

## Inventory of Tree Species with respect to Anthropogenic Activities: A Case Study of Federal University Wukari, Taraba State

<sup>1</sup>Japhet, R. A., <sup>2</sup>Jeyol, M. C.\* & <sup>3</sup>Okrikata, E.

Department of Biological Sciences, Faculty of Biosciences, Federal University Wukari, Nigeria

\*Corresponding author: [anongo@fuwukari.edu.ng](mailto:anongo@fuwukari.edu.ng)

### ABSTRACT

The impacts of anthropogenic activities on composition and distribution of tree species of Federal University Wukari, Taraba State, Nigeria were investigated in 2024/2025. Field surveys were conducted across eight sampling sites to record tree species, abundance and richness. Species identification was by guidebooks and PlantNet mobile app. Margalef richness, Shannon-Wiener index, Simpson dominance and Sørensen's similarity coefficient between sites were computed. A total of 483 trees from 32 species and 18 families were documented. Fabaceae was the most dominant family (8 species), followed by Myrtaceae (3 species). 13 families were represented by only 1 species each. Site D had the highest tree count (179 individuals), largely *Moringa oleifera* (60) and *Citrus sinensis* (60) due to their economic and ecological benefits, such as food, shade, and erosion control. Site H had the highest species richness ( $d=3.877$ ) and Simpson diversity index ( $SDI=0.915$ ). Site D had the least Shannon-Wiener index ( $H=1.463$ ) and Margalef richness index ( $d=1.735$ ). Site C had the lowest Simpson diversity ( $SDI=0.652$ ). The entire community had a high Shannon-Wiener index ( $H=2.759$ ), high Simpson diversity index ( $SDI=0.920$ ) and moderate Margalef richness index ( $d=5.016$ ). Sørensen's analysis revealed high similarity (88%) between Sites E and F, but minimal overlap (19%) between Sites C and D due to high anthropogenic impacts. The study revealed that the economic trees had the highest diversity than the indigenous/native ones indicating high threat to the tree composition of FUW campus due to infrastructural developments.

**Keywords:** Tree Species, Anthropogenic Activities, Fabaceae, Shannon-Weiner index, Sørensen's Similarity index

### INTRODUCTION

Forest ecosystems are critical in regulating climate, preserving biodiversity, supporting soil fertility, and providing habitats for wildlife (Lukina *et al.*, 2021). Overexploitation has led to a significant decline in tree diversity and is widely acknowledged as a serious environmental and economic challenge across the globe (Asifat *et al.*, 2019). Trees offer invaluable benefits to humans and the environment as a whole (Ogwu *et al.*, 2016). An increase in tree species diversity enhances the number of ecological niches and supports a greater variety of associated species. They play vital roles in ecosystem functioning, including species conservation, soil erosion control, and the maintenance of habitats for both animals and plants (Barrios *et al.*, 2018). Trees are increasingly exploited due to anthropogenic activities,

particularly for infrastructural development, such as roads, buildings, water supply systems, sewage networks, electrical grids, and telecommunications, all of which form the foundation for large-scale development (Ruddell *et al.*, 2020). While such developments support socioeconomic progress, they also challenge the conservation of natural ecosystems (Blicharska *et al.*, 2019). A balanced approach facilitates ecological resilience by maintaining biodiversity hotspots, supporting research in environmental science, and fostering green campus initiatives (Nchake *et al.*, 2022).

Despite these concerns, there is limited documented data on the current status of tree species diversity within the Federal University Wukari campus. The absence of a comprehensive inventory of tree species makes it difficult to evaluate the ecological impact of ongoing and past anthropogenic disturbances. Though, a preliminary survey had earlier been conducted on the distribution and structure of the trees within the Campus by Jeyol and Yerima (2023), this research aimed to investigate areas yet to be sampled.

## **MATERIALS AND METHODS**

### **Description of Study Area**

Wukari Local Government Area (LGA) has a tropical climate characterized by both dry and wet seasons. The dry season commences around November and ends in March. It has an average annual rainfall of 1200-1800mm with an average temperature of 20°C. Soil type and hydrology allow for cultivation of crops such as yam, cassava, groundnut, cowpea, maize, millet, rice, onion, okra, pepper, tomatoes, livestock production, animal grazing, fishing and forestry. The study area is dominated by Jukun and other minority tribes including Tiv and Hausa. The local government area is blessed with agricultural land.

