VEGETATION STRUCTURE AND DIVERSITY OF URBAN PARKS AND GARDENS IN BENIN CITY, EDO STATE, NIGERIA

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ABSTRACT

The diversity and species richness of parks and gardens were assessed in the urban settings of Benin City. Ogba Zoological Garden and Nature Park and the Benin Golf Course were selected for the study. Random sampling inventory was used to carry out field inventory, tree heights and diameter at breast height (Dbh) were measured at the sites. The relative density, dominance, important value index (IVI), species richness, evenness and diversity were also estimated. The results showed that Ogba Zoological Garden comprised of 244 trees/ha with a species composition of 50 and distributed into 23 families and has diversity index of 3.72. Benin Golf Course, had a population estimate of 77 trees/ha comprising of 15 species distributed into 9 families with a diversity index of 2.12. Although, the diversity index was high for both parks, Ogba Zoo had some threatened species with important value index greater than one. Therefore, conservation efforts should be geared towards protecting those species which include *Cylicodiscus gabunensis, Bosqueia angolensis*, and Anthocleista vogelii.

Keywords: Park and Garden, urban forest, conservation, biodiversity

1. | Introduction

Urban parks and gardens form a major part of urban ecosystems that promotes the conservation of biological diversity and provide numerous ecosystem services and benefits (Ma *et al.,* 2023). They are areas in cities that are rich in flora and fauna species, with complex biological structures and carry out different ecosystem functions (Olokeogun *et al.,* 2020; Ma *et al.,* 2023). They are primarily managed to provide recreational and relaxation services to the public (Olokeogun *et al.,* 2020). They also provide diverse ecological, social, cultural, economic and health benefits to the society (Svendsen *et al.,* 2016; Talal *et al.,* 2021). Ecologically, urban parks help in the conservation of different species of plants and animals and provide ecosystem goods and services like regulation of microclimate, noise reduction, improve air and water quality, habitat provision, soil conservation, and carbon dioxide mitigation (Yeshitela, 2020). The nature and serenity in urban parks promote physical and psychological health, morbidity and longevity and minimizes blood pressure, stress, aggression and risk of diabetes (Talal *et al.,* 2021). It also improves emotional and mental development and sleeping patterns (Huai and Van de Voorde, 2022). Urban parks are also a place for social interactions and physical activities that connect people from diverse culture and ethnicity (Talal *et al.,* 2021; Huai and Van de Voorde, 2022).

There is increasing pressure on urban tree biodiversity of which parks and garden constitute a major part (Aronson *et al.,* 2017; McDonald *et al.,* 2018). It has been reported that urban parks and gardens tend to have low diversity of tree species and create more spaces for infrastructure rather than vegetation (Muhlisin *et al.,* 2021). Thus, there is need for increase knowledge about the abundance and distribution of trees in urban park to aid its conservation and management (Yan *et al.,* 2016; Muhlisin *et al.,* 2021). This will also help to promote community participation in urban tree conservation (Smith *et al.,* 2018; Muhlisin *et al.,* 2021). This study assessed the tree species characteristics and distribution in the two selected urban parks and gardens located in Benin metropolis.

2 | Materials and Methods

2.1 | Study Area

The study was carried out in two selected parks and gardens located within the urban settings of Benin City, the Capital of Edo State, Nigeria. The parks and gardens selected for this study were Benin Golf Course and Ogba Zoological Garden and Nature Park. Benin Golf Course is situated at Reservation Road in Oredo Local Government Area (LGA). It is located between latitudes of 6^0 19′ 16″ N and 6^0 19′ 26″ N and longitudes 5^0 37′ 2″ E and 5^0 37′ 14″ E. There are two golf courses separated by a road and one has a larger area than the other. Golf I the larger area golf course has an estimated area of 6.44ha while Golf II was 3.96ha in size. The golf course is owned by the Benin Club social group. Ogba Zoological Garden and Nature Park is a tropical rainforest reserve that harbours a zoo and it is situated along Oko-Ogba Road in Oredo LGA. It is located between latitude 6^0 17′ 443″ N and 6^0 17′ 474″ N and longitude 5^0 35′ 045″ E and 5^0 35′ 070″ E. It originally occupies a land area of 59.729 hectares with a mean elevation of 46 m above sea level (Agianaku and Aigbokhan, 2018) but due to increased urban development, a large area has been deforested and it presently reduced and stands at an estimated area of 7.41 ha.

