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Assessment of Urban Forest Tree Species Population and Diversity in Ibadan, Nigeria

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Abstract This research focuses on the urban tree species population and diversity within Ibadan metropolis as a means of creating biodiversity database for the urban centre in South west, Nigeria. This was determined by assessing urban forest tree abundance, species diversity and growth yield. All trees with diameter at breast height (dbh) ≥ 10 cm were identified, dbh measured and their frequencies taken in all the area enumerated within Ibadan. There are 155 tree stems belonging to 26 families and 54 tree species within Ibadan built-up areas and 101 tree stems belonging to 16 families and 19 tree species in peri-urban centre of Ibadan. The two most abundant species and families were *Delonix regia* of Fabaceae family and *Terminalia ivorensis* of Combretaceae family (18 and 17 stems) respectively while Fabaceae family has (7 species). The value of the Shannon's max diversity index (H_{max}) of (3.99 and 2.94), Shannon-Wiener diversity index (3.35 and 2.48) and species evenness 0.84 were the same for peri-urban centre, while the growth variable were basal area and volume of (22.8m^2 and 18.5m^2) and (284.8m^3 and 275.3m^3) respectively. This study provide information on the level of tree species biodiversity due to infrastructure development that has reduced forest cover within the built-up areas of Ibadan which can expose the city to lot of environmental hazard.

Keywords Biodiversity Indices, Tree Species Diversity, Population, Urban and Peri-urban Forest

1. Introduction

Nigeria's population density presents a mix of an increasing growth rate and intense rural–urban migrations. This lead urban forest destruction and social amenities development which makes the urban centres attractive for high migration potentials. Urban forestry is the careful studies, monitoring, and management of urban forests, i.e. tree populations in urban settings for the purpose of improving the urban environment. It is also imperative to know that urban forest refers to all publicly and privately owned trees within an urban area, including individual trees along streets and in backyards, as well as stands of remnant forest (Nowak *et al.,* 2001) [1]. Biodiversity includes the variety of different species (plants, animals - including humans, microbes and other organisms), the genes they contain, and the structural diversity in ecosystems. Keystone Center (1991) [2] defined biodiversity as the variety of life and all the processes that keep life functioning. Trees in urban areas provide numerous benefits such as public aesthetic appeal, the root of trees prevent erosion, trees improve air quality, serves as wind break, shelter belt, protect water flow, sequence carbon, ameliorate harsh weather condition, serves as raw materials to the wooden industries, preserve water shed, serve as recreation centres for relaxation and home garden as food. Urban forest provides numerous tangible environmental benefits that often go unrecognized as reported by (McPherson and Simpson 1999) [3]. In recent years, there has been increased research on quantification of ecosystem services, the direct benefits that urban forest ecosystem provides to people (Millennium Ecosystem assessment 2005) [4]. Research and enumeration of various urban forest benefits can create citizen awareness towards the values of urban forest within an area that is publicly owned forest, as well as provide a basis for management of such benefits. It will also be of help to know that urban biodiversity is influenced by the status of original surrounding ecosystems and these can be managed properly during constructions within the built-up environment which can influenced the economic, social and cultural values derived from urban forest. The home garden, street trees, estate trees can harbour significant biodiversity. Assessing the status and trends of tree species diversity population is essential for sustainable development, strategies and planning of the urban centres in Nigeria.

2. The Study Area

This research was carried out in Ibadan, Oyo State Nigeria. It is the city at the junction of the savannah and the rain forest. It is the third largest metropolitan area, by population, in Nigeria after Lagos and Kano, with a population of 2.84million according to UN World Urbanization Prospects, 2010. Ibadan is located in south-western Nigeria in the south-eastern part of Oyo. Ibadan city lies on the geographical coordinates of 7º23′47″N, 3º55′0″E, with abundance of human and natural resources. The city enjoys a tropical climate with two distinct seasons. These are the raining season (April-October) and the dry season (November-March). Temperature ranges between 25ºC and 35ºC. Tropical forest exists in the south, while guinea savannah predominates in the northern peripheries. Ibadan lies about 30 miles (48km) inside the northern boundary of the lowland rainforest zone of western Nigeria.