Wukari is situated in the southern part of Taraba State, lying approximately on longitude 9°7'83"E and latitude 7°8'50"N. It covers an area of approximately 4,308 square meters (1.663 sq mi) and has a projected population of about 328,146 as at December, 2016 with ten wards. The Local Government shares boundaries with Ibi LGA to the North West, Donga LGA to the North East and Ukum LGA of Benue State to the South-East (TADP, 2018). Wukari is characterized by extensive river valley systems and broad lowlands, which contribute to its fertile soils and support diverse agricultural activities.

### **Description of Study Site**

Federal University Wukari (FUW) is a prominent higher institution located in Wukari LGA Taraba State, Nigeria in the North-East region of Nigeria. It is located between latitude (7°50'37"N) and longitude (9°46'30"E). Federal University Wukari is strategically positioned within Wukari LGA, which serves as a key administrative and educational hub in the state. The campus is about 200 kilometers southeast of Jalingo, the state capital, and is accessible via major roads that connect it to other parts of the state and the country. The campus comprises various facilities such as academic blocks, administrative buildings, student hostels, and recreational spaces. Internal roads and walkways link different sections of the campus, while essential services such as electricity, water supply, and waste management systems are adequately provided. The university has outlined plans for expansion, including new academic buildings, research centers, and residential areas.

The study site included eight sampling units within the Federal University Wukari campus and was categorized based on the level of anthropogenic activities. Random sampling was employed to select specific plots within each unit. Coordinates of the eight (8) sampling sites were also obtained.

**Table 1: Sampling Sites, Description and GPS Coordinates of the Location**

<b>Sampling sites</b>	<b>Location description</b>	<b>Latitude</b>	<b>Longitude</b>
Site A	From the gate to the academic staff quarters	7°84'06"N	9°77'27"E
Site B	From the end of the staff quarters to the beginning of the Agricultural Research Farm	7°84'07"N	9°76'61"E
Site C	From the beginning of the poultry farm to the beginning of the Biological Garden	7°84'07"N	9°76'72"E
Site D	From the Biological Garden to the beginning of the Catholic Church Building	7°84'32"N	9°76'86"E
Site E	The Senate building surroundings	7°84'31"N	9°77'10"E
Site F	From the PG school to the Convocation Square	7°84'41"N	9°77'11"E
Site G	New student hostel area	7°84'70"N	9°77'28"E
Site H	From the Staff school to the last gate	7°84'98"N	9°77'51"E

### **Data Collection Methods**

The study employed a cross-sectional survey design to assess tree species diversity within the Federal University Wukari campus. This design facilitated the comparison of sampling sites with varying levels of anthropogenic activity and their effects on tree diversity.

A field inventory was carried out to document the tree flora. The study area was divided into eight sampling units (A, B, C, D, E, F, G and H) to ensure precise recording of the various tree species. Using the main road as a transect, samples were collected to allow an accurate count of all tree to analyze species present. Each species found within the sampling units was noted, along with its frequency of occurrence. A global positioning system (GPS) device was used to capture the coordinates of each sampling site.

### **Tree Species Identification**

Tree species were identified using standard Tree Identification Guidebooks, including Tropical Tree Crops (Szejner and Emanuelli, 2016) and Trees of Nigeria

(Edet *et al.*, 2023). PlantNet Mobile App (version 3.20.6) was also used to identify the tree species (Coşkunserçe, 2024). Local names were also used to identify taxonomic species. Photographs of the different zones and specific plots were taken to visually document the level of development and its impact on the vegetation (Depauw *et al.*, 2022).

### Data Analysis

Quantitative parameters like frequency were used to analyze the data. Species Diversity indices such as Shannon-Weiner Index was used to measure diversity both richness (number of species) and evenness (relative abundance of each species) within the community, while Margalef Species Richness Index measured Species richness. Simpson Diversity Index and Sorensen Similarity Coefficients assess the dominant and common species in the community and compare the species composition within sites respectively.

## RESULTS AND DISCUSSION

A total of 483 individual trees from 32 species belonging to 18 families were identified and recorded from the selected eight (8) sampling sites at Federal University Wukari campus. As a key part of green infrastructure, trees offer a variety of social, communal, psychological, economic, and environmental benefits (Tsvuura *et al.*, 2023). Jeyol and Yerima (2023) reported a total of 203 trees belonging to 20 species in Federal University Wukari, which is lower, compared to the current study and may be due to the larger sampling sites covered in the present study.

