



## Amenity Trees Diversity in Selected Tertiary Institutions within Port Harcourt Metropolis, Rivers State, Nigeria

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**ABSTRACT:** Trees are a central component of most urban communities, providing diverse benefits such as improving air quality, increasing aesthetic appeal, preventing erosion and providing habitat for wildlife. However, there is inadequate information on the distribution and diversity of these trees within our academic environments. This study investigates the distribution, frequency and species diversity of amenity trees within the main campuses of tertiary institutions in River State, Nigeria. The selected tertiary institutions are University of Port-Harcourt (Institution A) and Rivers State University (Institution B). Five (5) major roads in each campus were randomly selected, and 200m along each road was selected as sample areas. Ten (10) meter was marked from the edge of the road, and complete inventory was taken of all trees within the marked sample area. Diameter at breast height (DBH), crown diameter and tree height were measured. Shannon-Weiner and Simpson diversity index were used to calculate amenity trees diversity, while Margalef specie richness was used to calculate the species index. A total of 539 trees were surveyed on both campuses, comprising 26 different species and 10 families. *Casuarina equisetifolia* had the highest frequency with 92 trees in B. Simpson diversity index showed higher diversity ( $D = 0.78$ ) in B amenity trees than A ( $D = 0.81$ ). Shannon-Weiner species evenness was 0.71 and 0.76 for Institutions A and B respectively. Margalef specie richness index were 2.90 for A and 1.40 for B. This study provides baseline information for ecosystem management of urban forest tree species within campuses. For sustainable management of trees on campuses, frequent inventory and survey should be conducted to establish their abundance, distribution and diversity.

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Trees are the unsung heroes of our urban environment whose roles cannot be over emphasized. They provide countless services such as conservation of species, soil erosion control and flora and fauna habitat preservation (Armenteras *et al.*, 2009). According to Ezeabasili *et al.*, (2015) urban forestry involves the planting and maintaining of a group of trees within a built environment. These built environments could be cities, residential towns, institutional areas such as schools, churches, mosques etc. Trees in academic institutions located in cities are part of urban forests (Raji and Babalola, 2018). University of Port Harcourt is a typical urban environment. Over the years, urban environment has experienced tremendous increase in human population which has led to different anthropogenic disturbance on the trees (Omoro *et al.*, 2010). The University being an academic area is highly populated and is an example of a typical urban environment. The report of United-Nations (2006) stated that over the next four decades all of the world's population growth will occur in urban areas and over 60 percent of the global population will reside in urban areas. Kumar *et al.*, (2006) started that management

interventions is required to maintain the overall biodiversity, productivity, and sustainability. All over the world, overexploitation has been noted as a major environmental and economic problem resulting in the rapid loss of tree diversity (Mani and Parthasarathy, 2006). Suratman (2012), stated that information on composition, diversity of tree species and species-rich communities is of key importance in the planning and implementation of biodiversity conservation efforts. Diversity is an indicator that allows appreciating links between the richness and the abundance of individuals' trees; it reflects the degree of heterogeneity or stability of vegetation. Biodiversity conservation depends basically on the knowledge of the structure, species richness, and the ecological characteristics of vegetation. Quantitative information of these variables is important in understanding the status of the forest estate, decision-making, planning and implementation of conservation strategy (Suratman, 2012). Ogwu *et al.*, (2016) reported that sustainable development advocates that humans and biodiversity coexist side by side. A university campus should be promoted as a model environment for

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sustainable development. Knowledge on tree species diversity and distribution would serve as baseline information to know the status of the tree species in the study area; which is basic in understanding regeneration processes, such as tree growth, tree mortality, under-storey development, and the spread of disturbances (Francisco *et al.*, 2017). To protect and prevent trees decline in our urban environment, it is essential to examine the current status of species diversity, composition and abundance of tree species as this will provide guidance for management and conservation. This study is aimed at assessing tree species diversity and distribution within two tertiary institutions in Port Harcourt, Rivers State, Nigeria with the view to providing baseline information useful to developing conservation strategy.

