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Ecosystem services and mapping of amenity trees in Port Harcourt Zoo, Nigeria

*Oladele A.T. and Udo N.E.

Department of Forestry and Wildlife Management, University of Port Harcourt, Nigeria

*Corresponding author (E-mail: adekunle.oladele@uniport.edu.ng)

ABSTRACT

This paper reports the benefits, which selected stakeholders derive from amenity trees in Port Harcourt Zoo, Nigeria. Two sets of structured questionnaires were administered for data collection among some stakeholders - tourist (99) and residents in the neighbourhood (98), between August and November, 2015. The trees encountered were identified while their benefits to respondents' were noted and co-ordinates carefully recorded with GPS equipment and subsequently mapped. Results revealed that 41.4% of the tourists were attracted to the park by trees and animals, 39.4% were attracted by the serenity and cool breeze derived under and around the trees. Some tourists visited for collection of plant parts for medicine (18.0%). Benefits derived from the amenity trees by the neighbourhood around the zoo include: cool breeze (35.0%), serene/scenic view of the environment (21.0%), noise reduction (26.0%), games/ bird viewing (10.0%) and local medicinal plants collection (8.0%). In all, 84 amenity trees were encountered in the zoo park comprising 29 species belonging to 18 families. Identified stakeholders were observed to derive environmental, psychological, social and livelihood support benefits from the amenity trees.

Keywords: Urban trees, Ecosystem services, Zoo stakeholders, medicinal plants.

INTRODUCTION

Urban trees play active roles in providing goods and services, improve livelihood, and enhance the wellbeing of inhabitants (Fuwape and Onyekwelu, 2011). These roles can be divided into consumptive (Timber, foods, fuel-wood and medicine) and non-consumptive (ecological and social services such as environmental protection and amelioration, biodiversity conservation, recreation, beautification and water shed protection). Trees in urban areas are also referred to as amenity trees for the invaluable services they rendered for humans (Coder, 2004). Amenity trees are usually planted in residential facilities, avenues and walkways, city parks and recreation centres, institutions (schools, research centres, hospitals and public buildings), zoological gardens and other forms of urban biodiversity conservation areas.

The concept of urban forest was reported to be well developed in western world and that it forms part of urban development plans (Simpson and McPherson, 2007; Nowak *et al.*, 2010); however this is not the case in sub Saharan West African countries. In Nigeria, planned urban trees are mostly restricted to elite's residential areas usually referred to as Government Reservation

Areas (GRAs) in capital cities and institutions. They are also available in local or community parks, which are scanty and only exist in major cities. Port Harcourt zoo and Isaac Boro Park are the only two public recreation centres stocked with trees in the city of Port Harcourt. Although there are other recreation centres such as 3-5 star Hotels, Golf club, Shell residential area park and Polo club among other private facilities containing trees but they are not open to the public. Globally, trees are important component of zoological gardens (Ayodele and Alarape, 1998; Ayoade *et al.*, 2012; Lane, 2015; Choudhury, 2015). They provide shade, food and shelter for the animals and mimic those in natural forest environment for good animal health. Other benefits include: provision of appealing and serene environment for tourists and as picnic area apart from crucial to educating visitors about biodiversity and importance of habitat preservation.

Perceptions of different stakeholders about trees in zoos vary based on culture, education and levels of social and economic development of the people. Residents in the neighbourhood of Agodi gardens in Ibadan, Nigeria once see garden trees as potential firewood and fertile arable land due to poverty (Ayodele and Alarape, 1998) while trees in Giza zoo, Egypt were perceived by the neighbourhood as providing recreational services in the 1970s (El-Messiri, 2004). Wyman *et al*., 2012 observed that neighbourhoods' of parks and gardens in North America perceived park trees as source of goods as well as environmental and social services. This may be linked to high literacy level, modernisation and relatively high per capita income in North America compared to the developing tropical countries.

The main objective of this study was to investigate the perceptions and benefits, which selected stakeholders', derive from amenity trees in Port Harcourt Zoo, Nigeria.