The study identified exotic, economic, and native tree species, as shown in Table 2. Eight (8) exotic species (25%), such as *Gmelina arborea*, *Eucalyptus* spp., *Leucaena leucocephala*, and *Dimocarpus longan*, are present in the study and are mostly introduced for timber, ornamental, or afforestation purposes. There were seven (7) economic species (22%) in the area. This includes *Anacardium occidentale*, *Mangifera indica*, *Psidium guajava*, *Vitellaria paradoxa*, *Moringa oleifera*, *Citrus sinensis*, and *Elaeis guineensis*. These tree species are widely cultivated for their fruits, oil, nuts, and medicinal values, and they form an essential part of local livelihoods and trade. The native tree species were seventeen (17) and make up 53% of the tree species identified. They include *Azadirachta indica*, *Swietenia macrophylla*, *Parkia biglobossa*, *Adansonia digitata*, *Tamarindus indica*, *Prosopis africana*, *Kigelia africana*, and the *Ceiba pentandra* tree, and they help to provide ecological stability, cultural heritage, and multiple ecosystem services such as shade, soil enrichment, and habitat for biodiversity.

**Table 2: Exotic, Economic and Native Tree Species**

S/N	Native tree species	Exotic tree species	Economic tree species
1	<i>Azadirachta indica</i>	<i>Gmelina arborea</i>	<i>Anacardium occidentale</i>
2	<i>Swietenia macrophylla</i>	<i>Borassus aethiopum</i>	<i>Mangifera indica</i>
3	<i>Parkia biglobossa</i>	<i>Eucalyptus</i> spp.	<i>Psidium guajava</i>
4	<i>Syzygium cumini</i>	<i>Leucaena leucocephala</i>	<i>Citrus sinensis</i>
5	<i>Ficus</i> spp.	<i>Dimocarpus longan</i>	<i>Vitellaria paradoxa</i>
6	<i>Adansonia digitata</i>	<i>Erythrina crista-galli</i>	<i>Moringa oleifera</i>

7	<i>Tamarindus indica</i>	<i>Phytolacca dioica</i>	<i>Elaeis guineensis</i>
8	<i>Prosopis Africana</i>	<i>Vachellia sieberiana</i>	
9	<i>Robinia pseudoacacia</i>		
10	<i>Neocarya macrophylla</i>		
11	<i>Leucospermum conocarpodendron</i>		
12	<i>Burkea Africana</i>		
13	<i>Kigelia Africana</i>		
14	<i>Ceiba pentandra</i>		
15	<i>Terminalia mantaly</i>		
16	<i>Ficus microcarpa</i>		
17	<i>Populus alba</i>		
<b>Total</b>	<b>17</b>	<b>8</b>	<b>7</b>
<b>Percentage</b>	<b>53%</b>	<b>25%</b>	<b>22%</b>

