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STAND COMPOSITION AND STRUCTURE OF AMBOI FOREST RESERVE IN TARABA STATE, NIGERIA

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The study examined the stand composition and structure of Amboi Forest Reserve in Taraba State, Nigeria. Sixty eight (68) hectare plots were demarcated out in the forest. Each hectare plot was re-demarcated into four (4) equal sizes of 50m x 50m (2,500m^2) out of which one was randomly selected for the assessment. The enumeration covers all individual tree species from ≥ 5cm diameter. Data collected were the lists of the tree, diameter at breast height (dbh) and total heights. Haga altimeter and diameter tape were used for the measurements of the trees total heights and diameter at breast heights (dbh). The result indicates that the forest was composed with 111 trees species belonging to 32 taxonomic families. The family of Fabaceae had the highest number of trees sampled, followed by Moraceae. *Cola digitata* in the family of Sterculiaceae was the most abundant individual tree species in the forest, followed by *Myrianthus arboreus* in the family of Moraceae. The diameter class from 20cm – 29 cm and height class of 10m-19m had the highest number of tress. The structure of the forest showed that majority of the tree species were in co– dominant, followed by the intermediate. The distribution of the trees in diameter and total heights in the forest indicates there are no maximum volumes of produce required annually as a result of over-exploitation. Enrichment planting is recommended in order to sustain the forest.

Keywords: Forest Reserve, forest structure, composition, diameter class, height.

INTRODUCTION

Forest and woodlands contribute significantly to 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, fuelwood, timber and medicinal plants (Laura et al., 2017). They provide the global community with biological diversity, generic materials and carbon sequestration. Deforestation, chiefly caused by the conversion of forest land to agriculture and livestock areas, threatens not only the livelihoods of foresters, forest communities and indigenous peoples, but also the variety of life on our planet (FAO, 2018). It is a major threat and it occurs in forest lands where rapid growing population 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 affects 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.

According to Edmond (2005), Nigeria was once covered by widespread 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. FAO (2005) reported that Nigeria had the largest deforestation rate in the world having lost 55.7% of her primary forest. The Nigerian 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. As a result, the forest areas in the country are disappearing at the rate of 2.3% yearly. Activities such as agriculture, urbanization, road construction, and mining, among others were the driving factors to forest depletion globally.

Amboi Forest Reserve like many other Reserves in the world continues to suffer from these destructive human forces despite the fact that it is one of the important biodiversity hotspots in Taraba State. It is surrounded by many communities out which the majorities are poor and rely on the forest coupled with the poor management of the forest (World Bank 1990). The forest natural resources are likely to be degraded. The reason for the examination of the forest composition and structure is to know the available variety in the reserve and distribution of the stands that form the forest structure.

MATERIAL AND METHODS

The study was carried out in Amboi Forest Reserve in Taraba State Nigeria. The area lies between latitude $07^0$10'N and longitude $10^0$43E (Ministry of Land and Survey 2009) Figure 1. The area is within the lowland rain forest zone of the state. Sample plots of 50m x 50m (2,500m^2) size were laid out in the forest out of which 68 were randomly selected for enumeration. Data collected were species name, total heights and diameter taken at the breast height (dbh) of all woody plants in each plot. Trees were identified by their botanical names and family names by an experienced forest taxonomist and the book on Nigeria trees (Keay, 1989). Tree heights were classified into five strata according to Clutter et al., (1993). Haga altimeter and diameter tape were used for total height and diameter measurements respectively. The data were analyzed by grouping the tree species into their taxonomic families, number, frequencies, and percentages.