METHODOLOGY

Study Area

The study was conducted in Port Harcourt zoological garden, Trans Amadi area, Obio-Akpor Local Government Area (LGA), Rivers State, Nigeria, which is popularly known as Port Harcourt Zoo. Port Harcourt city comprised (Obio-Akpo, Ikwerre and Port Harcourt LGAs) and lies along Bonny River in the Niger Delta region. It has estimated population of 1,189,838 persons (NPC, 2010). The city is under the influence of tropical monsoon climate, characterized by lengthy rainy periods and short dry seasons (December and February). Precipitation is highest (370mm) in September; average temperature is 25°C - 28°C (Wizor, 2014). Trans Amadi is a 92500 acre industrial and residential neighbourhood (Fig. 1). The zoological park was established in 1974, opened for public use on October 1st, 1975 and is currently managed by the Rivers state Ministry of Culture and Tourism. It attracts visitors from within and around Port Harcourt city.

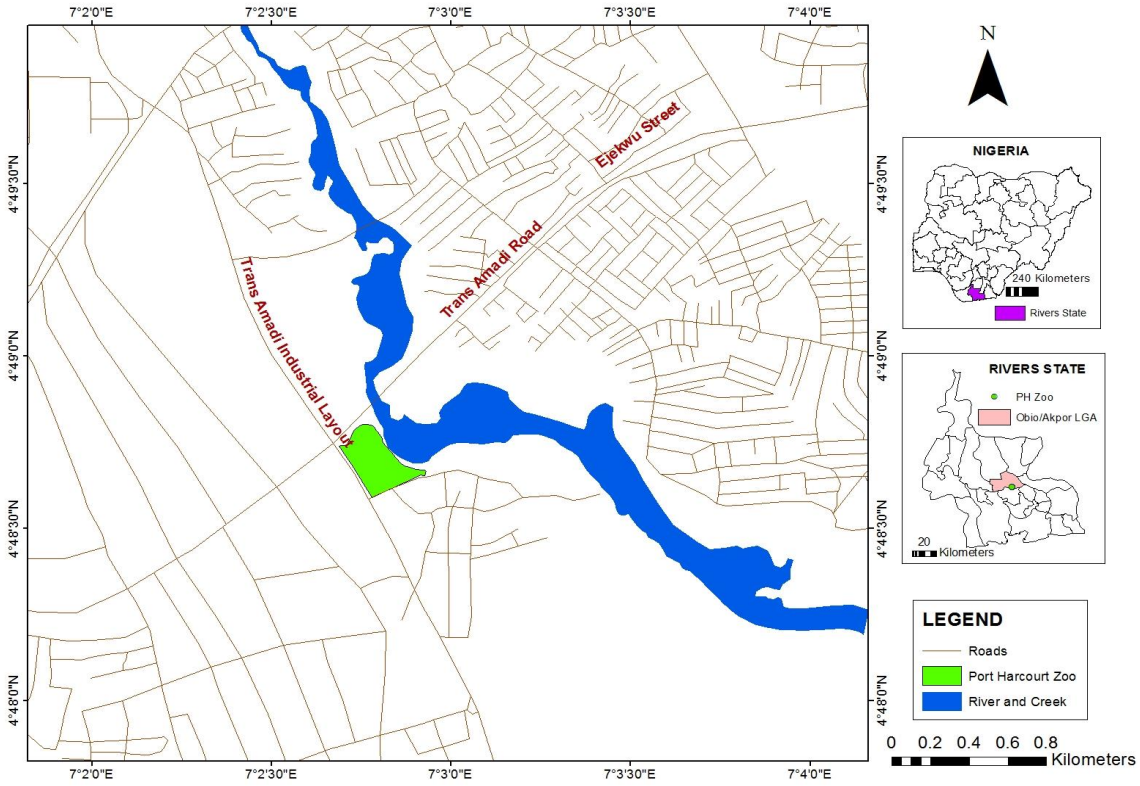

Fig.1: Map of Port Harcourt city showing location of the zoo

Data collection and analysis

Data for the study was collected by administering pre-tested questionnaires among randomly selected tourists (99) and neighbourhood residents (98) between August and November 2015. Three (3) major stakeholders (Government/Zoo Staff, Tourists and Neighbourhood residents) were considered out of which two were selected randomly for questionnaire administration. Questions were designed to elicit information on demographic characters, reasons and frequency of visit, benefits (social, cultural, psychological, ethno-botanical) and perceived functions of the trees located in the zoological garden. Co-ordinates of the trees were taken with the help of a modern Global positioning system (G.P.S) facility. Resulting data was subjected to descriptive statistics, tables, bars and graphs. Tree co-ordinates were used to produce map of amenity trees in the zoo.

