

Biodiversity, Socio-Economic and Cultural Importance of Trees in Emerging Nigerian Urban Entres: Case Study of Akure City, Nigeria

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ABSTRACT

Recent awareness of the importance of trees have led to their increasing integration in cities. The biodiversity, socio-economic and cultural importance of trees in Akure city, Nigeria was investigated. Akure was stratified into modern (urban) and ancient (peri-urban); secondary and higher institution sections. The population of Akure is 387,087 inhabitants. A total of 66 tree species were identified in Akure; with 45 and 21 species occurring in modern and ancient sections, respectively. Within the modern section, species with high relative dominance were *Caryota spp* (28.7) and *Polyathia longifolia* (23.2) while *Carica papaya* (14.2) and *Mangifera indica* (12.9) dominated the ancient section of the city. Secondary schools were dominated by *Gmelina arborea* (21.4) and *Elaeis guinensis* (15.2). The dominant species in higher institutions were *Terminalia catapa* (19.2) and *Cocos nucifera* (18.1). The socio-economic importance of trees, which depended on the social and educational status of inhabitants, were: ornamental (38%), food/cash crop (36%), timber (11%), shade (9%), life-fence (3%), medicine (3%), cultural purposes (1%). In higher institutions, ornamental (52%) and shade (17%) were the most important uses of trees while in secondary schools, edible fruits (35%) and shade (19%) were important. In the ancient section, food/cash crop was the overwhelming (77%) use of trees while ornamental (90%) was the dominant use in modern section. Most inhabitants in the ancient section sold some of their tree products for income. Some trees served dual purposes depending on the social status of their owners. While *T. catapa* and *M. indica* were mostly used for food/cash crop by inhabitants of ancient section, they were used for shade in the modern section. Although medicinal purpose is not currently among the dominant uses of trees in Akure, there are indications that number of people using tree parts for this purpose is increasing. While the poor use trees for food and income in Nigerian emerging cities, the rich use them for ornamental purpose.

Key words: Tree species diversity, urban centres, economic, social, cultural

INTRODUCTION

Though the concept of Urban and Peri-urban Forestry (UPF) is not new, it was only recently that the nutritional and socio-economic importance of trees to urban dwellers are being considered. The importance of UPFs are well documented in published literature (El Lakany, 1999; McPherson and Simpson, 1999; Konijnendijk *et al.*, 2004; Williams *et al.*, 2009; Onyekwelu, 2017). Recent studies have shown that urban forests and trees offer provisioning, cultural and supporting services just like conventional forests (Kuchelmeister, 2000; Shackleton, 2006). The right tree in the right place can provide beauty, a shady place to shelter from the sun, food, soil stabilization, increase property values, conservation and cultural benefits.

There is high rural–urban migration in developing countries due to better infrastructures and means of livelihood in urban centres, which makes the need for UPFs higher now than ever before. For example, Onyekwelu (2013) observed

that population in urban settlements in Nigeria, which increased from 16.2% of total population in 1950 to 49.0% in 2010, is expected to increase to 71.3% by 2050. Thus, Urban forestry will remain relevant in urban centres in developing countries because of the high urbanization growth rate (Konijnendijk *et al.*, 2006). Urban and peri-urban forestry (UPF) has being defined as “the art, science and technology of managing trees and forest resources in and around urban community ecosystems for physiological, sociological, economic and aesthetic benefits that trees provide society” (Konijnendijk *et al.*, 2006). UPF deals with individual trees, groups of trees and woodlands, involves a wide variety of habitats and is concerned with a range of benefits and problems (Konijnendijk *et al.*, 2004). It involves trees planted in and around compounds, road sides (avenue trees), ornamental trees, public gardens, etc as well as trees integrated with crops in urban centres through arboriculture (Onyekwelu and Olaniyi, 2012).

Aspects of UPF include: (i) integrative, incorporating different elements of urban green structures into a whole; (ii) interdisciplinary, involving experts from natural and social sciences; (iii) strategic, aimed at developing long-term policies and plans for urban tree resources, connecting to different sectors, agendas, and programs; (iv) participatory, aimed at developing partnerships between all stakeholders; and (v) aimed at multiple benefits, stressing the economic, environmental, and socio-cultural goods and services urban forests can provide (Konijnendijk *et al.*, 2004; Randrup *et al.*, 2005).