## MATERIALS AND METHOD

**Study area:** The study was conducted in two universities (One federal and one state) in Port Harcourt; University Park, University of Port Harcourt (A) and the main campus of the Rivers State University of Science and Technology (B). The University of Port Harcourt, Choba is located in Ikwerre local government area of Rivers state, Nigeria. It lies between latitude 04°53'38.3" N and longitude 06°54'38" E. Rivers State University of Science and Technology is located at Nkpolu-Oroworuko Community in Port Harcourt, the capital of Rivers State, Nigeria. It lies between latitude 4°47'21" N and longitude 6°59'54" E. The university was established in October, 1980 from the Rivers State College of Science and Technology. It is the first Technological University in Nigeria, and the first state owned State University in the Niger Delta region of Nigeria. Port Harcourt lies in the southern Niger delta area of Nigeria, in Rivers state. It rests in the mangrove swamp forest vegetation. The city has a tropical climate characterized by a rainy season between April and October, and a cold drier season between January and March.

**Data collection:** Data for this study were collected through sampling the avenue roads in the main campuses of the universities. 200 meters each of five major roads in each campus was selected through a random sampling and data were collected from the amenity trees in the selected roads. The service of Taxonomist was employed in the identification of the trees species. Each of the trees found in the campuses were identified to species level with their scientific name, local name and family. Tree growth parameters were measured on the trees. The measured parameter includes tree height, diameter at breast height and crown diameter. Stem diameters, crown diameter and

total height were measured using diameter tape, meter tape and Haga altimeter respectively.

**Data analysis:** Plant population and species diversity were analyzed using the following species diversity indices:

Shannon-Weiner Index of Diversity ( $H'$ ) - Species diversity within the study area were analyzed using the diversity index of Shannon and Weaver (1949), the index varies depending on the number of species present. It is higher when there are more species, indicating greater diversity. Shannon-Weiner Index of diversity ( $H'$ ) was calculated following Kent and Coker (1992) and Magurran (2004):

$$H' = -\sum p_i \ln p_i \quad (1)$$

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

Simpson index is a measure of species dominance. As biodiversity increases, the Simpson index decreases. Therefore to get a clear picture of species dominance, Simpson index is given as; (Simpson, 1949)

$$D_s = 1 - \frac{\sum n_i(n_i - 1)}{N(N - 1)} \quad (2)$$

Where: n is the total number of organisms of a particular species and N is the total number of individual of all species.

Tree species richness was analyzed using Margalef species richness index (d), which is used as a simple measure of species richness according to Margalef (1958).

$$D_x = \frac{(S-1)}{\ln N} \quad (3)$$

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

Relative Density (RD), is used to assess species relative distribution of the town using;

$$RD = \left(\frac{n_i}{N}\right) \times 100 \quad (4)$$

Where  $n_i$  = the number of species and N = the total number of trees in the town.

## RESULTS AND DISCUSSION

**Floristic composition of amenity trees in the study area:** A total of five hundred and thirty-nine (539)

individual trees representing 26 species and 15 families were identified in the study areas. Some tree species found in A are *Azadiractha indica*, *Gmelina arborea* (plate 1) and *Roystonea regia*, *Casuarina equisetifolia* in B (plate 2) respectively. Arecaceae was the dominant family with 4 and 3 species in A and B respectively. In terms of the number of trees individuals per family, Meliaceae was the dominant family in the A with 84 trees while Casuarinaceae was dominant in B with 92 trees (Table 1 and 2). In

Institution A, *Azadiractha indica* and *Roystonea regia* were the most dominant species with 84 and 47 individuals respectively (table 1). *Casuarina equisetifolia* and *Polyalthia longifolia* were identified as the most dominant with 92 and 65 individuals respectively in B (table 2). Trees species identified in the survey were higher for A (17) than B (9). However, Institution B had a total of 292 individual trees while Institution A had 247 trees.

