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ASSESSMENT OF TREE SPECIES DENSITY AND STRUCTURE IN GANGUME FOREST RESERVE BALI LOCAL GOVERNMENT AREA TARABA STATE, NIGERIA

Maiguru, A.A.
Department of Forestry and Wildlife Management. Federal University Wukari, Taraba State, PMB 1020, Nigeria.

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ABSTRACT

Taraba State is one of the states in Nigeria that produce high quality timber. A study to determine the density and stands structure of Gangume Forest Reserve was carried out in Bali Local Government Area of Taraba State, Nigeria. Twenty hectare plots were lay out in the forest and each plot was re-demarcated into four equal sizes of 50m x 50m and one was randomly selected for enumeration. A total of 592 tree species were enumerated belonging to 17 families. The data were analyzed using frequency, percentage, density, basal area, diameter (dbh), and total height of the tree species. The result of the study revealed that the average density was 118 trees/ha, total basal area was 18.2918m2 with an average of 0.91459m2/ha and the diameter distribution revealed that majority (152) 26.0% of the trees falls into diameter class of 20-29cm, followed by 10-19cm (102) 17-2%, and 30-39cm (101) 17.0%. The density was more in the lower DBH from 10cm to 39cm accounting for a total of 380 (64.1) trees in the forest. Four stratum of tree species population structures were identified with the intermediate strata with the highest (201) 33.9% population of trees, followed by the co-dominant with (199) 33.6%, ground floor with (192) 32.4% and the dominant/emergent with only (10) 1.6% population of trees. There is high human activities in the forest despite the fact that the forest has good reproduction and ability of regeneration. The forest should be left undisturbed to regenerate naturally.

Keywords: Gangume Forest Reserve, Trees Density, Basal Area Of Trees, Diameter, Height, Structure.

1. INTRODUCTION

Forest and woodlands contribute significantly to the economic development and environmental security. They support many people including farmers, herdsmen, rural dwellers and many others. They provide protection to watershed; constitute a major source of income, and employment. The poor depend on forests for their basic needs, such as food, fodders, fiber, fuel wood, timber and medicinal plants. They provide the global community with biological diversity, generic materials and carbon sequestration. Deforestation is the major threat and it occur in forest lands where rapid growing population is driven for their basic needs, it become wasteful when trees essential for watershed protection and biodiversity conservation are removed or cleared for agricultural production. These then led to the eroding away of the forest resource base and environmental instability. Loss of forests and trees often also affect the poor directly by destroying a valuable asset on which their livelihood depends and indirectly, by destroying the biodiversity and ecosystems which are essential for the maintenance of life support systems.

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According to Edmond (2005), Nigeria was once covered by wide – spread vegetation comprising of dense tropical forest in the south and Savanna grassland in the North. A great percentage of this luscious vegetation has been cleared by the pressure mounted by human activities. He further pointed out that the forest is being depleted at an annual rate of 3 – 5%. The total change in forest cover from 1900 –2000 stood at about 40 million hectares. Mandie (2003) reported that the Nigeria population is growing at the rate of 2.9% annually. As a result, the forest areas in the country are disappearing at the rate of 2.3% yearly. Gangume Forest Reserve is one of the oldest forest reserve in the state. It was gazette in the year 1957 with a gazette No NN64/1957. It was created for the production of timber. The reserve is surrounded by many communities that the majorities are poor and rely on the forest. Coupled with the poor management of the forest, the forest natural resources are likely to be degraded (World Bank 1990). The reason for the examination of the forest density and structure is to know the number of available variety in the reserve and distribution of the stands that form the forest structure.

2.MATERIALS AND METHOD

2.1 The Study Area

The research was conducted in Gangume Forest Reserve in Bali local government area Taraba State, Nigeria (Figure 1). The area lies between latitude $7^0$30'00'' to $8^0$10'00" North of the equator and longitude $5^0$45'00'' to $6^0$15'00" East of the Greenwich meridian (Taraba State Government 2005). The local government share common boundaries with Ardo Kola and Gassol local government areas in the north, Donga and Kurmi local government areas in the west and Gashaka Local Government from the south. It also share border with Adamawa state in the north-east border. The reserve occupied a total land area of about 62.46km^2. Twenty (20) hectare plots were laid out in the forest. Each hectare plot was demarcated in to four (4) equal sizes of 50mx50m (2,500m^2) out of which one was randomly selected for enumeration. The total land area of 50000km^2 (5ha) was used for the study. Data collected were number of individual trees in each sampled plot, diameter at breast height (dbh) and total height. Equations 1-3 were used for the analysis of the data.

N= $\frac{h}{a} x\ c$ …….equation 1

Where: h = one hectare;
a = area of plot in hectare;
c= number of trees counted in the plot;
N = estimated number of trees/hectare.

