ASSESSMENT OF STAND STOCKING IN AMBOI FOREST RESERVE, TARABA STATE, NIGERIA

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Abstract: The study was carried out to estimate woody plants stand density in Amboi Forest Reserve in Taraba State, Nigeria. All individual woody plants of ≥ 5 cm diameter in each plot were enumerated. Data collected were the species total heights and diameter at breast height (dbh). The total numbers of trees and basal area from each plot were used to estimate the stands densities. Sixty eight hectare plots of land were demarcated out from the forest. Each hectare plot was re-demarcated into four equal sizes of 50 x 50 m (2500 m^2) out of which one were randomly selected for enumeration. They enumeration covers a total land area of 170,000 m^2 (17 ha). The total number of trees and basal area from each plot were used to estimate plant densities. Diameter tape and halga altimeter was used for the measurements of the species diameter at breast height (dbh and total heights in the respective plots. The result shows that Plots 1 and 5 had the highest number of trees (density) with 37 each while; plot 13 had the least number of trees of 14. The total number of trees encountered in the study area was 7,532 with a mean of 110.8 per hectare. The stand basal area is ranged from 0.151 to 1.77 m^2, and the total basal area obtained in the study area was 63.33 m^2 with a mean of 0.93 m^2 per hectare. Plot 26 had the highest basal area with 1.77 m^2 and plot 33 had the least with 0.60 m. The results showed that the forest is under- stocked and to increase the number of trees in the reserve so as to raise the basal area per hectare of the forest, it is recommended that enrichment planting be carried out using fast growing exotic and indigenous species.

Keywords: Amboi forest reserve, forest stocking, basal area, tree density

Introduction

Forests play important role in maintaining fundamental ecological processes, as well as in providing livelihoods and support economic growth (UNEP 2000; FAO, 2009a). The biological function and richness in diversity of forests help to produce stability in the ecosystems. In addition to ecological importance of forests, a diversity of forest wildlife provides citizens with a wealth of economic and social benefits. Worldwide, the degradation, fragmentation and conversion of forest ecosystems are progressing rapidly (Abramowitz, 1998).

Human activities such as careless exploitation of fuel-woods, logging and shifting cultivation result in degradation, deforestation of forest and forest reserves. Forests are under great anthropogenic pressure and require management intervention to maintain and/or improve their biodiversity conservation, productivity and sustainability (Kumar *et al.*, 2002). Pickett (1995) opined that understanding the factors related to anthropogenic disturbances that affect the forest biodiversity can help conservation managers suggest best practices for forest management. According to Higman *et al.* (2000), the basic requirement of a sound forest management strategy is the availability of reliable database that provides adequate information on the extent, state and potentials of the resources. Akindele (2001) also reported that relevant information about forest resources provide forest managers with the necessary guides for rational decision and management planning as well as its implementation. Stand density measures have widely used as indicators of ecosystem status and they have play critical roles in studies dealing with the assessment of human impact on ecological systems (Leitner and Turner, 2001). Knowledge of stand density in forest management is an essential apparatus to check crowdness and competition of trees in a forest stand. Understanding species density patterns is important for helping forest managers evaluate the complexity and resources of forest.

Amboi Forest Reserve is one of the important biodiversity hotspots in Taraba state alongside Gashaka-Gumti National Park (GGNP) and Ngel Nyaki Forests. There is no information on the forest stocking. The objective of the study therefore is to provide information on the forest stocking which might be a basic requirement for the forest sound management strategy.

