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ASSESSMENT AND MAPPING OF THE DISTRIBUTION OF FOOD AND MEDICINAL TREE SPECIES IN ABEOKUTA METROPOLIS, OGUN STATE, NIGERIA

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Abstract

The study assessed the distribution and mapping of tree species of food and medicinal values in Abeokuta North and Abeokuta South Local Government Areas of Ogun State. Ten communities were sampled with five from each LGAs and a total of hundred (100) semi-structured questionnaire was administered during the study. Relevant information on the medicinal and food tree species, the uses to which the identified tree species are put, and the parts utilized were collected. Data on the geographic locations of all the trees encountered were also collected. Tree species richness, evenness, relative density, diversity, and conservation status were estimated. Species diversity parameters were compared between the two LGAs using t-test. Descriptive statistics (frequency and percentage) were used for analyzing demographic information and socio-economic data. A total of eight (8) species belonging to six (6) families were identified. Azadirachta indica had the highest relative density (35%). Overall, the diversity was higher in Abeokuta North than in Abeokuta South with 1.23 ± 0.37 and 1.19 ± 0.19, respectively. However, species diversity, richness, and dominance did not differ significantly between the two LGAs. The five most-utilized tree species were Azadirachta indica, Ficus exasperata, Mangifera indica, Morinda lucida and Terminalia catappa. About 69% of the respondents identified urbanization as a possible cause of the decrease of medicinal and food trees. There is, therefore, a need for concerted efforts to ensure that valuable tree species are protected to prevent local extinction. Also, there should be awareness among the people on the benefits of having medicinal and food tree species around them, while taking tree planting campaigns very seriously, at all levels to ensure sustainable environmental management.

Key Words: *Mapping, Food and medicinal trees, Abeokuta, Azadirachta indica*

Introduction

Trees are the unsung heroes of our environment, which provide several ecosystem services, among them are food and medicine (McPherson and Simpson, 2003). The practice of having trees outside the forest includes not only aesthetics but also functions for both environmental and socio-economic uplifting (Kohli *et al*., 1998). Tree products have provided man's needs including shelter, clothing, food, flavours, fragrance, and medicines which

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have been an important part of diets and ethnomedicine for thousands of years (Ugbogu *et al*., 2012). Medicinal and food trees are particularly beneficial to mankind and their importance cannot be overemphasized (Malami and Abdullahi, 2015).

Increasing urbanization and development have placed urban forests under extreme pressure, threatening their ability to maintain the basic ecological functions including water and air purification, upon which human existence depends (United States Department of Agriculture (USDA), 1996). According to Ajewole (2005), the urban environment is generally characterized by impervious surfaces, highly radiating and reflective materials like concrete and metals. These are in addition to the presence of economic activities, such as heating, cooking, and transportation. All of these have an inherent ability to produce immense heat, smoke, and dust, which collectively and severally degrade the environment.

It is estimated that about 80% of the population in developing countries depends on medicinal plants in the treatment of diseases (Bandaranayake, 2006; Ekor, 2014), and those medicinal plants represented a primary health source for the pharmaceutical industries (Veeramuthu *et al*., 2006). According to Dambatta and Aliyu (2011), 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. Also, Nwauzoma and Dappa (2013) 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 orthodox medicine. Consequently, ethnomedicinal plants require adequate and periodic monitoring and assessment, which can help to understand their structures, species composition and aid their environmental perpetuity for use and human survival in such societies.

The uses of GIS technology for assessing tree species distributions have been explored in some of the most advanced countries of the world in the last two decades (Isa and Othman, 2010; Reddy, 2017). However, studies of such kinds are limited in Nigeria due to the non-availability of high-resolution imageries in most cases, and the very high associated costs of imagery pre-processing, processing, and analyses on the other hand (Oke and Akindele, 2022). In most countries, especially in Nigeria, the availability of relevant and current information about the human environment and how it changes over time has been lacking (Ezeomedo and Igbokwe, 2006). This problem has consequently been affecting the achievement of sustainable management. And as such requires research for accurate and timely information that is required for environmental forecasting and planning.

