

Floristic Composition and Diversity of Tree Species in Residential Areas of Wukari Metropolis, Taraba state, Nigeria

¹Tafida, M. A.*, ¹Ahmadu, D. G., ²Kyugah, J. T. & ²Jeyol, M. C.

¹Department of Biological Sciences, Faculty of Biosciences, Federal University Wukari, Taraba State, Nigeria

*Corresponding author: tafida4399@gmail.com

ABSTRACT

The study assessed the composition and diversity of tree species in selected residential areas of Wukari Metropolis, Taraba State, Nigeria. The research was conducted in three sites, namely the Mission area (Site A), the Government Residential Area (GRA) (Site B), and the Federal University Wukari (FUW) staff quarters (Site C). Systematic field surveys were employed to identify and enumerate trees across the study sites. Fourty plots each measuring 50m x 50m were randomly selected in each site for the study. The data obtained were analyzed to determine species composition, abundance, and diversity using PAST 4.03 software. A total of 568 individuals representing 26 tree species belonging to 11 families were observed and recorded. The family Fabaceae was the most represented with seven species, while the Anacardiaceae family contributed significantly through *Mangifera indica*, which emerged as the most abundant species with 258 individuals. Site-level comparison revealed distinct differences in diversity indices. Site A recorded 19 tree species with a high dominance index (0.4123), indicating the prevalence of a few species, particularly mango and cashew. Site B, with 22 tree species, had the highest Shannon-Wiener Index (2.143) and Margalef's Richness Index (3.404), suggesting greater diversity and richness. Site C, although recording only 12 species, showed the highest Evenness Index (0.696), reflecting a more balanced distribution of individuals among species. The findings highlight the role of residential areas in supporting urban tree diversity in Wukari Metropolis. While the GRA area exhibited the greatest species richness and diversity, the Mission area was dominated by a few species, and the FUW staff quarters displayed higher species balance despite lower richness. The study provides useful baseline information for urban forestry management and biodiversity conservation in the metropolis.

Keywords: Trees, Diversity, Mission Area, Government Reserve Area (GRA)

INTRODUCTION

Urban tree vegetation is essential for maintaining ecological balance, environmental quality, and urban livability. Trees help regulate microclimate, improve air quality, prevent soil erosion, and support biodiversity (Wolf *et al.*, 2020). Furthermore, urban trees contribute to the conservation of biodiversity by providing habitat, food, and resources for a variety of flora and fauna species, such as birds, insects, and small mammals (Chukwu *et al.*, 2022). In addition to these ecological functions, urban trees offer economic, cultural, and social benefits such as shade, fruit, and aesthetic value, which enhance residents' well-being (Salmond *et al.*, 2016). However, the rapid pace of urbanization and development has posed significant threats to urban vegetation and

biodiversity. The expansion of residential, commercial, and industrial areas often leads to the removal or fragmentation of natural habitats, resulting in the loss of plant and animal species (Salami *et al.*, 2021).

Several studies have been conducted in Nigeria and beyond to assess the composition and diversity of urban tree species. Agbelade *et al.* (2017) investigated tree species richness and vegetation indices in Abuja, while Chukwu *et al.* (2022) examined species diversity and structural characteristics of avenue trees in Awka. Similarly, Abdullahi & Abba (2021) assessed the floristic composition of Kumo town, and Salami *et al.* (2021) analyzed tree diversity across three northern states of Nigeria. These studies consistently demonstrated variations in tree species composition, diversity, and dominance patterns, often influenced by urbanization intensity, land-use practices, and ecological conditions.

Despite these contributions, little is known about the composition and diversity of tree species in Wukari Metropolis, Taraba State. Wukari, like many other rapidly expanding urban areas in Nigeria, is experiencing increasing anthropogenic pressures, which may alter the structure and ecological functions of urban tree communities. However, systematic studies focusing on the residential areas of Wukari are scarce.

