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Professional paper

Mapping and Assessment of Ethno-Medicinal Trees in Built Up Areas - University of Port Harcourt, Nigeria

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Abstract

Background and Purpose: Several urban tree species are important in ethno-medicine, especially in the developing tropical regions. Their assessment in urban landscapes is becoming an important issue. The study assessed and mapped the ethno-medicinal trees in the built up area land use type of the University of Port Harcourt, Nigeria, with a view to examining their spatial variation in terms of composition and diversity between the residential and non-residential areas of the University Park.
Materials and Methods: The study employed the use of geographic information system (ArcGIS 9.3) for the mapping. Built up area land use was subdivided into residential and non-residential where the ethno-medicinal trees were recorded, identified and enumerated. Global positioning system was used to determine the coordinates of each tree. The species composition and diversity were calculated and a comparison was made between the residential and non-residential land use types. The pattern of spread of the ethno-medicinal trees was determined by the nearest neighbour analysis.
Results: A total of 37 ethno-medicinal trees species were found in the study area, while the species composition was 499 in the residential area and 438 in the non-residential area. *Azadirachta indica* was the highest (233) in composition. Ethno-medicinal tree species in the study area consist of 19 families of which Anacardiaceae, Rutaceae, Moraceae and Combretaceae were the highest. Species diversity was higher in the non-residential land use (2.698) than in the residential land use (2.222).
Conclusion: The nearest neighbour analysis reveals that the z-score value was higher in the non-residential area (-23.06) than in the residential area (-0.30), but the pattern of distribution in both areas were clustered. The study recommended periodic monitoring and the assessment of ethno-medicinal trees in the study area for conservation purposes.

Keywords: geographic information systems, nearest neighbour analysis, urban forestry, species diversity, species richness, species evenness

INTRODUCTION

The assessment of ethno-medicinal plants in urban landscapes is becoming an important issue, especially in the developing world, where many of these plant species are being used as avenue [1] and ornamental trees. Urban forestry integrating ethno-medicinal plants is particularly beneficial to mankind and its importance cannot be underestimated, especially in this era, when the developing countries are witnessing tremendous changes [2, 3]. However, Ajewole [4] explained that urban forestry is a planned, integrated and systematic approach to the management of trees and woodland/forest resources in urban and peri-urban areas for their contributions to the physiological, sociological, psychological and economic well-being of the urban society.

Since the first earth summit in Rio de Janeiro, there has been a sustained global awareness of the importance of the superfluity of biodiversity and natural resources from tropical forests for several purposes, which included the potent ethno-botanical uses of the plants in these forests [5]. World Health Organization (WHO) [6] reported that about 80% of the population in the developing countries depends on medicinal plants in the treatment of diseases, and that medicinal plants represented a primary health source for the pharmaceutical industry. Hence, WHO produced guidelines for the global use of traditional medicine. According to Dambatta and Aliyu [7], the use of herbal medicine in Nigeria represents a long history of human interaction with the environment, and the plants used in traditional medicine contain a wide range of substances that can be used to treat chronic as well as infectious diseases. Nwauzoma and Dappa [8] noted that herbal or traditional medicine has been a major aspect of the socio-cultural heritage in Africa for hundreds of years even before the advent of conventional medicine. In addition, Wahab *et al.* [9] reported that the use of medicinal plants as a source of relief from illness is as old as mankind. As a result, the ethno-medicinal plants require adequate and periodic monitoring and assessment which can help to understand their structures (the diameter at breast height - dbh, species composition, tree height, crown spread, biomass and tree location) [10] and aid their environmental sustainability for use and human survival in such societies.

The application of geographic information system (GIS) in phenomenon location has been well spelt in various spatial-related studies and this can be extended to urban forestry. According to Wood [11], GIS in urban forestry has long been recognized as a useful tool in the management of natural resource development, land use planning, wildlife management, environmental planning and forestry planning. Miller [12] also noted that urban tree mapping and inventories are key areas that can be greatly enhanced by GIS. GIS is therefore a tool that gives urban foresters and planners the ability to manage and predict the future growth of the urban forests in a better way [11, 13].