RESULTS

Demographic parameters of stakeholders interviewed in the study showed that sex distribution of tourists to Port Harcourt zoo composed of higher number of males (57.6%) than females (42.4%) tourists while majority were aged below 40 years as reflected in Table 1.

Table 1: Demographic characteristics of stakeholders in Port Harcourt Zoo

Demographic Characters		Tourist (n = 99)		Neighbourhood Residents (n = 98)	
		Freq.	**%**	**Freq.**	**%**
Sex	Male	57	57.6	56	57.1
	Female	42	42.4	42	42.9
Age (Years)	Below 20	11	11.1	-	-
	20 – 30	40	40.4	35	35.7
	31 – 40	37	37.4	37	37.8
	41 – 50	9	9.1	10	10.2
	Above 50	2	2.0	16	16.3
Marital status	Married	56	56.6	58	59.2
	Single	40	40.4	34	34.7
	Separated	1	1.0	2	2.0
	Widow(er)	2	2.0	4	4.1
Family size	1 – 5	61	61.6	65	66.3
	6 – 10	36	36.4	29	29.6
	Above 10	2	2.0	4	4.1
Residency (Tourist)	Port Harcourt	89	89.9	-	-
	Outside Port Harcourt	10	10.1	-	-
Residency (Neighborhood)	Trans Amadi Ind. layout	-	-	33	33.7
	Slaughter Area	-	-	18	18.4
	Peter Odili Road	-	-	24	24.5
	Total Grace Avenue	-	-	23	23.5

Source: Field survey, 2015

A greater percentage of the tourists were married (56.5%) while 57.1% of them were males. Some elderly individuals selected for interview declined completing survey questionnaires hence, most residents available for the interview around the zoo were relatively young and aged 20 – 30 years (35.7%), 31 – 40 (37.8%) and above 50 years old (16.3%). Most of the residents in the neighbourhood (59.2%) were married with modal (66.3%) family size of between 1 and 5 persons. Large family size is typical of sub-Sahara Africa as documented by many workers (Bongaarts 2011; Taylor and Maithya, 2007; Kama, 2017). About 46.0% of the tourists visit the zoo occasionally, 21.0% each visits weekly and monthly, respectively while 11.0% visits yearly (Fig. 2).

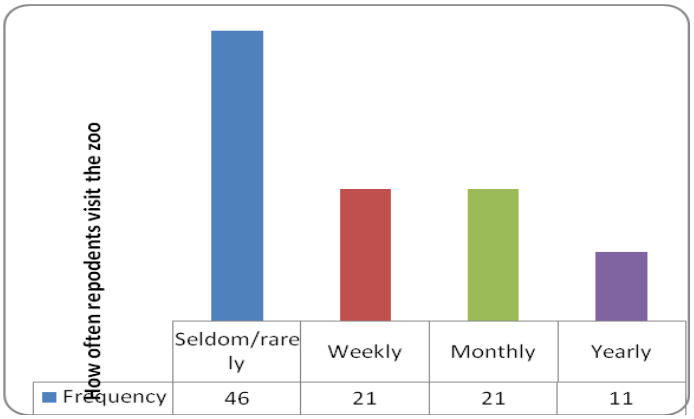

Fig. 2: Tourists frequency of visit to Port Harcourt zoo

About 41.4 % of tourists are motivated by trees and animals, animals only motivated 30.3% of the tourist, serenity and environmental coolness motivated 12.1% and trees only attracted 8.1% of the visitors to the zoo (Fig.3)**.**