RESULTS AND DISCUSSION

A total of 111 tree species representing 31 taxonomic families were identified in the forest during the study (Table 1). The result shows that 1935 individual trees were enumerated during the study. The family of Fabaceae had the highest (13) number of trees represented in the forest with a total frequencies of (273) and 14.11% of the total tree species enumerated, followed by the family of Moraceae with 11, with a total frequencies of 160 and 8.27%, while the least were the families of Guttiferae, Olacaceae, Myristaceae, Myrataceae, Dipterocarpaceae, Pandanceae, and Anacardiaceae represented by one tree each with one (0.1%) frequency. The purpose of this finding is to know whether the forest is rich in species diversity as the forest structure and compositions are instrumental in the sustainability of forests since they play a major role in the conservation of species, and the management of forest ecosystems (Tilman 1988; Ssegawa and Nkuutu 2006). The total number of tree species encountered in the reserve was in agreement with Chapman and (2001), who reported that Amboi forest highlights its botanical significance and that it was vital the area was conserved for its floristic composition and habitat for fauna. Table 2 shows that *Cola digitata* Mast. in the family of Sterculiaceae had the highest (75) 3.9% of individual tree species distribution in the forest, followed by *Myrianthus arboreus* P. Beauv. in the family of Moraceae with 60 (3.1%). The species composition in Amboi Forest Reserve cannot be compared with any previous record because no such study has ever been carried out in the forest. However, the forest is composed with enough tree species, except that human disturbances are high which is bringing the development of the forest backward. This is in agreement with O'Hara et al., (1996) who opined that human disturbances to forest can move the forest development forward or backward. Figure 2 shows diameter distribution of tree species in the forest. A total of 529 (28.0%) of the trees were in diameter class of 10cm – 19cm, followed by diameter class of

Table 1. Forest Stands Composition in Amboi Forest Reserve.

S/N	Family	No of species	Frequency	Percentage
1.	Fabaceae	13	273	14.11
2.	Moraceae	11	160	8.27
3.	Rubiaceae	9	77	3.98
4.	Euphorbiaceae	8	263	13.59
5.	Sterculiaceae	7	171	8.84
6.	Mimosaceae	7	116	5.99
7.	Apocynaceae	6	128	6.61
8.	Meliaceae	5	105	5.43
9.	Papilionaceae	4	18	0.93
10.	Combretaceae	3	65	3.36
11.	Ulmaceae	3	39	2.02
12.	Bombacaceae	3	40	2.07
13.	Annonaceae	3	30	1.55
14.	Palmae	2	43	2.22
15.	Irvingiaceae	2	46	2.38
16.	Balanitaceae	2	6	0.31
17.	Sapotaceae	2	6	0.31
18.	Longaniaceae	2	34	1.76
19.	Verbenaceae	2	60	3.10
20.	Burseraceae	2	13	0.67
21.	Ebenaceae	2	12	0.62
22.	Guttiferae	1	30	1.55
23.	Olacaceae	1	34	1.76
24.	Simaroubaceae	2	29	1.50
25.	Myristicaceae	1	30	1.55
26.	Chrysobalanaceae	2	15	0.78
27.	Myrtaceae	1	20	1.03
28.	Dipterocarpaceae	1	26	1.34
29.	Ochnaceae	2	5	0.26
30.	Pandanceae	1	42	2.17
31.	Anacardiaceaeae	1	2	0.13
	Total	111	1935	100

Source: Field Survey (2015).

30cm – 39cm with 492 (26.1%), while the least was in diameter class of ≥90cm with 3 (0.1%). This result is similar with that of Jimoh et al., (2012) who reported that the largest proportion of trees was in the lowest dbh class (10-50 cm) with 86% and 85% for the close-canopy forest and the secondary forest respectively in Oban Division of CRNP, Nigeria. There was a reduction in the proportion of the trees as dhb increases. According to Kimaro and Lulandala, (2013) and Akinyemi et al., (2002), felling of mature trees for timber, clearing of land for farming, collection of fuelwood and other non-timber forest products, as well as farmers encroachment most likely have affected the quantity and quality of species in many forest reserves.

Figure 3 shows the trees total height distribution in the study area. The result revealed that majority (768) 40.7% of the trees were in the height class of 10m – 19m, followed by 505 (26.8%) in 30m – 39m height, while the least was in ≥ 40m with 7 (0.39%). The co-dominant (29m - 39m) in Table 3, had the highest (893) 46.10% number of trees, followed by

Table 2. Species of trees encountered in Amboi Forest Reserve.