Although studies on using GIS techniques for tree mapping have been carried out in some parts of Nigeria (Oyebade *et al*., 2020; Moshood *et al*., 2023), however, not many studies have been conducted in Abeokuta Metropolis. Thus, there is a need to ascertain the extent of damages and profile information about the existence of valuable medicinal and food tree species to formulate sustainable management strategies and enhance

human survival and living conditions in the area (Adeyemi *et al*., 2015).

Although Adeyemi *et al*. (2015) and Eludoyin *et al*. (2015) investigated species distributions in built-up areas of Imo and Rivers States. However, the information from Abeokuta metropolis has not been captured. The food and medicinal tree species native to this site remain unknown, just as their geographic distributions within the area. Moreover, the purposes for which those locally important species were retained or propagated in the area were not yet documented. Due to lack of information, most of these food and medicinal tree species have been indiscriminately removed by humans for other domestic purposes, and as many more are not aware of their values. Therefore, this study focused on geo-referencing the distributions of available food and medicinal tree species as well as profiling their utilizations which will help in preventing their over-exploitation to ensure their conservation for future purposes.

Methodology

Study Area

Abeokuta is the largest city and state capital of Ogun State in Southwest Nigeria. It is situated on the east bank of the Ogun River, near a group of rocky outcrops in a wooded savanna on longitudes 3°30′ and 3°37′ E and latitudes 7° and 7°5′ N (Figure 1). The city of Abeokuta covers the Abeokuta North and South Local Government Areas of the state. The Yorubas are the main ethnic group in the area, but the original settlers were the Egbas, who founded the historic city. The study area is characterized by two main rocks with scattered hills that are interfluves between different river systems. The minimum and maximum temperatures recorded vary between 24 and 30°C. The area enjoys a rainfall of about 1,000mm in the western part and 2,000 mm in the eastern part. The study area has tropical rainforests with red and sandy soils (Adediwura, 2012). It has a Federal Medical Centre, a university teaching hospital, and several health centres and dispensaries.

