* (2012) and as follows: Abundant = RA ≥ 5.00, Frequent = 4.00 ≤ RA ≤ 4.99, Occasional = 3.00 ≤ RD ≤ 3.99, Rare = 1.00 ≤ RD ≤ 2.99 and Threatened/Endangered = RD < 1.00.

RESULTS AND DISCUSSION

Woody tree species abundance and Relative abundance at the Take off campus of Federal University Dutsin-Ma

Result from the inventory revealed that a total of 161 trees belonging to 12 different species and 7 different taxonomic families were encountered (Table 1). The most abundant tree species recorded were *Azadirachta indica*, *Terminalia mantaly* and *Eucalyptus camaldulensis* with a total of 78, 23, 11 and relative abundance of 48.45%, 14.29% and 11.80% respectively. *Adansonia digitata, Delonix regia* and *Eucalptus torelliana* were identified as the threatened species with relative abundance of 0.621 each. In all, 33.33% tree species were abundant, 25% were threatened, 16.66% were frequent and 16.66% were occasional and 8.33% were rare. The family *Fabaceae* was the most represented with 03 individuals, followed by Myrtaceae (02), *Meliaceae* (02), *Combretaceae* (02) while all the other families recorded 01 species only (Table 1).

Table 1: Woody tree species Abundance and relative abundance in the study area

Family	Botanical name	Common name	Abundance	RA (%)	Status
Fabaceae	*Senna siamea*	Cassod tree	7	4.348	Frequent
Meliaceae	*Azardirachta indica*	Neem	78	48.447	Abundant
Myrtaceae	*Eucalyptus camaldulensis*	River red gum	19	11.80	Abundant
Fabaceae	*Albizia lebbeck*	Lebbeck tree	7	4.348	Frequent
Myrtaceae	*Eucalyptus torelliana*	Cadaga tree	1	0.621	Threatened
Annonaceae	*Polyalthia longifolia*	False ashoka	5	3.106	Occasional
Combretaceae	*Terminalia catappa*	Country almond	5	3.106	Occasional
Combretaceae	*Terminalia mentaly*	Madagascar almond	23	14.286	Abundant
Fabaceae	*Delonix regia*	Flamboyant	1	0.621	Threatened
Malvaceae	*Adansonia digitata*	Baobab	1	0.621	Threatened
Meliaceae	*Khaya seneglensis*	Mahogany	11	6.832	Abundant
Arecaceae	*Hyphaene thebalca*	Doum palm	3	1.863	Rare
Total			**161**		

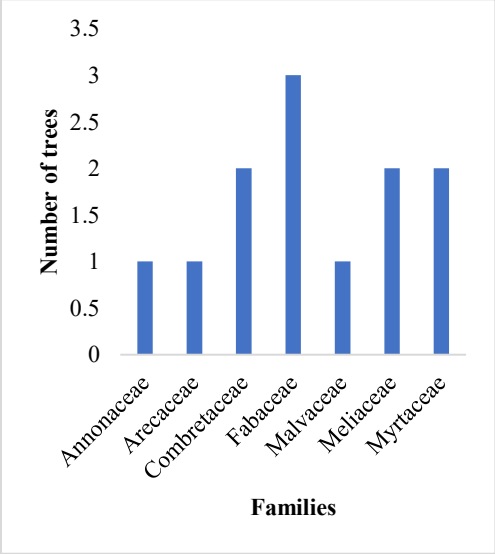

Figure 2: Taxonomic family distributions by of trees in the study area

Woody tree species distributions and mean DBH across the selected sample locations

Table 2 shows the distribution of tree species in the various sample locations across the study area and the recorded mean DBH of the various tree species. The Second Gate Area had the highest number of trees (abundance =46), followed by the clinic (abundance=35) and the mosque area (abundance =31) while the senate building area had the lowest number of trees (abundance=19). *Adansonia digitata* had the highest mean diameter at breast height with the value of 3.71; followed by *Khaya seneglensis* with the value of 0.38, while *Terminalia catappa* and *Polyalthia longifolia* and had the lowest values of 0.12 and 0.10 respectively (Table 2).

Tree species diversity in FUDMA Take-off Campus

During the survey, the entire study area had a diversity index of 1.72, indicating a moderate diversity. Site A which was the Senate building had the highest species richness of 7, followed by the second gate area with species richness of 6. Shannon-Weiner Diversity and Simpson Index of Diversity were higher in the Senate building and Second gate area with values 1.78, 0.81 and 1.48, 0.72 respectively (Table 3). The clinic site had diversity index of 1.284 and 0.695 for Shannon-Weiner and Simpson index respectively. The sport complex area recorded the lowest diversity with the values 0.47 and 0.24 for Shannon and Simpson index respectively. Equitability indices, which measure how evenly the individuals were distributed among the species, showed 0.69 for the entire study area. The mosque area recorded the highest value (0.91) while the sport complex had the lowest equitability index (0.53) (Table 3)

Table 2: Distribution and DBH of woody tree species across the study area

Botanical name	Common name	Frequency					Mean DBH(M)
		SBA	MA	SGA	SCA	CA	
Senna siamea	Cassod tree	2	0	5	0	0	0.19
Azardirachta indica	Neem	2	16	21	26	13	0.18
Eucalyptus camaldulensis	Red river gum	0	5	5	0	9	0.22
Albizia lebbeck	Lebbeck tree	1	0	5	0	1	0.17
Eucalyptus torelliana	Cadaga tree	0	0	0	0	1	0.14
Polyalthia longifolia	False ashoka	5	0	0	0	0	0.10
Terminalia catappa	Country almond	5	0	0	0	0	0.12
Terminalia mentaly	Madagascar almond	3	0	9	0	11	0.22
Delonix regia	Flamboyant	1	0	0	0	0	0.31
Adansonia digitata	Baobab	0	0	0	1	0	3.71
Khaya seneglensis	Mahogany	0	10	1	0	0	0.38
Hyphaene thebalca	Doum palm	0	0	0	3	0	0.24
Total	**12**	**19**	**31**	**46**	**30**	**35**	