There are several studies on ethno-medicinal trees in Nigeria [8, 9, 14-16]. The majority of these studies used a questionnaire to carry out the inventory on ethno-medicinal trees. The inventories were not carried out within an institution, except in the work of Jimoh *et al.* [17] in the University of Agriculture Campus, Makurdi, Nigeria. The mapping of ethno-medicinal trees with the use of geo-information technologies such as GIS in natural forest and agro-ecosystem was carried out in Pakistan and Spain [18, 19], but such work is rare, especially in institutional-based environment, such as universities, research Institutes and teaching hospitals globally. This study therefore focused on mapping and assessing the ethno-medicinal trees within the University Park of the University of Port-Harcourt with a view to examining their spatial variation in terms of composition and diversity between the residential and non-residential areas of the Park.

MATERIALS AND METHODS

Study Area

The research was conducted in the University Park, University of Port Harcourt, Port Harcourt, Nigeria. Covering the total area of 461 ha the University Park extends from 04º52'30" to

04º55’00” north latitude and from 06º54’40” to 06º55’40” east longitude (Figure 1). Port Harcourt is situated in subequatorial region. A moist south-west wind and northeast trade winds are responsible for the variations in weather conditions experienced in Port Harcourt City. The moist south-east air stream blows over the region between February and November and the region receives its rains, while the northeast trade wind blows over Port Harcourt in from November up to February, which ushers in the dry season. Port Harcourt records a mean annual temperature of 28°C; relative humidity is generally high over Port Harcourt with a mean annual figure of 85%. The peak of rainy season usually occurs from June to October, with the total annual rainfall of more than 2500 mm. The soil of Port Harcourt city is of the recent alluvial soil. Port Harcourt is dominated by low-lying coastal plains which structurally belong to the sedimentary formation of recent Niger delta, with an elevation less than 15.24 m.

Land Use Map Generation

SPOT imagery of the study area of 2.5 m x 2.5 m spatial resolution was acquired from Google Earth, 2013 version to generate the land use map. The imagery was geo-referenced in ArcGIS 9.3 to world geographic coordinate system (WGS 84). Land use types were captured in polygons from which built up area land use was dissolved. The built up area land use for this study was further subdivided into the residential area and the non-residential area.

Tree Mapping Generation

The coordinates (i.e. latitudes and longitudes) of all ethno-medicinal trees in the built up area of the University Park were recorded by global positioning system (GPS) of Garmin eTrex 30 with the precision level of ±7 m. An experienced traditional healer was assisted in identifying the ethno-medicinal uses of the recorded tree species. Tree specimens were collected, identified, pressed and deposited in the herbarium