Material and Methods

Study area

Amboi Forest Reserve lies between latitude 07^0 10^1N and longitude 10^0 43^1 and 10^0 46^1 E (Ministry of land and survey 2009). The reserve is located 15 Kilometers east of Baissa, the headquarters of Kurmi Local Government Area (L.G.A). Sixty eight (68) hectare blocks were demarcated from the forest. Each hectare was further re-demarcated into four equal sizes of 50 × 50 m (2.500 m^2), out of which one was randomly selected for the assessment. Altogether, a total land area of 170,000 m^2 (17 ha) was used for the study. Data collected were the number of trees, diameter at breast height (dbh) and total height of individual tree in each plot. For the data analysis, the density of each plot was determined using the numbers of trees and calculation of their basal areas per plot to per hectare. The number of trees per hectare was obtained using the method of Avery and Burkhart (2002) as follows:

$N = \frac{h}{a} \times c$ ----------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. The formula is:

$$BA = \frac{\pi D^2}{4(100)^2}$$

Where: BA = Basal Area (m^2); π = constant (3.142);
D = Diameter at breast height (dbh)

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:

$BA = \frac{h}{a} \times d$----------equation 2

Where: BA = basal area per hectare; h = One hectare
a = Area of plot in hectare; d = Basal area in each plot.

