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TREE DIVERSITY, CONSERVATION STATUS AND UTILIZATION POTENTIALS OF SHASHA RAINFOREST RESERVE, SOUTHWESTERN, NIGERIA

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ABSTRACT

An inventory of the entire tree species ≥10cm diameter at breast height (dbh) was carried out within Forestry Research Institute of Nigeria (FRIN) investigation 133 Shasha in Osun State, Nigeria. This study was carried out to ascertain the tree species diversity, conservation status and utilization potentials in the study area. The results were obtained from 16 sample plots of 50×50m in four tracts located through cluster sampling technique. In all, an average total of 295 stands distributed among 66 tree species and 28 families were encountered. High value of Shannon-Weinner index H'=3.73 and Evenness of E=0.89 were obtained for the reserve. At present, only few trees have attained the merchantable size of 48cm dbh. The 63 tree species in the study site were categorized into four groups namely, stable, vulnerable, endangered and threatened status. The result revealed that stable group had 1.59%, vulnerable 4.76%, endangered 44.44% and threatened 49.21%. Result of the Utilization potentials revealed that utility classes 7 - 8 accounted for 55.6% (comprises of tree species with no potential use for sawn timber), while 45.4%. of trees in classes 1 – 6 comprises of trees with timber potentials. This study highlighted species population diversity, conservation status and utilization potentials of the study site and called for ecological application in the management of forest reserves in Nigeria.

Contribution/Originality: This study contributes to the existing literature on the diversity and conservation of trees in southwestern forest reserves.

1. INTRODUCTION

Forest can be described as an ecosystem dominated by large dense growth of trees and shrubs (Adekunle & Ige, 2006). Nigeria used to act as the reservoir of genetic diversity and potential variability with her immense wealth of plant species belonging to hundreds of genera and scores of families. However, with population pressure and the need to satisfy the demands for food, fuel wood, shelter and developmental projects, millions of hectares of forests have been cleared and the wood burnt off or used as firewood (Igboanugo, 2011). Salami (2011) reported that the tree and protected forest reserves of Nigeria are mainly located in the southern part of the country and it occupied 93,345sq.km in 1993 that is 9.6% of the total land area of the country. This area by 1994 increased to 11.4% and later dropped to 10% in 1995 (CBN, 2001). Oriola (2009) also reported that the rainforest of the southern, Nigeria had been degraded to secondary forest through pressure on the forest reserves due to high population density,

shifting cultivation and annual bush burning, changing the forest into derived savanna. Also, Salami (2011) reported on over exploitation of the rich biodiversity in Nigeria rainforest through uncontrolled logging and conversion of forestland into agricultural plantations and as a result of this, the area covered by rainforest is rapidly shrinking at alarming rate. Today, the removal of trees above carrying capacity has resulted in forest degradations, biodiversity loss and aridity. It has also posed adverse effects on environment. Degraded reserves strongly incurred significantly adverse soil erosion and wasteland (Aina-Oduntan, Adegeye, Akinyemi, & Oloketuyi, 2014). International Union of Conservation of Nature (IUCN) in one of its objectives on the world commission on protected areas recognized and maintained protected areas as natural solution to global challenges such as climate change, land degradation, food and water security, health and disaster risk reduction. Demand for timber resources is increasing at such a rate that forest ecosystem are being destroyed. Sustainability has become an essential issue for combating forest degradation. The aim of this study, therefore is to explored inventory information that could be used to determine the current issues of tree species diversities, conservation status and utilization potentials of Shasha Forest Reserve in Southwestern Nigeria, this will be of help to develop strategies for future conservation and other land use planning in the study area. Also, it will further enhance the sustainable utilization of the resources therein, (Akinyemi et al., 2002; Akinyemi, 2017; Ojo, 1998).

2. METHODOLOGY

2.1. The Study Site

The Reserve is located in Ife South Local Government Area of Osun State. It lies between Latitude 9° 4' and 9° 50'N and longitude 3° 54' and 4° 6'E. The altitude of the forest is 12 2 m.