3. Data Collection

The data for this research was collected from Ibadan metropolitan city of Oyo State, Nigeria. Government owned Institutions (schools, public buildings, higher institutions), worship centres (Church and Mosque buildings), privately owned institutions (schools, public buildings, higher institutions, Hotels, recreation centres, parks and gardens), Street and link roads. The selection Ibadan city for this study was done purposefully due to the population density and the comercial significant of the city. Green areas within Ibadan metroplis was sampled by the measuremnet of the trees diameters at base, middle and top, diamerter at breast height and height with the aid of spiegel relaskop and girth tape. Coordinates were taken with hand-held Global Positioning System (GPS) in all the locations selected within Ibadan. All trees with diameter at breast height (dbh) greater than or equal to 10 cm were identified, dbh measured with Girth Tape, height measured with Spiegel Relaskop and their frequencies taken. Tree species identification was done using keys in flora manuals and match-up technique. For trees that could not be identified on the field, representative samples (leaves, fruits and bark) were collected and taken to the herbarium for identification. Identified woody trees were classified as species, family and biodiversity indices were computered.

4. Data Analyses

Forest Structure and Tree Species Diversity

All tree species within selected locations in Ibadan were selected and were assigned to families using Keay (1989) [5] as guide.

Basal Area

The basal area of all trees within Ibadan metropolis was calculated using the formula:

$$BA = (\pi D2)/4 \quad (1)$$

where, BA = Basal area (m^2), D = Diameter at breast height (cm) and л= pie (3.142). The total BA for each plot was obtained by adding all trees BA in the plot.

Volume

The volume of all trees within Ibadan metropolis was calculated using the Newton's formula (Hush *et al*., 2003) [6]:

$$V = (h/6)\ (Db + 4\ Dm + Dt) \quad (2)$$

where, V = Tree volume (m^3), Db, Dm and Dt = tree cross-sectional area at the base, middle and top of merchantable height, respectively (m^2) and h tree height (m). The equation is expressed as (2)

Species Diversity Index

Species diversity index shall be computed using the Shannon-Wiener diversity index equation (3); Kent and Coker, 1992; Guo *et al*., 2003)[9,10].

$$H' = -\sum_{i=1}^{s} p_i \ln p_i \quad (3)$$

Where: H' = Shannon-Wiener diversity index; S = total number of species in the community; pi = proportion of S made up of the ith species; ln = natural logarithm.

Species Relative Dominance

Species relative dominance (RD (%)), used in assessing relative space occupancy, will be estimated using equation (4) (Aidar *et al*., 2001) [8].

$$RDo = (\sum Bai \times 100)/\sum Ban \quad (4)$$

Where: Bai = basal area of all trees belonging to a particular species i; Ban = basal area of all trees in a city.

Importance Value Index

The Importance Value Index (IVI) of each species shall be computed with the relationship: (RD + RDo)/2) (Brashears et al., 2004) [7].

Species Relative Density

Species relative density, which is an index for assessing species relative distribution (Brashears *et al*., 2004) [7], was computed with equation (6).

$$RD = (ni/N) \times 100 \quad (6)$$

where: RD (%) = species relative density; ni = number of individuals of species i; N = total number of all individual trees of all species in the entire community.

Shannon's Maximum Diversity Index

Shannon's maximum diversity index will be calculated using equation (7) (Guo et al., 2003) [10]

$$Hmax = In(S) \quad (7)$$

Where: Hmax = Shannon's maximum diversity index; S = total number of species in the community

Shannon's equitability (EH), which is obtained using equation (8) (Kent and Coker, 1992) [9].

$$EH = H'/Hmax = \sum Pi\ In(Pi)/In(S) \quad (8)$$

Where: H' = Shannon-Wiener diversity index; S = total number of species in the community; pi = proportion of S made up of the ith species; ln = natural logarithm; Hmax = Shannon's maximum diversity index; S is as defined as above