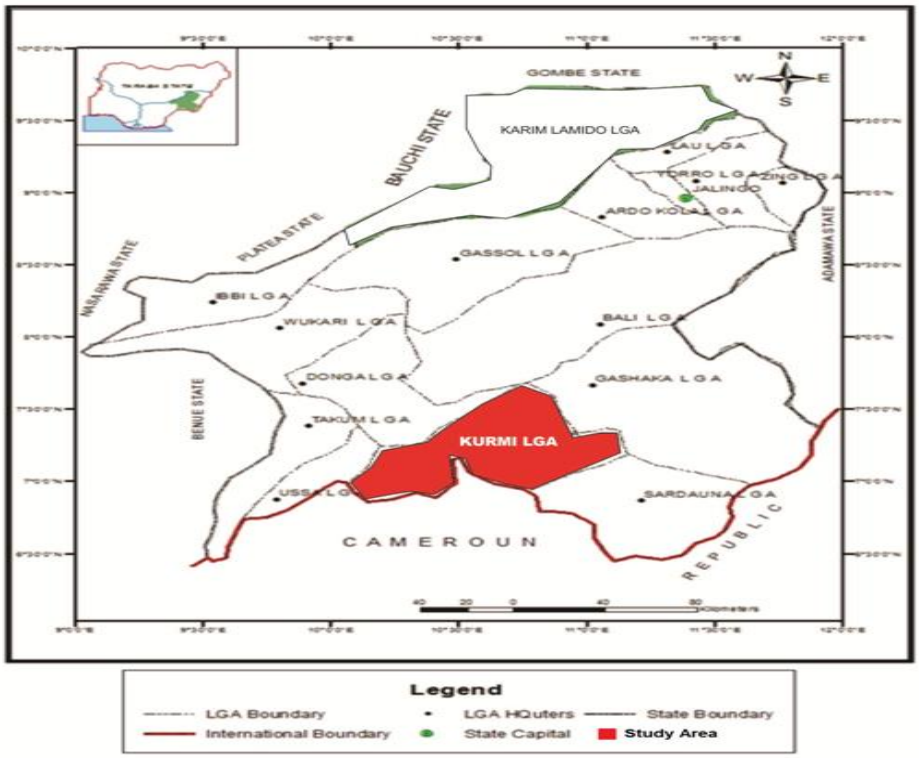

Fig. 1: Map of Taraba State showing Kurmi local government area

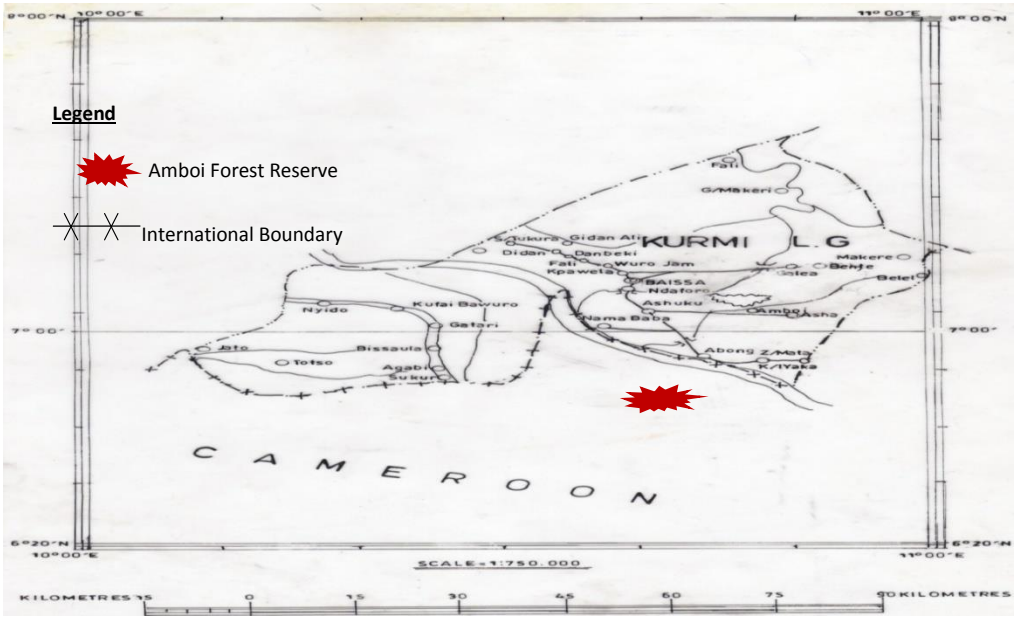

Fig. 2: Map of Kurmi Local Government Area showing Amboi Forest Reserve

Results and Discussion

Table 1 above revealed that a total of 7,538 trees were enumerated in the study area with an average of 110.8 trees per hectare. Plots 1 and 5 had the highest number of 37 **(**148/ha) trees each, followed by plots 42 and 48 with 35(140/ha) each. While plot 13 had the least with 14 (56/ha). The average stand number of trees/ha recorded in Amboi forest is very low when compared with the number of trees per hectare reported in some tropical forests in Nigeria by Adekunle *et al.* (2004) and Jimoh *et al.* (2012) for some tropical forests in Nigeria. This could be due to the local community engagement in the deforestation activities in the forest. The number is also lower than the 152 and 171 trees per hectare reported for tropical Burro Island by Hubbel and Foster (1983) and Thorington *et al.* (1983), and tropical Amazonia forest with 1720/ha (Campbell *et al.*, 1992).

Table 1: Number of trees/plot/hectare in Amboi Forest Reserve

Plot number	Number of trees/plot	Number of trees/ha
1	37	148
2	31	124
3	26	104
4	31	124
5	37	148
6	29	116
7	25	100
8	20	80
9	25	100
10	20	80
11	21	84
12	18	74
13	14	56
14	24	96
15	25	100
16	28	112
17	24	96
18	26	104
19	20	80
20	26	104
21	22	88
22	33	132
23	27	108
24	31	124
25	34	136
26	31	124
27	27	108
28	29	116
29	29	116
30	23	92
31	24	96
32	33	132
33	30	120
34	26	104
35	29	116
36	24	96
37	22	88
38	27	108
39	30	124
40	27	108
41	34	136
42	35	142
43	25	100
44	33	132
45	33	132
46	29	116
47	26	104
48	35	140
49	25	100
50	22	88
51	33	132
52	31	124
53	28	112
54	19	76
55	25	100
56	28	112
57	32	128
58	32	128
59	28	112
60	30	120
61	26	104
62	27	108
63	34	136
64	25	100
65	33	132
66	32	128
67	29	116
68	28	112
Total	1883	7532
Mean	27.6	110.8

Source: Field survey (2015)