The soil type is the ferruginous tropical soil on crystalline acidic rock, the topography is gently undulating plain (Adekunle & Ige, 2006). The climate is characterized with long raining season. The rainy season starts from February to November. The climate of the area can also be described as typical of the humid rainforest with total mean annual distribution with two peaks in June and August. Temperature ranges between 23.14 °C in September (coolest) and 28.05 °C in January (the hottest). The annual mean temperature for the reserve is at 25.4 °C. Relative humidity for the reserve also varied between 66.27% in January to 98.96% in October. Mean annual Relative humidity for the area is 85.04%. Shasha forest reserve's vegetation is classified by Keay (1959) along with the rest of the Nigerian high forest as tropical lowland rainforest. Jones (1946) recognized the forest type as dry lowland, distinct from the wet forest of the southern part of the Omo forest reserve.

2.2. Data Collection Method

Systematic cluster sampling\ technique was used for plot location in the study site. The 200 x 500 m area, referred to as clusters was partitioned into sample plots of 50 x 50 m. Sixteen of such temporary plots were selected for tree enumeration, This method was adopted by some authors (Adekunle & Ige, 2006; Adekunle & Olagoke, 2008; FORMECU, 1999; Ozoike, 2002).

2.3. Tree Species Enumeration

All living trees with diameter (dbh) ≥10 cm on each temporary plot were identified, recorded, and grouped into families. For easy identification, the service of a taxonomist from Forestry Research Institute of Nigeria was employed. The botanical names of every living tree encountered in the stud y sites were recorded. Tree growth variable measurement was limited to DBH.

2.4. Data Analysis

Analysis of variance (ANOVA) was used to test for differences in all growth variables and species diversity indices (e.g. number trees per hectare, relative density, species richness and evenness).

