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Composition and Status of Urban Forest Ecosystem in Benin Metropolis, Nigeria

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ABSTRACT

Urban forests are unique features of the environment making them part of green infrastructure in cities and is fast gaining prominence in developing African countries. Assessing urban forests structure is essential for planning and can contribute to sustainable development. However, current information on the status of urban forests which are planning and monitoring toolsare either not available or the available ones are out-dated.This study used a mixed approach involving aerial and field survey to document current information on the status of the urban forests, using Benin Metropolis of Nigeria as a case study. Urban forests and green areas were extracted from 2-years (1988 and 2018) Landsat imageries and unsupervised classification using the *Iterative Self-Organizing Data Analysis (ISODATA) Technique*. Additionally, species composition and plant diversitywere assessed. From findings, Benin Metropolis has over 90 different species belonging to 39 families. The minimum diversity criteria were met on analysis of the diversity of this population. Unfortunately, in 30-years (1988 - 2018), the Metropolis had increased in area extent from 93km^2 to 200km^2, whereas, vegetated areas reduced significantly by 60% between 1988-2018. Notably,the extent of urban forests loss implies a compromised ecosystem and biodiversity. This information may be used to sensitize decision makers and city planners on the need for formulation and implementation of policies that could enhance adoption of urban tree planting and conservation of urban forest in cities in Nigeria, and elsewhere.

Keywords: Species diversity, sustainable development, tree species, urban forests

Introduction

Urban forests include all naturally occurring or introduced trees in urbanized societies (Baur *et al*., 2016). Specifically, the urban forests may consist of different tree species (Figure 1) on avenues, roads, informal green spaces, free zones, residences *inter alia* (Wolf and Kruger, 2010). In fact, the forests are unique features of the environment making them part of green infrastructures in cities and is fast gaining prominence globally. For instance, the global sustainable development goals, particularly goals 11 (sustainable cities and communities), 13 (climate action) and 15 (life on land) highlights the importance of the urban forests in improving the liveability of urban communities, improving human health, encouraging communal cohesion and ensuring sustainable development worldwide. This is owing to the ability of urban forests to contribute to climate change processes and ensuring access to safe green areas by 2030.Moreover, urban forests when properly managed can improve the living conditions in urban communities through their important role in delivering multiple benefits and services. For instance, urban forests provide provisioning, socio, cultural and health benefits that are relevant to city dwellers. Most importantly, urban forests provide regulating and/or environmental services such as climate and/or temperature modification, carbon storage, acting as air filters, lowering noise impacts, reducing rainfall run off and the risks of flooding and erosion, improving the aesthetic appeal of urban landscapes, amongst others (Nowak, 2016; Arabomen *et al*., 2019). Notably, more cities are moving towards becoming eco-cities, cities where the inhabitants are aware of the benefits of the urban forests and the importance of protecting their forests.

Unfortunately, despite the importance of the urban forests and their services, global forests in cities continue to decline at an alarming rate from rapid unplanned urban sprawl and population increase. For instance, the United Nations reported that urban population accounted for 54% of the total world's population in 2014, and this growth is expected to continue in coming decades (United Nations, 2018). In Nigeria, from a population of less than 6 million in the 60s' the urban dwellers came to about 19 million in the 80s' and to over 100 million in 2016. In Benin City, built up areas have increased in size and complexity over time (Eseigbe and Ojeifo, 2007). Benin metropolis is expanding into the fringe interface from core areas thereby increasing the land areas occupied by settlements. This upsurge in population puts extreme pressure on the urban forests and has led to loss of trees for urbanization in many urban development projects including expansion and construction of roads, estate development, infrastructure and amenities, and other land allocation priorities. The result is negative effect on tree abundance, its services and overall environmental conservation (Raji and Babalola, 2018).