**Table 1:** Floristic composition of amenity tree species in University of Port Harcourt

S/N	Species	Family	Common names	Frequency	Relative density
1	<i>Azadiractha indica</i>	Meliaceae	Neem tree	84	34.00
2	<i>Roystonea regia</i>	Arecaceae	Royal palm	47	19.18
3	<i>Elaeis guineensis</i>	Arecaceae	African palm tree	25	10.20
4	<i>Cocos nucifera</i>	Arecaceae	Coconut tree	9	3.67
5	<i>Delonix regia</i>	Fabaceae	Flamboyant tree	3	1.22
6	<i>Terminalia mantaly</i>	Combretaceae	Madagascar almond	38	15.51
7	<i>Hura crepitans</i>	Euphorbiaceae	Monkey no climb	3	1.22
8	<i>Caryota urens</i>	Arecaceae	Fishtail palm	13	5.30
9	<i>Spondias cytherea</i>	Anacardiaceae	June plum/ambarella	3	1.22
10	<i>Tectona grandis</i>	Verbenaceae	Teak	1	0.40
11	<i>Mangifera indica</i>	Anacardiaceae	Mango tree	5	2.04
12	<i>Terminalia catappa</i>	Combretaceae	Almond tree	1	0.40
13	<i>Gmelina arborea</i>	Verbenaceae	Gmelina	5	2.04
14	<i>Polyalthia longifolia</i>	Annonaceae	Masquerade tree	6	2.44
15	<i>Treculia africana</i>	Moraceae	African breadfruit	1	0.40
16	<i>Milicia excelsa</i>	Moraceae	Iroko tree	1	0.40
17	<i>Spondias mombin</i>	Anacardiaceae	Hog plum	2	0.81
Total				247	100



**Plate 1:** Amenity trees along major in Uniport and **Plate 2:** Amenity trees and palm along major road in RSU

**Table 2:** Floristic composition of amenity tree species in River State University

S/N	Species	Family	Common Names	Frequency	Relative density
1	<i>Casuarina equisetifolia</i>	Casuarinaceae	She oak tree	92	31.50
2	<i>Casuarina spp.</i>	Casuarinaceae		42	14.38
3	<i>Polyalthia longifolia</i>	Annonaceae	Masquerade tree	65	22.26
4	<i>Roystonea regia</i>	Arecaceae	Royal palm	23	7.87
5	<i>Gmelina arborea</i>	Verbenaceae	Gmelina tree	6	2.05
6	<i>Elaeis guineensis</i>	Arecaceae	African palm tree	58	19.86
7	<i>Cocos nucifera</i>	Arecaceae	Coconut tree	1	0.34
8	<i>Terminalia ivorensis</i>	Combretaceae	Black afara	3	1.02
9	<i>Delonix regia</i>	Fabaceae	Flamboyant tree	2	0.68
Total				292	100

*Diversity of amenity trees in Study areas:* Tree diversity indices in terms of relative abundance,

Margalef index, species richness, Shannon Wiener diversity (H), and Simpson index for the study areas

are presented in table 3. The results of Shannon-Wiener diversity index (H') for Institutions A and B were: 2.02 and 1.67, while Shannon's maximum diversity index (Hmax) was 2.83 and 2.20 for A and B respectively (Table 3).

**Table 3:** Biodiversity indices for amenity trees in the study area

	Institution A	Institution B
No. of Individual Trees	247	292
No. of Family	8	6
Diversity index (H')	2.02	1.68
Max. Diversity (H <sub>Max</sub> )	2.83	2.20
Species Evenness (E <sub>H</sub> )	0.71	0.76
Simpson's Dominance index (D)	0.81	0.79
Specie richness	17	9
Margalef index	2.90	1.41

The result of tree species evenness in A and B was 0.71 and 0.76. Based on the result, Institution A consistently showed a higher diversity index than B expect for the number of individual trees and species evenness.