The basal area of each tree measured was calculated using Avery and Burkhart (2002) formula is:

BA = $\frac{\pi D2}{4(100)2}$ ----------equation 2

Where: BA = basal Area (m^2);
Π = Constant (3.142);
D = Diameter at breast height (cm)

The total basal area of each tree species were added together to obtained the total per plot. The total basal area per hectare was extrapolated using this formula:

BA = $\frac{h}{a} x\ d$ ……..... equation 3

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Where: BA = basal area per hectare
h = One hectare
a = Area of Plot in hectare
D = Basal area in each plot.
Volume of trees per hectare (VTH)
The volume of trees per hectare was obtained by multiplying the basal of a tree and its height. The basal area of trees per plots were blown up to per hectare.
VTH = Basal Area x height

3. RESULTS AND DISCUSSION

The results on the density of trees in Table 1 shows that Gangume Forest Reserve has an average number (118) of trees per hectare. The average trees density recorded in the study area is higher than the average number (110) of trees per hectare recorded by Maiguru et al. (2019) for Amboi Forest Reserve in Taraba State Nigeria. However, the average density of trees per hectare in the study area is lower than the average number (323) of trees recorded in Afi River Forest Reserve by Aigbe et al. (2014) south – south, Nigeria. The average density of trees recorded in the forest, is also lower when compare with those recorded in Wain River, East Kalimantan with 385/ha and 535/ha (Sidiyasa, 2001). The reason for the low tree density recorded in the study area could be due to excessive human disturbances and for the fact that some large-sized trees would have been removed through logging operation for some uses in the past (Hadi et al.,(2009).

Table 1: Number of Trees / plot / Hectare in Gangume Forest Reserve

Plot Number	Number / plot	Number / Hectare
1	25	100
2	22	88
3	33	132
4	31	124
5	28	112
6	19	76
7	25	100
8	28	112
9	32	128
10	32	128
11	28	112
12	30	120
13	26	104
14	27	108
15	34	136
16	25	100
17	33	132
18	32	128
19	29	116
20	28	112

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Total	592	2,368
Mean	29.6	118.4

Source: Field Survey (2023)

The result on tree basal area in Table 2 revealed that a total of 18.2918m^2 was recorded in the forest with an average of 0.91459m^2 per hectare. Plot 17 had the highest tree basal area 1.48 m^2, followed by plot 16 with 1.3444m^2, and plot 10 with 1,2732m^2, while plot 9 had the least with 0.048m^2. The total tree basal area recorded in the forest can be compared to Amoro forest with 18.5m^2 and others in Afromontane forests in Ethiopia like Kuandishi Afromontane forest (Berhanu et al.2015) and Zengena forest (Tadele et al.2014) However, the basal area of the forest is small compared to the normal basal area value of a virgin tropical forests in Africa with 23.37m^2/ha (Lamprecht 1989). The low tree basal area could be attributed to indiscriminate cutting of trees coupled with the fact that majority of the trees in the forest are within the diameter range of 20-29cm.

Table 2: Tree basal area/plot/ha in Gangume Forest Reserve

Plot No	Basal area/plot	Basal area/ha
1	0.1871	0.7484
2	0.2246	0.2246
3	0.1922	0.7688
4	0.02254	0.9016
5	0.2002	0.8008
6	0.1938	0.7752
7	0.3011	1.244
8	0.2070	0.828
9	0.2620	1.048
10	0.3183	1.2732
11	0.2616	1.0464
12	0.2029	0.8116
13	0.2209	0.8836
14	0.1837	0.7348
15	0.1853	0.7412
16	0.3361	1.3444
17	0.3700	1.48
18	0.2068	0.8272
19	0.2016	0.8064
20	0.2509	1.0036
Total	4.57295	18.2918
Mean	0.2286475	0.91459S

Source: Field survey (2022)

The result on the diameter of trees(dbh) distribution in the forest showed that diameter class of 20-29cm had the highest number 152(26.0%) trees, followed by diameter class of 10-19cm with 102 (17.2%) trees and diameter class of 30-39cm with 101 (17.0%). The diameter class of >90cm had the least 18(3.0%) number of trees. The distribution shows that there was increased in number of trees from diameter classes from (10-79cm), while there was decreased in number