Although, timely detection of changes in urban forests structure are essential for planning, especially where such changes are negative, however, current and up-to-date information which are planning and monitoring tools are not available, or the available ones are outdated. Conversely, literature methodically analyzed a model for assessing urban forests structure (Clark and Matheny, 1998). This model consists of a major criteria of vegetation component with specific indicators used for measuring the progress over time. The model is region independent and quantitatively based such that it can be adopted and applied in many developing African cities. Thus, the conceptual framework of this study operates on the premise that achieving sustainable development of urban forests requires healthy tree resource and quality care. Therefore, this study employed an integrated approach of aerial and field survey to assess the status of the urban forests in developing countries, using Benin metropolis in Nigeria as a case study. Specific objectives were to (1) examine the abundance and diversity of the urban forest species (2) investigate the changes in vegetated areas for the period of 1988 and 2018. It is envisaged that findings from this study may be used to sensitize forest managers, city planners and policy makers towards monitoring of urban areas, and future development of cities in Nigeria, and elsewhere.

Figure 1: Tree species on different land use zones in Benin Metropolis

Methodology

Study area

Benin metropolis is in the Southern region of Nigeria. It is the 4th largest metropolitan area in the country with an estimated 1 495 800 inhabitants in a land area of 1 204km² (Eseigbe and Ojeifo, 2007). The geographical coordinate is located at approximately Latitudes 6°10' and 6°30'N and Longitude 5°30' and 5°45'E. The average daily temperature is about 25°C. The metropolis has two seasons: a rainy period from March to October and a dry (harmattan) season from November to February (Eseigbe and Ojeifo, 2007). The predominant vegetation is the moist deciduous forest that is composed of indigenous and exotic trees. The metropolis is recognized for its biological importance owing to a diverse and rich flora in areas such as botanical gardens, streets or avenues, public open spaces, roadsides, institutions and residences (Eseigbe and Ojeifo, 2007).The boundary for this study was extracted from Google Earth satellite imagery of Benin metropolis for 2016 (Figure 2). This was digitized in the Quantum Geographic Information System (QGIS 2.18) to produce the shape files and composite image of built-up areas in the core and fringe of the LGAs (Nowak *et al.*, 2014; Aladesanmi *et al.*, 2017; Balogun and Onokerhoraye, 2017).

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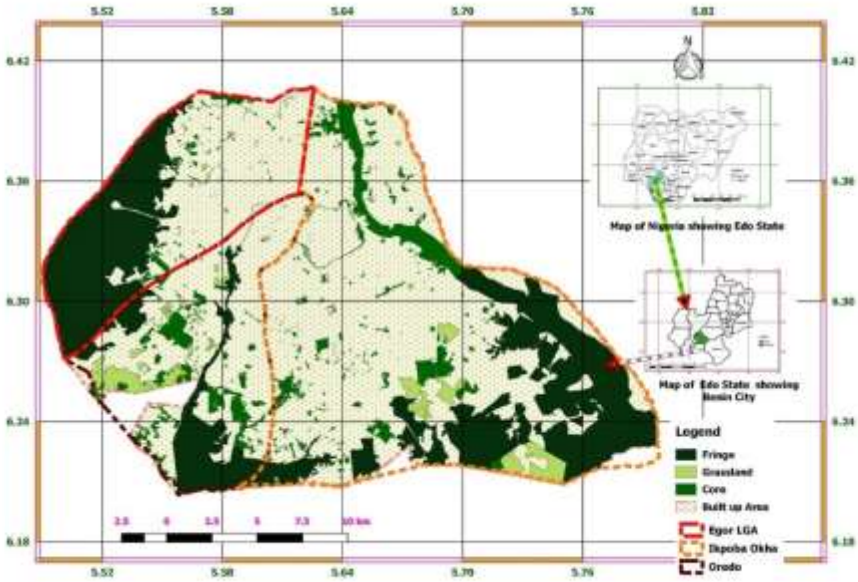

Figure 2 Schematic of Benin metropolis showing the LGs, core and fringe areas

Geospatial Survey and Analysis

Requisite data included:

Image acquisition: Two years (1988 and 2018) Landsat imageries were downloaded from the United States Geologic Survey (USGS) archive. Both images were of the same season and the best available scene taken from path 190 and row 55 of the World Referencing System.

Image subsetting: This was done to reduce the size of the Landsat images to the area needed for the study, in ArcMap 10.6 software. The shapefile of Benin metropolis covering approximately 27 000 ha was digitized on a map, and georeferenced to have the same geographic projection as the Landsat images and to ensure a perfect overlap (Adeyemi, 2017).