2.2 | Data Collection

The study sites were purposively selected because it is located in the city which makes it a park and garden type of urban forest. A simple random sampling technique was used to carry out field inventory and measurement of trees that are greater and equal 10cm in diameter at breast height (Dbh). Four percent sampling intensity was used to set up eight plots with a total area of 0.32ha at Ogba Zoo. Also, at Benin Golf Course, 5.6% sampling intensity was used to set up nine plots having a total area of 0.36ha for GOLF I while 6% sampling intensity was used to set up six plots with a total area of 0.24ha in GOLF II. Thus, for Benin Golf Course a total area of 0.6ha was sampled and used for this research. Circular plots were laid with a radius of 11.3m which amounts to an area of 0.04ha. Variables measured were tree diameter at breast height and total height

2.3 | Data Analysis

Data were analysed using mean and percentages and were presented in tables and charts. Also, basal area, relative dominance, relative density, importance value index, Shannon-Weiner Index, Shannon's Maximum Diversity Index, Margalef's Index of Species Richness, species evenness and similarity index were calculated using the following formulas as shown in Equations 1-9;

$$BA = \frac{\pi D^2}{4} \quad (1)$$

Where: BA = Basal area (m^2); D = Diameter at breast height; л = Pie (3.142)

$$RDo = \frac{(\sum Ba_i \times 100)}{\sum Ba_n} \quad (2)$$

Where; RDo is Relative Dominance; Ba_i is Basal area of trees belonging to a specific species; Ba_n isBasal area of every tree species in the community

$$\text{Relative Density (RD)} = \frac{n_i}{N} \times 100 \quad (3)$$

Where; ni = Number of individual species i; N is Total number of individuals in the entire population

Importance Value Index (IVI) = $\frac{RD+RDo}{2}$ (4)

Shannon-Weiner Index (H') =

$$- \sum_{i=1}^{k} pi\ In\ pi \quad (5)$$

where k is Number of tree species; p_i = Proportional abundance of the ith species; In is Natural logarithm

Shannon's Maximum Diversity Index (H_{max})

$$= \ln(S) \quad (6)$$

where S = Total number of species in community

Species Evenness (Shannon-Weiner's equitability 'EH') = $\frac{H'}{H_{max}} = \frac{\sum P_i\ In(P_i)}{In(S)}$ (7)

Margalef's Index of Species Richness (M)

$$= \left(\frac{S-1}{\ln N}\right) \quad (8)$$

Where; S = Number of a particular species; N is Total number of all individual species

Similarity Index (S) = $\frac{2C}{S_1+S_2}$ ……..(9)

Where; C is Number of species two communities have in common; S_1 is Total number of species in community 1; S_2 is Total number of species in community 2

3. | Results and Discussion

3.1 | Family Distribution of Urban Trees at Parks and Gardens

Results presented on Table 1 shows that Ogba Zoo had the highest tree family composition of twenty-three (23) and family Fabaceae had the most dominant family tree species with a percentage occurrence of 21.80%. This was followed by family Moraceae (15.39%) and Combretaceae (10.26%). However, Golf Course urban trees were distributed in nine (9) families with dominant families being Anacardiaceae (28.20%), Annonaceae (23.90%) and Fabaceae (23.90%). Other studies have reported different composition of families in park and garden, for example Mato *et al.,* (2024) reported that tree species were distributed among nineteen (19) families in the Nigerian Defence Academy Biological Garden and family Fabaceae was the most dominant family in their study with a percentage distribution of 47.37% which was similar to the report of this study. Similarly, in five recreations centres assessed in Ibadan City, Agodi Garden had the highest tree species family composition of twenty-five (25) while Ibadan Golf Club had the least family representation of nine (9). Family Fabaceae had the highest occurrence in all the recreation centres except in Agodi Gardens where family Verbenaceae was the most dominant (Bolanle-Ojo *et al.,* 2020). Olokeogun *et al.,* (2020) who also evaluated the tree species distribution at urban parks and gardens of Ibadan City reported that a total of thirty-four (34) families were encountered with the most occurring being Fabaceae. At Cilegon City in Indonesia, where forty-six (46) families were found in urban parks, family Fabaceae was also the dominant (Muhlisin *et al.,* 2021). However, Ogce *et al.,* (2022) recorded a total of 32 families found in urban parks in seven different locations assessed in Turkey and the most occurring families were Pinaceae and Rosaceae. Family Fabaceae is known for its invasive characteristic which has been linked to its dominance and it is also mostly found in the tropical rainforest region (van Wilgen *et al.,* 2001; Mahbubur-Rahman and Ismot-Ara-Parvin, 2014; Olajuiyigbe and Akwarandu, 2019; Bolanle-Ojo *et al.,* 2020).