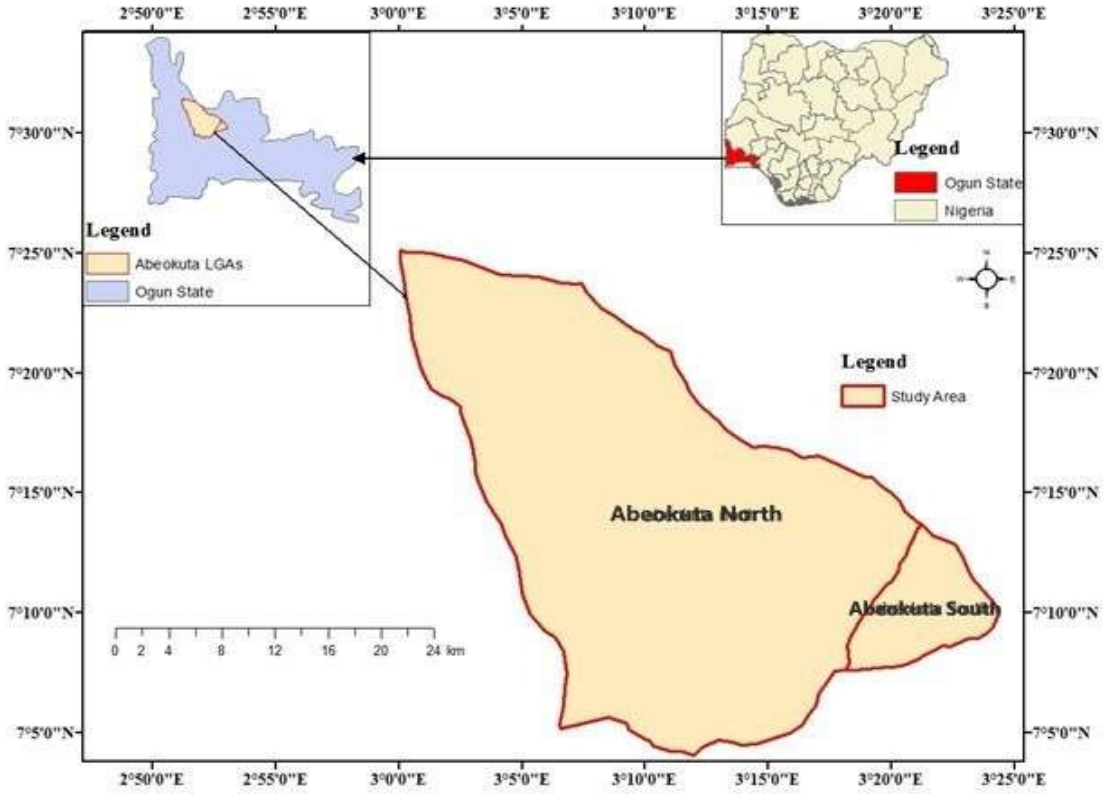

Fig. 1: Map of the study area (inset: Map of Nigeria showing Ogun State and Map of Ogun State showing the study area)

Sampling Procedure and Data Collection

This study was carried out in two local government areas that are within Abeokuta Metropolis (i.e. Abeokuta North and South). The study involved socio-economic and biological surveys. For the socio-economic survey, a two-stage sampling technique was adopted for the study. Each of the two LGAs in Abeokuta Metropolis was divided into political wards, and each of the wards was divided into communities. Five (5) communities were randomly chosen from each of the LGAs. A systematic sampling technique was then adopted for questionnaire administrations to twenty (20) individuals in each of the selected communities, making a total of hundred (100) respondents. Information on the uses to which the tree species in the area are put as well as the preferred species was gathered using a semi-structured questionnaire. The biological survey involved a total enumeration of all food and medicinal trees in the built-up areas with Dbh ≥10cm. The built-up areas were divided into two: residential and non-residential areas, where food and medicinal trees were found. A Geographical Positioning System (GPS) receiver was used to obtain the coordinates of each tree.

Data Analysis

Species diversity was computed using Shannon-Wiener Diversity Index:

$$H' = -\sum_{t=i}^{S} PiIn(Pi) \ldots \ldots (1)$$

Where S = total number of species in the community; Pi = proportion of each species in the sample; ln = natural logarithm.

The species relative density (RD in %) was computed as:

$$RD = \frac{number\ of\ individua\ of\ species}{total\ number\ of\ all\ trees\ in\ the\ study\ area} \times 100 \ldots \ldots (2)$$

The various species were scored according to their relative densities (RD) as follows: Abundant (RD ≥ 5.00); Frequent (4.00 ≤ RD ≤ 4.99); Occasional (3.00 ≤ RD ≤ 3.99); Rare (1.00 ≤ RD ≤ 2.99) and Threatened/Endangered (RD < 1.00) as adopted by Adeyemi *et al.* (2015).

The species evenness was computed using Shannon's Equitability Index:

$$E_H = \frac{H'}{\mathrm{H_{max}}} = \frac{\sum_{t=1}^{S} PiIn(Pi)}{In(S)} \ldots \ldots (3)$$

Where $H_{\max}(ln\ S)$= Shannon's maximum diversity index; H'= Shannon Wiener diversity index; *S* = total number of species in the community; *Pi* = proportion of each species in the sample; *ln* = natural logarithm.

The species richness was determined using Margalef's index, expressed as:

$$D_{mg} = \frac{(s-1)}{1} lnN \ldots \ldots (4)$$

Where *S* = number of species encountered; *N*= total number of individuals in the area.

Descriptive statistics such as frequency, percentage, and mean were used to summarize information on the uses and perceptions of respondents about food and medicinal trees in the study area. Also, inferential statistics (t-test) was used to compare information between the study LGAs. The pattern and spread of the most commonly utilized food and medicinal trees were determined using maps.