S/N	Name of species	Family	Frequency	Percentage (%)
1.	*Cola digitata*	Sterculiaceae	75	3.88
2.	*Mansonia altissima*	Sterculiaceae	2	0.10
3.	*Cola gigantea*	Sterculiaceae	39	2.02
4.	*Pterygota macrocarpa*	Sterculiaceae	11	0.57
5.	*Sterculia tragacantha*	Sterculiaceae	24	1.24
6.	*Cola hispida*	Sterculiaceae	18	0.93
7.	*Cola mellini*	Sterculiaceae	2	0.10
8.	*Treculia africana*	Moraceae	37	1.91
9.	*Ficus eleasticorides*	Moraceae	13	0.67
10.	*Myrianthus arboreus*	Moraceae	60	3.10
11.	*Antiaris africana*	Moraceae	16	0.83
12.	*Ficus capensis*	Moraceae	7	0.36
13.	*Treculia heudelotti*	Moraceae	3	0.16
14.	*Ficus macroperma*	Moraceae	13	0.67
15.	*Ficus exasperata*	Moraceae	8	0.41
16.	*Bosquiea angolensis*	Moraceae	1	0.05
17.	*Musanga cecropioides*	Moraceae	1	0.05
18.	*Sacoaphalus probequini*	Moraceae	1	0.05
19.	*Klainedoxa gabonensis*	Irvingeaceae	32	1.65
20.	*Irvingia gabonensis*	Irvingeaceae	14	0.72
21.	*Khaya grandifoliola*	Meliaceae	42	2.17
22.	*Trichilia preuriana*	Meliaceae	36	1.86
23.	*Guarea thompsonii*	Meliaceae	1	0.05
24.	*Khaya senegalensis*	Meliaceae	23	1.19
25.	*Trichilia heudelotii*	Meliaceae	3	0.16
26.	*Celtis pentandra*	Bombacaceae	6	0.31
27.	*Ceiba pentandra*	Bombacaceae	31	1.60
28.	*Bombax buonopozense*	Bombacaceae	3	0.16
29.	*Hydrodendron gabonensis*	Fabaceae	21	1.09
30.	*Erythrophleum suaveolens*	Fabaceae	30	1.55
31.	*Brachystegia eurycoma*	Fabaceae	13	0.67
32.	*Afzelia africana*	Fabaceae	20	1.03
33.	*Berlina grandiflora*	Fabaceae	21	1.09
34.	*Daniellia ogea*	Fabaceae	1	0.05
35.	*Daniellia oliveri*	Fabaceae	28	1.45
36.	*Anthonotha macrophylla*	Fabaceae	29	1.50
37.	*Berlinia confusa*	Fabaceae	1	0.05
38.	*Detarium senegalensis*	Fabaceae	12	0.62
39.	*Dialium guineense*	Fabaceae	38	1.96
40.	*Hylodendron gabunense*	Fabaceae	21	1.09
41.	*Funtumia elastic*	Apocynaceae	47	2.43
42.	*Voacanga africana*	Apocynaceae	23	1.19
43.	*Alstonia boonei*	Apocynaceae	4	0.21
44.	*Holarrhena floribunda*	Apocynaceae	10	0.52
45.	*Anglintus arborea*	Apocynaceae	2	0.10
46.	*Ouratea spp*	Ochnaceae	2	0.10

Table 2. Continue.