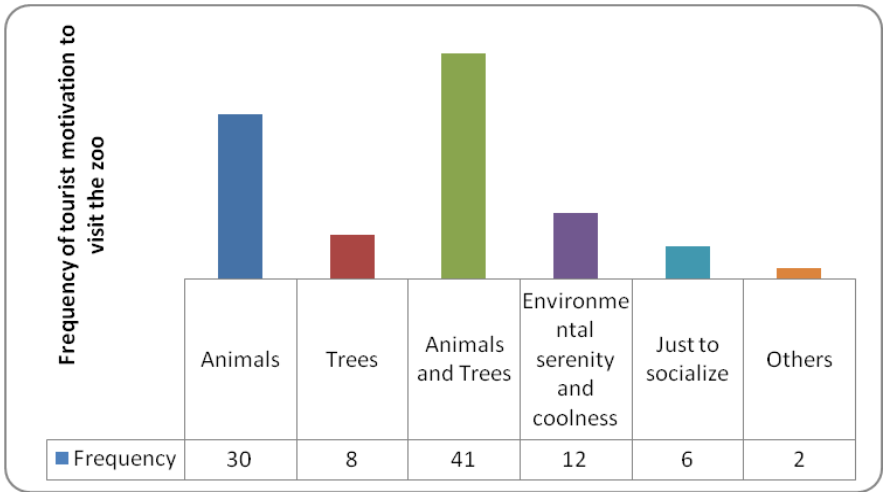

Fig. 3: Factors attracting tourist to Port Harcourt zoo

Benefits derived from Port Harcourt Zoo by Neighbourhoods

Figure 4 shows 35.0% of the residents' in the zoo neighbourhood enjoy the benefit of cool atmosphere due to the presence of trees in the zoo, 21.0% of them enjoy beautiful scenic view of the environment, 26.0% perceive trees in the zoo as helping in noise reduction, 10.0% enjoy viewing birds that visit the trees while 8.0% perceive their collection of local medicinal plants and edible fruits as benefits from the zoo.

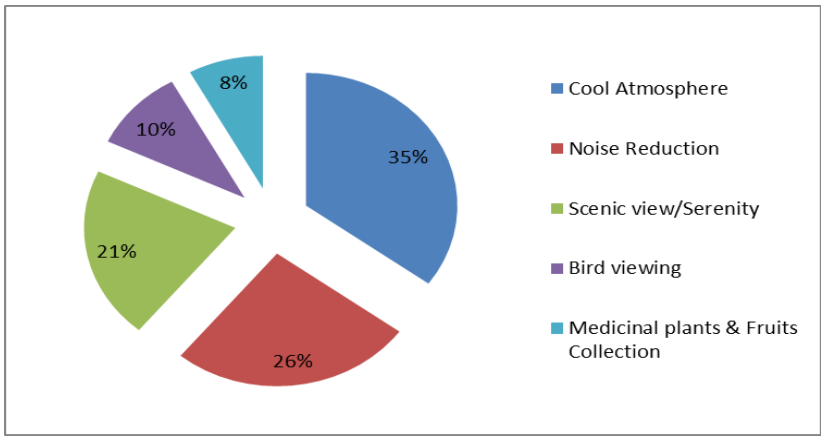

Fig. 4: Benefits derived from the zoo by the neighbourhood residents

Ethno-botanical utilization of protected in Port Harcourt Zoo

Table 2 shows that 29 species of trees were conserved in Port Harcourt zoo. Local utilization include social and environmental services, food, firewood, live fences, ornamentals and treatment of various ailments locally such as malaria, sickle cell anaemia, fire burn, diarrhoea and convulsion among others.

Table 2: Ethno-botanical utilisation of Trees in Port Harcourt Zoo

No	Species name/Family	Local name/common name	Frequency /Abundance/ Population	Uses	Mode of administration
1	*Gmelina arborea* Roxb. (Verbanaceae)	Gmelina	17	The tree trunk is used as timber. Tree is cultivated as an ornamental. Leaves used to treat fire burn.	Sawnwood. Squeeze leaf and apply the juice to the affected part.
2	*Irvingia gabonensis* Bailon. (Irvingiaceae)	Ogbono	7	Fruit eaten as fruit. Cotyledon used as thickener for soup.	Fruit is eaten fresh Seed is dried and grinded
3	*Eucalyptus camadulensis* Dehnh. (Myrtaceae)	Eucalyptus tree	5	The tree is cultivated as an ornamental.	Cultivated as ornamentals
4	*Elaeis guineensis* Jacq. (Aracaceae)	Palm tree	5	The fruit oil is used to treat convulsion.	Oil from the fruit is drunk and rubbed on the child's body
5	*Delonix regia* (Hook) Raf. (Mimosaceae)	Flamboyant tree	4	Firewood/Ornamental.	Cultivated as ornamentals.
6	*Pentaclethra macrophylla* Benth. (Mimosacease)	Ugba	4	Eaten as food.	Seed is dried and cook
7	*Polyathia Longifolia* Blume (Anonaceae)	Police/Masqurade tree	3	Ornamental tree, Fuelwood and windbreak.	Beautification
8	*Anthocleista vogeli*		3	For malaria treatment.	Boil the leaves and