*Tree growth variables for amenity trees in the study area:* Tree growth variables were measured and recorded for amenity trees in the university campuses. Tree height values ranges from 7.26m – 17.08m and 6.66m – 16.14m in Institutions A and B respectively (table 4 and 5). The species with the highest height values in A and B are *Elaeis guineensis* and *Terminalia ivorensis* respectively. Mean crown diameter ranges from 5.28m – 14.07m in A (table 4) while B mean crown diameter ranges from 4.47 – 15.50 (table 5). Crown cover area recorded for Institutions A and B were 2520.35m<sup>2</sup> and 2465.13m<sup>2</sup> respectively. *Casuarina equisetifolia* recorded the highest crown cover area in B, covering 1124.38m<sup>2</sup> (5.62%) of the sampled. In Institution A, *Azadirachta indica* recorded a crown cover area of 1074.29m<sup>2</sup> (5.37%) of the study area (Table 4.and.5).

**Table 4:** Tree growth variables of sampled trees in University of Port Harcourt

S/N	Species	N	Mean Height	Mean Dbh	Mean CD	Crown cover	% Cover
1	<i>Azadirachta indica</i>	84	15.02	1.911	12.79	1074.29	5.37
2	<i>Roystonea regia</i>	47	13.26	1.48	8.80	413.61	2.07
3	<i>Elaeis guineensis</i>	25	17.08	2.34	6.35	158.57	0.79
4	<i>Cocos nucifera</i>	9	10.37	0.78	7.99	71.95	0.36
5	<i>Delonix regia</i>	3	13.40	0.98	14.07	42.22	0.21
6	<i>Terminalia mantaly</i>	38	13.74	1.24	11.10	421.74	2.11
7	<i>Hura crepitans</i>	3	12.65	2.43	12	36	0.18
8	<i>Caryota urens</i>	13	11.06	0.99	6.56	85.26	0.43
9	<i>Spondias cytherea</i>	3	8.40	0.87	6.88	20.63	0.10
10	<i>Tectona grandis</i>	1	15.30	3.40	16.38	16.38	0.08
11	<i>Mangifera indica</i>	5	14.42	3.66	12.88	64.38	0.32
12	<i>Terminalia catappa</i>	1	11.73	4.32	13.27	13.27	0.07
13	<i>Gmelina arborea</i>	5	7.26	0.78	6.88	34.39	0.17
14	<i>Polyalthia longifolia</i>	6	14.06	1.03	5.28	31.65	0.16
15	<i>Treculia africana</i>	1	16.30	3.62	13.40	13.40	0.07
16	<i>Milicia excelsa</i>	1	8.71	0.47	5.13	5.13	0.03
17	<i>Spondias mombin</i>	2	9.51	1.08	8.74	17.48	0.09

**Table 5:** Tree growth variables of sampled trees in River State University

S/N	Species	N	Mean Height	Mean Dbh	Mean CD	Crown Cover	% Cover
1	<i>Casuarina equisetifolia</i>	92	13.76	1.95	12.22	1124.38	5.62
2	<i>Casuarina spp</i>	42	12.39	1.24	8.39	352.66	1.76
3	<i>Polyalthia longifolia</i>	65	14.02	1.23	4.91	318.91	1.59
4	<i>Roystonea regia</i>	23	6.66	1.02	4.47	102.91	0.51
5	<i>Gmelina arborea</i>	6	12.99	3.68	10.47	62.81	0.31
6	<i>Elaeis guineensis</i>	58	7.53	1.55	7.29	422.81	2.11
7	<i>Cocos nucifera</i>	1	8.11	0.61	5.18	5.18	0.03
8	<i>Terminalia ivorensis</i>	3	16.14	3.86	14.83	44.48	0.22
9	<i>Delonix regia</i>	2	15.13	3.77	15.50	30.99	0.15