3.2 | Urban Parks and Gardens Tree Species Distribution and Abundance

The results of tree species characteristics and distribution at Benin Golf Course are presented in Table 2. A total population of forty-six (46) individual trees belonging to thirteen (13) species and thirteen (13) genera were encountered. The most occurring

Table 1 | Tree Families Distribution at Golf Course and Ogba Zoo

S/N	Family	Golf Course		Ogba Zoo	
		No. of spp.	Percentage	No. of spp.	Percentage
1	Acanthaceae	0	0.00	1	1.28
2	Anacardiaceae	13	28.20	0	0.00
3	Annonaceae	11	23.90	0	0.00
4	Apocynaceae	1	2.20	3	3.85
5	Arecaceae	0	0.00	2	2.56
6	Bignoniaceae	0	0.00	1	1.28
7	Cannabaceae	0	0.00	1	1.28
8	Capparaceae	0	0.00	3	3.85
9	Casuarinaceae	4	8.70	0	0.00
10	Combretaceae	1	2.20	8	10.26
11	Clusiaceae	0	0.00	3	3.85
12	Ebenaceae	0	0.00	1	1.28
13	Euphorbiaceae	0	0.00	1	1.28
14	Fabaceae	11	23.90	17	21.80
15	Gentianaceae	0	0.00	1	1.28
16	Hypericaceae	0	0.00	1	1.28
17	Irvingiaceae	1	2.20	0	0.00
18	Malvaceae	0	0.00	2	2.56
19	Meliaceae	0	0.00	6	7.69
20	Moraceae	1	2.20	12	15.39
21	Myrtaceae	0	0.00	1	1.28
22	Olacaceae	0	0.00	4	5.13
23	Pinaceae	0	0.00	1	1.28
24	Rubiaceae	0	0.00	1	1.28
25	Sapindaceae	0	0.00	3	3.85
26	Sapotaceae	3	6.50	0	0.00
27	Urticaceae	0	0.00	2	2.56
28	Verbenaceae	0	0.00	3	3.85
	Total	**46**	**100**	**78**	**100**

species was *Spondias mombin*, belonging to family Anacardiaceae was encountered twelve (12) times, and also had the highest relative density, importance value index and Margalef's species richness index of 26.09%, 20.46 and 2.87 respectively. *Alstonia boonei* had the highest Dbh of 90cm and relative dominance of 24.31%, while *Cassia fistula* had the lowest Dbh, relative dominance and importance value index of 12cm, 0.42% and 1.30 respectively. Trees with the least relative density of 2.27% and zero (0) Margalef's species richness were *Mangifera*

indica, Alstonia boonei, Terminalia mantaly, Cassia fistula, Irvingia gabonensis and *Ficus thonningii*.

Table 2 | Tree Species Diversity Indices at Benin Golf Course, Benin City

Family	Tree Species	Freq	Mean DBH (m)	RDo (%)	RD (%)	IVI	M
Anacardiaceae	*Spondias mombin*	12	0.498	14.84	26.09	20.46	2.87
	Mangifera indica	1	0.53	8.41	2.17	5.29	0.00
Annonaceae	*Polyalthia longifolia var pendula*	11	0.303	2.82	23.91	13.36	2.61
Apocynaceae	*Alstonia boonei*	1	0.902	24.31	2.17	13.24	0.00
Combretaceac	*Terminalia mantaly*	1	0.125	0.46	2.17	1.32	0.00
Casuarinaceae	*Casuarina equisetifolia*	4	0.571	11.04	8.70	9.87	0.78
Fabaceae	*Cassia fistula*	1	0.12	0.42	2.17	1.30	0.00
	Delonix regia	6	0.477	7.72	13.04	10.38	1.31
	Acacia auriculiformis	2	0.707	14.95	4.35	9.65	0.26
	Albizia lebbeck	2	0.175	0.99	4.35	2.67	0.26
Irvingiaceae	*Irvingia gabonensis*	1	0.57	9.70	2.17	5.94	0.00
Moraceae	*Ficus thonningii*	1	0.32	3.04	2.17	2.61	0.00
Sapotaceae	*Manilkara obovata*	3	0.205	1.29	6.52	3.91	0.52
		46					