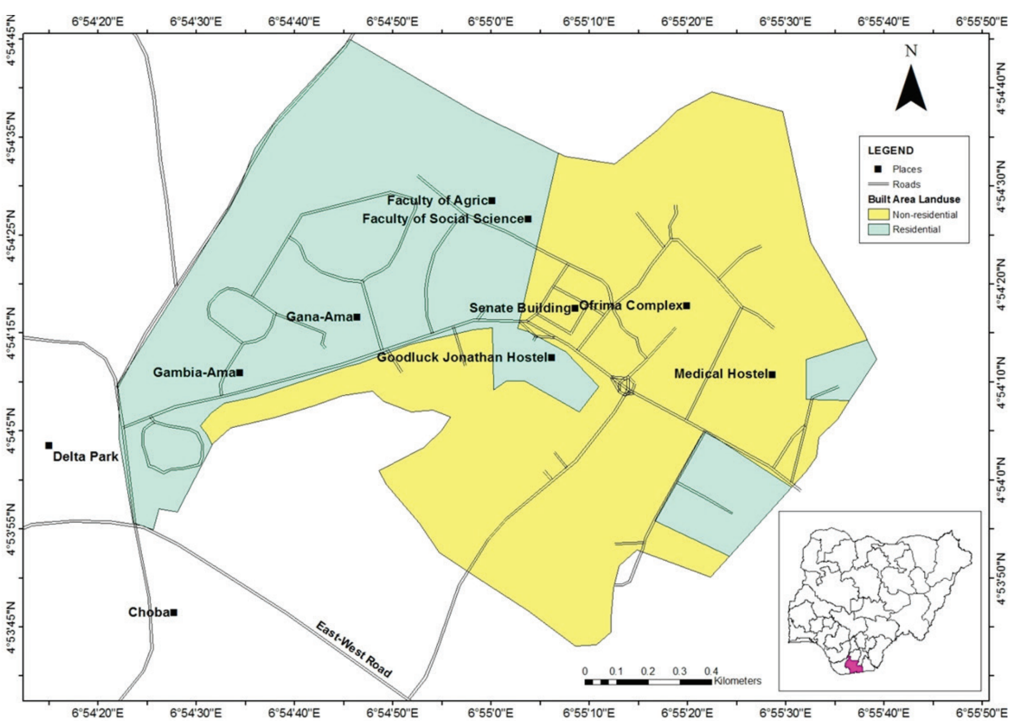

FIGURE 1. Map of University Park, University of Port Harcourt

of the Department of Forestry and Wildlife Management, University of Port Harcourt, for referencing. The recorded coordinates were imported to ArcGIS 9.3 for mapping.

The Determination of Ethno-Medicinal Tree Diversity, Richness and Evenness

Tree species diversity index (H') was computed using Shannon and Wiener's diversity index, a commonly used index in the literature on biological diversity and ecological monitoring [20, 21]:

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

where: *pi* is the proportion of individuals belonging to the *i*-th species calculated as pi = S/N; ln is logarithms (base e), S is the number of individuals of one species, and N is the total number of all individuals in the sample.

The species richness was determined using Margalef's index [22] expressed as:

$$D_{mg} = S\text{-}1/\ln N$$

where: D_{mg} is Margalef's index, S is the number of species, N is the total number of individuals encountered, and ln is the natural logarithm (base e).

Species evenness of ethno-medicinal trees was calculated using Pieolu's index [23] modified by Magurran [24]:

$$E' = H'/\ln S$$

where: H' is the Shannon-Wiener diversity index and S is the number of species. E' is constrained between 0 and 1.

Statistical Analysis

Descriptive analysis was used to describe the composition and diversity in both residential and non-residential areas of the built up areas. The nearest neighbour analysis was used to determine and compare the pattern of distribution of ethno-medicinal trees in both residential and non-residential land use types using the z-score value. This analysis was performed in ArcGIS 9.3 version.

RESULTS

Species Composition of Ethno-Medicinal Trees

The species composition of ethno-medicinal trees in the residential and non-residential areas of the built up area land use is shown in Table 1. A total of 37 tree species of ethno-medicinal importance were found in the study area. However, the total frequencies of ethno-medicinal trees were 936 of which 499 were in residential and 437 in non-residential areas. Margalef's index showed the ethno-medicinal tree species richness in residential and non-residential areas of the built up areas in the University Park as 4.0240 and 4.6035 respectively (Table 2). According to the results of the family diversity of ethno-medicinal tree species in the study area (Figure 2), Combretaceae, Anacardiaceae, Caesalpinaceae, Moraceae and Rutaceae families had the highest occurrence of four ethno-medicinal tree species, each in the University Park built up areas. Species representing the four (4) families above possess the ability to perform dual functions of local medicines and edible fruit or shade provision, and therefore they are planted or protected in the built up areas of the university.

Species Diversity of Ethno-Medicinal Trees in the Residential Areas (RAs) and Non-Residental areas (NRAs)

Species diversity of ethno medicinal trees in the study area is shown in Table 3. Ethno-medicinal tree species were more diversified in NRA (2.6981) than RAs (2.222) due to the fact that NRAs mostly include ornamental trees which may not be given priority in the RAs. Plants used for medicine and food are usually cultivated in home gardens.