Image classification: This was done using the unsupervised Iterative Self- Organizing Data (ISODATA) technique. This method was used to ensure that the classes relevant to the study were adequately represented. Hence, two classes were delineated to represent built-up/settlements and vegetated/undisturbed areas. Both classes conform to the USGS classification system. Furthermore, ***change detection analysis*** was done to quantify the changes between images of the same area at a different period in accordance with Hegazy and Kaloop, 2015.

Tree Survey and Analysis

Administratively, Benin metropolis has three (3) Local Government Areas (LGAs) and thirty-nine (39) districts with 10, 11 and 18 districts respectively in each LGA. Multistage sampling was usedto obtain primary data needed. The LGAs (Egor, Ikpoba-Okha and Oredo) was the first stage. The second stage werethe districts. The third stage was the core and fringe areas. Tree survey was conducted in twenty-seven (27) selected sites, representing 70% of the total number of districts and nine (9) in each Local Government Area (LGA) in Benin metropolis (see Figure 3).

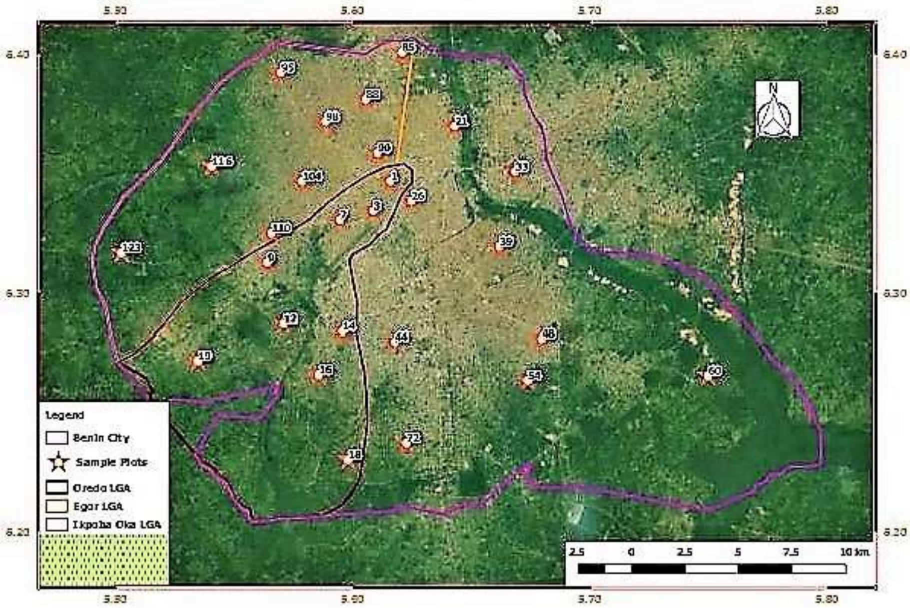

Figure 3 Selected sample plots in core and fringe areas of Benin City

The survey was conducted between June and November 2017. A standard transect line method was adopted for identification of tree species in the selected areas (Nowak *et al*., 2014; Uka and Belford, 2016; Aladesanmi *et al*., 2017). The transect line of 100m was made using a nylon rope marked and numbered at 5m intervals; then all trees with diameter at breast height ≥ 10 cm and within birds' eye view (in terms of closeness and accessibility) located on either side of the transect were identified to species level using the taxonomic keys of Flora of West Tropical Africa. The number of same tree species per site were obtained from the total number of the entire tree species recorded in the 2 x 100m transect line. In total, 27km^2 were surveyed, that is about 5% of the total urban area coverage (2018) in Benin metropolis. Each sampled area contains its coordinates. The coordinates were entered in the Garmin etrex30 GPS to track the selected area for the inventory. The result from this was used to develop the compendium of tree species for the study areas. Additionally, plant ecological indices such as richness, relative density, diversity index, evenness and similarity index of tree species were computed for surveyed trees in the area (Kent and Coker, 1992; Guo *et al*.,2003;Brashears *et al*.,2004;Nath *et al*., 2005).