5. Result

Tree Species Distribution Pattern within Ibadan

Tree species relative abundance, frequency, diversity and diameter at breast height within Ibadan were computed with biodiversity and growth variables equations. A total number of individual tree was 155 and 101 stems, 25 and 16 families belonging to 54 and 19 species were enumerated (Table 1a, 1b). In total, fifty four (54 and 19) tree species were found in Ibadan in which *Delonix regia* of Fabacea family has the highest number of population with a frequency of eighteen (18), closely followed by *Terminalia ivorensis* of Combretaceae family has frequency of seventeen (17) and *Azadirachta indica* of Meliceae family has a frequency of fifteen (15) in Ibadan. The value of the Shannon's max diversity index (H_{max}) of 3.99 and 2.94, indicated relatively diverse tree species with Shannon-Wiener diversity index (H′) of 3.35 and 2.48 and species evenness (E_H) of 0.84 which was the same for peri-urban centre. These results revealed that the correlation between species richness and evenness are similar as suggested by Onyekwelu *et al*; (2007) [12] that Shannon's equitability revealed that species evenness in forest communities are similar which is collaborated by the difference between H′ and H_{max}. Biodiversity indices are computed to show the level of diversity and abundance of species in different locations with similar scale for comparison and the higher the value the greater the species richness within the locations.

Biodiversity indices and Growth Variables of tree species within Ibadan

The biodiversity indices and growth variables of tree species within Ibadan were computed. The value of the Shannon's max diversity index (H_{max}) is 3.99, 2.94 while Shannon-Wiener diversity index (H′) is 3.35, 2.48 and and equitability index, using Pielou's evenness index of 0.84, 0.84 were obtained in (Table 4). The highest basal area and volume of trees within the city ($0.43m^2$ and $4.32m^3$, respectively) were contributed by *Delonix regia* and *Azadirachta indica*. This was followed by *Astonia boonei* and *Delonix regia* with basal area and volume of $0.83m^2$ and $8.53m^3$, respectively. The least basal area and volume ($0.13m^2$ and $1.67m^3$, respectively) were recorded for *Eucalyptus torrelliana* and *Morinda lucida*. However, *Delonix regia* had the highest species importance with an IVI of 9.39 %. This was closely followed by *Azadirachta indica* with IVI of 8.28. The families with the highest mean dhb (177.4cm) and height (18.8m) were Apocynaceae and Meliaceae, respectively. Ibadan metropolis contains variety of trees species which serve various purposes which include beautification, income generation, food supplements and medicinal purposes. Apart from beautification and medicinal values of trees, they also sequestrate carbon and this is beneficial to humans because excess of carbon in the atmosphere is dangerous to human's health. The result of this research indicated that people with trees within their houses enjoy tree shades as reported by (Heisler *et al.*, 1995) [12] and (Ulrich 1984) [13] pointed out; tree shade reduces ultraviolet radiation and its associated health problems. Tree leaves have the capacity to filter air which can improve the health condition of the people within the city and reduce air pollutants as reported by (Nowak *et al*., 2006) [14] that trees improve air quality by lowering air temperatures, altering emissions from building energy use and other sources, and removing air pollutants through their leaves. It was also gathered that trees are used as wind break and provide fruits for the people's nutritional intake as reported by (Fuwape and Onyekwelu, 2011) [15] the traditionally, people planted trees around their houses for fruits, nuts, leaves, fuel wood, fodder, building materials and windbreaks.

Table 1a. Tree Species Distribution and Diversity within Ibadan Metropolis (Urban), Ibadan