Spatial Distribution of Ethno-Medicinal Trees

Spatial distribution of ethno-medicinal trees (Figure 3) revealed that most of the ethno-medicinal trees were found along the roads within the University Park, especially *Azadirachta indica* A.Juss, which was prominent along the

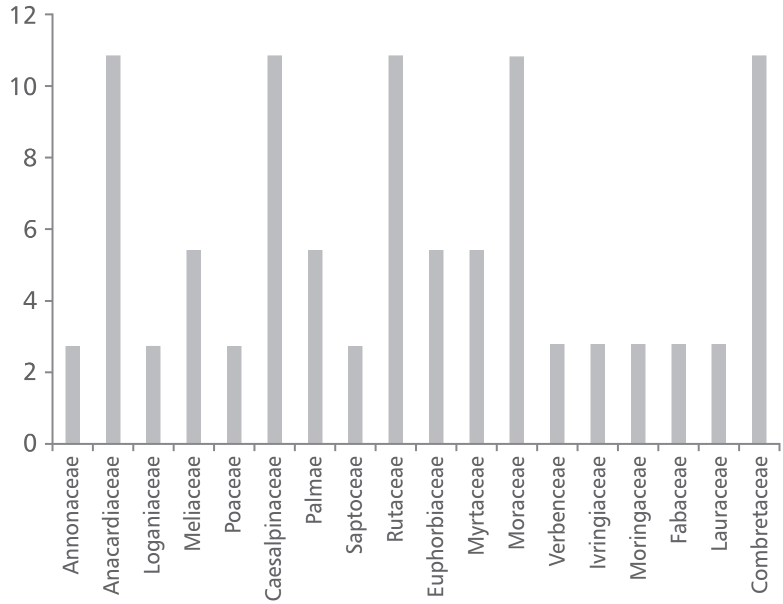

FIGURE 2. Diversity of ethno-medicinal trees in built up areas of University Park, University of Port Harcourt, Nigeria

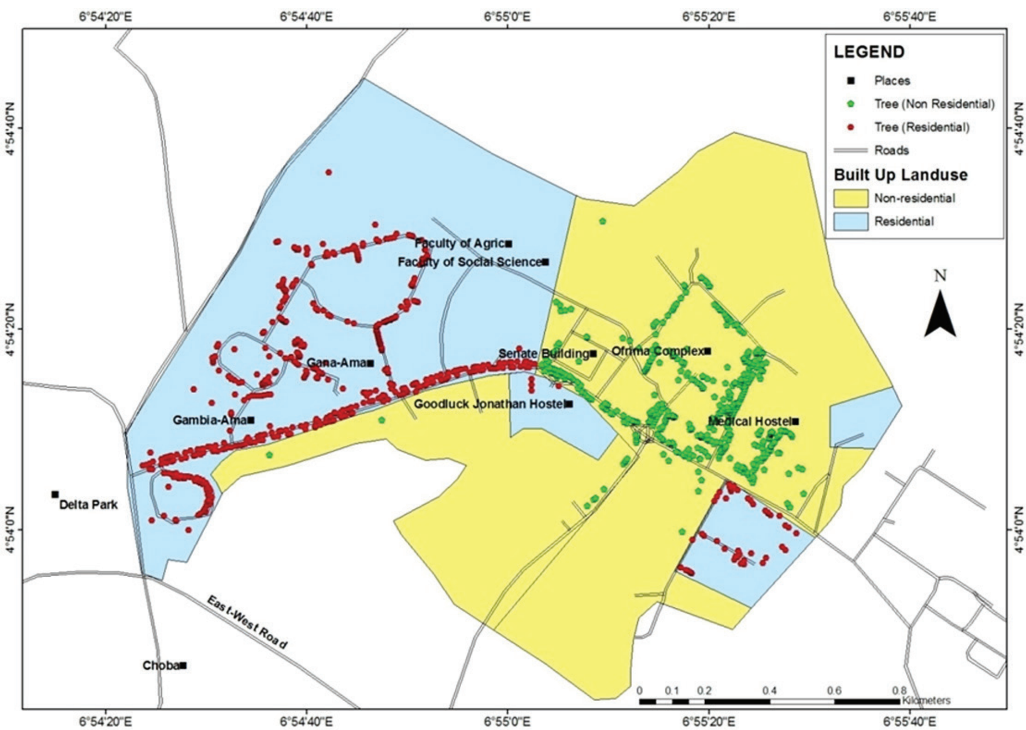

FIGURE 3. Distribution of ethno-medicinal trees in residential and non-residential area