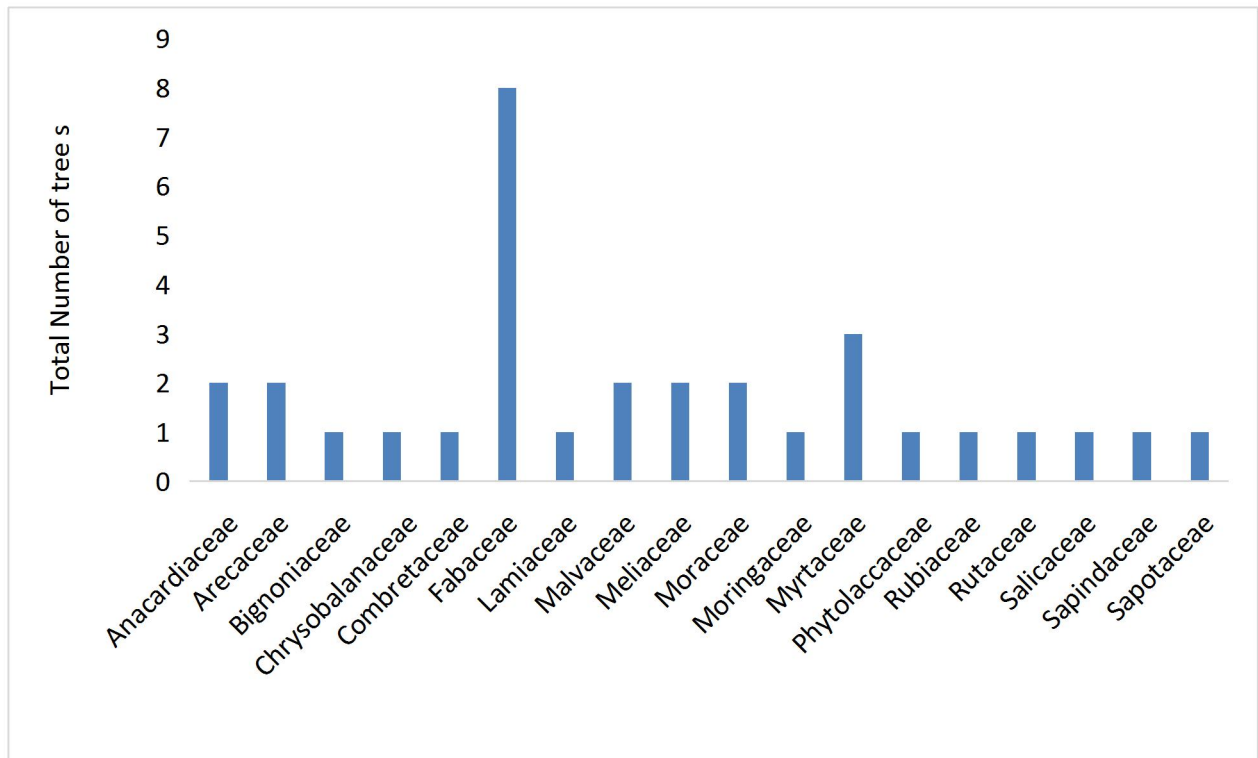
**( $\Sigma N = 32$ )**

The distributions of individual trees among the families identified and among the eight (8) sampling sites are shown in Fig 1 and Fig 2. Fabaceae was the most dominant family (8 species). The prevalence of Fabaceae can be attributed to its efficient seed dispersal mechanisms, which facilitate widespread distribution (Angbonda *et al.*, 2021; Jeyol and Yerima, 2023). Many Fabaceae species are ecologically resilient, thriving in diverse climatic conditions, and may help explain their widespread presence, as they have the ability to compete with and potentially displace native tree species. Their economic value, including the provision of timber, food, and medicinal resources, also contributes to their abundance, as communities often conserve them for sustainable use (Maroyi, 2023). Their diverse seed dispersal mechanisms, including explosive pod dehiscence and animal-mediated spread, facilitate colonization.