S/N	Tree species	Family	Freq.	MHt	MDbh	B.A	Vol.	RD	RD_O	IVI
1	*Adansonia digitata*	Bombacaceae	1	12.0	17.10	0.35	4.24	0.80	2.11	0.84
2	*Albizia ferruginea*	Mimosoideae	1	12.7	14.02	0.32	4.09	0.80	1.92	0.77
3	*Albizia lebbeck*	Mimosoideae	1	10.5	15.10	0.33	3.50	0.80	1.98	0.79
4	*Albizia zygia*	Mimosoideae	2	11.0	16.40	0.35	3.81	1.60	2.06	1.65
5	*Astonia boonei*	Apocynaceae	1	12.8	31.10	0.52	6.61	0.80	3.08	1.23
6	*Azadirachta indica*	Meliaceae	15	14.2	16.41	0.35	4.92	12.00	2.06	12.38
7	*Bombax buonopozense*	Bombacaceae	1	16.5	28.15	0.48	7.92	0.80	2.86	1.14
8	*Borassus aethiopum*	Arecaceae	1	12.3	11.91	0.41	5.00	0.80	2.42	0.97
9	*Calitris intertropical*	Cactaceae	1	10.4	20.36	0.51	5.28	0.80	3.02	1.21
10	*Callitris intratropica*	Cupressaceae	1	10.0	18.20	0.48	4.80	0.80	2.86	1.14
11	*Casuarina equisetifolia*	Casuarinaceae	1	17.8	14.50	0.44	7.76	0.80	2.60	1.04
12	*Ceiba pentandra*	Malvaceae	1	13.6	27.10	0.60	8.10	0.80	3.55	1.42
13	*Cocos nucifera*	Arecaceae	3	12.5	14.61	0.44	5.47	2.40	2.60	3.13
14	*Delonix regia*	Fabaceae	18	10.0	14.20	0.43	4.32	14.40	2.58	18.55
15	*Elaeis guinensis*	Palmae	1	8.6	18.42	0.76	6.54	0.80	4.53	1.81
16	*Erythrina speciosa*	Fabaceae	1	11.2	16.30	0.18	1.97	0.80	1.05	0.42
17	*Eucalyptus camaldulensis*	Myrtaceae	1	14.6	15.20	0.17	2.45	0.80	1.00	0.40
18	*Eucalyptus citriodora*	Myrtaceae	1	14.0	19.30	0.20	2.78	0.80	1.18	0.47
19	*Eucalyptus citrusdorra*	Myrtaceae	1	13.8	11.84	0.14	1.99	0.80	0.86	0.34

Table 1a Continued. Tree Species Distribution within Ibadan Metropolis (Urban), Ibadan

S/N	Tree species	Family	Freq.	MHt	MDbh	B.A	Vol.	RD	RD_O	IVI
20	*Eucalyptus torrelliana*	Myrtaceae	1	14.6	9.26	0.13	1.86	0.80	0.76	0.30
21	*Ficus exasperate*	Moraceae	1	16.5	13.72	0.24	3.88	0.80	1.40	0.56
22	*Ficus goliath*	Moraceae	1	13.6	22.61	0.32	4.32	0.80	1.89	0.76
23	*Ficus nitida*	Moraceae	3	10.8	22.43	0.32	3.41	2.40	1.88	2.26
24	*Gliricidia sepium*	Fabaceae	5	10.3	17.56	0.27	2.77	4.00	1.60	3.21
25	*Gmelina arborea*	Verbenaceae	6	14.8	15.18	0.25	3.67	4.80	1.48	3.54
26	*Hildegardia barterii*	Meliaceae	2	8.6	23.30	0.32	2.79	1.60	1.93	1.55
27	Hura crepitans	Euphorbiaceae	1	11.6	11.9	0.22	2.55	0.80	1.31	0.52
28	*Khaya grandifoliola*	Meliaceae	1	18.8	26.14	0.35	6.66	0.80	2.11	0.84
29	*Khaya senegalensis*	Meliaceae	1	12.6	15.10	0.25	3.11	0.80	1.47	0.59
30	*Lannea welwitschii*	Anacardiaceae	1	16.4	28.10	0.38	6.15	0.80	2.23	0.89
31	*Malus domestica*	Rosaceae	1	10.0	16.52	0.26	2.60	0.80	1.55	0.62
32	*Mangifera indica*	Anacardiaceae	2	13.6	19.10	0.28	3.86	1.60	1.69	1.35
33	*Milicia excela*	Moraceae	2	12.9	22.21	0.31	4.05	1.60	1.87	1.50
34	*Millettia regia*	Moraceae	1	14.0	9.48	0.20	2.80	0.80	1.19	0.48
35	*Millettia thonningii*	Papilionioideae	2	16.2	22.20	0.31	5.08	1.60	1.87	1.49
36	*Morinda lucida*	Rubiaceae	1	8.6	8.72	0.19	1.67	0.80	1.16	0.46
37	*Newbouldia laevis*	Bignoniaceae	1	10.2	10.56	0.21	2.13	0.80	1.24	0.50

