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COMPOSITION AND DISTRIBUTION OF ECONOMIC TREE SPECIES IN NAGI FOREST RESERVE, BENUE STATE, NIGERIA

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ABSTRACT

The inventory of economic trees in Nagi Natural Forest Reserve, Benue state was carried out to determine the status and dominance tree species. A total area of 0.4ha was sampled representing twenty percent of the reserve. Ten (10) sample plots of equal size (20 m x 20m) were randomly selected using simple random design. In each plot, all living trees with stem diameter (dbh) ≥10 cm were identified with their botanical names and their diameter at breast heights were all measured. A total number of 84 trees were enumerated on 0.4 ha sample area. The results of the study showed that 19 genera belonging to 15 families were present.Families of Caesalpiniceae, Chrysobalanceae, Euphobiaceae and Leguminosae were dominant with two species each. All other families had only one species each. Based on the results obtained, only three (3) economic tree species out of the 22 protected were found in Nagi forest reserve. These include Prosopis africana, Parkia biglobosa and Khaya senegalensis, with frequencies of 9, 6 and 4, respectively. Prosopis africana recorded the highest mean basal area (0.27m) while Bridelia ferruginea (0.012m) recorded the least basal area. Higher number of stands were recorded in P. africana (9) and the least number of stands were recorded in Daniellia oliverii (2). Also, Prosopis africana was the most dominant while Morinda lucida was the least dominant. Sustainable management of the protected species should be consider as a priority by Government and individual. This can be achieved through establishment of plantation of such protected species. This could prevent the imminent loss of biological diversity that would eventually accompany the exploration.

Key Words: Economic, tree, species, dominant, forest reserve.

INTRODUCTION

Forest provides habitat for organisms that make up earth biodiversity, many small animals use trees as shelter and protection from predators. The natural forest ecosystems have economic benefits potentials to the livelihood of Benue. Tee and Ageende (2005), listed some of these benefits which include: fuel wood, lumber, food, oil, exudates, fiber and medicinal extracts, etc. These economic trees are conserved, but most communities in Benue are lacking conservation ethics.

Deforestation has been attributed to be the aftermath of various activities of man in his daily struggle for survival (Akosim *et al* 1999; Adeduntan (2009). Jatau (2011) reported that the degree of deforestation is enormous over certain periods of time, therefore create a range of species diversity loss when it's not checked, will result to a huge environmental menace. According to Hutcheson and Jones (1999) and; Adeduntan *et al* (2005), habitat fragmentation and distribution are factors that can contribute to environment complexity, which might have affected the structural integrity and diversity of all forest habitat.Benue state Government, in 2010, gazetted twenty two (22) tree species as economic trees under protection. Six years on, the status of these

tree species in reserves within Benue state remains unknown. Sustainable management and utilization of the economic trees in the state requires update information which can be effectively achieved through inventory. Such information is generally inadequate in Nagi Forest Reserve, Benue state. Thus, this study was carried out to determine the status and dominance of economic trees in the area. The loss of forest economic tree species is on increase; over-exploitation and the disappearance of more economic trees and other important species is a threat to Benue state. It is therefore necessary to ascertain the status of these economic trees, their abundance and dominance in the study area; also, to recommend some management measures aimed at improving the status of these tree species.

Study Area.

The Nagi Forest Reserve is located on longitude 8^0 91′ E and latitude 7^0 41′ N. It lies about 12km along Naka – Agagbe road and is located in the guinea savanna vegetation zone (Johnson and Marcellinus,2015).