Table 3 shows the trees structure and distribution at Ogba Zoological Garden and Nature Park. A total of seventy-eight (78) trees distributed among fifty species belonging to forty-five (45) genera were encountered at Ogba Zoological Garden and Nature Park. Family Fabaceae had the highest tree species representation among other families. *Cylicodiscus gabunensis* had the highest Dbh, relative dominance and important value index of 172cm, 19.13% and 10.21 respectively. *Bosqueia angolensis* belonging to family Moraceae had the highest relative density (10.26%) and Margalef's species richness index (1.61). *Entandrophragma candollei* and *Strombosia scheffleri* had the least importance value index of 0.67 while *Strombosia scheffleri* had the least Dbh (10cm) and relative dominance (0.07%). Tree species with zero (0) Margalef's species richness had the least relative density of 1.28% and there were thirty-five (35) tree species in that category.

Thus, the least important species for Golf Course was *Cassia fistula* (1.30) while that of Ogba Zoo were *Entandrophragma candollei* and *Strombosia schefflera* with IVI of 0.67. However, *Bosqueia angolensis* (10.26%) was the most abundant. According to Mato *et al.,* (2024), the result of research at the Nigerian Defence Academy biological garden, stated that *Detarium macroparpum* and *Linnea schimperi* had the highest and least important value index of 8.26 and 0.58. A previous study on vegetation assessment of Ogba Zoo showed that *Funtumia elastica* and *Pentaclethra macrophylla* had the highest important value index of 79.85 and 74.85 in the undisturbed section of the park while *Hevea brasiliensis* was the most important in disturbed area (Agianaku and Aigbokhan, 2018). More also, some tree species at Ogba Zoo are threatened as they have important value index less than one unlike in Benin Golf where none of the

Table 3 | Tree Species Diversity Indices at Ogba Zoological Garden, Benin City

Family	Tree Species	Freq	Mean DBH (m)	RDo (%)	RD (%)	IVI	M
Acanthaceae	*Avicennia africana*	1	0.269	0.47	1.28	0.88	0.00
Apocynaceae	*Alstonia macrophylla*	1	0.492	1.56	1.28	1.42	0.00
	Alstonia boonei	1	0.160	0.16	1.28	0.72	0.00
	Funtumia elastica	1	0.915	5.42	1.28	3.35	0.00
Arecaceae	*Livistona rotundifolia*	2	0.897	5.38	2.56	3.97	0.23
Bignoniaceae	*Newbouldia laevis*	1	0.147	0.14	1.28	0.71	0.00
Cannabaceae	*Celtis zenkeri*	1	0.123	0.10	1.28	0.69	0.00
Capparaceae	*Buchholzia coriacea*	3	0.289	0.67	3.85	2.26	0.46
Combretaceae	*Terminalia catappa*	1	0.515	1.71	1.28	1.50	0.00
	Terminalia superba	3	0.382	1.74	3.85	2.79	0.46
	Terminalia ivorensis	3	0.397	1.49	3.85	2.67	0.46
	Combretum apiculatum	1	0.182	0.21	1.28	0.75	0.00
Clusiaceae	*Allanblackia floribunda*	3	0.155	0.16	3.85	2.01	0.46
Ebenaceae	*Diospyros dendo*	1	0.213	0.30	1.28	0.79	0.00
Euphorbiaceae	*Hura crepitans*	1	0.728	3.42	1.28	2.35	0.00
Fabaceae	*Delonix regia*	2	0.280	0.56	2.56	1.56	0.23
	Afrormosia elata	1	0.365	0.86	1.28	1.07	0.00
	Piptadeniastrum africanum	2	1.068	9.99	2.56	6.28	0.23
	Pentaclethra macrophylla	1	0.193	0.24	1.28	0.76	0.00
	Albizia zygia	1	0.140	0.12	1.28	0.70	0.00
	Afzelia africana	1	0.634	2.60	1.28	1.94	0.00
	Acacia auriculiformis	1	0.284	0.52	1.28	0.90	0.00
	Detarium senegalense	1	0.134	0.12	1.28	0.70	0.00
	Baphia nitida	1	0.140	0.12	1.28	0.70	0.00
	Erythrophleum africanum	1	1.015	6.66	1.28	3.97	0.00
	Anthonotha macrophylla	1	0.424	1.16	1.28	1.22	0.00
	Daniellia ogea	2	0.327	0.72	2.56	1.64	0.23
	Cylicodiscus gabunensis	1	1.720	19.13	1.28	10.21	0.00
Gentianaceae	*Berlinia grandiflora*	1	0.282	0.52	1.28	0.90	0.00
Hypericaceae	*Anthocleista vogelii*	1	1.192	9.19	1.28	5.23	0.00
Malvaceae	*Harungana madagascariensis*	1	0.188	0.23	1.28	0.76	0.00
Meliaceae	*Sterculia oblonga*	2	0.493	2.03	2.56	2.29	0.23
	Khaya ivorensis	1	0.544	1.92	1.28	1.60	0.00
	Entandrophragma utile	3	0.172	0.19	3.85	2.02	0.46