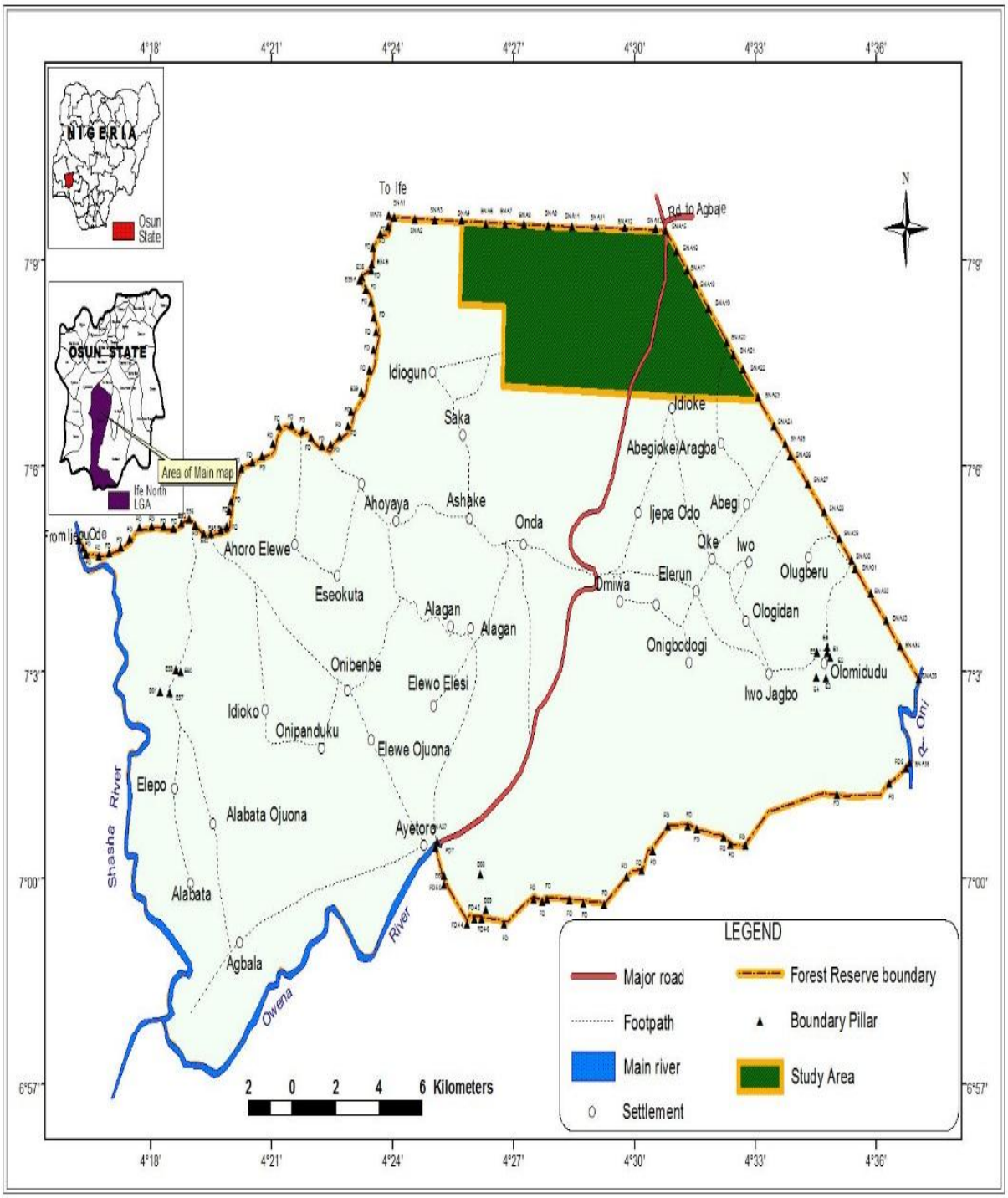

Figure-1. Shasha Forest Reserve.

2.5. Tree Species Diversity Indices

The following indices were employed following Magurran (2004) and Lü, Yin, and Tang (2010) to address objectives 1 and 2.

i. Shannon –Weinner diversity index

$$H' = -\sum_{i=1}^{s} P_i \mathrm{Ln}(P_i)$$

Where: H' is the Shannon Wienner diversity index; S and N_i are the total number of in the community; Pi is the proportion of S made up of the species.

ii. Pielou's species evenness index

$$E = \frac{H'}{LnS}$$

E is the species evenness, n_i is the number of individual in species and Ln is natural logarithm.

2.6. Tree Species Classification According to Utility Classes

The seven utility classes recognized by Adekunle (2002) were used. The first six were categorized as being very useful at present, while the seventh were trees not utilized at present as sawn timber. The classification is as follows.

Utility 1: species utilized at present

1. Plywood and veneers.
2. Furniture and high class joinery.
3. Heavy construction

Utility 2: Utility timber (General purpose woodwork- crates, form wood and others)

Utility 3: Pulp and matches.

Utility 4: Specialised uses (tools and carving mainly).

Utility 5: Capable of reaching 40cm diameter at breast height

Utility 6: Barely reaching 40cm diameter at breast height.

Utility 7: Not commonly utilized as sawn timber

Utility 8: species not utilized as sawn timber

3. RESULTS AND DISCUSSION

3.1. Tree growth variables of Shasha Forest Reserve

Table 1 presented the diversity indices of Shasha forest reseve. The species composition of 295 stands distributed among 66 species and 28 families. The H^+ value of 3.73 occurrence and E value of 0.89.The high value of H is an indication that the reserve is highly diversified while E is also an indication that no single species is having absolute dominance of occurrence. Many species shared equal number of frequency (Akinyemi, 2019).

Table-1. Tree Species Diversity Indices of Shasha Forest Reserve.

Diversity Indices	Shasha FR
Species	66.00
Individuals	295.00
Shannon index	3.73
Sorensis index	0.96
Evenness	0.89
Family	28

Source: Akinyemi (2017).