47.	*Tabernaemontana pachysiphon*	Apocynaceae	42	2.17
48.	*Elaeis guineensis*	Palmae	41	2.12
49.	*Borassus aethiopum*	Palmae	2	0.10
50.	*Auberville aethiopum*	Mimosaceae	16	0.83
51.	*Albizia zygia*	Mimosaceae	18	0.93
52.	*Tetrapleura tetraptera*	Mimosaceae	49	2.53
53.	*Parkia biglobosa*	Mimosaceae	17	0.88
54.	*Prosopis africana*	Mimosaceae	8	0.41
55.	*Albizia adianthifolia*	Mimosaceae	2	0.10
56.	*Trilespisium madagascariensis*	Mimosaceae	6	0.31
57.	*Hanoa klaianpara*	Simaroubaceae	1	0.05
58.	*Hannoa klaineana*	Simaroubaceae	28	1.45
59.	*Parinari glabra*	Chrysobalanaceae	1	0.05
60.	*Ricinodendron heudelotti*	Euphorbiaceae	40	2.07
61.	*Phyllanthus discoideus*	Euphorbiaceae	48	2.48
62.	*Parinari curatellifolia*	Chrysobalanaceae	14	0.72
63.	*Hymenocardia acida*	Euphorbiaceae	15	0.78
64.	*Spondianthrus preussii*	Euphorbiaceae	19	0.98
65.	*Mallotus oppositifolius*	Euphorbiaceae	45	2.33
66.	*Macaranga hurifolia*	Euphorbiaceae	34	1.76
67.	*Antidesma laciniatum*	Euphorbiaceae	3	0.16
68.	*Mitragyna ciliate*	Rubiaceae	21	1.08
69.	*Rothmannia hispida*	Rubiaceae	13	0.67
70.	*Crossopteryx febrifuga*	Rubiaceae	8	0.41
71.	*Nauclea latifolia*	Rubiaceae	4	0.21
72.	*Rothmannia urcelliformis*	Rubiaceae	5	0.26
73.	*Carpolobia alba*	Rubiaceae	7	0.36
74.	*Rothmannia longiflora*	Rubiaceae	14	0.72
75.	*Rothmannia whitefield*	Rubiaceae	1	0.05
76.	*Gardenia imperialis*	Rubiaceae	1	0.05
77.	*Vitex doniana*	Verbenaceae	30	1.55
78.	*Vitex simplicifolia*	Verbenaceae	30	1.55
79.	*Mammea africana*	Guttiferae	30	1.55
80.	*Monotes kerstingii*	Dipterocarpaceae	26	1.34
81.	*Anthocleista djalonensis*	Longamiaceae	27	1.40
82.	*Anthocleista vogelii*	Longamiaceae	7	0.36
83.	*Canarium schweinfurthii*	Burseraceae	8	0.41
84.	*Dacryodes klaineana*	Burseraceae	5	0.26
85.	*Terminalia superba*	Combretaceae	1	0.05
86.	*Anogeissus leiocarpus*	Combretaceae	36	1.86
87.	*Uapaca togoensis*	Euphorbiaceae	59	3.05
88.	*Terminalia glaucescens*	Combretaceae	28	1.45
89.	*Syzygium guineense*	Myrtaceae	20	1.03
90.	*Pycnanthus angolensis*	Myristicaceae	30	1.55
91.	*Pterocarpus erinaceus*	Papilionaceae	1	0.05
92.	*Pterocarpus macrocarpa*	Papilionaceae	5	0.26

Table 2. Continue.

93.	*Pterocarpus mildbraedii*	Papilionaceae	7	0.36
94.	*Afromosia laxiflora*	Papilionaceae	5	0.26
95.	*Cleistopholis patens*	Annonaceae	10	0.52
96.	*Monodora brevipes*	Annonaceae	17	0.88
97.	*Xylopia africana*	Annonaceae	3	0.16
98.	*Lophira lanceolata*	Ochnaceae	3	0.16
99.	*Celtis brownie*	Ulmaceae	22	1.14
100.	*Holoptelea grandis*	Ulmaceae	16	0.83
101.	*Celtis durandii*	Ulmaceae	1	0.05
102.	*Diospyros preussii*	Ebenaceae	11	0.57
103.	*Diospyros mespiliformis*	Ebenaceae	1	0.05
104.	*Pandanus candelabrum*	Pandanaceae	42	2.17
105.	*Olax subscorpioidea*	Olacaceae	34	1.76
106.	*Chrysophyllum albidum*	Sapotaceae	1	0.05
107.	*Synsepalum stipulatum*	Sapotaceae	5	0.26
108.	*Lannea acida*	Anacardiaceae	2	0.10
109.	*Balanites wilsoniana*	Balanitaceae	2	0.10
110.	*Craterispernum ceriathum*	Balanitaceae	4	0.21
111.	*Dialium senegalensis*	Fabaceae	38	1.10
	Total		1935	100