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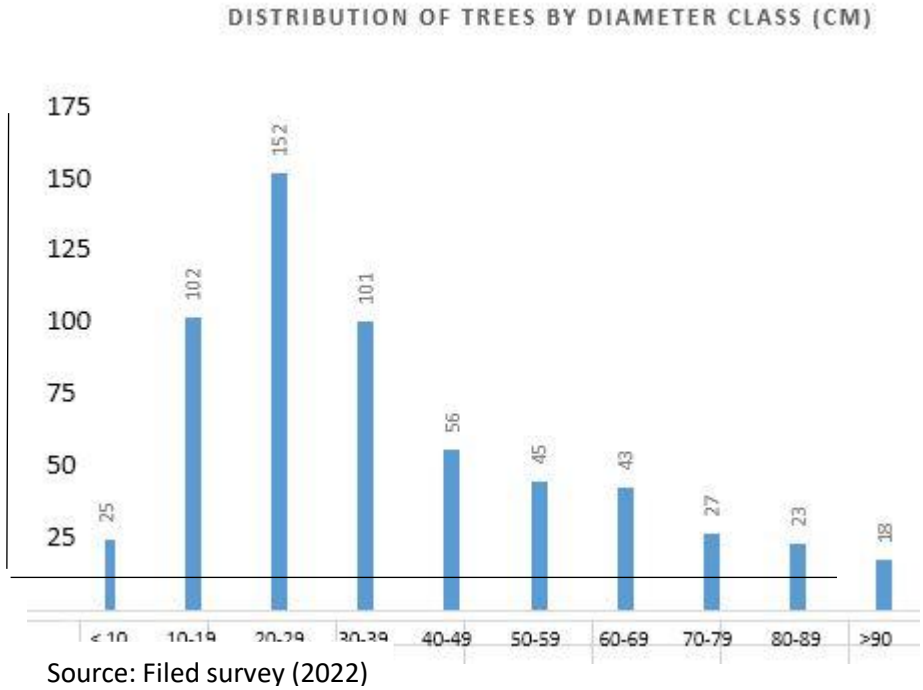
of trees from diameter classes 80 to >90cm. The density of trees was more in the diameter range from (10-39cm) accounting for (64.1%) 380 number of individual tree species indicating that the forest has good reproduction and regeneration potential. The finding is in the opposite with the work of Savadogo et al. (2007) in Tiogo which showed decreased from the lower to higher among in the DBH classes. However, if the forest stands are allowed to mature, there will be a high natural diversity in the forest. The decreased in the
number of trees in the diameter range from >90cm may be attributed to the fact that some large-sized trees must have been harvested in the past and the forest is showing sign of degradation.



Source: Filed survey (2022)

The forest structure

The analysis of the forest structure in Table 3 revealed that tree species in the height class of >40m (Dominant/Emergent top canopy species) were only 10 (1.6%) of the total trees sampled comprising of species of *Erythrophylum suavolens, Ceiba pentandra, Recinodendron heudelotii, Holoptelea grandis* and *Celtis durandii.* The next canopy was the co-dominant with height class range from 29-39m and has a total number of 199 (33.6%) trees. The dominant tree species were *Alstonia boonei, Tetrapleura tetraptera, Treculia africana, Hydrodendron gabunensis, Phyllanthus discoiedeus, Mansonia altisma, Trechillia preurariana, Pycnathus angolensis, Pterygota macrocarpa, Brychystegea eurycoma,* and *Mammea africana.* And also some dominant species like *Holoptelea grandis, Khaya grandifoliola, Celtis durandii, Mitragyna ciliate,* and *Melicea excels*a were found in the co- dominant class. The intermediate canopy with height range from 11-20m had the highest number 201(33.9%) of trees comprising of *Myrianthus arboreus, Dacryodes klaineana, Trilepisium madagascariensis, Craterispermum cerianthum, Funtumia elastic, Tabernaemontana pachysiphon, Monodora spp, and Anthonotha*

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macrophylla, while the ground floor of the forest <10m was dominated by shrubs of various species totaling 192 (32.4%). The species include *Mallotus oppositifolius, Cola digitata, Olax subscpoides, Pandamus candelabrum, Anthonotha macrocarpa,* and climbers like *Calamus deratus, Entada manii, Lacosperma o[pacum, Landophia spp, Dracaena spp, Heisteria parrifolia, and Pycnocoma cornuta.* The common herbs found were in patches include and *Calamus deeratus.* The purpose of this finding was to know whether the forest has a complex structure as the forest with complex structure is thought to be a productive forest. This agreed with O'Hara (1996) who reported that stand structure of a forest was characterized as a progression through stages toward older forest stand, and that disturbances by human beings could move stand structure development backward or forward in the process, depending on their type, severity, and how long is the disturbance.

Table 3: The Forest Structure

Class	Height (m)	No of trees	Percentage (%)
Dominant/Emergent	< 40	10	1.6
Co-dominant	29-39	199	33.6
Intermediate	11-20	201	33.9
Ground Floor	> 10	192	32.4
Total		592	100

Source: Field Survey (2022)

The forest has higher tree density of 118 trees per hectare than Amboi Forest Reserve of the same tropical forest zone in Nigeria despite the fact that the forest is showing sign of degradation as the number of trees with large dbh are very low. The forest has the potential to regenerate naturally if left undisturbed. For now further exploitation of timber species from the forest should be regulated.

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