Results and Discussion

Tree Survey

Urban forests form vital part of green infrastructure in cities that can play essential roles in urban ecosystems through the numerous services they provide (Arabomen *et al*., 2019). In this study, Benin metropolis was a repository of over 90 tree species belonging to 39 families (Table 1). The families that recorded the highest number of trees included Euphorbiaceae, Moraceae, Fabaceae, Apocynaceae, Anarcardiaceae and Mimosaceae. The Shannon-Wiener diversity index (H^i =4.15), Shannon's maximum diversity index (H_{max} =4.58), Shannon's equitability index (E_H =0.91) were recorded for the metropolis.

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Table 1 Summary result of tree ecological indices in Benin metropolis

Parameter	
Number of tree species	2 489
Number of families	39
Species richness	96
Diversity index ($\mathbf{H^i}$)	4.15
Maximum diversity index ($\mathbf{H_{max}}$)	4.58
Species evenness ($\mathbf{E_H}$)	0.91

Moreover, *Anacardium occidentale* (86) had the highest number of trees per hectare in the core areas. *Cocos nucifera* (67) and *Terminalia catappa* (67) recorded the second highest number of trees per hectare. Relative density ranged from 0.12% to 10.4%. *Anarcardium occidentale* (10.4%), *Cocos nucifera* (8.08%), *Terminalia catappa* (8.08%), *Mangiferaindica*(7.60%), *Terminalia mentalis* (6.33%), *Persea Americana* (6.39%) and *Polyalthia longifolia* (5.43%) had the highest relative density in the core areas (Table 2).

Table 2 Identified tree species in core areas

Tree species	Family	Common name	No./ha	$P_i \ln P_i$*	RD(%)
Albizia sassa	Mimosaceae	Walnut tree	1	0.01	0.11
Albizia sp	Mimosaceae	African walnut	2	0.01	0.22
Artocarpus communis	Moraceae	Bread fruit	18	0.08	1.94
Allophylus africanus	Sapindaceae	-	36	0.13	3.87
Alstonia boonei	Apocynaceae		19	0.08	2.04
Anacardium occidentale	Anacardiaceae	Cashew tree	86	0.22	9.25
Annona muricata	Annonaceae	Sour sop	9	0.05	0.97
Chrysophyllum albidum	Sapotaceae	Cherry	3	0.02	0.32
Citrus sinensis	Rutaceae	Orange	20	0.08	2.15
Cocos nucifera	Palmae	Coconut tree	67	0.19	7.20
Croton zambesicus	Euphorbiaceae	-	1	0.01	0.11
Dacryodis edulis	Burseraceae	Pear tree	45	0.15	4.84
Daniellia ogea	Caesalpiniaceae	-	2	0.01	0.22
Delonix regia	Caesalpiniaceae	Flamboyant tree	25	0.10	2.67
Elaeis guineensis	Palmae	Oil palm tree	15	0.07	1.61
Ficus capensis	Moraceae	Ficus	22	0.09	2.37
Ficus exasperate	Moraceae	Ficus	8	0.04	0.86
Ficus mucuso	Moraceae	Ficus	2	0.01	0.22
Ficus polita	Moraceae	Ficus	1	0.01	0.11
Ficus sp	Moraceae	Ficus	3	0.02	0.32
Ficus thonningii	Moraceae	Ficus	4	0.02	0.43
Gmelina arborea	Verbenaceae	Melina	5	0.03	0.54
Hevea brasiliensis	Euphorbiaceae	Rubber tree	7	0.04	0.75
Hevea creptans	Euphorbiaceae	Para rubber tree	1	0.01	0.11
Irvingia gabonensis	Irvingiaceae	Ogbono	7	0.04	0.75
Khaya senegalensis	Meliaceae	-	6	0.03	0.65
Mangifera indica	Anacardiaceae	Mango tree	63	0.18	6.77
Microdesmis puberula	Euphorbiaceae	-	3	0.02	0.32
Morinda lucida	Rubiaceae	-	10	0.05	1.08
Moringa oleifera	Moringaceae	Moringa	18	0.08	1.94