Source: Field survey (2015)

intermediate (11m - 28m) with 768 (39.69%), the least was the dominant (>40m) with 7 (0.39%) trees. The result is dissimilar with that of Jimoh et al., (2012) who showed that the highest proportion of trees belonged to the middle stratum (21-31m), 28% falls into the lower classes (10-21m) and the upper-storey (30-40m) was the third richest stratum. The emergent stratum was represented but only in very small proportions which was quite similar to the result presented in this study. This shows that the forest is not a normal forest that which is with ideal growing stock, ideal distribution of age - classes of component crop and putting in an ideal increment. The result further indicated that higher numbers of tree species diameter and total heights were recorded in the lower classes. This is an indication that the forest trees were dominated by young ones which may take a long period of time before they will reach maturity. Trees in the emergent stratum are difficult to find in many Nigerian tropical rainforests today, due to logging pressures (Jimoh et al., 2012). The fact that we still have them represented in the area is a good indicator of conservation success. This shows that the potential of this lowland rainforest as an ecotourism destination is threatened. This is because the canopy structure is such that the largest proportion of the trees is in the middle canopy, which according to Michael (2001), harbors most species of rainforest wildlife due to availability of food at this level. This presents a good habitat for certain wildlife species which may stimulate ecotourism. The purpose of the finding is to determine whether the forest structure is characterized as one on progression or not. This is in line with O'Hara (1996) who reported that forest structure is characterized as a progression through stage toward the older forest. Moreso, the stand structure has an effect on both the aesthetic and recreational values as well as on the abundance of flora and fauna species (Pitkänen, 1997) and it has become an important factor in the analysis of forest ecosystems (Zenner and Hibbs, 2000).

CONCLUSION AND RECOMMENDATION

Amboi Forest Reserve is composed of 111 tree species, however, there is no previous record to compare whether some tree species have gone extinct or have emerged in the forest. However, the result shows the forest is well composed of tree species. The high number of trees in diameter class