Therefore, this study aims to fill this gap by providing a comprehensive assessment of the tree species composition and diversity in selected residential areas of Wukari Metropolis. The specific objectives were to identify and document the tree species present in the study sites, analyze their abundance, and evaluate their diversity indices to provide baseline information that can guide future urban forestry management and conservation strategies in the area.

MATERIALS AND METHODS

Study Area

The study was conducted in Wukari Metropolis, the administrative headquarters of Wukari Local Government Area in Taraba State, Nigeria. Wukari lies between latitude 7°51'N and longitude 9°47'E, with an elevation of about 207 meters above sea level. The area experiences a tropical climate characterized by a distinct wet season (April–October) and dry season (November–March), with a mean annual rainfall of approximately 1,200–1,500 mm and mean temperature of 28–33 °C (Meer & Tella, 2018).

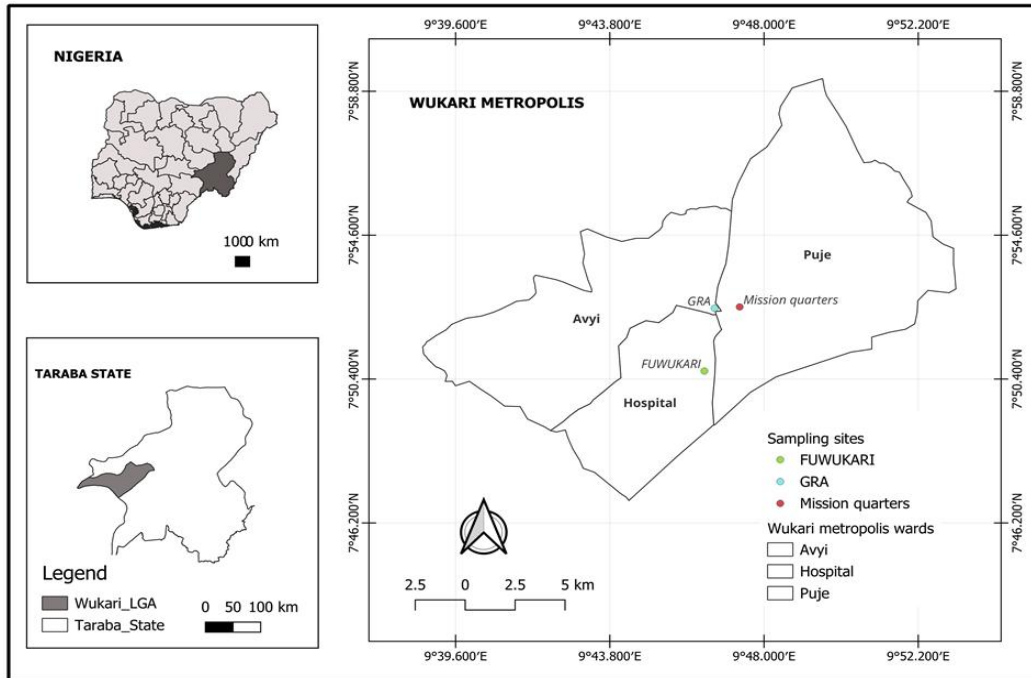


Figure 1. Map of Study Area

Sampling Sites

Three residential sites were selected for this study: Mission Area (Site A), Government Reserved Area (Site B), and Federal University Wukari (FUW) Staff Quarters (Site C). These sites were chosen due to their ecological, residential, and social significance within the urban landscape of Wukari Metropolis.

Experimental Design

The study employed a Stratified Random Sampling method to survey tree vegetation within residential houses in Wukari metropolis. The sampling design was stratified into three residential zones: Mission Quarters area, Government Residential Area (GRA), Federal University staff residential area

Within each zone, 40 plots were randomly selected, each measuring 50m x 50m. The total area covered by these plots was approximately 10 hectares per zone.