Tree species diversity in FUDMA Take-off Campus

During the survey, the entire study area had a diversity index of 1.72, indicating a moderate diversity. Site A which was the Senate building had the highest species richness of 7, followed by the second gate area with species richness of 6. Shannon-Weiner Diversity and Simpson Index of Diversity were higher in the Senate building and Second gate area with values 1.78, 0.809 and 1.48, 0.72 respectively (Table 3). The clinic site had diversity index of 1.28 and 0.695 for Shannon-Weiner and Simpson index respectively. The sport complex area recorded the lowest diversity with the values 0.47 and 0.24 for Shannon and Simpson index respectively. Equitability indices, which measure how evenly the individuals were distributed among the species, showed the highest value for the mosque area (0.91) and lowest for sport complex (0.53) (Table 3).

Discussion

This study recorded 161 trees, which is less than 203 recorded by Musa et al. (2023) in the same environment. This difference may be attributed to the fact that the authors recorded all species irrespective of tree species DBH, while the present study focused only on trees with DBH of ≥10cm.The number of species obtained was lower than the findings of Soba *et al.* (2023) and Abudullahi and Mudavanhu (2025) who reported 36 and 35 species in Faculty of Agriculture in Nassarawa State University Keffi, Nassarawa state, and Abubakar Tafawa Balewa University, Bauchi state Nigeria respectively. The difference in abundance and richness in different areas may be attributed to differences in size of the study area, climatic, edaphic and anthropogenic factors. This finding aligns with the report of Krebs (1992) on species-area relationship which affirmed that larger areas support more habitats, species and thus, higher abundance, when compared with smaller areas.

The most abundant tree species recorded in the study area were *Azadirachta indica* and *Terminalia mantaly*. Relatively high abundance of *Azadirachta indica* could be attributed to its ecological adaptability to the arid and semi- arid climatic conditions of the Northern region of Nigeria. This finding corroborates the submissions of Kithure *et al*. (2015) that *A. indica* has adaptability to a wide range of climatic and topographic conditions and thrives well in dry, stony shallow soils. The wide acceptability of *Terminalia mantaly* in the study area could be associated with its ornamental and shade-providing qualities (Gabriel *et al.,* 2020). The dominance of Fabaceae in the study area was similar to the work of Sodimu *et al.* (2024) who recorded Fabaceae as the dominant family in study of species composition and diversity in Ahmadu Bello University botanical garden, Zaria, Kaduna State, Nigeria. However, the finding from this study was in contrast with the findings of Agbelade (2021) which reported Sterculiaceae as the dominant family in Federal University of Technology, Akure, Nigeria. The dominance of Fabaceae observed in this study conforms with the findings of Bello *et al.* (2021) who noted that the dominance of Fabaceae was attributed to the large number of species represented by the family (Mimososacea, Ceasalipinacea and Paplionaceae) as compared with several other families with just one sub-family in the tropics.

The diversity and evenness observed in this study is relatively low, compared with the findings of Moshood *et al.* (2023) in University of Lagos campus, Lagos, Nigeria. This may be attributed to the dominance of some trees such as *A. indica* over others in the study area. According to Wakawa *et al*., (2017), variation in diversity between geographical locations can arise from differences in sampling strength and some abiotic factors such as climatic, topographic, edaphic, and dispersal rates. The low diversity recorded indicates that although the existing trees offer various ecosystem services, it poses a disadvantage to urban wildlife like birds whose presence and diversity are greatly influenced by the diversity of vegetation of an environment

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Table 3: Diversity indices of tree species in the study area

Sample Location	Taxa_S	Shannon_H	Simpson_1-D	Evenness_e^H/S	Dominance_D
Entire study area	12	1.72	0.72	0.69	0.28
Site A: SBA	7	1.78	0.81	0.85	0.19
Site B: MA	3	1.00	0.60	0.91	0.40
Site C:SGA	6	1.48	0.72	0.74	0.28
Site D:SCA	3	0.47	0.24	0.53	0.76
Strata E: CA	5	1.28	0.70	0.72	0.31

CONCLUSIONAND RECOMMENDATIONS

The study has shown that FUDMA Take-off campus has moderate woody species diversity and abundance. From the findings, it is evident that variation in abundance, diversity and distribution existed in different sample plots. The study also proved that although some tree species are abundant, others such as the *Eucalyptus torelliana* are threatened. Conclusively, the campus environment remains an important place for conservation of species against indiscriminate felling. It is therefore important that efforts should be geared towards collecting seeds/fruits of various tree species especially threatened and endangered woody tree species and raising them. Similarly, with increasing desert encroachment in the north generally, the need to raise and plant more trees especially in that part of the country has become critically important to further mitigate the climate change impact in Katsina State.

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Authors' Contributions

ZM conceptualized the study, performed data analysis and wrote the first draft of manuscript. KAA & SS collected data and performed literature searches for introduction and discussion. All authors read and approved the final draft of the manuscript.

Ethical Statement

Not applicable

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