Results and Discussion

Demographic Information of Respondents in the Study Area

The demographic information of the respondents in the study is presented in Table 1. Sixteen percent (16%) of the respondents were between 25-35 years old, 35% were between 36-50 years old and 49% were 51 years and above (Table 1). Thirty-six percent (36%) of the respondents were males while 64% were females (Table 1). Two percent (2%) of the respondents were singles, 84% were married, 2% were divorced and 12% were widows/widowers (Table 1). Thirteen (13%) of the respondents had 1-3 members in their household, 38% had 4-6 members and 49% had 7 and above household members (Table 1). In terms of educational qualification, 50% of the respondents had no formal education, 41% had primary education, 6% had secondary education and 3% had tertiary education

(Table 1). Four percent of the respondents (4%) of the respondents were farmers, 43% were traders, 21% were artisans, 20% were civil/public servants and 12% were engaged in other occupations (Table 1). In terms of years of experience, 10% of the respondents had 1-5 years of experience, 40% had 6-10 years of experience and 50% had 11 and above years of experience (Table 1). The highest percentage of people with indigenous knowledge of species was found in people above 51 years old. This corroborates the report of Habibur *et al*. (2011), who observed that elderly persons (above 45 years of age) possess more knowledge regarding medicinal plant use and identification than younger generations. However, while older people have a vast knowledge of the treatment of disorders ranging from simple cuts to incurable diabetes, younger people are knowledgeable only about plants used to treat common ailments such as cuts, wounds, scabies, aching joints, stomach pain, cold, coughs, diarrhea, and dysentery. Ashok and Tripathi (2017) also noted that many of the traditional methods and general knowledge of medicinal flora are being lost to time. As healers and elders age and die, their knowledge dies with them. The results also revealed that most of the respondents were women and were the main custodians of traditional knowledge. This is in line with Habibur *et al*. (2011), who noted that females knew more about the usage of medicinal plants than males. Further investigation revealed that most of the older females in the study area were found to be familiar with the traditional uses of medicinal plants growing in their vicinity.

Table 1: Demographic information of respondents in the study area

Categories	Frequency	Percentage (%)
Age		
25- 35 years	16	16
36-50 years	35	35
51 and above years	49	49
Gender		
Male	36	46
Female	64	64
Marital Status		
Single	2	2
Married	84	84
Divorced	2	2
Widow/Widower	12	12
Household size		
1-3	13	13
4-6	38	38
7 and above	49	49
Level of Education		
No formal Education	50	50
Primary	41	41
Secondary	6	6
Tertiary	3	3
Occupation		
Farming	4	4
Trading	43	43
Artisanship	21	21
Civil/public service	20	20
Others	12	12
Years of experience		
1-5 years	10	10
6-10 years	40	40
11 years and above	50	50

Composition of Tree Species in the Study Area

A total of 392 trees belonging to 8 species and 6 families were encountered during the study and were known to be used for medicinal and food purposes in the sampled communities (Table 2). *Azadirachta indica* was the most frequently occurring species with a relative density of 35% (Table 2). This was followed by *Teminalia catappa and Mangifera indica* with relative densities of 21% and 23%, respectively. The least frequently occurring species in the area were *Adansonia digitata* and *Spondias mombin* with relative densities of 2.3% and 4.6%, respectively (Table 2). *Azadirachta indica* being the most used for medicinal purposes conforms with the report of Sanjay and Rupashree (2014), who noted that *Azadirachta indica* leaves were the most frequently mentioned and utilized homemade herbal medicine. The result showed that six (6) families of tree

species were encountered and mentioned most during this study, most of which are used for food and medicinal purposes. Most of the tree species used for medicinal purposes are also used for food purposes as in the case of *Terminalia catappa, Mangifera indica, Spondias mombin*, and *Adansonia digitata*. This is in line with Agbelade *et al*. (2016), who noted that tree species encountered in urban and periurban centres are used for food, as nutrition supplements, and as medicinal substances.