Data Collection

An inventory survey was carried out in the three study sites. Tree species with a diameter at breast height (DBH) ≥ 10 cm were identified and recorded. For each tree species, the number of individuals was enumerated. Data on species frequency, density, and dominance were collected following standard procedures (Ismail, 2020; Abdullahi & Abba, 2021). Tree species identification was carried out using a range of resources, including tree identification guide books such as Szejner and Emanuelli (2016) "Tree species identification in the tropics", Tropical Tree Crops (Okpeke, 1987), Trees of Nigeria (Keay, 1989), Useful Plants of West Tropical African (Burkill, 1997 and 2000) and PlantNet, an AI-powered app for tree species identification. Common names and local knowledge were also employed to aid identification of tree species.

Diversity index

The diversity analysis, including the Shannon-Wiener Diversity Index (H^1), species evenness, species richness, and Index of Dominance were computed using the following formula below:

Shannon-Weiner index (H), which is the measure of diversity within a site according to Shannon & Wiener (1949); Jeyol & Yerima (2023).

$$H' = - \sum_i^S p_i \ln(p_i)$$

Where $P_i = S / N$, S = number of individuals of one species; N = total number of all individuals in the site and \ln = logarithm to base e

$$\text{Species Richness} = \frac{(S-1)}{\ln N} \quad (\text{Jeyol \& Yerima, 2023})$$

Where S = total number of species; N = total number of individuals in the site and \ln = natural logarithm.

$$\text{Evenness (E)} = \frac{H}{\ln S} \quad (\text{Salami \& Lawal, 2018})$$

$$\text{Index of Dominance (D)} = \sum (p_i)^2$$

Where:

H' = Shannon-Wiener Diversity Index;

\sum = sum;

$p_i = S/N$ (S = number of individuals of a species, N = total number of all individuals)

N = total number of individuals of all species

\ln = the logarithmic proportion of the species;

E = evenness,

S = total number of species present.

Data Analysis

The data collected were subjected to quantitative ecological analysis. The composition and diversity of tree species were assessed using both descriptive statistics and biodiversity indices using PAST 4.03 software (Hammer *et al.*, 2001).

The following formulas were applied for the calculation of basal area, frequency, relative frequency, density, relative density, relative dominance, important value index

The basal area of all trees in the study areas $BA = \pi D^2/4$. Where: BA = Basal area (m^2), D = Diameter at breast height (m) and $\pi = (3.143)$.

$$\text{Frequency} = \frac{\text{Number of plots in which species occurs}}{\text{Total number of plots}} \times 100 \quad (\text{Ismail, 2020})$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100 \quad (\text{Ismail, 2020})$$

$$\text{Density} = \frac{\text{Total number of tree species in the study area}}{\text{Total number of plots studied}}$$

(Abdullahi & Abba 2021)

$$\text{Relative Density (RD)} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

(Jeyol & Yerima, 2023)

$$\text{Relative Dominance (RDO)} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \times 100$$

(Abdullahi & Abba 2021)

Important Value Index IVI = Relative Frequency + Relative Density + Relative Dominance (Ismail, 2020).

RESULTS

Inventory of Tree Species in Residential Areas of Wukari Metropolis

Table 1 shows the inventory of tree species found in the three residential areas of Wukari Metropolis. The data collected during the study identified a total of 26 tree species belonging to 11 different plant families. In the Mission area (Site A), 19 tree species belonging to 11 families were recorded. In the Government Residential Area (GRA, Site B), 22 tree species belonging to 11 families were recorded. In the Federal University Wukari staff residential areas (Site C), 12 tree species belonging to 8 families were recorded. The Fabaceae family has the highest number of species with a total of 7 species recorded across the three sites. Sapotaceae, Bignoniaceae and Apocynaceae have the least number of species with one (1) species respectively as shown in figure 1. The species with the highest number of trees is the *Mangifera Indica* (mango), with a total of 258 individuals recorded across the three study sites. *Ficus sur forssk* (bush fig) and *Cola cordifolia* (mandingo cola) have the least number of trees with 1 individual recorded for both species at site C (FUW).