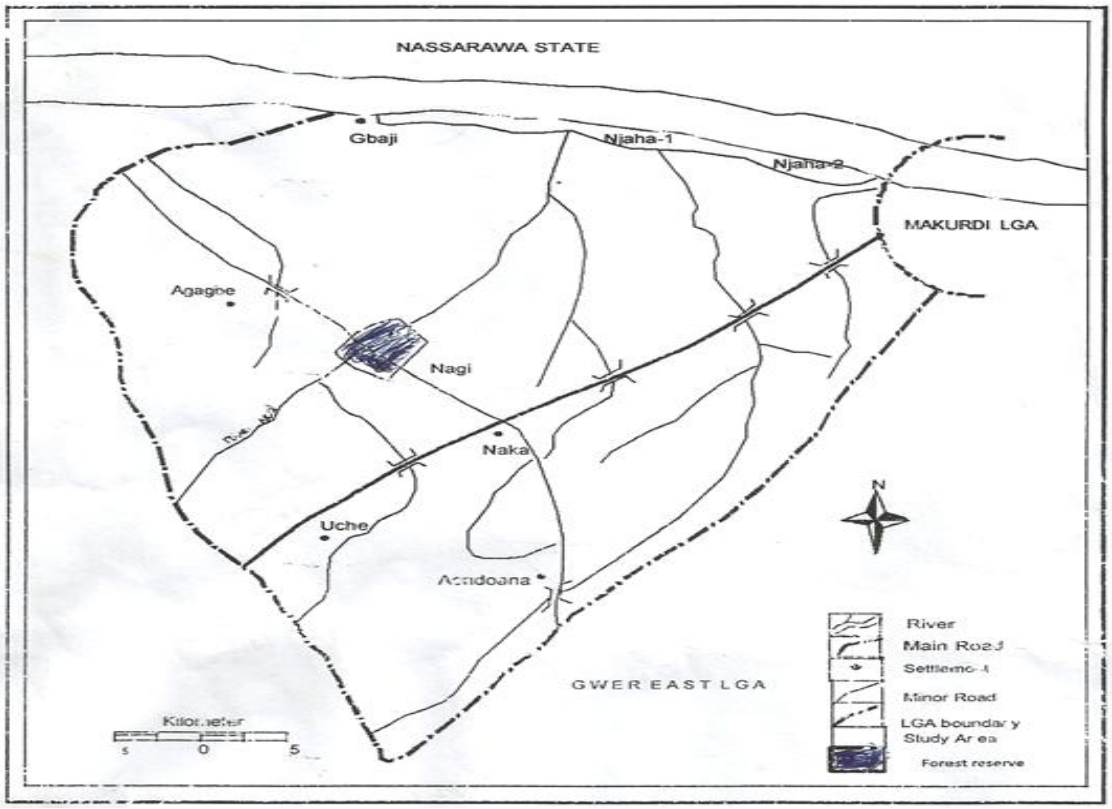

Figure 1: Gwer- West Local Government Area showing the study area (Johnson and Marcellinus, 2015).

MATERIALS AND METHODS

Sampling design

The study area was divided into two hectares. In each hectare, simple random sampling was used to locate sample plots of 20m x 20m which were randomly laid. Within each sample plot, data on all trees ≥ 10cm in diameter at breast height were enumerated. The following variables were measured: Diameter at breast height (DBH), Diameter at base (DB), Diameter at middle (Dm) cm, Diameter at top (Dtop), merchantable height (MH), Total Height (TH).

The instruments used for data collection include: 30meter measuring tape and Spiegel-relascope. Spiegel-relascope was used in measuring the merchantable and total heights of the trees. While 30meter measuring tape was used to measure Bole Height, DB, DM, Dtop.

Survey of economic trees for relative frequency, density, relative density, relative dominance, importance value index, girth and height classes. The basal area of the entire economic trees

encountered in the sample plot in the study area was calculated using the formula:

$$BA = \frac{\pi D^2}{4} \text{ ---------- equation 1}$$

Where; BA = Basal Area (m^2); D = Diameter at breast height (cm)

The total BA for the sample plot was obtained by adding up all the basal area of all the trees in it. The mean basal area was estimated by dividing the total plot basal area by the number of sample plots selected for each location. The BA per hectare was obtained by multiplying the mean by each of the plot with the number of plots in a hectare.