Morusmesozygia	Moraceae	Mulberry	1	0.01	0.11
Musanga cecropioides	Moraceae	-	1	0.01	0.11
Newbouldia laevis	Bignoniaceae	Tree of life	35	0.12	3.76
Peltophorumpterocarpum	Caesalpiniaceae	-	34	0.12	3.66
Pentaclethra macrophylla	Mimosaceae	-	2	0.01	0.22
Persea americana	Lauraceae	-	53	0.16	5.69
Pinus caribaea	Pinaceae	Pine tree	14	0.06	1.51
Plumeriarubra	Apocynaceae	Pigeon wood	6	0.03	0.65
Polyalthia longifolia	Annonaceae	Masquerade tree	35	0.12	3.76
Psidium guajava	Myrtaceae	Guava	38	0.13	4.09
Roystonea regia	Arecaceae	Royal palm tree	10	0.05	1.08
Senna alata	Fabaceae	-	3	0.02	0.32
Senna siamea	Fabaceae	-	14	0.06	1.51
Spondiasmombin	Anacardiaceae	Plum tree	4	0.02	0.43
Sterculia tragacantha	Sterculiaceae	-	2	0.01	0.22
Tectona grandis	Verbenaceae	Teak	11	0.05	1.18
Terminalia catappa	Combretaceae	Almond tree	67	0.19	7.20
Terminalia mentalis	Combretaceae	Almond	62	0.18	6.67
Theobroma cacao	Malvaceae	Cocoa tree	3	0.02	0.32
Thevetia neriifolia	Apocynaceae	-	9	0.05	0.97
Total number of trees	930				
Number of families	26				
Species richness	51				
Diversity index (H^i)	3.36				
Maximum diversity (H_{max})	3.95				
Species evenness (E_H)	0.85				

* *Shannon diversity index*

Additionally, in the fringe areas, *Dacryodis edulis* in Burseraceae family had the highest number of trees (173) per hectare. This was followed by *Elaeis guineensis* with 135 trees per hectare. Relative density varied from 0.07% to 11.61%. Species with high relative density were *Dacryodis edulis* (11.61%), *Elaeis guineensis* (9.06%) and *Ficus axasperata* (6.10%) (Table 3). Furthermore, 39 tree species (S_s = 57%) were common to both the core and fringe areas.

Table 3 Identified tree species in fringe areas

Species	Family	Common name	No./ha	$P_i \ln P_i$*	RD(%)
Albizia ferruginea	Mimosaceae	Walnut tree	2	0.01	0.13
Albizia sp	Mimosaceae	African walnut	6	0.02	0.39
Albizia zygia	Mimosaceae	-	43	0.10	2.76
Alchornea cordifolia	Euphorbiaceae	-	56	0.12	3.59
Alchornea laxiflora	Euphorbiaceae	-	30	0.08	1.92
Allanblanckia floribunda	Guttiferae	-	5	0.02	0.32
Allophylus africanus	Sapindaceae	-	12	0.04	0.77
Alstonia boonei	Apocynaceae	-	23	0.06	1.46
Anacardium occidentale	Anacardiaceae	Cashew tree	19	0.05	1.22
Annona muricata	Annonaceae	Sour sop	12	0.04	0.77
Anthocleista djalonensis	Loganiaceae	-	4	0.02	0.26
Azadirachta indica	Meliaceae	Neem tree	11	0.04	0.71
Bombax sp.	Bombacaceae	-	5	0.02	0.32