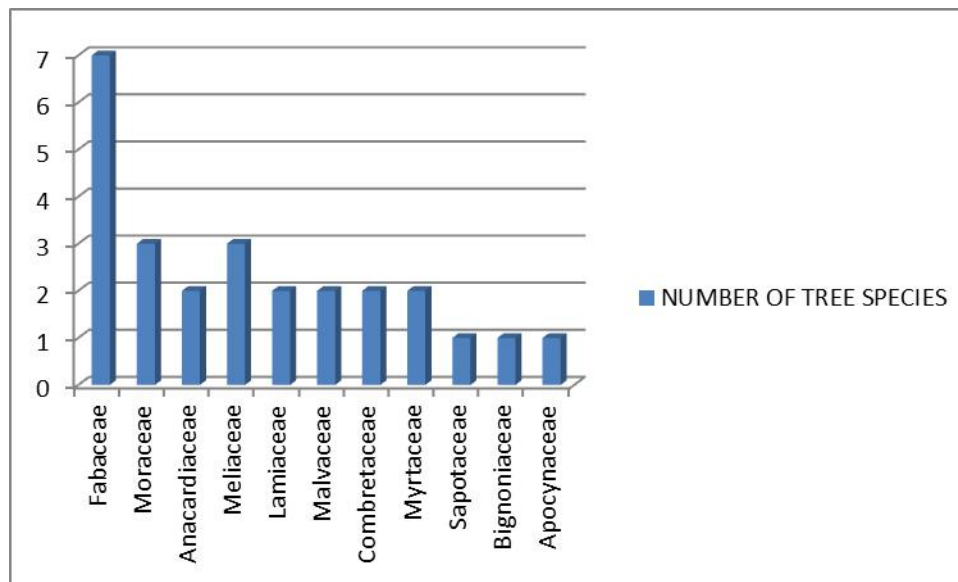


Figure 2. Total tree species among families

Table 1. Inventory of Tree Species in Residential Areas of Wukari Metropolis

COMMON NAME	BOTANICAL NAME	FAMILY	SITE A (MISSION)	SITE B (GRA)	SITE C (FUW)	TOTAL	R.A (%)
Mango	<i>Mangifera indica</i>	Anacardiaceae	198	52	8	258	45.42
African Copaiba Balsam Tree	<i>Daniellia oliveri</i>	Fabaceae	0	5	2	7	1.23
Locust Bean	<i>Parkia biglobosa</i>	Fabaceae	4	6	0	10	1.76
Neem	<i>Azadirachta indica</i>	Meliaceae	26	66	2	94	16.55
Satellite tree	<i>Terminalia mantaly</i>	Combretaceae	1	13	0	14	2.46
Black Plum	<i>Vitex doniana Sweet</i>	Lamiaceae	0	4	0	4	0.70
Tropical Almond	<i>Terminalia catappa</i>	Combretaceae	3	1	0	4	0.70
Cashew	<i>Anacardium occidentale</i>	Anacardiaceae	56	8	0	64	11.26
Pod Mahogany	<i>Afzelia quazensis</i>	Fabaceae	0	2	10	12	2.11
Shea Butter	<i>Vitellaria paradoxa</i>	Sapotaceae	3	4	4	11	1.94
Gum Tree	<i>Eucalyptus camaldulensis Dehnh</i>	Myrtaceae	3	6	0	9	1.58
Gmelina	<i>Gmelina arborea</i>	Lamiaceae	13	11	13	37	6.51
Senegal Mahogany	<i>Khaya senegalensis</i>	Meliaceae	0	4	0	4	0.70
Yellow Cassia	<i>Senna siamea</i>	Fabaceae	0	4	0	4	0.70
Benin Juju Tree	<i>Newbouldia laevis</i>	Bignoniaceae	2	0	0	2	0.35
Senegal Coral Tree	<i>Erythrina senegalensis</i>	Fabaceae	5	3	0	8	1.41