Table 2: Tree species composition in the study area

S/N	Species	Family	Local names	Rel. density	Freq	Local Status
1	*Adansonia digitata*	Malvaceae	Ose	2.3	9	Rare
2	*Anacardium occidentale*	Anacardiaceae	Kasu	5.4	21	Abundant
3	*Azadirachta indica*	Meliaceae	Dongoyaro	35	136	Abundant
4	*Ficus exasperata*	Moraceae	Epin	5.4	21	Abundant
5	*Mangifera indica*	Anacardiaceae	Mangoro	21	82	Abundant
6	*Morinda lucida*	Rubiaceae	Oowo	4.1	16	Frequent
7	*Spondias mombin*	Anacardiaceae	Iyeye	4.6	18	Frequent
8	*Terminalia catappa*	Combretaceae	Frutu	23	89	Abundant
	Total			100	392	

Diversity Indices of Tree Species in the Study Area

The result of the 't' statistics for comparing species diversity parameters between the two local governments in the study area is shown in Table 3. For the number of species, the mean value for Abeokuta North and South was the same (4.60 ± 1.14) while t_{cal} and p-value were 0.00 and 1.00, respectively showing no significant difference between the means. The mean diversity value for Abeokuta North was 1.23 ± 0.38 and that of Abeokuta South was 1.19 ± 0.19, t_{cal} was 0.25 while the p-value was 0.81 (Table 3). Abeokuta North had a mean value of 0.95 ± 0.21 while Abeokuta South had 1.09 ± 0.19 for richness with t_{cal} of 1.14 and a p-value of 0.29 (Table 3). Abeokuta North had a mean of 0.35 ± 0.15 while the mean value for Abeokuta South was 0.37 ± 0.08, the t_{cal} was 0.32 and the P-value was 0.76 (Table 3). The diversity index value recorded in the two LGAs of the study area were lower than 3.08 reported in Minna, 3.56 reported in Abuja (Agbelade *et al*., 2016) as well as 3.88 reported in Ilorin (Moshood *et al*., 2022). In another study, Duran *et al*. (2006), obtained a diversity indices range of 2.69 to 3.33, which indicated that their study ecosystems were more diverse than that of Abeokuta due to the high loss of trees species to industrialization, road expansions projects, and urbanization. This is in line with Premavani *et al*. (2014), who reported that the plant diversity ranges are declining at an alarming rate due to anthropogenic factors and these may lead to the extinction of many valuable species.

Table 3: Diversity indices of trees identified in the study area

Parameter	LGA	Community	Mean ± SD	t_{cal}	p-value	Remarks
Species	Abeokuta north	5	4.60 ± 1.14	0.00	1.00	ns
	Abeokuta south	5	4.60 ± 1.14			
Diversity	Abeokuta north	5	1.23 ± 0.37	0.25	0.81	ns
	Abeokuta south	5	1.19 ± 0.19			
Richness	Abeokuta north	5	0.95 ± 0.21	1.14	0.29	ns
	Abeokuta south	5	1.09 ± 0.19			
Dominance	Abeokuta north	5	0.35 ± 0.15	0.32	0.76	ns
	Abeokuta south	5	0.37 ± 0.08			

Food and Medicinal Uses of the Identified Tree Species in the Study Area

Plant species belonging to 8 species and 6 families were recognized as being used by the people in Abeokuta for the treatment of various common diseases. Table 4 shows the list of the species, parts used, and uses in the selected communities in the study area. The result further shows that most of the tree species encountered are used alone or in combination with other plants for medicinal purposes to treat one ailment or the other. This is in line with Focho *et al*. (2010), who observed various uses and combinations of medicinal plants with orthodox medicines. Virtually all the species of relevance in the study area are multifunctional or multi-purpose. This agrees with the report of Odugbemi *et al.* (2007), who stated that in the preparation of herb recipes for malaria therapy, single plants (monotherapy) can be used or in combination with more than one plant for greater effectiveness. The combination of these different plants has been proven to be very effective in curing several ailments and dysfunctions associated with malaria in humans. This is also supported by the report of Kadiri (2015), who noted that herbal preparations are more potent in the treatment of disease when the plant's secondary metabolites are in combined form.