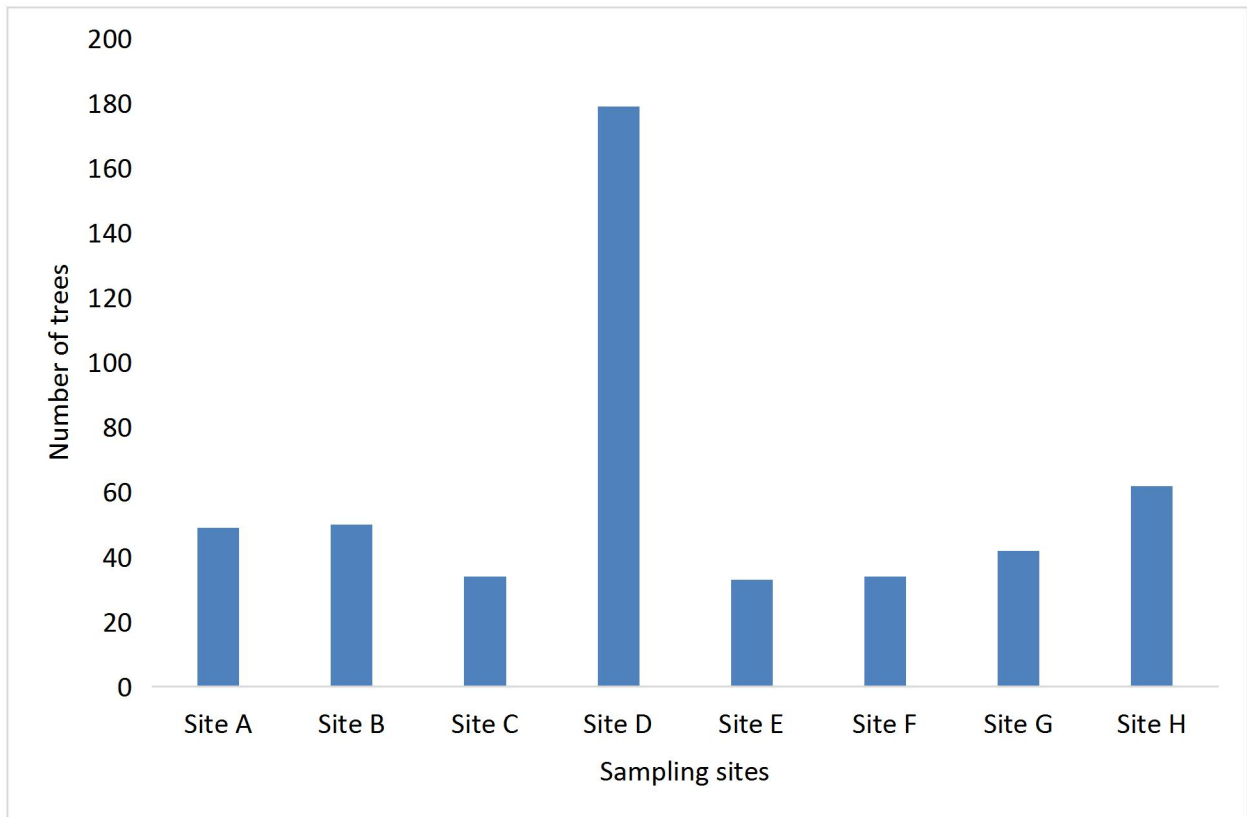
The dominance of Fabaceae species in Federal University Wukari stems from their ecological adaptability, economic value, and resilience to disturbances. These plants thrive in the savanna and tropical climates in Taraba State due to nitrogen-fixing root nodules, which enhance soil fertility and allow growth in nutrient-poor soils (Angbonda *et al.*, 2021). Valuable species like *Parkia biglobosa* (locust bean) and *Pterocarpus erinaceus* (African rosewood) are cultivated for food, timber, and medicine (Jeyol and Yerima, 2023). Fabaceae also withstand anthropogenic pressures such as fire and logging through rapid regeneration (Ati and Kungo, 2023). However, invasive species (*Leucaena leucocephala*) may out-compete native flora via allelopathy (Maroyi, 2023).

The dominance of Fabaceae aligns with findings of Osabiya *et al.* (2022), Ati and Kungo (2023), Ezenwenyi *et al.* (2023), and Jeyol and Yerima (2023), where Fabaceae was reported as the most abundant family. Ogwu *et al.* (2016) observed that the Aracaceae and Fabaceae families were the most prevalent on the University of Benin, Ugbowo campus. Following Fabaceae, Myrtaceae ranked second (3 species), including others like *Psidium guajava* and *Syzygium cumini*. Susilowati *et al.* (2021) reported that Meliaceae was the most abundant family, followed by Fabaceae and Sapindaceae. Olaoti-Laaro *et al.* (2021) reported that Malvaceae was the most

represented in the Natural Forest of Onigambari Forest Reserve, Oyo State, followed by Euphorbiaceae and Apocynaceae.



**Figure 1:** Distribution of the Total Individual Trees among the Families



**Figure 2:** Distribution of the Total Individual Trees among the Sampling Sites

The Shannon-Wiener diversity index, Margalef species richness index, and Simpson diversity index of the sampling sites are shown in Table 3. Site E had the highest Shannon-Wiener index ( $H=2.789$ ), while site D had the lowest Shannon-Wiener index ( $H=1.463$ ). Site H had the highest species richness ( $d=3.877$ ), while site D had the lowest species richness ( $d=1.735$ ). Site H recorded the highest Simpson diversity ( $SDI=0.915$ ), whereas site C exhibited the lowest Simpson diversity ( $SDI=0.652$ ). Shannon-Weiner index and Margalef index among the sampling sites ranges from moderately to nearly high diversity and high species evenness (Table 3). Site H emerged as the site with high species diversity and richness due to the presence of the FUW Staff School which allows minimal anthropogenic activity during school sessions only. Tree diversity shows the number of species and the range of different species present in a particular area (Zhao *et al.*, 2022). When tree diversity declines, it also affects the diversity of animals that rely on these trees for food and shelter.