Thus, UPF is an integrated approach to planting, caring and managing trees in cities to secure environmental, social and economic benefits for urban dwellers (Miller, 1997; Onyekwelu, 2013). Traditionally, people in West Africa plant trees around their houses for fuelwood, fruits, nuts, seeds, leaves, fodder, raw materials for handicrafts and building, etc (Fuwape and Onyekwelu, 2011). Thus, UPF play important roles in poverty alleviation and provisions for livelihoods. In addition, UPF helps in purifying the climate of cities, act as carbon sinks, mitigate global warming, reduce storm, water runoff, assist with processing wastewater, etc (El Lakany, 1999; McPherson and Simpson, 1999).

In Nigeria, tree planting and management in human settlements was largely based on their nutritional, social, cultural and spiritual benefits (Onyekwelu and Olaniyi, 2012). However, these benefits are not fully harnessed because of the prevailing general lack of information on UPF and the low value of trees in urban centres. Available literature shows that the assessment of biodiversity and socio-economic importance of trees in Akure metropolis has not been carried out. This is essential, especially now that the government has embarked on urban renewal programme. This study investigates the diversity of trees species in Akure city, Nigeria and their contributions to social and economic livelihood of its dwellers.

METHODOLOGY

This study was conducted in Akure, Nigeria. The city, which is surrounded by tracts of tropical rainforests and supports a large timber industry, has a population of 387,087 inhabitants. Akure lies between longitude 5.1210°E to 5.1595°E and latitude 7.2809°N to 7.3075°N. The rainy season lasts from March to November with mean annual rainfall of 1700 to 2300 mm while the dry season lasts from December to February. Mean relative humidity is about 80% while mean annual temperature is about 27°C. The elevation of the city is about 200 m above sea level.

For the purpose of data collection, Akure was stratified into modern (urban) and ancient (peri-urban) sections as well as secondary school and higher institution sections. “Peri-

urban” centre is the area of the city that is neither entirely urban nor purely rural; the partly urbanized rural area located in urban area (OECD, 1979). Semi-structured questionnaire was used to obtain information from 60 respondents in urban section of the city and another 60 respondents from peri-urban section. Respondents were encouraged to fill the questionnaire immediately in order to facilitate quick and 100% retrieval.

For biodiversity assessment, educational institutions, religious worship centres, private houses, major streets, and markets were visited. Trees were identified by a taxonomist and their frequencies of occurrence taken. Where a tree species could not be identified in the field, representative samples (leaves, fruits, bark, etc) of the tree were taken for identification in the laboratory.

The questionnaires were coded prior to analysis (e.g. descriptive statistics like frequencies, percentages, tables, charts). All identified tree species were assigned to families using Keay (1989) as a guide. Biodiversity indices (e.g. Relative Density (RD), Relative Dominance (RD_o), Shannon-Wiener diversity index (H'), species evenness (E_H), Importance Value Index (IVI) and Sorensen's species similarity index (SI)) were computed following the methods adopted by Guo *et al.* (2003) and Onyekwelu *et al.* (2008).

RESULTS

There were more female respondents (63.3%) in urban section than male (36.7%) while in peri-urban section, the percentage of male respondents (51.7%) were slightly higher than that of female respondents (Table 1). A high percentage of respondents in both urban (55.0%) and peri-urban (80%) sections of the city were married, which was followed by respondents who were single (35% and 15% in urban and peri-urban sections, respectively).

Young respondents (30 years and below) accounted for 38.4% and 30% of respondents in urban and peri-urban sections of Akure city, respectively. The results indicated that there were more middle-aged respondents (31 – 50 years) in peri-urban centres (51.6%) than in urban sections (35%). About 68.3% and 63.3% of respondents in urban and peri-urban sections of the city, respectively have tertiary education, which is higher than that of those with secondary education (Table 1). Only few respondents did not have any form of formal education (1.7% and 10.0% urban and peri-urban sections, respectively).