BA_{ha} = Basal Area per hectare

i. Relative Dominancewas obtained using the formula:

$$RD_o = \frac{\sum BAiX100}{\sum BAn} \text{ ----------2}$$

Where; RD_o= Relative Dominance; BAi = Basal Area of individual trees belonging to a particular species; BAn = Standard basal Area

ii. Relative Frequency (RF)was obtained using Oduwaiye*et al* (2002);

$$RF = \frac{\sum Fi}{Fn} X100 \text{ ----------3}$$

Where: RF = Relative Frequency; F_1 = Number of plots where species i would be found; F_n= Total frequency of all species

iii. Importance Value Indexof economic tree species was calculated using the formula below:

$$IVI = \frac{RF+RD1+RD2}{3} \text{ ----------4}$$

Where: IVI = importance value index; RF = relative frequency; RDI = Relative density; RD2 = Relative dominance

RESULTS AND DISCUSSION

Table 1 shows list of tree species gazetted as protected trees in 2010 by Benue state government. Twenty two (22) tree species were identified for protection, only three (3) species were found within the study area. These include *Prosopis africana, Parkia biglobosa* and *Khaya senegalensis* having frequencies of 9, 6 and 4, respectively. *P. africana* was found in seven (7) plots out of the ten plots sampled while *P. biglobosa* and *K.senegalensis* were found in six (6) and four (4) plots respectively. A total of 19 tree species were found in the study area, belonging to 15 families (Table 2). Each family of *Caesalpiniceae, Chrysobalanceae, Euphobiaceae* and *Leguminoceae* was represented by two species while the rest were represented by one species each.

Based on this result, the forest reserve was not adequately protected, if the reserve was well protected, it would have regenerated and provided greater resources. This result agrees with Johnson and Marcellinus (2015), they reported that the Nagi forest has some activities militating against its sustainability, observations showed that certain activities such as farming, lumbering and bush burning are depleting the forest resources.

The tree species with the highest frequency was recorded on *Prosopis africana* which occurred in seven (7) plots and had a total of 9 stands. *Parkiabiglobosa* had a total of 6 stands and is found in 6 plots out of 10 plots sampled. *Detarium microcarpum* had 6 stands and was found in 5 plots out of 10 Plots Sampled. *Danielliaoliverii* was the least with 2 stands and was found in only 2 plots out of 10 plots sampled. The highest mean dbh values were obtained in *Daniellia oliverii* (0.64m), followed by *Prosopis africana* (0.56 m) and *Parkia biglobosa* (0.53); while least dbh values were obtained in *Brideliaferruginea* (0.125m), *Terminalia avicennioides* (0.15) and *Morindalucida* (0.15). The same trend was observed in mean basal area.

Table 1: List of Protected Trees by Benue State Government and their status in Nagi Forest Reserve, Benue state Nigeria

S/No	Tree Species/scientific Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	p10	spp. Freq.
1	*Militia excelsa*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	NE	
2.	*Entandrophragma spp*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
3.	*Khaya grandifoliola*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
4	*Terminalia superba*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
5	*Triplochiton scleroxylon*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
6.	*Afzelia africana*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
7.	*Antiaris africana*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
8.	*Berlina spp*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
9.	*Vitellaria paradoxa*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
10.	*Borassus aethiopum*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
11	*Canarium schweinfurthii*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
12.	*Elaeis guineensis*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
13.	*Khaya senegalensis*	N.E	1	N.E	1	N.E	N.E	N.E	1	N.E	1	4
14.	*Parkia biglobosa*	1	1	1	N.E	1	N.E	1	N.E	N.E	1	6
15.	*Prosopis africana*	2	1	1	1	N.E	2	N.E	1	1	N.E	9
16.	*Terminalia ivorensis*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
17.	*Chrysophyllum albidum*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
18.	*Irvingia spp*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
19.	*Cola acuminate*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
20.	*Dacryodes edulis*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
21.	*Anacardium occidentale*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
22.	*Psidium guajava*	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	N.E	
	Total	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**19**

Key: N.E = Not encountered; P = Plot

Three (3) species out of the 22 protected by the government were found in the study area. This is an indication that their status is actually threatened. Probably this might have informed the state government decision to put them under protection. This result is in accord with Akinola and Akindele (2012), who reported that the vulnerability of Nigeria forestland areas to de-reservation, encroachment and deforestation without protection, control and legislation is completely intolerable and may suffer more wearisome abuse in the future than in the past and present.

P. africana is a high value tree species with the highest frequency value (9) as obtained in the study; the species was found in greater number than any other tree species. The wood is used for carving mortar and pestle; these products are used in every household for pounding yam among other things. The wood is also used for the production of high value charcoal. These harvests are destructive in nature hence the need to protect the tree. The seeds of *P. africana* are used as condiments similar to those of *Parkia biglobosa*. *Khaya senegalensis* and *P. biglobosa* are used as high value timber for construction. *K. senegalensis* is reported to have anti –termite properties, hence is preferred in construction sites. It is also used in curing various ailments. Total of 84 trees were found in the study area, belonging to 19 genera and 15 families on a 0.4 hectare of land. This is an indication that the study area is rich in tree species. There is every possible need to sustainably manage the reserve in order to improve its present status.