Peepal Tree	<i>Ficus religiosa L.</i>	Moraceae	2	0	0	2	0.35
Flamboyant	<i>Delonix regia</i>	Fabaceae	2	0	0	2	0.35
Luckynut	<i>Cascabela thevetia</i>	Apocynaceae	1	2	0	3	0.53
Sycomore	<i>Ficus sycomorus L.</i>	Moraceae	1	3	0	4	0.70
Myrtle	<i>Corymbia torelliana</i>	Myrtaceae	3	0	0	3	0.53
Baobab	<i>Adansonia digitata L.</i>	Malvaceae	1	1	0	2	0.35
Okpehe	<i>Prosopis Africana</i>	Fabaceae	0	3	1	4	0.70
Cape-Ash	<i>Ekebergia capensis</i>	Meliaceae	0	0	4	4	0.70
Bush Fig	<i>Ficus sur Forssk</i>	Moraceae	0	0	1	1	0.18
Mandingo Cola	<i>Cola cordifolia</i>	Malvaceae	0	0	1	1	0.18
Grand Total	26	11	324	198	46	568	100

R.A = Relative Abundance

3.2 Diversity and Abundance of Tree Species in the Study Areas

The diversity indices presented in Table 2 reveal key findings about the tree species communities in the three study areas. Site A exhibits the highest Dominance Index of 0.41, indicating an uneven distribution with a few dominant species, while Site B and Site C have lower Dominance Indices, suggesting more even distributions. The Shannon-Wiener Diversity Index is highest for Site B at 2.1, reflecting the greatest overall species diversity, in contrast to Site A's lower value of 1.4. Site C has the highest Evenness Index of 0.69, and Site B the highest Margalef's Richness Index of 3.4, underscoring the superior diversity and species richness in the GRA area compared to the other sites.

Table 2. Diversity Index of Tree Species within the Study Area

	D	H`	E	S
Site A	0.41	1.4	0.24	2.8
Site B	0.19	2.1	0.45	3.4
Site C	0.18	1.9	0.69	2.4

D= Dominance, H` = Shannon-Wiener index, E= Evenness, S= Species richness

Important Value Index of Tree Species

The Importance Value Index (IVI) is combination of the Relative Density, Relative Frequency, and Relative Dominance of each tree species, providing an assessment of the ecological importance and influence of the tree species within the study areas. Looking at the IVI values in the table, it is evident that the Mission area (Site A) has a higher concentration of dominant tree species, with Mango (*Mangifera indica*) having an exceptionally high IVI of 162.8, followed by Cashew (*Anacardium occidentale*) with an IVI of 53.4. In contrast, the GRA (Site B) and FUW (Site C) areas exhibit a more even distribution of IVI values, with a greater diversity of tree species contributing to the overall community structure.

Table 3 Important Value Index (IVI) of Tree Species

COMMON NAME	BOTANICAL NAME	SITE A (MISSION)	SITE B (GRA)	SITE C (FUW)	MEAN
Mango	<i>Mangifera indica</i>	162.8	82.4	59.8	101.7
African Copaiba Balsam Tree	<i>Daniellia oliveri</i>	0	10.6	16.4	9.0
Locust Bean	<i>Parkia biglobosa</i>	7.8	8.4	0	5.4
Neem	<i>Azadirachta Indica</i>	21.6	78.7	15.7	38.7
Satellite tree	<i>Terminalia mantaly</i>	1.6	12.8	0	4.8
Black Plum	<i>Vitex doniana Sweet</i>	0	7.1	0	2.4
Tropical Almond	<i>Terminalia catappa</i>	3.5	1.7	0	1.8
Cashew	<i>Anacardium occidentale</i>	53.4	12.6	0	22.0
Pod Mahogany	<i>Afezelia quazensis</i>	0	4.5	64.7	23.1
Shea Butter Gum Tree	<i>Vitellaria paradoxa Eucalyptus camaldulensis Dehnh</i>	3.8	7.8	29.6	13.7
		3.8	8.5	0	4.1
Gmelina	<i>Gmelina arborea</i>	18.3	18.9	70.1	35.8
Senegal Mahogany	<i>Khaya Senegalensis</i>	0	12.9	0	4.3
Yellow Cassia	<i>Senna siamea</i>	0	7.3	0	2.4
Benin Juju Tree	<i>Newbouldia laevis</i>	1.6	0	0	0.5
Senegal Coral Tree	<i>Erythrina senegalensis</i>	4.9	5.5	0	6.7
Peepal Tree	<i>Ficus religiosa L.</i>	2.3	0	0	0.76
Flamboyant	<i>Delonix regia</i>	2.4	0	0	0.8
Luckynut	<i>Cascabela thevetia</i>	1.7	3.2	0	1.6
Sycomore	<i>Ficus sycomorus L.</i>	1.7	5.0	0	2.2
Myrtle	<i>Corymbia torelliana</i>	2.6	0	0	0.9
Baobab	<i>Adansonia digitata L.</i>	4.9	7.5	0	4.1
Okpehe	<i>Prosopis africana</i>	0	4.6	7.7	4.7
Cape-Ash	<i>Ekebergi capensis</i>	0	0	22.1	7.4
Bush Fig	<i>Ficus sur Forssk</i>	0	0	6.2	2.1
Mandingo Cola	<i>Cola cordifolia</i>	0	0	7.8	2.6