A high Simpson diversity index suggests that there is a very low chance of two randomly chosen individuals belonging to the same species (Kunakh *et al.*, 2023).

**Table 3: Species Diversity Indices of the Eight Sampling Sites**

Sites	H	$\bar{d}$	SDI
A	1.837	2.060	0.828
B	2.303	2.812	0.901
C	1.585	2.836	0.652
D	1.463	1.735	0.722
E	2.789	2.288	0.786
F	2.275	3.119	0.907
G	2.204	2.943	0.890

H	2.642	3.877	0.915
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H: Shannon-Wiener diversity index, d: Margalef species richness index, and SDI: Simpson diversity index.

**Shannon**

H close to 1 = High diversity

H close to 0 = Low diversity

**Margalef**

d < 8 = Low diversity

d ≥ 8 = High diversity

**Simpson**

SDI close to 1 = High evenness

SDI close to 0 = Low evenness

**Sorenson Similarity Coefficient between the Sites:** The comparison of the level of diversity between the sites and the computed values of Sørensen’s coefficient for comparing their similarities is presented in Table 4. The Sørensen’s Similarity coefficient shows that Sites E and F had the highest pairwise similarity (88%), followed by Sites B and E (76%) and Sites B and F (75%). The lowest similarity was observed between Sites C and D (19%).

The close similarity between those sampling sites reflects that the sampling sites are heading toward sameness indicating loss of ecological diversity of the study area.

**Table 4: Sorenson Similarity Coefficient between the Sites**

Sites	Sorenson Similarity Coefficient							
	A	B	C	D	E	F	G	H
A								
B	57%							
C	40%	52%						
D	21%	36%	19%					
E	67%	76%	50%	42%				
F	67%	75%	52%	36%	88%			
G	51%	58%	35%	27%	67%	67%		
H	62%	62%	50%	44%	69%	69%	62%	

**CONCLUSION**

The high diversity of trees observed in the study sites was highly skewed to the economic trees than the indigenous/ native species because communities often conserve for sustainable use. This indicates that the native trees of Wukari in Federal University Wukari is threatened by anthropogenic activities and could also result to loss of genetic heritage or diversity. Site H emerged as the site with high species diversity and richness due to the presence of the FUW Staff School which allows minimal anthropogenic activity during school sessions only. High tree species diversity attracts high diversity of animals that rely on these trees for food and shelter. The close similarity between those sampling sites using the Sørensen’s Similarity coefficients, reflects that the sampling sites are heading toward sameness indicating loss of ecological and species diversities of the study area. The dominance

of Family Fabaceae is its ability to withstand anthropogenic pressures such as fire and logging through rapid regeneration. Therefore any physical developments that will exert considerably significant impacts on the local and immediate environment of FUW at both construction and operational stages should be prohibited.

### CONFLICTS OF INTEREST

The authors declare no conflicts of interest

### REFERENCES

- Angbonda, D. M. A., Monthe, F. K., Bourland, N., Boyemba, F., and Hardy, O. J. (2021). Seed and pollen dispersal and fine-scale spatial genetic structure of a threatened tree species: *Pericopsis elata* (HARMS) Meeuwen (Fabaceae). *Tree Genetics and Genomes*, 17(3): 27.
- Asifat, J. T. and Hill, J. (2019). Assessment of tree diversity and abundance in selected forest reserves in Osun State, Southwestern Nigeria. *Open Access Library Journal*, 6(10): 1.
- Asifat, J. T., Oyelowo, O. and Orimoogunje, O. O. I. (2019). Assessment of tree diversity and abundance in selected forest reserves in Osun State, Southwestern Nigeria. *Open Access Library Journal*, 6(10): 1-16.
- Ati, M.H. and Kungo, J.K. (2023). Assessment of Tree Species Diversity and Abundance in Forest Arboretum and Adjacent Farm at Badole, Dutsin-Ma. *Research Journal of Botany*, 18 (1): 1-8.
- Barrios, E., Valencia, V., Jonsson, M., Brauman, A., Hairiah, K., Mortimer, P. E. and Okubo, S. (2018). Contribution of trees to the conservation of biodiversity and ecosystem services in agricultural landscapes. *International Journal of Biodiversity Science, Ecosystem Services and Management*, 14(1): 1-16.
- Blicharska, M., Smithers, R. J., Mikusiński, G., Rönnbäck, P., Harrison, P. A., Nilsson, M. and Sutherland, W. J. (2019). Biodiversity's contributions to sustainable development. *Nature Sustainability*, 2(12): 1083-1093.
- Coşkunserçe, O. (2024). Use of a mobile plant identification application and the out-of-school learning method in biodiversity education. *Ecology and Evolution*, 14(4): e10957.
- Depauw, L., Blondeel, H., De Lombaerde, E., De Pauw, K., Landuyt, D., Lorier, E. and De Frenne, P. (2022). The use of photos to investigate ecological change. *Journal of Ecology*, 110(6): 1220-1236.
- Edet, D. I., Basse, P. W., Azubuike, N. O. and Obia, H. B. (2023). Assessment of flora species diversity at the Department of Forestry and Wildlife Technology Botanical Garden, FUTO, Owerri. *Nigerian Journal of Wildlife Management*, 7(2): 47-58.
- Ezenwenyi, J. U., Chukwu, O., Adum, N. N., Ezeano, C. I., and Eze, J. J. (2023). Assessment of Open Grown Tree Species Diversity in Nnamdi Azikiwe