	Entandrophragma candollei	1	0.103	0.07	1.28	0.67	0.00
Mimosaceae	*Guarea thompsonii*	1	0.107	0.07	1.28	0.68	0.00
Moraceae	*Bosqueia angolensis*	8	0.182	0.23	10.26	5.24	1.61
	Milicia excelsa	1	0.987	6.30	1.28	3.79	0.00
	Ficus thonningii	1	0.152	0.15	1.28	0.72	0.00
	Antiaris africana	1	0.192	0.24	1.28	0.76	0.00
	Ficus natalensis	1	0.193	0.24	1.28	0.76	0.00
Myrtaceae	*Syzygium cumini*	1	0.534	1.84	1.28	1.56	0.00
Olacaceae	*Strombosia scheffleri*	1	0.100	0.07	1.28	0.67	0.00
	Coula edulis	1	0.205	0.27	1.28	0.78	0.00
	Strombosia pustulata	2	0.265	0.45	2.56	1.51	0.23
Pinacaea	*Pinus caribbea*	1	0.417	1.13	1.28	1.20	0.00
Rubiaceae	*Mitragyna ciliata*	1	0.916	5.42	1.28	3.35	0.00
Sapindaceae	*Blighia sapida*	3	0.218	0.32	3.85	2.08	0.46
Urticaceae	*Musanga cecropioides*	2	0.188	0.23	2.56	1.40	0.23
Verbenaceae	*Gmelina arborea*	3	0.613	3.15	3.85	3.50	0.46
TOTAL		**78**					

tree species had important value index less than one (Ayalew and Alemu, 2021).

3.3 | Population Structure of Urban Park and Garden

Figure 1 shows that the diameter of trees at the Benin Golf Course fell within the range of 10-99 cm. Most of the trees were in the diameter class of 20-29 cm and 30-39 cm and there was no tree represented at 81-90cm diameter class.

Moreover, trees at Ogba Zoo were in the diameter range of 10-179 cm (Figure 2). The trees were mostly within the diameter class of 10-19 cm and no tree was found in the diameter classes 120-129, 130-139, 140-149, 150-159 and 160-169 cm, respectively.