	Planchon. (Loganiaceae)				mango leaves, drink the infusion.
9	*Cola pachycarpa* Schott & Endl. (Sterculiaceae)	Oiya/Achicha	2	Leaves are used to wash off bad spirits (meta physical). Fruits eaten as snack	Boil with water and bath. Fruits mesocarp eaten fresh.
10	*Dacryodes edulis* G.Don.f. (Burseraceae)	Ube, African pear	2	Fruits eaten as snack.	Roast or boil fruits
11	*Ficus exasperate* Linn. (Moraceae)	Sand paper tree	1	Fuelwood	Leaves rubbed on smoked cooking pots to remove sooths
12	*Vitellaria paradoxa* Gaertner (Sapotaceae)	Uri/Ugbatirikun	2	The fruit oil is used to treat convulsion. The fruit oil is used for massage.	Fruit oil extracted and used on the affected parts.
13	*Hura crepitans* Linn.*(Euphorbiaceae)*	Hura	2	The tree is cultivated as an ornamental.	Cultivated as ornamentals and for shade.
14	*Albizia zygia* Durazz. (Fabaceae)		2	Fire wood, Timber	Sawnwood, Dry and split for firewood
15	*Funtumia elasitca* (Preuss) Stapf. (Apocynaceae)	Okpo	1	Fish poison	Mix seed with sand and broadcast in stream as poison.
16	*Psidium guajava* Linn. (Myrtaceae)	Guava tree	1	Leaves are used to treat diarrhoea.	Boil leaf and take the infusion
17	*Terminalia cattapa* Linn. (Combretaceae)	Almond tree	1	Nuts eaten as snacks.	Dry the fruits to extract the nuts
18	*Mangifera indica* Linn (Anacardiaceae)	Mango tree	1	Leaves are used to treat malaria.	Boil mango and *Anthocleistii vogeli* leaves together, drink the infusion.
19	*Milicia excels* (Welw.)Benth.&Hook.f. (Moraceae)	Iroko	1	Timber	Sawnwood
20	*Pterocarpus santaloides* L.f (Fabaceae)	Oha	1	Malaria and Waist pain treatment.	Leaves boiled and used as poultice to treat malaria.
21	*Spondias cythera* Sonn. (Anacardiaceae)	Plum	1	Eat fruit as snack.	Fruit eaten fresh
22	*Pycnanthus angolens* (Welw) Warb. (Myristicaceae)		1	Timber	Sawnwood
23	*Morinda lucida* Linn. (Rubiaceae)		1	Malaria treatment.	Boil leaf with water and drink the infusion
24	*Anthonota macrophylla* Pal (Apocynaceae)	Obiriba	1	Firewood and Yam stakes.	
25	*Newbouldia laevis*		1	Live fence, Shrine tree	Planted in shrines

	Seeman.Ex.Bureau (Bignoniaceae)			and boundary demarcation
26	*Uapaca staudii* Bailon. (Uapacaceae)	1	The tree is cultivated as an ornamental. Timber	Cultivated as ornamentals
27	*Ficus sur* Linn. (Moraceae)	1	Medicine to treat sickle cell disease.	Fruit is eaten fresh.
28	*Awushu*	1	Malaria treatment.	Boil leaf with water and drink the infusion

Source: Field survey, 2015

Mapping of Trees in Port Harcourt Zoo

The map in Fig. 5 reveals that trees in the zoo are planted close to buildings (animal houses) protecting the animals from direct solar radiation and consequently maintain cool environment in the animal houses.