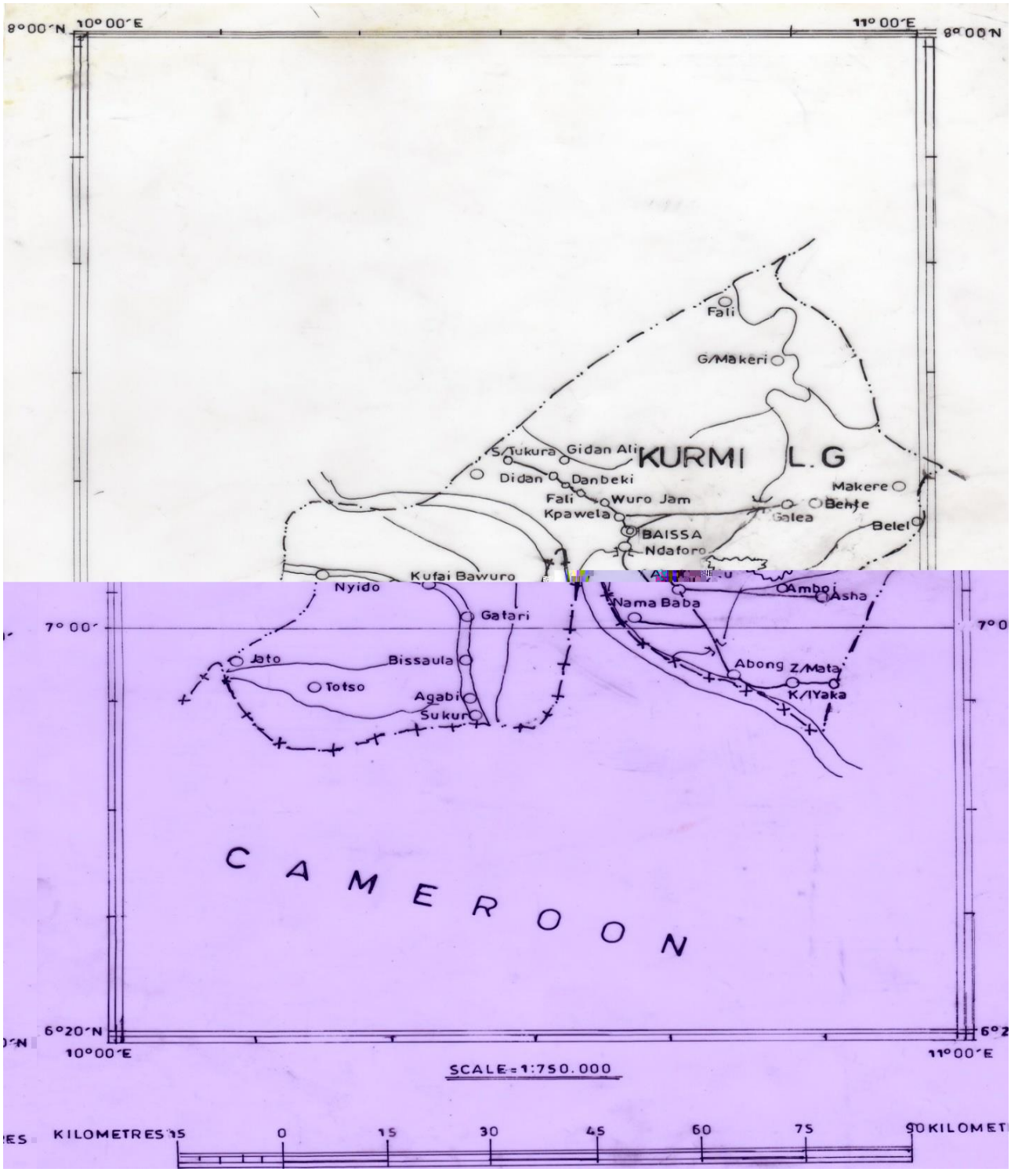

Figure 1. Map of Kurmi Local Government Area showing Amboi Forest Reserve.
Source: Ministry of Land and Survey (2015).

of 20-29 cm and height class of 10m-19m shows high level of over-exploitation in the forest. It is therefore recommended that felling for whatsoever purpose should be suspended and the managers of the forest