Civil service was the dominant occupation of respondents in both urban (63.3%) and peri-urban sections (55.0%) of Akure city (Table 1). Only few respondents in urban (1.7%) and peri-urban (3.3%) sections were farmers. About 35.0% and 30.0% of the total respondents in urban and peri-urban sections, respectively earned between ₦51,000.00 and

Table 1: Demographic/socio-economic characteristics of respondents

	Urban Section		Peri-urban section	
	Frequency	Percentage	Frequency	Percentage
Sex				
Male	22	36.7	31	51.7
Female	38	63.3	29	48.3
Marital Status				
Married	33	55	48	80
Single	21	35	9	15
Widowed	2	3.3	3	5
Divorced	4	6.7	-	-
Age Distribution				
Less than 20yrs	7	11.7	1	1.7
21 - 30 years	16	26.7	17	28.3
31 - 40 years	14	23.3	14	23.3
41 - 50 years	7	11.7	17	28.3
51 - 60 years	11	18.3	9	15
above 60 years	5	8.3	2	3.3
Educational Status				
No formal Education	1	1.7	6	10
Pry Education	4	6.7	6	10
Secondary Education	14	23.3	10	16.7
Tertiary Education	41	68.3	38	63.3
Major Occupation				
Farmer	1	1.7	2	3.3
Civil servant	38	63.3	33	55
Private sector employment	5	8.3	8	13.3
Contractor	4	6.7	1	1.7
Business	9	15	14	23.3
Others	3	5	2	3.3
Mean Monthly income (₦)				
less than 10,000	2	3.3	5	8.3
10,000 – 30,000	9	15	13	21.7
31,000 – 50,000	14	23.3	14	23.3
51,000 – 75,000	21	35	18	30
75,000 – 100,000	14	23.3	10	16.7

₦75,000.00 monthly while 23.3% and 16.7% respondents in urban and peri-urban sections earned between ₦75,000.0 and ₦100,000.0. Between ₦31,000.00 and ₦50,000.00 was earned by 23.3% of the respondents in both city sections (Table 1). Some respondents earned less than ₦10,000.00 per month. There was higher tree diversity in urban section of Akure than in peri-urban section. A total of 45 trees species, belonging to 19 families, were encountered in urban section of Akure, which is higher than the 21 tree species, belonging to 10 families in peri-urban section. Leguminosae was the dominant family in urban and peri-urban sections of Akure with frequency of 10 and 6 tree species, respectively while *Delonix regia* and *Gliricidia sepium* were the most abundant tree species with frequency of 144 and 57 trees in urban and peri-urban sections, respectively.

Species relative density (RD) ranged from 0.12 to 17.40% in urban section and from 0.46 to 26.40% in peri-urban

section of Akure city. Some tree species with high RD in the urban section were: *Delonix regia*, *Terminalia cattapa*, *Caryota* spp, *Polyathia longifolia*, *Mangnifera indica*, etc while *Gliricidia sepium*, *Carica papaya*, *Gmelina arborea*, *Mangnifera indica*, etc had high RD in peri-urban section. In urban section, species relative dominance (RDo) ranged from 0.329 - 28.7%, with *Caryota* spp (28.7) and *Polyathia longifolia* (23.2) having high RDo. In peri-urban section, RDo ranged from 0.39 to 21.7%, with *Mangnifera indica* (21.7%) and *Carica papaya* (20.2%) having high RDo. Secondary schools were dominated by *Gmelina arborea* (21.4) and *Elaeis guinensis* (15.2) while higher institutions were dominated by *Terminalia catapa* (19.2) and *Cocos nucifera* (18.1).

Based on Importance Value Index (IVI), tree species that are important in the floristic composition of the urban section were: *Antiaris africana* (6.5), *Polyathia longifolia* (6.6), and *Delonix regia* (9.571). In the peri-urban section,

species with high IVI were: *Mangnifera indica* (20.500), *Carica papaya* (15.268) and *Gmelina arborea* (18.562). Shannon-Wiener diversity index (H') for trees in urban and peri-urban sections were 1.85 and 2.85, respectively while Shannon's maximum diversity index (H_{max}) and Shannon's equitability (E_H) were 5.38 and 0.34, respectively for urban section and 6.72 and 0.43, respectively for peri-urban section.

The inhabitants of Akure city are interested in tree planting. This was evident from the 88.3% and 78.3% of respondents in urban and peri-urban sections of the city, respectively that indicated having planted trees (Table 2). In addition, 95% and 100% of respondents in urban and peri-urban sections, respectively indicated willingness to plant new/more trees around their houses, educational institutions, worship centres, etc (Table 2). While respondents in peri-urban section of the city showed more preference for fruits trees (e.g. *Carica papaya*, *Mangifera indica*, *Terminalia catapa* etc), those in the urban part had more preference for ornamental trees (e.g. *Caryota* spp and *Polyathia longifolia*). The benefits derived by inhabitants from trees planted in urban and peri-urban centres of Akure city include: edible fruits/seeds/nuts, fuelwood, ornamental, avenue trees, vegetable, shade, wind break, medicinal herbs, animal fodder, etc (Plate 1). The results of