Table 2: Economic Trees in *Nagi* Forest Reserve, Benue State, Nigeria

S/no	Species	Family
1	*Lannea schimperi*	Anacardiaceae
2	*Daniellia oliverii*	Caesalpiniceae
	Detarium microcarpum	Caesalpiniceae
3	*Maranathes polyandra*	Chrysobalanceae
	Parinari curatellifolia	Chrysobalanceae
4	*Terminalia avicennioides*	Combretaceae
5	*Antidesma venosum*	Euphobiaceae
	Bridelia ferruginea	Euphobiaceae
6	*Parkia biglobosa*	Fabiaceae
7	*Burkia africana*	Leguminosae
	Pterocarpus erinaceas	Leguminosae
8	*Anthocleista dialogues*	Loganiaceae
9	*Khaya senegalensis*	Meliaceae
10	*Prosopis africana*	Mimosoideae
11	*Ficus sur*	Moraceae
12	*Syzyggium guineense*	Myrtaceae
13	*Lophira lanceolata*	Ochnaceae
14	*Morinda lucida*	Rubiaceae
15	*Vitex doniana*	Verbenaceae

Yield values on per hectare basis are presented in Table 3. The table shows yield characteristics of the tree species measured in the study area, these include: Basal area (BA) and Volume (vol). The highest number of stands per hectare were recorded in *Prosopisafricana* (23), followed by *Detarium microcarpum* (15) while least value was obtained in *Daniellia oliverii* (5). Basal area per hectare in *P. africana* (6.10m^2) was highest, follow by *P. erinaceas* (4.67m^2) and P. *curatellifolia* (4.34m^2). While the lowest values were recorded in *A. dialogues* (0.11m^2), *B. ferruginea* (0.13m^2) and *T. avicennioides* (0.19m^2). The highest volumes (**Ha^{-1}**) were obtained in *P. africana* (12.04m^3), *P. biglobosa* (5.93m^3) and *D. oliverii* (4.25m^3); while the least volumes (**Ha^{-1})** were obtained from *A. dialogues* (0.02m^3), *B. ferruginea* (0.03m^3) and *M. polyandra* (0.04m^3) (Table 3).

Table 3: Yield of Tree Species in *Nagi* Forest Reserve, Benue State - Nigeria

Tree species	**Stems Ha^{-1}**	**BA Ha^{-1} (M^2)**	**Vol Ha^{-1} (M^3)**
Prosopis africana	23	6.10	12.04
Maranathes polyandra	13	1.78	0.04
Parinari curatellifolia	13	4.34	0.11
Detarium microcarpum	15	0.72	4.01
Daniellia oliverii	5	1.63	4.25
Vitex doniana	13	1.91	1.47
Antidesma venosum	13	0.29	0.07
Parkia biglobosa	15	3.52	5.93
Morinda lucida	13	0.23	0.04
Pterocarpus erinaceas	10	4.67	0.12
Burkea africana	10	0.70	0.62
Lannea schimperi	8	0.44	0.33
Terminalia avicennioides	10	0.19	0.03
Anthocleista dialogues	8	0.11	0.02
Lophira lanceolata	10	0.32	0.14
Bridelia ferruginea	10	0.13	0.03
Syzygium guineense	8	0.54	1.39
Ficus sur	8	0.72	0.44
Khaya senegalensis	10	1.35	1.55

Table 3 shows yield volume per hectare; volume is a function of basal area, merchantable height and the number of stands involved. Trees with high number of stems per ha (P .*africana*) tends to have high volume values (Ha^{-1}). *D. microcarpum* though with high number of stands per ha (15) relative to *P .erinaceas* (10 stands per ha), had low volume per hectare because of its low mean dbh (0.047). The results showed high mean volume (vol) in *D. oliverii, P. africana* and *P. biglobosa*.