- University, Awka, Nigeria. In *e-Proceedings of the Faculty of Agriculture International Conference* (pp. 383-388).
- Jeyol, M. C. and 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.
- Kunakh, O. M., Volkova, A. M., Tutova, G. F. and Zhukov, O. V. (2023). Diversity of diversity indices: Which diversity measure is better?. *Biosystems Diversity*, 31(2): 131-146.
- Lukina, N. V., Geraskina, A. P., Gornov, A. V., Shevchenko, N. E., Kuprin, A. V., Chernov, T. I. and Gornova, M. V. (2021). Biodiversity and climate-regulating functions of forests: current issues and research prospects. *Вопросы Лесной Науки*, 4(1): 1.
- Maroyi, A. (2023). Medicinal uses of the Fabaceae family in Zimbabwe: A review. *Plants*, 12(6): 1255.
- Nchake, M. A. and Shuaibu, M. (2022). Investment in ICT infrastructure and inclusive growth in Africa. *Scientific African*, 17, e01293.
- Ogwu, M.C., Osawaru, M. E., Obayuwana, O. K. (2016). Diversity and abundance of tree species in the University of Benin, Benin City, Nigeria. *Appl Trop Agric*. 21(3): 46-54.
- Olaoti-Laaro, S. O., Taiwo, D. M., Adeniji, K. A., Odewo, S. A., Animashaun, Z. T., Woghiren, A. I. and Adedoyin, E. D. (2021). Tree Species Diversity and Distribution in the Natural Forest of Onigambari Forest Reserve, Oyo State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 25(5): 829-834.
- Osabiya, O. S., Adeduntan, S. A. and Akinbi, O. J. (2022). A survey of tree species diversity in Akure Forest Reserve and Okomu National Park. *Journal of Research in Forestry, Wildlife and Environment*, 14(1): 119-127.
- Ruddell, B. L., Gao, H., Pala, O., Rushforth, R. and Sabo, J. (2020). Infrastructure. *The Food-Energy-Water Nexus*, 259-295.
- Shannon, C. E. and Wiener, W. (1949). The mathematical theory of communication. *Urbana, University of Illinois Press*. 177.
- Susilowati, A. R. I. D. A., Rangkuti, A. B., Rachmat, H. H., Iswanto, A. H., Harahap, M. M., Elfiati, D. and Ginting, I. M. (2021). Maintaining tree biodiversity in urban communities on the university campus. *Biodiversitas Journal of Biological Diversity*, 22(5): 2839-2847.
- Szejner, M. and Emanuelli, P. (2016). Tree Species Identification in the Tropics. In *Tropical Forestry Handbook* (pp. 451-470). Springer, Berlin, Heidelberg.

- Tsvuura, S., Mudhara, M. and Mabhaudhi, T. (2023). An analysis of the perceived societal benefits of and threats from trees for the delivery of livelihoods and community development. *Plants, People, Planet*, 5(3), 424-436.
- Zhao, Z., Hui, G., Yang, A., Zhang, G. and Hu, Y. (2022). Assessing tree species diversity in forest ecosystems: A new approach. *Frontiers in Ecology and Evolution*, 10, 971585.