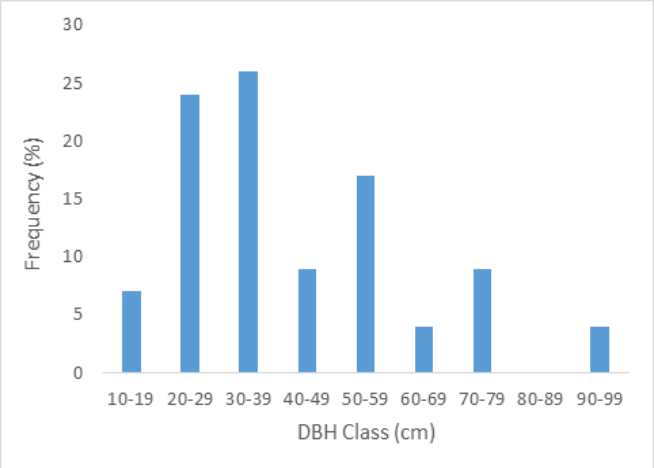

Figure 1 | Diameter Distribution of Trees at Benin Golf Course

Figure 2 | Diameter Distribution of Trees at Ogba Zoological Garden

Thus, trees were distributed in almost every Dbh classes in Benin Golf Course showing that the forest is using its structural and functional resources well (Whitmore, 1989; Kacholi, 2019). However, for Ogba Zoo, the Dbh class distribution showed a reverse J-shaped indicating a disturbed forest with a high regeneration potential (Sahu *et al.,* 2012; Kacholi, 2019).

3.4 | Tree Growth Characteristics and Species Diversity Indices of Study

Results from Table 4 shows that Benin Golf Course only had a higher mean Dbh (42.35 cm) and difference between Maximum Diversity and Shannon Diversity Index (1.71) values than Ogba Zoo which dominated in the other characteristics assessed (Table 4). It is estimated that Ogba Zoo contained 244 trees/ha while that of Golf Course is 77 trees/ha. Thus, Ogba Zoo with a diversity index of 3.72 had a higher species richness and diversity than Golf Course.

Table 4 | Summary of Tree Parameters and Biodiversity Indices obtained from Urban Parks and Gardens

Tree Parameters/Biodiversity Indices	Ogba Zoo	Golf Course
Number of Species	50	13
Number of Families	23	9
Number of Trees per ha	244	77
Mean DBH (cm)	39.67	42.35
Maximum DBH (cm)	172.00	92.30
Mean Height (m)	15.05	13.96
Maximum Height (m)	72.90	26.67
Shannon Diversity Index	3.72	2.12
Maximum Diversity	4.36	3.83
Diff. Btw. H′ & H_{max}	0.64	1.71
Species Evenness	0.85	0.55
Similarity index	0.127	

Although, both parks are recreation centres but the Benin Golf Course had a more specific use as it has been designed for playing golf only. This could be the reason for its low species diversity and abundance. Furthermore, ecological succession explains that the older a plant community is, the more species it has, but the lower the number of individuals per species (Fickert and Richter, 2025). This gives a better explanation of this study, as Ogba Zoo urban park is older than the Benin Golf Course. Also, the species diversity (3.17) recorded for Ogba Zoo in this study was higher than what was previously reported by Agianaku and Aigbokhan (2018). With species evenness of 0.85, Ogba Zoo tends to be more stable and resilient than Benin Golf Course (Olokeogun *et al.,* 2020).

4 | Conclusion

The study has revealed that urban parks and garden are relatively rich in tree composition and richness and thus help in promoting biodiversity conservation in cities. Ogba Zoo was richer in almost all tree variables assessed than the Benin Golf Course, except that Ogba Zoo had some threatened tree species. Conservation measures should be put in place to protect these species.

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References

Agianaku, O. F. and Aigbokhan, E. I. (2018), Flora of Ogba Zoo and Nature Park, Benin City, Nigeria: I. Vegetation Structure. *Nigerian Journal of Botany*, 31 (1) : 44

Aronson M. F., Lepczyk, C. A. Evans, K. L., Goddard, M. A., Lerman, S. B., Maclvor, J. S.,

Ayalew, T., and Alemu, S. (2021), Woody Plant Species Diversity of Dembeza Natural Forest,Enebsae Sarmider District, North Western Ethiopia. Journal of Plant Sciences, 9 (4) : 175–181.

Bolanle-Ojo, O. T., Falana, A. R., Bolanle-Ojo, O. I. and Levan, C. (2020), Assessment of Tree Species Diversity and Benefits in Selected Recreation Centres for Biodiversity Conservation in Ibadan Metropolis, Nigeria, Notulae Scientia Biologicae, 12 (1) : 100-113.

Fickert, T. and Richter, M. (2025). Vegetation Changes in Space and Time- A Special Issue on Plant Succession and Vegetation Dynamics. Diversity, 17 (7) : 482-497

Harris, V., Kendal, D., Hahs, A. K., and Threlfall, C. G. (2017), Green space context and vegetation complexity shape people's preferences for urban public parks and residential gardens. Landscape Research, : 1-14.