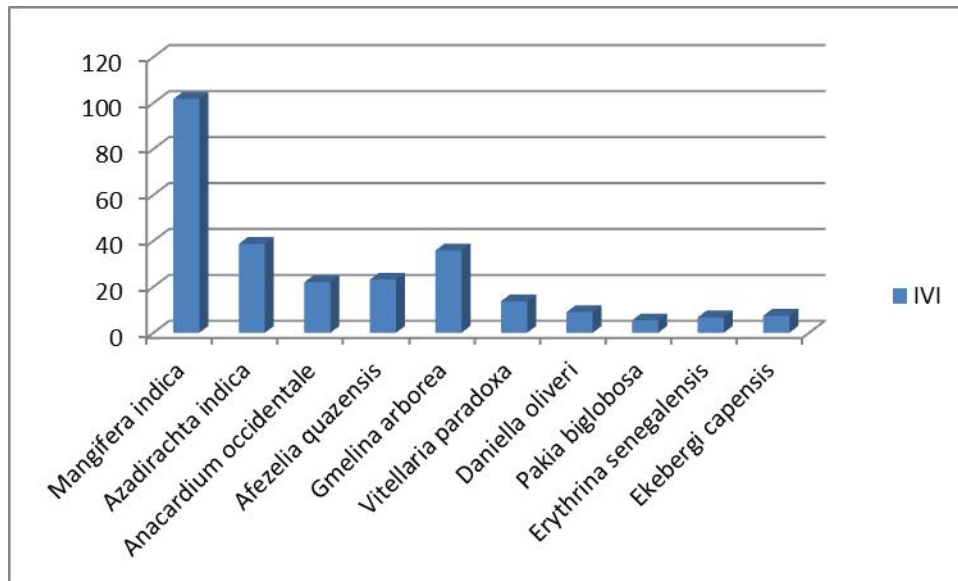


Figure 3. Important value index (IVI) of top ten tree species

DISCUSSION

The data collected during the study identified a total of 26 tree species belonging to 11 different plant families. The family fabaceae has the highest number of species with seven (7) species. This result is similar to that of Jeyol and Yerima (2023) who also observed that fabaceae is among family with highest species in Federal University Wukari (FUW). The diversity indices presented in Table 2 provide important understandings into the composition and structure of the tree communities across the three study sites in Wukari Metropolis.

The Dominance Index, which measures the degree of concentration of the most abundant species, shows that Mission area has the highest value at 0.41. This indicates a less even distribution of species, with a few dominant species accounting for a larger proportion of the community. In contrast, GRA and FUW staff quarters have lower Dominance Indices of 0.19 and 0.178 respectively, suggesting a more even distribution of species. This aligns with the findings of Agbelade *et al.* (2017), who also reported variations in dominance patterns across different urban areas.