Most people in the area make use of one or more of the species identified for either medicinal or food purposes. This corroborates the findings of Onyekwelu and Olaniyi (2012), who opined that urban forestry practices improve food security for poor urban people through the provision of edible vegetables, fruits, and nuts. It is observed that tree species cultured or managed vary from one location to the other depending on local relevance. Consequently, some communities have more tree species than others. This agrees with the study of Neumann and Starlinger (2001), Padalia *et al*. (2004), who stated that tree species diversity in tropical forests differs greatly from location to location mainly due to variation in biogeography, habitat, and disturbance as well as usage. This also agrees with Huston *et al.* (1994), who observed that high diversity relates to an area or community containing a large number of different species.

It was also noted that the part of the tree used mostly was the leaves. This observation agrees with Fadimu (2014), who noted that leaves were the most frequently used plant parts. This observation may be an indication that leaves are a major site for the deposition

of plant secondary metabolites. This however disagrees with Talkmore *et al*. (2015), who observed that roots are usually regarded as the most important part of plants. Bark, leaves, juice, fruits, and roots from the same plant are also used interchangeably by different healers.

Table 4: Utilization of tree species in treating common diseases in the study area

Species	**Parts used**	**Uses/disease it cures**
Adansonia digitata	Leaf, fruit, pulp, and bark	Fever, antimicrobial, kidney and bladder diseases, for flavoring, stomach upset, blood tonic and toothache.
Anacardium occidentale	Bark, leaf, and fruit	Malaria, elephantiasis, leprosy, ringworms, laxatives, and fruits (nuts).
Azadirachta indica	Leaf, stem, bark, and seed	Malaria, fever, jaundice, anthelmintic, syphilis, chewing stick, intestine worms, diabetes, yellow-eyes, antioxidant, stimulant, oedema, (whooping) cough, cold, blood tonic, chest pain.
Ficus exasperata	Bark	Hypertension, enlarged spleen, gonorrhea, stomach disorders, scabies, urinary ailments.
Mangifera indica	Leaf, root, stem, and bark	High blood pressure, skin lesions, insomnia, dysentery, diarrhoea, acute fever, rheumatism, anti-ulcer, wounds, hemorrhoids and edible fruits.
Morinda lucida	Leaf	Malaria and typhoid.
Spondias mombin	Leaf, seed, and juice	Fibroid, cataract (juice of leaves, with lime juice).
Terminalia catappa	Leaf and fruit	For dysentery, toothache, as a laxative, purgative, vermifuge.

Causes of Decrease in Food and Medicinal Tree Species in the Study Area

Table 5 shows the causes of the decrease in food and medicinal trees in the community. Sixty-nine percent (69%) of the respondents indicated that urbanization is the major reason for the decrease in medicinal and food trees in Abeokuta, 21% opined pollution, 8% opined construction as the cause while 2% opined that industrialization is the cause of the declining of medicinal purposes in the study area.

Table 5: Causes of decrease food and medicinal tree species in the study area

Variable	**Frequency**	**Percentage (%)**
Urbanization	69	69
Pollution	21	21
Road construction	8	8
Industrialization	2	2
Total	**100**	**100**

Mapping of Tree Species in the Study Area

The distribution of the five most important food and medicinal tree species in Abeokuta North and South is shown in Figure 2 while the spatial distribution of the tree species encountered in the study area is shown in Figure 3. From the map, it is evident that the tree species distribution in Abeokuta North is more than in the South with tree clusters mostly in the central parts and along roads and streets as avenue trees.