Table 1a Continued: Tree Species Distribution within Ibadan Metropolis (Urban), Ibadan

S/N	Tree species	Family	Freq.	MHt	MDbh	B.A	Vol.	RD	RD_O	IVI
38	*Parkia biglobosa*	Mimosaceae	1	12.4	12.49	0.22	2.79	0.80	1.34	0.54
39	*Phyllantus discoides*	Euphorbiaceae	2	12.0	19.21	0.28	3.42	1.60	1.70	1.36
40	*Pinus Caribbean*	Pinaceae	1	12.8	10.40	0.21	2.66	0.80	1.24	0.49
41	*Pinus oocarpa*	Pinaceae	2	12.1	17.50	0.27	3.25	1.60	1.60	1.28
42	*Plumeria alba*	Apocynaceae	2	10.2	9.18	0.20	2.02	1.60	1.18	0.94
43	*Polyalthia longifolia*	Annonaceae	5	14.8	16.12	0.26	3.79	4.00	1.53	3.05
44	*Pterocarpus macrocarpus*	Papilionioideae	1	11.5	16.10	0.26	2.95	0.80	1.53	0.61
45	*Pycnanthus angolensis*	Myristicaceae	2	14.6	16.18	0.26	3.75	1.60	1.53	1.22
46	*Ricinodendron heudelotii*	Euphorbiaceae	1	12.0	16.19	0.26	3.08	0.80	1.53	0.61
47	*Roysonea regia*	Arecacea	1	12.6	18.10	0.27	3.46	0.80	1.63	0.65
48	*Roystonea oleracea*	Arecaceae	1	12.0	18.10	0.27	3.29	0.80	1.63	0.65
49	*Senna siamea*	Fabaceae	3	10.0	23.12	0.32	3.23	2.40	1.92	2.31
50	*Tectona grandis*	Lamiaceae	12	12.4	14.50	0.24	3.00	1.60	1.44	1.15
51	*Terminalia catappa*	Combretaceae	15	10.2	23.20	0.32	3.30	4.00	1.93	3.86
52	*Terminalia ivorensis*	Combretaceae	17	11.2	26.10	0.35	3.96	5.60	2.11	5.90
53	*Terminalia superba*	Combretaceae	2	14.8	16.21	0.26	3.80	1.60	1.53	1.22
54	*Triplochiton scleroxylon*	Sterculiaceae	1	15.8	19.37	0.29	4.52	0.80	1.71	0.68
			155			16.8	211.2			

Freq – number of tree stems in the city, B.A. – Basal area of trees in the city, Vol. – Volume of trees in the city.

Table 1b. Tree Species Distribution and Diversity in Omi-Adio (Peri-Urban), Ibadan

S/N	Tree species	Family	Freq.	MHt	MDbh	B.A	Vol.	RD	RD_O	IVI
1	*Albizia lebbeck*	Fabaceae	2	14.0	34.6	0.30	4.23	1.98	1.64	1.81
2	*Astonia boonei*	Apocynaceae	1	21.0	22.9	0.38	7.97	0.99	2.06	1.52
3	*Azadirachta indica*	Meliaceae	11	8.6	38.8	0.47	4.05	10.89	2.55	6.72
4	*Cocos nucifera*	Arecaceae	6	11.1	38.6	0.28	3.16	5.94	1.54	3.74
5	*Elaeis guinensis*	Palmae	8	12.8	47.9	1.00	12.82	7.92	5.42	6.67
6	*Ficus exasperate*	Moraceae	3	11.2	59.8	0.86	9.66	2.97	4.67	3.82
7	*Gliricidia sepium*	Fabaceae	22	7.9	34.9	0.27	2.16	21.78	1.48	11.63
8	*Gmelina arborea*	Verbenaceae	5	18.0	82.8	3.66	65.97	4.95	19.85	12.40
9	*Khaya senegalensis*	Meliaceae	1	19.3	74.8	2.69	51.89	0.99	14.56	7.78
10	*Mangifera indica*	Anacardiaceae	1	14.4	46.9	0.78	11.22	0.99	4.22	2.61
11	*Militia thonningii*	Cactaceae	2	9.6	52.5	0.82	7.85	1.98	4.43	3.20
12	*Morinda lucida*	Rubiaceae	1	10.2	22.1	0.17	1.77	0.99	0.94	0.97
13	*Newbouldia laevis*	Bignoniaceae	1	16.0	67.4	2.90	46.33	0.99	15.69	8.34
14	*Senna siamea*	Mimosaceae	2	11.2	49.2	0.88	9.88	1.98	4.78	3.38
15	*Pycnanthus angolensis*	Myristiceae	7	7.1	43.8	0.42	2.96	6.93	2.26	4.60
16	*Ricinodendron heudelotii*	Euphorbiaceae	2	11.6	38.9	0.81	9.44	1.98	4.41	3.19
17	*Senna siamea*	Fabaceae	4	10.8	24.6	0.20	2.15	3.96	1.08	2.52
18	*Tectona grandis*	Lamiaceae	18	11.8	34.1	0.68	8.02	17.82	3.68	10.75
19	*Triplochiton scleroxylon*	Malvaceae	4	15.7	43.2	0.88	13.80	3.96	4.76	4.36
			101			18.5	275.3			