Brideliamicrantha	Euphorbiaceae	-	9	0.03	0.58
Cajanus cajan	Papilionaceae	-	20	0.06	1.28
Caliandra haematocephala	Fabaceae	-	10	0.03	0.64
Ceiba petandra	Bombacaceae	-	4	0.02	0.26
Chromolaena odorata	Asteraceae	Christmas bush	3	0.01	0.19
Citrus aurantifolia	Rutaceae	Citrus	6	0.02	0.39
Citrus sinensis	Rutaceae	Orange	19	0.05	1.22
Cnestisferruginea	Connaraceae	-	22	0.06	1.41
Cocos nucifera	Palmae	Coconut tree	38	0.09	2.44
Croton lobatus	Euphorbiaceae	-	10	0.03	0.64
Croton sp	Euphorbiaceae	-	6	0.02	0.39
Croton zambesicus	Euphorbiaceae	-	3	0.01	0.19
Cyathulaprostrata	Amaranthaceae	-	15	0.05	0.96
Cycasrevoluta	Cycadaceae	Palm tree	5	0.02	0.32
Dacryodis edulis	Burseraceae	Pear tree	173	0.24	11.1
Daniellia ogea	Caesalpiniaceae	Gum tree	4	0.02	0.26
Delonix regia	Caesalpiniaceae	Flamboyant tree	23	0.06	1.48
Dennettia tripetala	Annonaceae	Pepper fruit	2	0.01	0.13
Dialium guineense	Fabaceae	Velvet tamarind	5	0.02	0.32
Elaeisguineensis	Palmae	Oil palm tree	135	0.21	8.66
Euphorbia dendroides	Euphorbiaceae	-	1	0.01	0.06
Ficus axasperata	Moraceae	Ficus	91	0.17	5.84
Ficus benjamina	Moraceae	Ficus	11	0.04	0.71
Ficus capensis	Moraceae	Ficus	26	0.07	1.67
Ficus exasperata	Moraceae	Ficus	10	0.03	0.64
Ficus sp	Moraceae	Ficus	4	0.02	0.26
Ficus thonningii	Moraceae	Ficus	3	0.01	0.19
Gliricidia sepium	Fabaceae	-	4	0.02	0.26
Glyphaeabrevis	Tiliaceae	-	4	0.02	0.26
Gmelina arborea	Verbenaceae	Melina	4	0.02	0.26
Gomphrenaglobosa	Amaranthaceae	-	10	0.03	0.64
Greenwayerodendronsuaveolens	Annonaceae	-	17	0.05	1.09
Hevea brasiliensis	Euphorbiaceae	Rubber tree	13	0.04	0.83
Holarrhena floribunda	Apocynaceae	-	2	0.01	0.13
Huracrepitans	Euphorbiaceae	-	3	0.01	0.19
Icacinatrichantha	Icacinaceae	-	10	0.03	0.64
Irvingia gabonensis	Irvingiaceae	Ogbono	8	0.03	0.51
Lecaniodiscuscupanioides	Sapindaceae	-	7	0.02	0.45
Lonchocarpuscyanescens	Papilionaceae	-	21	0.01	1.35
Mangifera indica	Anacardiaceae	Mango tree	67	0.02	4.30
Milicia excels	Moraceae	Iroko	14	0.10	0.90
Moringa oleifera	Moringaceae	Moringa	8	0.12	0.51
Musanga cecropioides	Moraceae	-	3	0.08	0.19
Nauclea latifolia	Rubiaceae	-	4	0.02	0.26
Newbouldia laevis	Bignoniaceae	-	46	0.04	2.95
Pentaclethramacrophylla	Mimosaceae	-	9	0.06	0.58
Persea americana	Lauraceae	-	17	0.05	1.09
Phyllantus discoideus	Euphorbiaceae	-	11	0.04	0.71
Phyllantus mannianus	Euphorbiaceae	-	14	0.02	0.90
Plumeria rubra	Apocynaceae	Pigeon wood	8	0.04	0.51
Polyalthia longifolia	Annonaceae	Masquerade tree	42	0.02	2.69