TABLE 1. Species composition and richness of ethno-medicinal tree

S/N	Species	Common name	Local medicinal uses	RA	NRA
1	*Annona muricata* L. (Annonaceae)	Sour sop	Leaves used to lessen effect of cancer, fruits eaten as snacks	0	2
2	*Anacardium occidentale* L. (Anacardiaceae)	Cashew	Diarrhea, diabetes, fruits eaten as snacks	19	14
3	*Anthocleista vogelii* Planchon. (Loganiaceae)	Cabbage tree	Root used to treat gonorrhea	1	0
4	*Azadirachta indica* A.Juss (Meliaceae)	Neem tree	Decoction of leaves and stem barks as antimalarial	172	61
5	*Bambussa vulgaris* Schrader ex Wendl. (Gramineae)	Bamboo	Abortifacents, leaves used as male contraceptives	2	0
6	*Bauhinia tomentosa*L. (Caesalpinaceae)	Yellow Bauhinia	Diarrhea, dysentery and diabetes	1	0
7	*Borassus aethiopicum* Mart. (Palmae)	African fan palm	Aphrodisiac, boiled tender roots as snacks and condiments	3	12
8	*Chrysophyllum albidum* L. (Sapotaceae)	Cherry/African star apple	Fruits as snacks	2	9
9	*Citrus limon* (L.) Burm.f. (Rutaceae)	Lemon	Fruits and leaves used for cough and malaria	7	3
10	*Citrus reticulata* Blanco (Rutaceae)	Tangerine	Fruits and leaves used for cough and malaria	1	0
11	*Citrus sinensis* (L) Osbeck (Rutaceae)	Sweet orange	Leaves used for cough, ringworm and malaria	25	19
12	*Citrus paradisi* Macfad. (Rutaceae)	Grape fruit	Fruits and leaves used for cough and malaria	0	5
13	*Crotom zambesicus* Mull-Arg. (Euphorbiaceae)	Bushveld	Root as antidiabetic and antimalarial	1	13
14	*Delonix regia* (Boj. Ex Hook) Raf.(Papilionaceae)	Flame of the forest	Anthelminthic/ornamental	17	14
15	*Elaeis guineensis* Jacq. (Palmae)	Oil Palm tree	Malaria, fruits used for palm oil	79	88
16	*Eucalyptus camaldulensis* Dehnh (Myrtaceae)	Eucalyptus	Sore throat	34	27
17	*Ficus exasperata* Vahl. (Moraceae)	Sand paper tree	Wound healing	1	0
18	*Ficus mucoso* Welw. (Moraceae)	Fig tree	Snake bite	0	2
19	*Ficus sur* Forssk. (Moraceae)	Wild fig	Wound healing	0	1
20	*Gmelina arborea* L. Roxb. (Verbanaceae)	Gmelina	Wound healing	10	8
21	*Hura crepitans* L. (Euphorbiaceae)	Sandbox tree	Purgatives	12	32
22	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. (Irvingaceae)	Wild mango	Food condiment	2	0
23	*Mangifera indica* L. (Anacardiaceae)	Mango	Leaves and stem bark as antimalarial	60	45
24	*Milicia excelsa* (Welw.) CC Berg (Moraceae)	Iroko	Malaria, body pain and antiaging	0	4