this study indicated that the socio-economic importance of trees un urban and peri-urban centres depends on the social and educational status of the inhabitants. The socio-economic importance of trees in Akure (in decreasing order of importance) are: ornamental (38%), food/cash crop (36%), timber (11%), shade (9%), life-fence (3%), medicine (3%), cultural purposes (1%). In higher institutions, ornamental (52%) and shade (17%) were the dominant socio-economic importance of trees while in secondary schools, edible fruits (35%) and shade (19%) were the important uses. In the peri-urban section of the city, food/cash crop was the overwhelming (77%) use of trees while ornamental (90%) was the dominant use of trees in urban section. Some trees served dual purposes depending on the social status of their owners. For example, while *T. catapa* and *M. indica* are mostly used for food/cash crop by inhabitants of peri-urban section, they are used for shade in urban section.

Majority of the respondents in urban (93.3%) and peri-urban (91.7%) sections of Akure city consume their tree products or use them for other purposes other than commercial. Thus, only a small percentage of the inhabitants (6.7% and 8.3% of respondents in urban and peri-urban sections, respectively) sold some portions of their tree products (Table 1).

Table 2: Involvement of inhabitant in tree planting and socio-economic importance of urban trees (n=60)

	Urban Section		Peri-urban section	
	Frequency	Percentage	Frequency	Percentage
Involvement in tree planting				
Yes	53	88.3	47	78.3
No	7	11.7	13	21.7
Willingness to plant trees				
Yes	57	95	60	100
No	3	5	-	-
Sale of products from trees				
Yes	4	6.7	5	8.3
No	56	93.3	55	91.7
Annual income generated from the sale tree of products				
Less than ₦10,000	1	25	-	-
₦10,000-₦20000	2	50	3	75
₦20,000-₦30,000	1	25	-	-
₦30,000-₦40,000	-	-	-	-
₦40,000-₦50,000	-	-	-	-
Over ₦50,000	-	-	2	25
Employment potentials of urban and peri-urban forests				
Yes	3	75	4	80
No	1	25	1	20



Plate 1a: High School students playing under trees



Plate 1b: Cars packed under the shade of trees



Plate 1c: Relaxation spot at Alagbaka botanical garden, Akure



Plate 1d: Avenue trees

The dominant products sold by the respondents are edible fruits/seeds/nuts, vegetables and firewood. While none of the respondents in urban section sold firewood, 20% of the respondents in peri-urban section sold fuelwood. 75% and 80% of respondents in urban and peri-urban sections, respectively who sold portions of their tree products used employed labour for activities like harvesting, processing and/or sale of their products. Out of the respondents in urban section of Akure who sold some of their tree products, 50.0% generated annual income of ₦10,000.00 to ₦20,000.00, 25.0% realised ₦20,000.00 to ₦30,000.00 while another 25% generated less than ₦10,000.00 (Table 1). In the peri-urban section of the city, 75.0% of the respondents who sold their products generated ₦10,000.00 to ₦20,000.00 annually while 25.0% generated over ₦50,000.00.

DISCUSSION

The higher population of male respondents in peri-urban part of Akure city could imply higher potential for tree planting in this part of the city than in the urban part. Usually, the male population engage more in tree planting and farming while females are more involved in collection and sale of Non-Timber Forest Products (NTFPs). The higher male population in the peri-urban section of the city may explain the greater willingness to plant trees by inhabitants of this area. Since most inhabitants of the peri-urban section are poor (Fuwape and Onyekwelu, 2011), assistance/incentives may be needed to encourage them to plant trees as suggested by their lower involvement in tree planting when compared to urban section dwellers (Table 1).

Most inhabitants of Akure metropolis (urban and peri-urban) are aware of and benefit from urban forestry, which agrees with the findings of Olorundare (2008). The good education of the inhabitants of urban and peri-urban sections of Akure will influence their acceptability of urban forestry and their willingness to plant trees. Olorundare (2008) reported that education, income and household size had a significant influence in the acceptability of urban forestry by respondents in Ondo and Akure towns. Because of their high level of education, many respondents are aware of the benefits of urban and peri-urban forests. A high percentage of the respondents earned average monthly income of ₦51,000 – ₦75,000, which is an indication of their moderate living standard and implies that they have the financial capacity to plant trees.