Psidium guajava	Myrtaceae	Guava	36	0.03	2.31
Rauvolfia vomitoria	Apocynaceae	-	41	0.06	2.63
Ricinodendron heudelotii	Euphorbiaceae	-	6	0.03	0.38
Roystonea regia	Arecaceae	Royal palm tree	57	0.02	3.66
Senna alata	Fabaceae	Candle tree	11	0.01	0.71
Senna fistula	Fabaceae	Raintree	7	0.02	0.45
Senna occidentalis	Fabaceae	Coffee weed	4	0.05	0.26
Senna siamea	Fabaceae	-	19	0.06	1.22
Shurea spp	Dipterocarpaceae	-	3	0.09	0.19
Solanum sp	Solanaceae	-	8	0.03	0.51
Spatodia sp	Bignoniaceae	Tulip tree	5	0.02	0.32
Spondias mombin	Anacardiaceae	Plum tree	14	0.01	0.90
Sterculia tragacantha	Sterculiaceae	-	12	0.05	0.77
Tectona grandis	Verbenaceae	Teak	34	0.02	2.18
Terminalia catappa	Combretaceae	Almond tree	33	0.24	2.12
Terminalia mentalis	Combretaceae	Almond tree	6	0.02	0.38
Theobroma cacao	Sterculiaceae	Cocoa tree	10	0.06	0.64
Treculia africana	Moraceae	-	7	0.01	0.45
Tremaorientalis	Ulmaceae	-	8	0.02	0.51
Voacanga africana	Apocynaceae	-	6	0.21	0.38
Total number of trees	1559				
Number of families	36				
Species richness	83				
Diversity index (H^i)	3.83				
Maximum diversity (H_{max})	4.44				
Species evenness (E_H)	0.86				

* *Shannon-Wiener diversity index*

In this study, more than half of the sampled tree species were indigenous, with few exotic trees in Benin metropolis. These native trees were existing in the area prior to development, while the exotic trees were either planted or introduced by other means. This finding contradicts previous studies in other developing countries like Ghana, Eastern Cape of South Africa and Bangalore, India where exotic and alien species have been reported to constitute a greater proportion of trees in the urban landscapes (Nagendra and Gopal, 2010). Kuhns, (2009) reiterates that indigenous trees can advance biodiversity and creation of wildlife corridors while stimulating a feeling of spot for connection to nature (Wafa *et al*., 2017). Thus, the urban forest structure in Benin metropolis can serve as an in-situ conservation method to protect and conserve native forest tree species in Nigeria.

Moreover, similar tree species as from this study have been identified in some natural forest ecosystems in Nigeria and other African countries (Onyekwelu,2013). For example, some tree species in this study have been identified in tropical rainforest ecosystems and some forest reserves in Kumasi, Ghana, Ethiopia and other Southwestern states of Nigeria (Aladesanmi *et al.*, 2017; Wafa *et al*., 2017). Thus, the large number of trees species found in tropical forests could characterise urban landscape (Onyekwelu, 2013; Shackleton, 2015). This similarity of tree species richness in this study and natural forest ecosystems underscores the importance of the urban forests in biodiversity conservation.

Furthermore, an evaluation of species diversity index (SDI) in the metropolis showed that the urban forests structure is diverse in nature, owing to its species richness and even distribution. This compares to other Cities of the world. Sreetheran *et al*. (2011) reported SDI of 3.0 in Kuala Lumpur. Sun, (1992) reported a SDI of 3.5 for tree populations in USA cities and towns, while seven cities in United Kingdom recorded a SDI of 4.1. Biodiversity indices of urban forests show that if, properly managed, tree species in urban areas can contribute to conservation in built-up environment (Aladesanmi *et al*., 2017).

Geospatial survey

The thematic maps generated for this study provides an insight to the degree of disturbance and changes to the tree vegetation and urban cover in the Benin City. From the classified images (Figure 4), the vegetated areas in core part of the City in 1988 had become fragmented in 2018, leaving scattered trees and small patches of forests.