Huai, S. and Van de Voorde, T. (2022). Which environmental features contribute to positive and negative perceptions of urban parks? A cross-cultural comparison using online reviews and natural language processing methods. Landscape and Urban Planning, 218

Kacholi, D.S. (2019), Assessment of Tree Species Richness, Diversity, Population Structure and Natural Regeneration in Nongeni Forest Reserve in Morogoro Region, Tanzania. Tanzania Journal of Science, 45 (3) : 330-345.

Ma, Z., Zhang, P., Hu, N., Wang, G., Dong, Y., Guo, Y., Wang, C., Fu, Y. and Ren, Z. (2023), Understanding the drivers of woody plant diversity in urban parks in a snow climate city of China. Journal of Forest Resources, 34 : 1021-1032

Mahbubur-Rahman, A. H. M., and Ismo-Ara-Parvin, M. (2014), Study of medicinal uses on Fabaceae family at Rajshahi, Bangladesh. Research in Plant Science, 2 (1) : 6-8.

Mato, I. B., Ajibade, G. A., Madu, A. H., Suleiman, M. Z. and Imam, I. B. (2024), Diversity and conservation status of tree species in the Nigerian Defence Academy Biological Garden. World Scientific News, 190 (2) : 200-215.

McDonald, R. I., Colbert, M., Hamann, M., Simkin, R. and Sharp, R. (2018), Nature in the urban century: a global assessment of where and how to conserve nature for biodiversity and human wellbeing.

Muhlisin, S., Iskandar, J., Gunawan, B., and Cahyandito, M. F. (2021), Vegetation diversity and structure of urban parks in Cilegon City, Indonesia, and local residents' perception of its function. Biodiversitas, 22 : 2589-2603.

Ogce, H., Satiroglu, E., Bekiryazic, F., and Dincer, D. (2022), Comparing urban parks' woody plant diversity in seven different locations of Turkey. Forestist, 72 (3) : 266-274.

Olajuyigbe, S. O., and Akwarandu, K. E. (2019), Floristic composition and stand structure in a tropical watershed forest: Implication for biodiversity conservation. Environtropica, 15 : 79-94.

Olokeogun, O. S., Oladoye, A. O. and Aderounmu, A. F. (2020), Tree diversity in urban parks and gardens of Ibadan City, Nigeria. Asian Journal of Research in Agriculture and Forestry, 6 (4) : 29-40.

Sahu, S. C, Dhal, N. K. and Mohanty, R. C. (2012), Tree species diversity, distribution and population structure in a tropical dry deciduous forest of Malyagiri hill ranges, Eastern Ghats, India. Tropical Ecology, 53 : 163-168.

Svendsen, E. S., Campbell, L. K., and McMillen, H. L. (2016), Stories, shrines, and symbols: Recognizing psycho- social- spiritual benefits of urban parks and natural areas. Journal of Ethnobiology, 36 (4) : 881– 907.

Talal, M. L., Santelmann, M. V. and Tilt, J. H. (2021), Urban park visitor preferences for vegetation – An on-site qualitative research study. Plants, People, Planet, 3 (4) : 375-388

Van Wilgen, B. M., Richardson, D. M., Le Maitre, D. C., Marais, C., and Magadlela, D (2001), The economic consequences of alien plant invasion: examples of impacts and a:roaches to sustainable management in South Africa. Environment, Development and Sustainability, 3 : 145-168.

Whitmore, T. C. (1989), Southeast Asia tropical forests. In: Lieth, H. and Werger, M. J. A. (eds) Ecosystems of the World. Tropical rainforest ecosystems: Biogeographical and ecological studies. Elsevier: Amsterdam, :. 195-218.

Yan, Y., Zhang, C., Hu, Y., and Kuang, W. (2016), Urban land-cover change and its impact on the ecosystem carbon storage in a dryland city. Remote Sensing, 8 (1) : 1-18.

Yeshitela, K. (2020), Attitude and Perception of Residents towards the Benefits, Challenges and Quality of Neighbourhood Parks in a Sub-Saharan Africa City. Land, 9, 450 : 1-17.