Though most people living in Akure indicated that they are involved in tree planting, the urban section inhabitants planted more trees than peri-urban section dwellers, probably because urban section inhabitants earned higher income. The higher preference for planting of edible fruit trees could be attributed to their multiple benefits (e.g. fruits/seeds, herbs, fodders, fuelwood etc). The small portion of urban forest products that were sold by some respondents, in addition to the few people employed in harvesting and/or selling the tree products, are indications of socio-economic potentials of urban and peri-urban forests. It is expected that the sale of urban forest products will improve the livelihood of the people (Praestholm *et al.*, 2002). The planting or maintenance of trees in urban and peri-urban landscapes can provide employment and income generation opportunities through sale of tree products (Long and Nair, 1999; Konijnendijk *et al.*, 2004). Agbelade *et al.* (2016) concluded that UPFs play important socio-economic roles in urban centers in Nigeria through the provision of benefits like food and nutrition (mushrooms, fruits, seeds, vegetables, etc), timber, fuelwood, employment, income, recreation, environmental protection (landscape enhancement, erosion control, etc), health benefits. Onyekwelu (2017) opined that the provision of these NTFPs in urban forests will reduce the rate at which the people go into the natural forests for their collection. Urban forests can enhance urban agricultural production, primarily in agroforestry systems (FAO 2003; Akinbamijo, 2004), thus reducing the rate of conversion of forest land to agricultural land.

Urban and per-urban forests have important environmental and biodiversity values such as biodiversity conservation, carbon sinks, regulating micro-climate, mitigating global warming, etc (McPherson *et al.*, 1997; Harris *et al.*, 1999). The occurrence of 45 and 21 tree species in urban and peri-urban sections of Akure city, respectively shows that the urban section had higher tree species richness than peri-urban section, which could be attributed to the botanical gardens in Alagbaka in urban section of the city, which

contains many tree species. In addition, the higher species diversity index of the urban section (2.85) than the peri-urban section (1.85) of Akure is a further indication of higher biodiversity conservation in the urban section. The diversity index of the urban section of Akure compares favourably with and higher than those of some natural forests (Mgumia and Oba, 2003; Onyekwelu and Olusola 2014). From species evenness (E_H) values obtained in this study, it could be concluded that tree species are most evenly distributed in the urban section compared to the peri-urban section of Akure, probably due to the botanical garden in the urban section. Species evenness value obtained in this study is similar to the result of Onyekwelu *et al.* (2008).

The high population growth in Akure has led to more forest clearing within or surrounding the city metropolis. This has resulted in loss of biodiversity, reduction in urban and peri-urban forest area, etc (Fuwape and Onyekwelu, 2011). The high rate of urban and peri-urban forests removal in Akure calls for increase in establishment urban forests such as botanical parks, avenue trees, community woodlots, etc. The restoration of biodiversity in urban and peri-urban forests is a challenge to forest managers and conservationists today in all part of Akure and Nigeria. Onyekwelu (2017) observed that urban forest contributes to sustainable forest management by producing timber and NTFPs in non-forest lands from urban landscapes to supplement productions from forest lands. Though urban and peri-urban landscapes in West Africa are dominated by indigenous tree species (Long and Nair, 1999), the incorporation of trees in urban and peri-urban landscapes could be constrained by a number of factors including low seed availability, predation of seeds and seedlings, competition with grasses and other non-woody vegetation, soil degradation and unfavourable climate, etc (Onyekwelu *et al.*, 2008).

CONCLUSION

Most inhabitants of Akure metropolis (urban and peri-urban) are aware of and benefited from urban forestry. A high percentage of Akure inhabitants are involved in tree planting. More inhabitants, especially in the peri-urban section of the city, will plant more trees if provided with some incentives. There is higher preference for edible fruit trees due to the multiple benefits derived from them. The money obtained by inhabitants from selling urban forest products, the few people employed in harvesting and/or selling the products are indications of socio-economic potentials of urban and peri-urban forests. There is high tree species diversity in Akure metropolis. The occurrence of 45 and 21 tree species in urban and peri-urban sections of Akure, respectively shows that the urban section had higher tree species richness than peri-urban. In addition, the higher

species diversity index in urban section (2.85) than peri-urban section (1.85) indicates higher biodiversity conservation in urban section of Akure. Thus, the planting or maintenance of trees in urban landscapes can make important biodiversity conservation, environmental and socio-economic contributions to the city and its inhabitants.

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