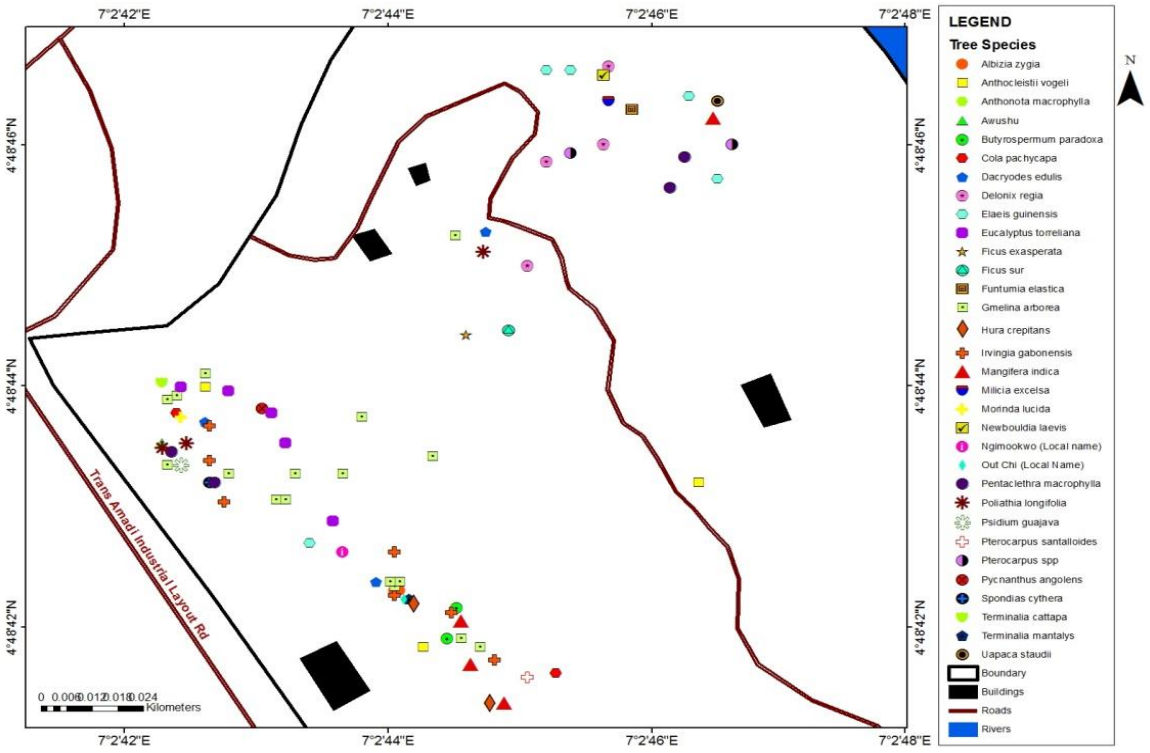

Fig. 5: Map showing the utilised area of Port Harcourt zoo revealing the coordinates of amenity trees and their nomenclature.

DISCUSSION

Most zoological gardens and National parks in Nigeria attract more male tourists than females. This trend was observed in Markudi zoo and Old Oyo National Park where male tourists were observed to constitute 59.5% and 78.0%, respectively (Okojie and Amujo, 2011; Alarape *et al*., 2015). This trend may not be unconnected to zoophobia, which had been observed to be higher among females compared to their male counterparts (Davey *et al.* 1998). Female tourists in zoos usually visit in company of men and family members to alleviate fear of animal except on special occasions, while male tourists visits zoo with or without female company. In addition, substantial numbers of women in developing countries are full housewives; they are usually engaged in domestic activities and sometimes engage in petty trading, hence, not financially buoyant and have little time for recreation. More than 80% of Nigerians live below poverty line of less than USD2$ per day and people with low income have been noted to have restricted access to parks due to poverty (Wolch *et al*., 2005).

Relatively, young people aged 20 – 40 years (77.8%) are mostly attracted to Port Harcourt zoo. This group of individuals are usually adventurous, agile and engaged in several social activities with good incomes used for leisure and recreation. This result is in agreement with studies in University of Ilorin zoo (Adefalu *et al.,* 2015). Visitors above 40 years old constitute only 11.1% (Table 1), apparently, these individuals have less time for leisure probably due to family responsibilities.

National Parks and game reserves are usually far from cities; they are sparsely distributed over locations which may sometimes requires a whole day travel in Nigeria. Therefore young couples and families with young children spend leisure period in nearby zoological gardens due to scarcity of city and community parks in Nigeria. Port Harcourt zoo is the only relatively stocked zoo in terms of animals and plant species in Rivers and four other neighbouring states (Abia, Bayelsa, Akwa-Ibom and Delta), hence, tourist from within and outside Port Harcourt are attracted throughout the year. Tourist from within Port Harcourt city was 89.9% while tourist from outside the city was 10.1%. Foreign visitors are not encountered during the survey work, even though the zoo is fairly stocked with various mammals, reptiles and birds. Absence of foreign visitors during our survey may be traced to security risks in the Niger Delta area of Nigeria at the survey period. Globally, foreign tourists have been reported to prioritize security of life and property in their choice of touring destinations (Ahmed and Azam, 2010; Kurež and Prevolšek, 2015).