Freq – number of tree stems in the city, B.A. – Basal area of trees in the city, Vol. – Volume of trees in the city.

Demographic Characteristics of Respondents in Relation to Socio-Economic Livelihood in Ibadan

Demographic characteristics of respondents, gender, marital status, age, and educational attainment from urban forest were presented (Table 2). The result of gender reveal that male has the highest percentage ranging from (77.1 and 85.8%), compared to the percentage of female which ranges between (14.2 and 22.9%) within the study area. The percentage of those that are married ranges between 51.4 and 60.0%, while those that are single has 28.6 and 34.3% and

the widowed has the least percentage with 11.4 – 14.3 within urban and peri-urban respectively. The percentage age of respondents between the age of 21 - 30 ranges between 25.7 and 34.3%, those between the age of 31 - 40 has the highest percentage ranges between 37.1 and45.7% while those in their middle age between 41 - 50 has 5.7 and 28.6%. The elderly with age 51 - 60 has percentage ranging between 2.9 and 5.7% and aged above 60 years has 2.9 and 11.4% within the urban and peri-urban respectively. The percentage of respondents with no formal education ranges between 5.7 and 28.6%, those with primary education has percentage between 20.0 and 22.9%. Percentage of respondents with secondary education ranges between 37.1 and 40%, while those with tertiary education ranges between 14.3 and 31.4% within urban and peri-urban respectively. Percentage income generation with less than ₦10,000 has the highest 28.6 and 51.4% while respondents between ₦10,000 - ₦30,000 have 28.6 and 37.1%. Respondents with income generation between ₦31,000 - ₦50,000 has 11.4 and 14.3%, while those with income between ₦51,000 - ₦70,000 (5.7 and 11.4%). Percentage of respondents with income greater than ₦70,000 has 2.9 and 8.6% within urban and peri-urban sector respectively. This result shows that there is higher percentage of male respondents involved in urban forest than the female in both the urban and peri–urban section of the town. This means that more products will be sold and this support what Cunningham *et al*. (2008) [16] noted that male household heads generally have a tendency to sell more output than female household heads, irrespective of the type of crop. Majority of the respondents are between the ages of 30 – 50 which is an indication that they are within the active age of the life. These findings agree with the result of Adekunle and Agbaje (2012) [17] which reported that large population of active working age group in the society might lead to pressure on the forest resources. Higher percentage of respondents about 51% earned less than or ₦10,000 per month from the sale of fruits. This findings affirmed the general statement that a large number of Africans especially Nigerians are living below 1USD per day as reported by (Adekunle *et al*., 2013) [18]. This is an indication that majority of this people will depend on other sources of income to enhanced the life.