The Shannon-Wiener Diversity Index, which considers both the number of species and the evenness of their distribution, is highest for Site B at 2.14. This reflects the greatest overall species diversity in the GRA area, compared to the lower values for Site A (1.39) and Site C (1.94). These findings are consistent with the studies by Haruna *et al.* (2018) and Chukwu *et al.* (2022), which found varying levels of Shannon-Wiener diversity in different urban green spaces.

The Evenness Index, which measures the relative abundance of the different species, is highest for Site C at 0.69, indicating a more even distribution of individuals among the tree species in the FUW residential area. Site A has the lowest Evenness Index of 0.24, corroborating the pattern of uneven distribution observed in the Dominance Index.

Margalef's Richness Index, which estimates the species richness accounting for the total number of species relative to the total number of individuals, is highest for Site B at 3.40. This suggests that the GRA area has the greatest species richness, while Site C has the lowest value of 2.35. These results align with the findings of Salami *et al.* (2021), who reported variations in tree species richness across different land-use types in northern Nigeria.

The observed differences in diversity indices across the study sites can be attributed to various factors, such as the intensity of urbanization, land-use patterns, management practices, and the introduction of exotic species. The higher diversity and evenness in the GRA area (Site B) may be indicative of a more balanced and ecologically functional urban tree community, in contrast to the more uneven and less diverse communities in the Mission (Site A) and FUW (Site C) areas.

The Importance Value Index (IVI) provides a comprehensive assessment of the ecological significance and dominance of individual tree species within the study areas. This metric combines information on the relative frequency, relative density, and relative dominance (basal area) of each tree species, offering insights into their overall influence and role in the urban ecosystem. The data reveals that the Mission area (Site A) is dominated by a few highly important species, with Mango (*Mangifera indica*) having an exceptionally high IVI of 162.76, followed by Cashew (*Anacardium occidentale*) with an IVI of 53.40. This aligns with the findings of Borokini (2011) and Oyebade *et al.* (2012), who also identified Mango and Cashew as among the most dominant tree species in the residential areas of Ibadan and Uyo, respectively. In contrast, the GRA and FUW staff quarters areas exhibit a more even distribution of IVI values, with a greater diversity of tree species contributing to the overall community structure. This is consistent with the patterns observed in the diversity indices, where these sites displayed lower Dominance Indices and higher Evenness Indices compared to Site A.

The dominance of certain tree species, as indicated by their high IVI values, can have significant implications for the urban ecosystem. Zankan *et al.* (2019) and Mustapha *et al.* (2022) emphasized the importance of understanding the IVI of tree species to guide management decisions and ensure the provision of diverse ecosystem services.

For instance, the high IVI of Mango and Cashew in the Mission area (Site A) suggests that these species play a vital role in the urban forest structure and function, potentially providing benefits such as shade, fruit production, and carbon sequestration. However, the dominance of these species may also indicate a lack of diversity, which could potentially make the urban tree community more vulnerable to pests, diseases, and environmental stresses (Chukwu *et al.*, 2022).

CONCLUSION

This comprehensive study on the composition and diversity of tree species in selected residential areas of Wukari Metropolis has provided valuable understanding into the composition and structure of the urban tree communities. The assessment of diversity indices, such as the Dominance Index, Shannon-Wiener Diversity Index, Evenness Index, and Margalef's Richness Index, revealed significant variations across the three study sites (Mission, GRA, and FUW).

The Mission area (Site A) exhibited the highest Dominance Index and the lowest Shannon-Wiener Diversity Index, indicating an uneven distribution with a few

dominant species. In contrast, the GRA (Site B) and FUW (Site C) areas displayed lower Dominance Indices and higher Diversity Indices, suggesting a more even and diverse tree community structure.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest that could influence the research work reported on this paper.