*Floristic composition of amenity trees in the study area:* The taxonomy, diversity and distribution of tree growth variables for amenity trees in the study area have been documented. The urban trees play a vital part in the health and welfare of people who lives and works in the environment thereby promoting sustainable development. The study reveals that the sampled university campuses possess different species

of trees. This finding is in agreement with the report of Babalola and Raji (2016) who also observed diverse tree species in academic area. The abundance and diversity of trees in the academic area may be as a result of the need to provide aesthetic environment and beautiful landscape for the University as well as provision of shade for student and staff. Generally trees are abundant in university environment because

of the benefits derived from urban trees such as increased property values (Panduro and Veie, 2013; Babalola and Raji, 2016 and Rosato *et al.*, 2017), control rainfall runoff and flooding (Livesley *et al.*, 2016), improve wellbeing (Hall and Hodges, 2011; Taylor *et al.*, 2001), purify the air and provide of shade (Agbelade *et al.*, 2016) and are desired for beautification (Bello and Yacim, 2014). *Mangifera indica*, *Delonix regia*, *Elaeis guineensis*, *Terminalia* spp. e.t.c. were some of the species found in the study area. Aigbokhan (2014) and Ogwu *et al.*, (2016) also found similar species in their study area due to the services such trees provides. However, the flora composition of the University Campuses especially University of Port Harcourt are under threat from infrastructural development and other anthropogenic activities. Similar findings have been reported by Wardle *et al.*, (2004) and Ogwu *et al.*, (2016). Chazdon, (2003), reported that as human population continue to grow, land use intensity increases and the negative effects of deforestation are likely to worsen hence sustainable management techniques are required to maintain the biodiversity and productivity of ecosystems (Reddy and Elanchezian, 2008).

*Diversity of amenity trees in Study areas:* In this study biodiversity index was used to assess the level of biodiversity in the study area. According to Agbelade *et al.*, (2016) biodiversity indices are generated to bring the diversity and abundance of species in different habitats to similar scale for comparison and the higher the value, the greater the species richness. Kacholi (2014) reports that understanding of tree species diversity, composition, and structure is very important in assessing sustainability of forest, species conservation, and ecosystems management. The results of Simpson's diversity index for the selected institutions are 0.81 for A and 0.79 for B. The results of Shannon-Wiener diversity index ( $H'$ ) for the two universities are: 2.02 (A), and 1.68 (B) while species evenness (Shannon's equitability (index) gave 0.71 (A) and 0.76 (B). However, amenity tree species are more evenly distributed in Institution A compared to B. The Shannon-Wiener diversity index and species evenness of this study were lower than the values of Amonum *et al.*,(2019). The Shannon-Wiener index of the amenity trees of the study universities is higher than the value (0.84) obtained by Ogwu *et al.*, (2016) for trees in University of Benin. The biodiversity indices obtained by Raji and Babalola (2018) for trees in University of Ilorin is similar with the finding of this study. Tree diversity is vital to tropical Forest biodiversity, because tree provide homes and resources to a wide variety of plant and animal species.

*Growth parameters of amenity trees:* The measurement and prediction of dbh, height and crown diameter of urban tree species will enable arborists, researchers, and urban forest managers to model costs and benefits, analyze alternative management scenarios, and determine the best management practices for sustainable urban forests (McPherson *et al.*, 2005). This study describes the amenity tree composition and distribution of the selected universities, giving dbh, height and crown diameter of tree species community. Tree growth variables were generally higher for Institution A compared to B. The growth of trees in the studied universities is an indication of the level of conservation of tree species which urban forest can offer. This growth may be as a result of control and strict prohibition of tree felling within the campuses.

*Conclusion:* Basic information on amenity trees in University of Port Harcourt and River State University which can be used for the development of species databases in both institutions has been revealed. The research conducted a species diversity analysis proving the study area as diverse with medicinal and socio-economically importance species. Necessary action should be undertaken towards the sustainability of these trees and conservation of urban forest at large. Frequent inventory should be conducted for trees on campus to note their abundance, distribution and diversity.

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