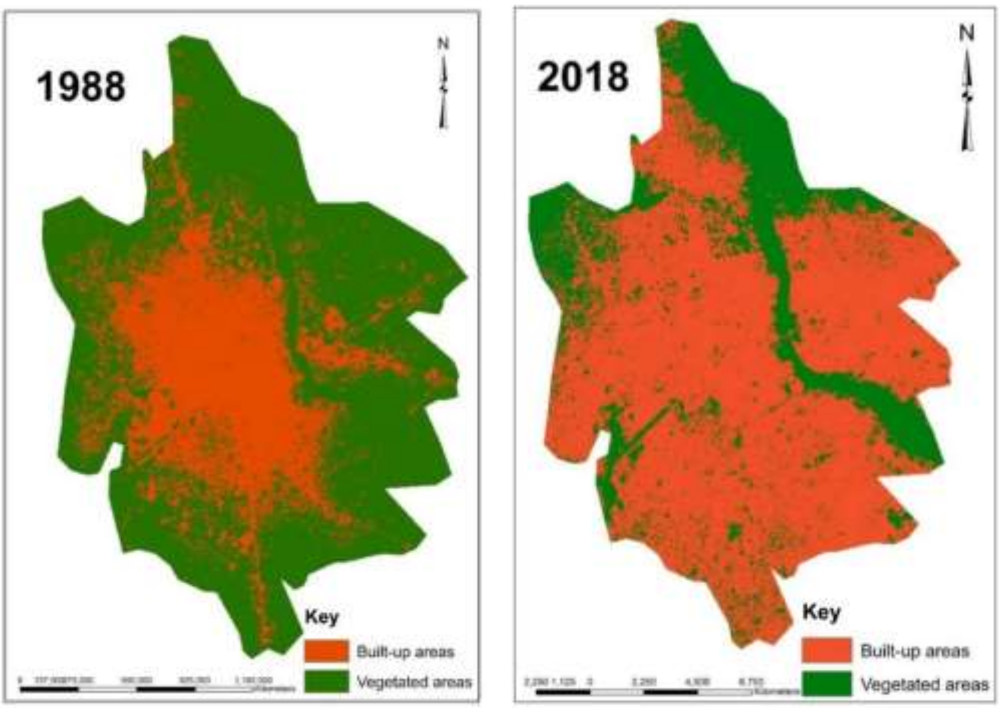

Figure 4 Classified images of Benin Environ for 1988 and 2018

Additionally, most of the vegetated areas in 1988 became settlement or bare ground in 2018. The results showed that vegetated areas, that is, the undeveloped/undisturbed areas which covered 18 007 hectares in 1988 had significantly reduced to 7 361 hectares in 2018, depicting a relative decrease of approximately 60% in vegetation class of the total land area. On the other hand, the settlement/urban areas increased by 73% from 9 320 hectares in 1988 to approximately 20 000 hectares in 2018, adding 39% of built-up areas to the total land area.

The reason for this can be related to the general high rates of urbanization resulting in rapid development and population growth. Cities, owing to their location, have the potential to attract many people probably because of access to infrastructure, good business opportunities and/or preference for City life. Moreover, an increase in population leads to the expansion of the City, hence, an increase in the demand for green areas to meet urban needs. Yu *et al*. (2011) reported that during the past two decades, most metropolitan areas in China have experienced unprecedented expansion, mainly due to overall population growth due to migration from rural to urban areas. Associated with the process of rapid urbanization, a significant amount of urban forest lands, have been developed into human settlements and other land uses (Song and Ding, 2009). Though it is rarely satisfactory to use past trends to predict the future especially anthropogenic conditions, since the circumstances which gave rise to the trends are not likely to continue, however, relating this to increase in infrastructures, buildings and other urban land uses, the result of this study suggests in some explicit ways the need for urgent intervention. Furthermore, while built-up areas are growing rapidly, the rate at which vegetated areas are lost is at best described as overstretched, hence, the need for urgent intervention by government, resource managers, city planners and other relevant stakeholders in the future planning of new areas in Benin metropolis.

Conclusion

This study made use of an integrated approach of aerial and field survey to provide baseline information on the status of the urban forests in developing African cities, using Benin metropolis in Nigeria as a case study. The findings showed that the urban forests in Benin metropolis was a repository of mostly indigenous and/or native forests tree species. There is dire need for regular monitoring of urban areas to promote in-situ conservation of this important resource in Nigeria. Unfortunately, built-up and settlement areas have expanded over time at the expense of vegetated and green areas. It is important that policies include the protection of trees in urban areas such that during the time of construction or development trees are conserved by giving priority in urban development projects. Additionally, it may be important to create awareness programs on the intangible benefits of trees in urban societies. These recommendations are to ensure that urban forests and the trees that form them are not only appreciated for their tangible and/or timber component, but most especially for the intangible environmental services such as aesthetics, shade, flooding and erosion control, climate modification *amongst others*.

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