TABLE 1. Species composition and richness of ethno-medicinal tree - continuation

S/N	Species	Common name	Local medicinal uses	RA	NRA
25	*Moringa olivera* Lam. (Moringaceae)	Moringa, miracle tree	Diabetes and hypertension	1	0
26	*Musanga cecropioides* R.Br. ex Tedlie (Cecropiaceae)	Umbrella tree	Stomach ache, hypertension	1	0
26	*Peltophorum pterocarpum* (DC.) Backer ex Heyne (Fabaceae - Calsalpinaceae)	Copperpod	Leaves used to treat pain at child birth	0	2
28	*Persia americana* Mill. (Lauraceae)	Avocado pear	Hypertension	1	7
29	*Psidium guajava* L. (Myrtaceae)	Guava	Leaves used as antimalarial	8	28
30	*Spondias mombin* L. (Anacardiaceae)	Hug plum	Chest pain, antiaging	1	1
31	*Spondias cytherea* L. (Anacardiaceae)	Golden apple	Antiaging	0	2
32	*Senna fistula* L. (Caesalpinaceae)	Indian laburnum	Skin infections and laxatives	0	4
33	*Senna* spp. (Caesalpinaceae)	-	Laxatives	0	1
34	*Terminalia superba* Engl. & Diels (Combretaceae)	Limba, Afara	Stem bark used for treatment of malaria	0	1
35	*Terminalia mantaly* H. Perrier (Combretaceae)	Button tree	Ornamental	8	1
36	*Terminalia catappa* L. (Combretaceae)	Almond fruit	Fruits edible and leaves boiled for malaria	30	30
37	*Terminalia ivorensis* A. Chev. (Combretaceae)	Black afara	Stem bark used for treatment of malaria	0	2
	Total			**499**	**438**

RA - residential area; NRA - non-residential area
Source: Field survey, 2014

TABLE 2. Species richness of ethno-medicinal trees (Margalef's index - D_{mg})

Land use type	S	S-1	N	lnN	D_{mg}=(S-1)/lnN
Residential area	26	25	499	6.2126	4.0240
Non-residential area	29	28	438	6.0822	4.6035

S - number of species; N - total number of individuals encountered; ln - natural logarithms (base e); D_{mg} - Margalef's index
Source: Field survey, 2014

major roads from Delta Park entrance to the University Teaching Hospital (UPTH) road. *A. indica* was used as an avenue tree in the study area, while *Mangifera indica* L. was prominent within the residential area. *Terminalia catappa* L. spread across the two areas because of its role in shade provision during hot weather, while *Psidium guajava* L. was more frequent in the non-residential area.

The Nearest Neighbour Analysis

The pattern of spread of ethno-medicinal trees through the use of the nearest neighbour analysis is shown in Table 4. The nearest neighbour

TABLE 3. Species diversity (Shannon and Wiener's diversity index) of ethno-medicinal tree in University of Port Harcourt, Nigeria