The ethno-botanical uses of amenity trees in Port Harcourt zoo result is in tandem with Benedict and McMahon, (2002) that trees strengthen the functionality of ecosystem for delivering multiple goods and services and as well enhancing the quality of life. These can be divided into consumptive products (provisioning services) such as fuelwood, fruits, wood for building and fencing, fodder, medicines (Kuchelmeister, 2000; Fuwape and Onyekwelu, 2011) and non-consumptive products (cultural and supporting services) such as habitat protection, watershed and soil protection, carbon sequestration, noise and air pollution reduction, beauty, shade, recreation, educational, scientific, spiritual and religious significance (Horst, 2006; Shackleton, 2012). Trees in the Port Harcourt zoo provide both consumptive and provisioning roles to the local community as well as the tourists. Even though the zoo is located in

urban centre many residents in the neighbourhood still collect medicinal plants to treat various ailments due to the unfounded believe that herbal medicines lack side effects coupled with non-affordability of synthetic drugs by majority of neighbourhood residents.

Trees are planted closely in the zoo (spacing range between 3 – 10m) to enhance quick and total canopy closure for shade, cool breeze in the environment and reducing air temperature. Tree population (Fig. 5) in the zoo attract tourist within and outside Port Harcourt metropolis. Close canopy of urban trees in Enugu, Nigeria has been noted to reduce air temperature by $6^{o}C$ (Obi and Chendo, 2014). Air temperature in the zoo is greatly influenced by closed tree canopy which protect the animals from hot weather of the tropics. Observed roles of tree canopy in the zoo is also in consistent with the findings of Scudo (2002) who asserted that leaves of trees allow 20% radiation to be transmitted through them and about 55% absorbed while 25% reflects back. The zoo is located in an urban area where noise is a major environmental pollution; the spatial arrangement of the trees in the zoo reduces noise optimally in and around the zoo thereby creating conducive environment for the animals and visitors as expressed in Fig. 4. This is in agreement with position of Nowak and Dwyer (2000) that dense trees have the capacity to reduce noise up to 50% or 6-10 decibels.

The inventory of trees in the zoo (Table 2) showed that *Gmelina arborea* species is the most abundant species in the zoo. The trees in the zoo are moderately sized to large deciduous tree with straight trunks. They are wide spreading with numerous branches forming a large shady crown, attains a height of 30m or more and a diameter at breast height (dbh) up to 1.5m. This tree characteristic motivates individuals within and outside Port Harcourt to visit the zoo for relaxation as these trees provide shade, which make the environment conducive for family picnic. Basic recreational facilities such as games/bird viewing serve as tourist attractions and motivates visit to the zoo (Fig. 4). Five star animals such as Elephant (*Loxodonta africana*) and Gorilla (*Gorilla gorilla*) are not available in the zoo which reduces frequency of visit by tourist. Most tourists visits the zoo on occassions such as festive period (Fig. 2) as also observed by Alarape *et. al.* (2015) on assessment of tourist satisfaction in Makurdi zoological garden where 18% of the tourist had no intention to revisit due to scanty games available in the zoo.

The study concludes that trees are crucial to environmental quality maintenance and consequently improve quality of life for humans. Protected trees in Port Harcourt zoo were perceived by stakeholder to improve the zoo microclimate, provide shade, suitable for recreation and education; hence attracts tourists to the garden. Residents in the neighbourhood enjoy improved environmental quality such as fresh air and reduced noise as well as other Non-wood forest products, which include local medicinal plants and fuel-wood collection. Trees situated close to structures housing some of the animals plays significant roles in maintaining good environments for the animals, map of the trees showed spaces yet to be planted (Fig. 5). Stocking the remaining open spaces with choice tree species will enhance the vegetation of the zoo. Port Harcourt zoo is located in the core of urban centre with the aim of attracting visitors, however, absence of certain star animals such as Elephant (*Loxodonta africana*) and Gorilla (*Gorilla gorilla*) coupled with poor management has led to reduction in tourists population. More trees are recommended to be planted in the zoo by

the concerned agencies for continuous environmental and social benefits in the zoo.

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