The yields of these tree species in the study area might have been affected as a result of environmental conditions of the area or probably poor protection and conservation/preservation which have great influence on the yields of tree species. This result is in accord with Johnson and Marcellinus (2015), who reported that areas that are interfered with by human exploitation usually have these components disturbed and the balance disrupted. The effects of the disturbance vary in severity depending on how much of the natural environment is still preserved in the process of resources exploitation and development.

Table 4: Tree Species Dominance in *Nagi* Forest Reserve, Benue State– Nigeria

Tree Species	F	R.F	D	R.D	Dom.	R. Dom.	I. V.I
Prosopis africana	9	10.71	22.5	4.5	2.44	20.45	11.89
Maranathes polyandra	5	5.95	12.5	2.5	0.71	5.95	4.80
Parinari curatellifolia	5	5.95	12.5	2.5	1.74	14.54	7.66
Detarium microcarpum	6	7.14	15.0	3.0	0.29	2.40	4.18
Daniellia oliverii	2	2.38	5.0	1.0	0.47	3.95	2.44
Vitex doniana	5	5.95	12.5	2.5	1.63	13.64	7.36
Antidesma venosum	5	5.95	12.5	2.5	0.76	6.39	4.95
Parkia biglobosa	6	7.14	15.0	3.0	0.14	1.18	3.77
Morinda lucida	5	5.93	12.5	2.5	0.09	0.78	3.07
Pterocarpus erinaceas	4	4.76	10.0	2.0	1.87	15.66	7.47
Burkea africana	4	4.76	10.0	2.0	0.28	2.35	3.04
Lannea schimperi	3	3.57	7.5	1.5	0.17	1.47	2.18
Terminalia avicennioides	4	4.76	10.0	2.0	0.07	0.62	2.46
Anthocleista dialogues	3	3.57	7.5	1.5	0.05	0.38	1.82
Lophira lanceolata	4	4.76	10.0	2.0	0.13	1.06	2.61
Bridelia ferruginea	4	4.76	10.0	2.0	0.05	0.43	2.40
Syzygium guineense	3	3.57	7.5	1.5	0.22	1.82	2.30
Ficus sur	3	3.57	7.5	1.5	0.29	2.41	2.49
Khaya senegalensis	4	4.76	10.0	2.0	0.54	4.51	3.76

Where: F=frequency; R.F= relative frequency; D= density; R.D= relative density; Dom. = dominance; R. Dom= relative dominance; IVI=importance value Index

Table 4 shows the species composition and dominance rating. A total of 84 tree stands were recorded in the study area, belonging to 19 genera. The 3 most dominant species were *P. africana* (2.44), *P. erinaceas* (1.87) and *P. curatellifolia* (1.74). Lower dominance values were obtained in *B. ferruginea* (0.05), *A. dialogues* (0.05) and *T. avicennioides* (0.07); similar trend was observed in importance value index. The importance value rating in Table 4 shows that the most dominant tree species in the forest reserve were *P.africana, P. erinaceas, P curatellifolia* and *V.doniana*. This finding showed that the forest reserve had few economic tree species in the study area. This may be as a result of indiscriminate encroachment/exploitation of the reserve even as the tree species are under government protection. This result agrees with Adeduntan (2009), who reported that natural forests are increasingly being depleted in Nigeria through indiscriminate extraction of economic trees and encroachment.

CONCLUSION AND RECOMMENDATION

A total number of 84 trees were enumerated with 19 genera belonging to 15 families in the study area. The families of C*aesalpiniceae,* C*hrysobalanceae, Euphobiaceae* and *Leguminosae* were the most highly represented, each with two species. All others had only one species each. *Prosopis africana* recorded the highest mean basal area while *Brideliaferruginea* recorded the least basal area. Higher number of stands were recorded in *P. africana* and the least number of stands were recorded in *Daniellia oliverii*. Also *Prosopis africana* was the most dominant while *Morindalucida* was the least dominant. Only 3 species out of the 22 species protected were found in Nagi forest reserve. These include *Prosopis africana*, *Parkia biglobosa* and *Khaya senegalensis*, with *Prosopis africana* recording the highest number of trees.

Based on this study, it is recommended that sustainable management of the protected species should be considered as a priority by Government, Non-Governmental Organization and Individuals through establishment of plantations

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