REFERENCES

- Abdullahi, S. & Abba, H. M. (2021). Floristic Composition and Diversity of Tree Species in Kumo Town and Its Environs. *Fudma Journal of Sciences*, 5, 560-566.
- Agbelade, A. D. Onyekwelu, J. C & Oyun, M. B. (2017): Tree Species Richness, Diversity and Vegetation Index for Federal Capital Territory, Abuja, Nigeria. *International Journal of Forestry Research*: 4(1):1-12.
- Borokini, I. (2011). Diversity, Distribution and Utilization of Urban Trees in Ibadan Metropolis, Southwest Nigeria. *Nature and Faune*, 2011, 26 (1): 53-59.
- Chukwu, O., Umeh, C. L., Ozomma, L. C. & Maduabuchukwu, C. K. (2022). Assessment of Species Diversity, Crown and Stem Diameter Distribution of Avenue Trees In Awka, Nigeria. *Journal of Forest Science and Environment*, 7, 20-26.
- Hammer, Øyvind, Harper, D. A. T. & Paul, D. R. (2001). Past: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica*, 4(1)4: 9pp.
- Haruna, H., Aliko, A. A., Zakari, S. M. & Omeiza, A. H. (2018). Quantitative Analysis of Plant Species Diversity in Kano Zoological Garden. *Bayero Journal of Pure and Applied Sciences*, 11(1), 208-213.
- Ismail, I. M. (2020). Phytosociology and Biodiversity Indices of the Woody Plants of Alfula Area, West Kordofan, Sudan. *Agriculture and Forestry Journal*, 4(1), 40-46.
- Jeyol, M. C. & Yerima, M. J. (2023). A Preliminary Survey of Tree Species Diversity: A Case Study of Federal University Wukari *FUDMA Journal of Sciences (FJS)*, 7(1): 40 – 46.
- Meer, B. B. & Tella, I. (2018). Assessment of Woody Species Diversity in Different Ecological Zones of Taraba State, Nigeria; A Strategy for Conservation. *Asian Journal of Research in Agriculture and Forestry*, 1(4); 1-12.
- Mustapha, Y., Adamu, S. & Inuwa, A. (2022). Importance Value Index (IVI) of Tree Species and Diversity of Baturiya Hadejia Wetland National Park, Jigawa State, Nigeria. *International Journal of Trend in Scientific Research and Development*, 6(2), 876-883.

- Oyebade, B. A., Popo-Ola, F. S. & Itam, E. S. (2012). Growth Characteristics and Diversity of Urban Tree Species in Selected Areas of Uyo Metropolis, Akwa Ibom State, Nigeria. *Advances in Applied Science Research*, 3(3), 1655-1662.
- Salami, K. D & Lawal, A. A. (2018). Tree Species Diversity and Composition in the Orchard of Federal University Dutse, Jigawa State. *Journal of Forestry Research and Management*, 15(2): 112 – 122.
- Salami, K. D., Shuaibu, R. B., Adekunle, V. A. J. & Ogunsola, J. D (2021): Comparative Analysis of Density, Diversity And Similarity of Forest Tree Species In Three Selected States Of Northern Nigeria. *Journal of Research in Forestry, Wildlife and Environment Vol. 13*(3).
- Salmond, J. A., Tadaki, M., Vardoulakis, S., Arbuthnott, K., Coutts, A., Demuzere, M., Dirks, K. N., Heaviside, C., Lim, S., Macintyre, H., McInnes, R. N. & Wheeler, B. W. (2016). Health and Climate Related Ecosystem Services Provided by Street Trees in the Urban Environment. *Environmental Health*, 15(1):36.
- Szejner, M. and Emanuelli, P. (2016). Tree Species Identification in the Tropics. *Tropical Forestry Handbook*, 10.1007/978-3-642-54601-3 - 110
- Wolf, K. L., Lam, S. T., McKeen, J. K., Richardson, G. R., Van Den Bosch, M. & Bardekjian, A. C. (2020). Urban Trees and Human Health: A Scoping Review. *International Journal of Environmental Research and Public Health*, 17(12): 4371.
- Zankan, J. A. A, Endas, L., Abubakar, Y. M. & Yakubu, I. B. (2019): Tree Species Density and Diversity in Jemaa Local Government Area of Kaduna State, Nigeria. *FUDMA Journal of Science (FJS)*. 3(2): 263