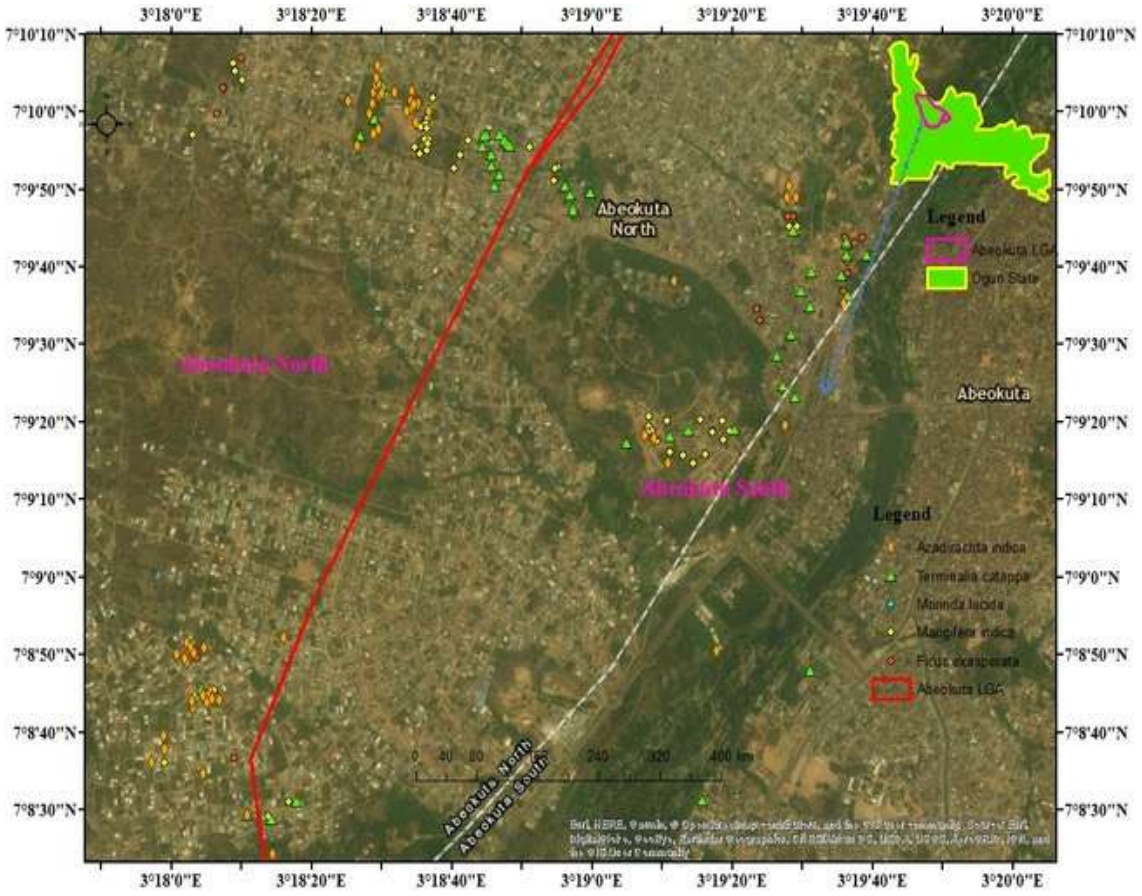

Fig. 2: Distribution of the five most important food and medicinal tree species in the study area