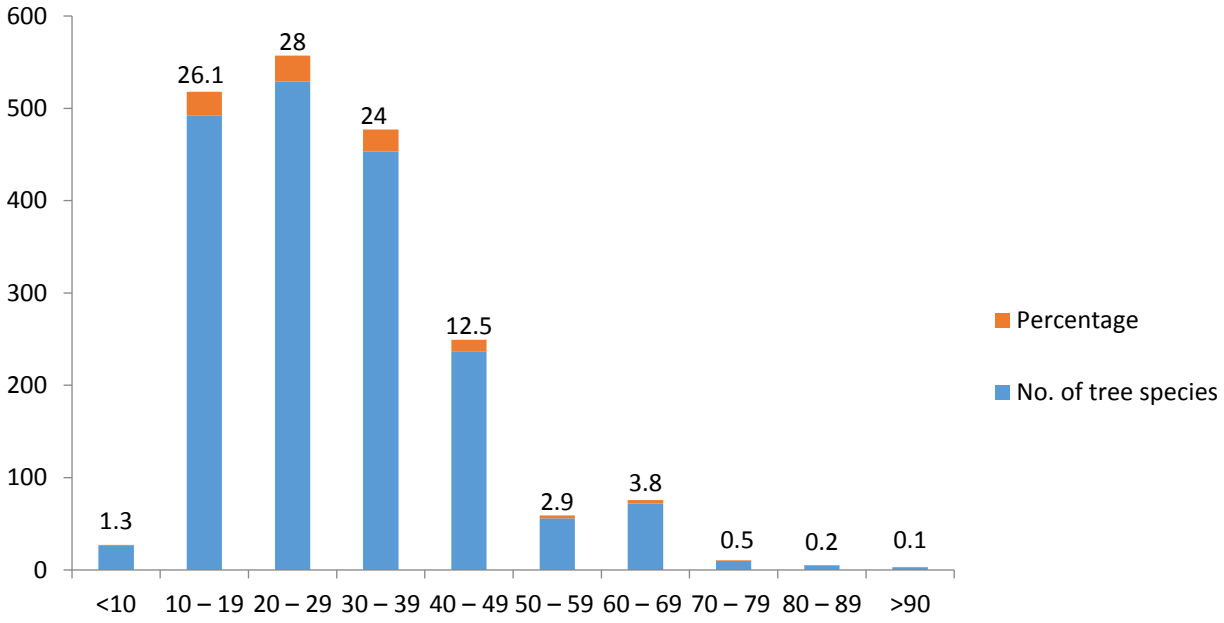

Figure 2. Forest Stand Distribution in Diameter (cm) in Amboi Forest Reserve
Source: Field survey, (2015).

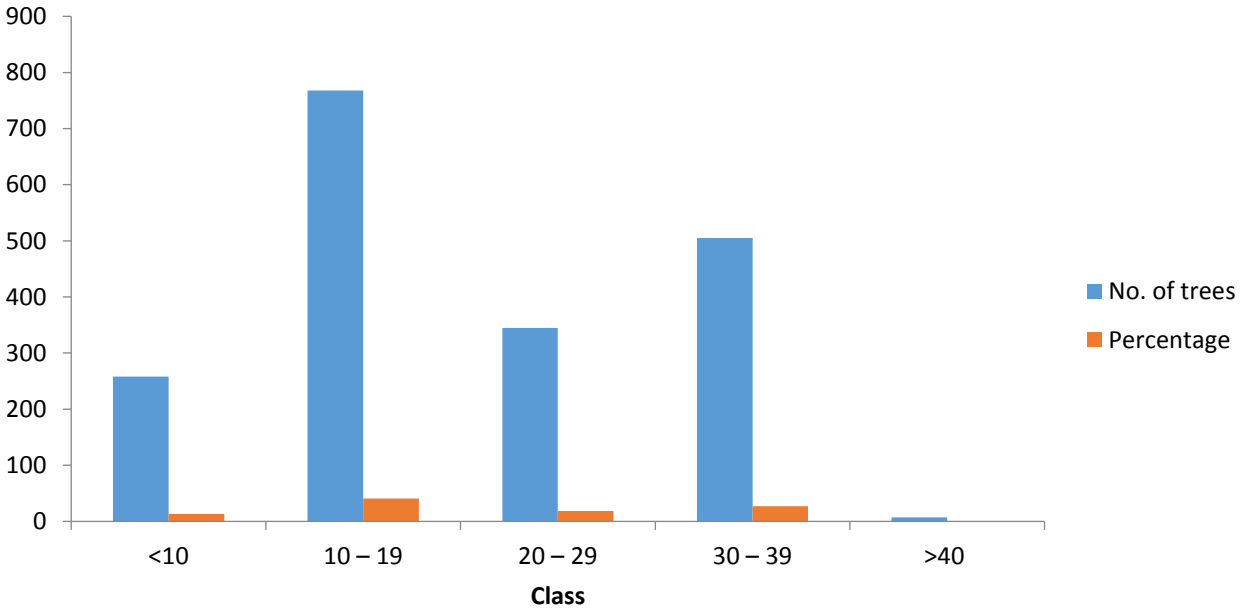

Figure 3. Height Distribution of Tree Species in Amboi Forest Reserve
Source: Field survey, (2015).

should embark on enrichment planting of the forest with fast growing exotic and indigenous tree species

Table 3. Amboi Forest Structure.

Class	Height	No. of trees	Percentage
Dominant	>40m	7	0.36
Co-dominant	29-39	892	46.10
Intermediate	11-20m	768	39.69
Ground floor	<10m	268	13.85
Total		1935	100

Sources: Field survey (2015).

in order to sustain the forest.

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