Relationship between the Income Generated and Demographic Variables

Table 3 shows the relationship between the level of income generation and demographic variables as indicated by the correlation coefficient values obtained. In this table there is high level of negative and insignificant correlation coefficient values which exist between almost all the demographic variables and the level of income obtained from urban forests. Marital status indicate positive value but not significant with correlation coefficient of 0.131. Highest correlation coefficient value (0.133) which was positive and insignificant was obtained between age of respondents and level of income generated from the study, while the least coefficient (-0.005) negative and insignificant was obtained between education status of respondents and the religion of respondents within urban and peri-urban forest. This result reveals that most respondents do not generate income from trees around their houses and within streets but derive other pleasures from urban forests. Kant (2003) [19] reported that ecosystem capital is valuable to human society not only for the products which may be thought of as commodities, that it contributes to the economic system but also for its functional contributions to the well-being of humanity.

Table 2. Demographic Information of Respondents in Ibadan (Urban and Peri-urban)

		Urban		Peri-Urban	
		Frequency	Percentage	Frequency	Percentage
Gender	Male	30	85.8	27	77.1
	Female	5	14.2	8	22.9
Marital status	Single	12	34.3	10	28.6
	Married	18	51.4	21	60.0
	Widowed	5	14.3	4	11.4
Age	21 – 30	9	25.7	12	34.3
	31 – 40	13	37.1	16	45.7
	41 – 50	10	28.6	2	5.7
	51 – 60	2	5.7	1	2.9
	>60	1	2.9	4	11.4
Education Status	No formal education	2	5.7	10	28.6
	Primary education	8	22.9	7	20.0
	Secondary education	14	40.0	13	37.1
	Tertiary education	11	31.4	5	14.3
Income Level	<10,000	18	51.4	10	28.6
	10,000 – 30,000	10	28.6	13	37.1
	31,000 – 50,000	4	11.4	5	14.3
	51,000 – 70,000	2	5.7	4	11.4
	>70,000	1	2.9	3	8.6

Table 3. Correlation Coefficient for Demographic Variables and Income Generation from Urban Forests

	Gender	Marital Status	Age	Religion	Educational Status	Income Level
Gender	1					
Marital Status	.131	1				
Age	-.026	-.445**	1			
Religion	-.256*	-.054	-.053	1		
Educational Status	-.098	-.248*	-.213	-.005	1	
Income Level	-.057	.054	.133	.024	.092	1

* means correlation is significant at the 0.05 level
** means correlation is significant at the 0.01 level

Table 4. Biodiversity indices and growth variables of tree species in Ibadan Metropolis

	Urban	**Peri-Urban**		**Urban**	**Peri-Urban**
Biodiversity Indices	**Values**	**Values**	**Tree Growth Variables**	**Values**	**Values**
No. of tree Species	54	19	No. of tree stem	155	101
No. of family	25	16	Mean Dbh (cm)	56.4	74.8
Shannon-Weiner Index (H')	3.35	2.48	Mean Height (m)	17.8	19.3
Pielou's Evenness Index (E_H)	0.84	0.84	Total basal area (m^2)	22.8	18.5
Maximum diversity index (H_{Max})	3.99	2.94	Total Volume (m^3)	284.8	275.3

6. Conclusions and Recommendation

The results of this research revealed the level of tree species diversity and population in Ibadan. The species diversity and abundance cannot be compared with some similar forest ecosystem in the tropical rainforest ecosystem. This city therefore needs improved conservation, management effort and intense research on biodiversity indicators in Nigerians city. Tree species with low richness and diversity should be considered as species that is about to extinct. Serious conservation effort should be geared for such species to prevent them from going to extinction. The result of this research will serve as baseline information and data that can be helpful in the appraisal and evaluation of plant resources within Ibadan as one of the tropical rainforest ecosystem city for its effective management. The continuous involvement of individuals, institutions, private organizations and non-governmental organization should be adequately rewarded to encourage them to do more in terms of tree planting in and around their buildings and the city. This study yields a list of species that contribute to the beautification of the streets, creates shades on the walk ways, protect houses and serve as avenues trees which tend to reduce harsh condition of the environment. The people should be educated and encouraged on the planting of exotic tree species which is fast growing. Seedlings should be made available for any individual or group of individuals that are interested in having trees around their houses or buildings as a form of encouragement.

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