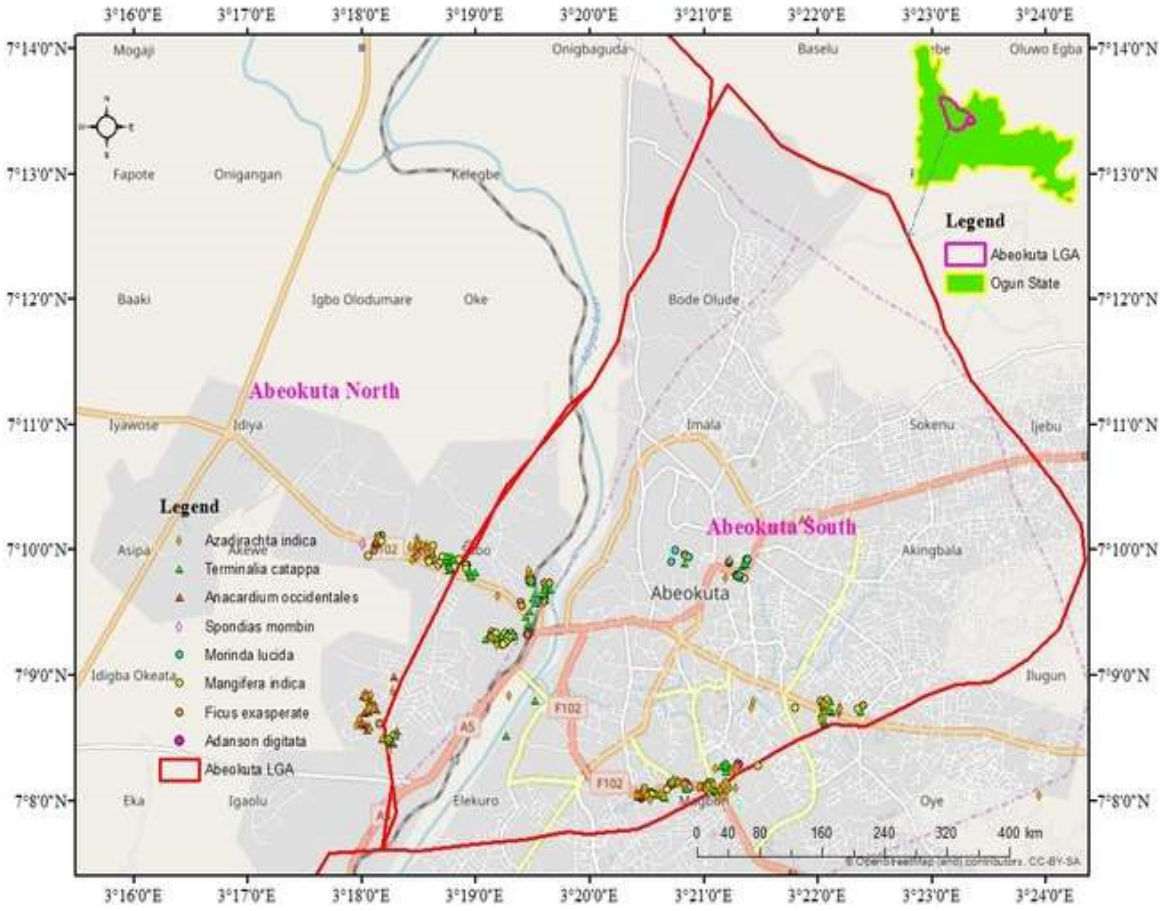

Fig. 3: Spatial distribution of tree species in the study area

Conclusion

This study shows the values that people of Abeokuta North and South attached to food and medicinal trees in their vicinities. It also shows that the identified trees are of importance to them because they help them to alleviate poverty as some people are seen selling some of the medicinal tree species, as seen in the case of *Azadirachta indica* to meet daily needs and improve their health conditions. During this study, it was noted that most residents of Abeokuta North lamented how the trees in their communities have been lost to road expansion and industrialization projects. In this study, eight (8) species of relative importance to people were recorded, and *Azadirachta indica* was at the top of the list of trees used for medicinal purposes. The study also revealed that the residents of Abeokuta appreciate the existence of trees of food and medicinal value, therefore they are ready to protect them. It, therefore, follows that the government should encourage urban tree planting to replace the removed trees that are important to the residents of the area. Also, there should be awareness among the people on the benefits of having medicinal and food tree species around them, while taking tree planting campaigns very seriously, at all levels to ensure sustainable environmental management.

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