	Species	Residential area				Non-residential area			
		S	pi	ln pi	pi ln(pi)	S	pi	ln pi	pi ln(pi)
1	*Annona muricata*	0	0	0	0	2	0.0045	-5.4036	-0.0243
2	*Anacardium occidentale*	19	0.0380	-3.2701	-0.1242	14	0.0319	-3.4451	-0.1098
3	*Anthocleista vogelii*	1	0.0020	-6.2146	-0.0124	0	0	0	0
4	*Azadirachta indica*	172	0.3446	-0.0653	-0.3671	61	0.1392	-1.9718	-0.2744
5	*Bambussa vulgaris*	2	0.0040	-5.5214	-0.0220	0	0	0	0
6	*Bauhinia tomentosa*	1	0.0020	-6.2146	-0.0124	0	0	0	0
7	*Borassus aethiopum*	3	0.0060	-5.1159	-0.0306	12	0.0273	-3.6008	-0.0983
8	*Chrysophyllum albidum*	2	0.0040	-5.5214	-0.0220	9	0.0205	-3.8873	-0.0796
9	*Citrus limon*	7	0.0140	-4.2686	-0.0597	3	0.0068	-4.9908	-0.0339
10	*Citrus reticulata*	1	0.0020	-6.2146	-0.0124	0	0	0	0
11	*Citrus sinensis*	25	0.0501	-2.9937	-0.1499	19	0.0433	-3.1396	-0.1359
12	*Citrus paradisi*	0	0	0	0	5	0.0114	-4.4741	-0.0510
13	*Croton zambesicus*	1	0.0020	-6.2146	-0.0124	13	0.0296	-3.5199	-0.1041
14	*Delonixregia*	17	0.0340	-3.3813	-0.1149	14	0.0319	-3.4451	-0.1098
15	*Elaeis guineensis*	79	0.1583	-1.8432	-0.2917	88	0.2009	-1.6049	-0.3224
16	*Eucalyptus camaldulensis*	34	0.0681	-2.6867	-0.1829	27	0.0616	-2.7870	-0.1716
17	*Ficus exasperata*	1	0.0020	-6.2146	-0.0124	0	0	0	0
18	*Ficus mucoso*	0	0	0	0	2	0.0045	-5.4036	-0.0243
19	*Ficus sur*	0	0	0	0	1	0.0022	-6.1192	-0.0134
20	*Gmelina arborea*	10	0.0200	-3.9120	-0.0782	8	0.0182	-4.0063	-0.0792
21	*Hura crepitans*	12	0.0240	-3.7297	-0.0895	32	0.0730	-2.6172	-0.1910
22	*Irvingia gabonensis*	2	0.0040	-5.5214	-0.0220	0	0	0	0
23	*Mangifera indica*	60	0.1202	-2.1185	-0.2546	45	0.1027	-2.2759	-0.2337
24	*Milicia excelsa*	0	0	0	0	4	0.0091	-4.6994	-0.0427
25	*Moringa oleivera*	1	0.0020	-6.2146	-0.0124	0	0	0	0
26	*Musanga cecropioides*	1	0.0020	-6.2146	-0.0124	0	0	0	0
26	*Peltrophorum pterocarpum*	0	0	0	0	2	0.0045	-5.4036	-0.0243
28	*Persia americana*	1	0.0020	-6.2146	-0.0124	7	0.0159	-4.1414	-0.0658
29	*Psidium guajava*	8	0.0160	-4.1351	-0.0661	28	0.0639	-2.7504	-0.1757
30	*Spondias mombin*	1	0.0020	-6.2146	-0.0124	1	0.0022	-6.1192	-0.0134
31	*Spondias cytherea*	0	0	0	0	2	0.0045	-5.4036	-0.0243
32	*Senna fistula*	0	0	0	0	4	0.0091	-4.6994	-0.0427
33	*Senna* spp.	0	0	0	0	1	0.0022	-6.1192	-0.0134
34	*Terminalia superba*	0	0	0	0	1	0.0022	-6.1192	-0.0134
35	*Terminalia mantaly*	8	0.0160	-4.1351	-0.0661	1	0.0022	-6.1192	-0.0134
36	*Terminalia catappa*	30	0.0601	-2.8117	-0.1689	30	0.0684	-2.6823	-0.1834
37	*Terminalia ivorensis*	0	0	0	0	2	0.0045	-5.4036	-0.0243
	Total	**499**			**2.2220**	**438**			**2.6981**

S - number of individuals; pi - proportion of individuals belonging to the i-th species calculated as pi = S/N; N - total number of all individuals in the sample; ln - natural logarithms (base e)
Source: Field Data analysis, 2014

TABLE 4. Nearest neighbour analysis

Land use	Nearest neighbour ratio	z score	Decision
Residential area	0.30	-0.30	Clustered
Non-residential area	0.42	-23.06	Clustered

Source: Field Data analysis, 2014

ratios of ethno-medicinal trees were 0.30 and 0.42 in the residential and non-residential area respectively.

The z-score revealed standard deviation of -0.30 in the residential land use type and -23.06 in the non-residential land use type. It may be inferred that the distribution pattern of ethno-medicinal trees in both residential and non-residential land use was clustered. This analysis shows the plants' locations in Figure 3, while the pattern may be due to the same environmental quality functions (avenue and shading functions) of the ethno-medicinal trees.