Table 2: Basal area/plot/ha in Amboi Forest Reserve

Plot No.	Basal Area Per Plot (m^2)	Basal Area Per Hectare (m^2)
1	0.2977	1.1908
2	0.2745	1.098
3	0.2730	1.092
4	0.1978	0.7912
5	0.2907	1.1628
6	0.2580	1.032
7	0.1795	1.718
8	0.1936	0.7744
9	0.2316	0.9265
10	0.1798	0.7192
11	0.1618	0.6472
12	0.1603	0.6412
13	0.1537	0.6148
14	0.2341	0.9346
15	0.2802	1.1208
16	0.2289	0.9156
17	0.3483	1.3972
18	0.3127	1.2508
19	0.1699	0.6796
20	0.2488	0.9952
21	0.1822	0.7288
22	0.2136	0.8544
23	0.2684	1.0736
24	0.2478	0.9912
25	0.3663	1.4652
26	0.4425	1.77
27	0.2261	0.9044
28	0.2024	0.8096
29	0.2024	0.9828
30	0.1975	0.79
31	0.2019	0.8076
32	0.1887	0.7548
33	0.1510	0.604
34	0.1535	0.614
35	0.1903	0.7612
36	0.2211	0.8844
37	0.1540	0.616
38	0.2884	1.1536
39	0.3070	1.228
40	0.1816	0.7264
41	0.3521	1.4084
42	0.1967	0.7868
43	0.1686	0.6744
44	0.1575	0.63
45	0.2195	0.878
46	0.2626	1.0504
47	0.1435	0.5754
48	0.2902	1.1608
49	0.1871	0.7484
50	0.2246	0.8984
51	0.0921	0.7684
52	0.2250	0.9
53	0.2003	0.8012
54	0.1938	0.7752
55	0.3012	1.2048
56	0.2068	0.8272
57	0.2626	1.0504
58	0.3181	1.2724
59	0.2616	1.0464
60	0.2031	0.8124
61	0.2206	0.8824
62	0.1835	0.732
63	0.1855	0.742
64	0.3359	1.3436
65	0.3702	1.4808
66	0.2066	0.8264
67	0.2018	0.8072
68	0.2505	1.002
Total	**15.8273**	**63.3094**
Mean	**0.2327**	**0.9310**

Source: Field survey (2015)

The low number of trees and basal area/ha experienced in the forest could be attributed to excessive tree felling going on in the forest coupled with indiscriminate bush burning. Considering the importance of the forest to the surrounding communities and the state at large, felling of trees should be regulated in the reserve.

In Table 2, the total basal area recorded in the study area is 63.30 m^2 with an average of 0.93m^2/ha. plot 25 has the highest basal area of 0.36 m^2 (1.77 m^2 /ha), followed by plot 7 with 0.17 m^2 (1.71 m^2 /ha). The least is in plot 33 with 0.15 m^2 (0.60 m^2/ha).The values of basal area in the study area is by far lower than the values reported by Adekunle *et al*. (2004) and Kumar *et al.* (2002) for some tropical forests of the world. The range from 0.60 m^2 to 1.77 m^2 of basal area recorded in Amboi Forest Reserve when compare to the standard basal area recommended by Holland *et al.* (1990) for a fully- stocked forest of 9.18 to 22. 56 m^2 is very low. It is also lower than the 15 m^2 suggested for a well- stocked tropical rainforest in Nigeria by Alder and Abayomi (1994). The low basal area/ha recorded in the forest could be attributed to excessive tree felling going on in the forest coupled with indiscriminate bush burning. It is in correspondence with the low number of trees recorded in the study area. Considering the importance of the forest to the surrounding communities and the state at large felling of trees should be regulated. To prevent extinction of some species and families, urgent steps need to be taken to arrest the dwindling low number of basal area and number of trees per hectare in Amboi Forest.

Conclusion and Recommendations

The study has revealed that Amboi Forest Reserve has an average of 110.8 trees per hectare which is low when compare to number of trees of other tropical rainforest reserves in the world and Nigeria considered for a fully- stocked forest. The basal area estimate obtained per hectare in the study area further suggests that the forest is not well-stocked. Gaps created in the forest were evident of over exploitation of the forest tree species. The forest needs restocking with fast growing indigenous and exotic tree seedlings.

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