DISCUSSION

Different land use forms have a significant effect on the species composition and diversity of flora resources of an ecosystem. The results from the study indicate high species diversity for the two land use forms with remarkable differences in the composition. Barbour *et al.* [25] noted that a large index value indicates greater species diversity; an index value above 2 is regarded as medium to high species diversity. Ethno-medicinal tree species diversity in the built up areas (RAs – 2.22 and NRAs – 2.69) are higher than 2 in the University Park, the University of Port Harcourt. It can then be rationally regarded high. Higher species composition of ethno medicinal tress in the RAs (499) may be due to the conservation measures of the residents by the cultivation and protecting of the trees. Larinde and Oladele [26] reported that the residents of the University of Port Harcourt plant and protect medicinal and fruit bearing trees in their homesteads. The culture of conserving frequently used medicinal plants in home gardens and traditional healers' premises were equally observed in south western Nigeria [27] in similar studies. Commonly used plant species are cultivated around residential areas for easy access and utilization. *A. indica* (172) and *M. indica* (60) are frequently employed in the treatment of malaria in tropical West Africa; this may be associated with the abundance of the two tree species in the RAs, since malaria has been reported to be the most prevailing disease among the poor population of the developing countries in West Africa [28]. *A. indica* contained Gedunin (seed oil), Nimbolide (leaves) and Azadirachtin (stem bark) as the active chemical compounds that inhibit the effect of malaria parasite *Plasmodium berghei. M. indica* contained1,2-benzenedicarboxylic acid that has antimalarial properties [29-31], and therefore they are planted in the RAs to meet the local needs as an antimalarial among the low income earners. Of the 499 plant population recorded in the RAs, ethno-medicinal tree species such *as Elais guineensis* Jacq. (79), *M. indica* (60), *Citrus spp.* (33), *T. catappa* (30) and *Anacardium occidentale* L. (19) have multiple uses: in the local medicine, in food provision, in generating additional household cash income and in providing environmental services. Dau and Elisha [32] noted the species abundance of plants with multiple usages in farmlands among farmers in Bauchi state of Nigeria. Abundant species in the NRAs comprise of ornamental and shade providing plants, and the species with massive branching habits observed in the survey include *Hura crepitans* L. (32), *M. indica* (45), *P. guajava* (28), *T. catappa* (30), *Delonix regia* (Boj. ex Hook.) Raf. (14), *A. occidentale* (14), *Crotom zambesicus* Müll.-Arg. (13) and *Terminalia mantaly* H.Perrier (8). Besides the beautification of the university landscape, shade provision is an essential service provided by the trees during hot tropical weather. People enjoy the cool breeze from the trees in sunny days to ease the tension, while the students are usually clustered around the trees for relaxation during extreme hot weather periods for stress relief. There are a lot of references on positive psychological and physiological effects of urban forests such as the stress reduction, and anxiety and depression management [33, 34].

An adequate understanding of the ecological indices of an ecosystem could provide better management approach for sustainable utilization of tree resources, especially in urban centres. Also, species diversity in a land use form determines the functioning of such area; RAs in the study is richer than NRAs in composition as a result of the functions thereof due to its ability to support livelihood and traditional healthcare. However, the tree diversity in NRAs possesses the potential for ecological restoration, unlike the RAs in the study. The z-score of the nearest neighbour analysis revealed a clustered arrangement of ethno-medicinal trees in the study. This is an indication that the trees were purposely arranged to satisfy a dual function of shade or fruits bearing and of landscape beautification, and therefore they are located close to buildings or as avenue trees, as revealed in Figure 3. The collection of plant parts for local medicine is usually done without permission from the university management, while stem barks and leaves are in most cases harvested indiscriminately without recourse to the survival of the plants. The total and unsustainable removal of *A. indica* and *M. indica* stem barks around the breast height have sometimes resulted in the death of many stands of these species.

CONCLUSION

Changes in land use/cover have a direct impact on ecosystem services in many ways, such as on the flora and fauna diversity, the products and services for human survival and the environmental balance. This study has confirmed the capacity of GIS to map ethno-medicinal trees. The species composition was higher in the residential area, while the species diversity was higher in the non-residential area. It is therefore recommended that there is need for periodic monitoring and assessment of ethno-medicinal trees in the study area for effective management and sustainable utilization. The monitoring should include other land use along with a public awareness campaign and the training of the residents on conservation measures for adequate knowledge of ethno-medicinal trees conservation. The training on the identification of ethno-medicinal trees, and the deliberate planting of other ethno-medicinal plants should be encouraged and the existing ones should be maintained by agencies concerned.

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