3.2. Conservation Status and Relative Density of Tree Species in the Study Site

Table 2 presents the results of conservation status and the relative density of tree species encountered in the study site, the result of relative density of species were categorized into four conservation status, namely: stable, vulnerable, threatened and endangered. Stable category comprises of *Strombosia postulata*, (RD=12.88%). Vulnerable category consists of three species which are *Myrianthus arboreus*, (RD=4.41%), *Musanga cecropioides* (RD=5.75%) and *Macaranga bateri* (RD=5.42%), threatened category comprises of 31 species of notable tree species which include *Cleistopholis patens* (RD=1.36%), *Hesalobus ecrispiflorus* (RD=2.02%), *Terminalia superba* (RD=2.03%), *Drypetes gilgiana* (RD=2.71%), *Ricinodendron heudelotii, lannea welwitshii* (RD=3.05%) and *Corynanthe pachyceras* (RD=2.03%).

Table-2. Tree species richness and conservation status of the study site.

Species	No. / ha	RD (%)	Conservation status
Cussonia bancoeusos	1	0.34	Endangered
Laneawel witschii	1	0.34	Endangered
Cleistopholis patens	4	1.36	Threatened
Hexalobus crispiflorus	6	2.03	Threatened
Alstonia boonei	3	1.02	Endangered
Funtumia elastica	8	2.71	Threatened
Holarrhema floribuda	4	1.36	Threatened
Hunteria umbellate	4	1.36	Threatened
Rauvolfia vomitoria	1	0.34	Endangered
Voacamqa Africana	1	0.34	Endangered
Spathoxea campanulata	4	1.36	Threatened
Cordia millenii	3	1.02	Threatened
Hylodeudron gabunense	4	1.36	Threatened
Anthonoth amacrophylla	3	1.02	Threatened
Buchholzia coviacea	3	1.02	Threatened
Terminalia superba	6	2.03	Threatened
Canthium hispidium	2	0.68	Endangered
Dispyros camaliculata	3	1.02	Threatened
Dispyros derudro	9	3.05	Threatened
Dispyros mespiliformis	5	1.69	Threatened
Dispyros piscatorial	2	0.68	Endangered
Dispyros suaveolens	4	1.36	Threatened
Drypetes gilgiana	8	2.71	Threatened
Drypetes paxii	1	0.34	Endangered
Drypetes prinopin	1	0.34	Endangered
Macaranga barteri	16	5.42	Vulnerable
Cicinodendron heudelotii	9	3.05	Threatened
Scotlelia coriacea	2	0.68	Endangered
Memecylon ceudedum	1	0.34	Endangered
Ekebergia senegalensis	1	0.34	Endangered
Entandrophragma angolense	1	0.34	Endangered
Guarea cedrata	5	1.69	Endangered
Trichilia wehoitschii	10	3.39	Endangered
Albizia lebbeck	1	0.34	Vulnerable
Bosquea angolense	2	0.68	Endangered
Ficus exasperate	1	0.34	Endangered
Milicia excelsa	2	0.68	Endangered
Musanga cecropoiodes	17	5.76	Vulnerable
Myrianthus arboreus	13	4.41	Vulnerable
Pycanthus angolense	7	2.73	Threatened
Strombosia postulata	38	12.88	Stable
Baphia nitida	3	1.02	Threatened
Barteri fistulosa	3	1.02	Threatened
Corynanthe pachyyceras	6	2.03	Threatened
Crossopteryx febrifuga	3	1.02	Threatened
Rothmania hispida	1	0.34	Endangered
Zanthoxylllum zenothoxyloides	2	0.68	Endangered
Mophyllus africanus	1	0.34	Endangered
Lecaniodiscus cupanioides	1	0.34	Endangered
Aimageria robusta	5	1.69	Threatened
Onrysophyllum albidium	1	0.34	Endangered
Malacantha alinifolia	4	1.36	Threatened
Hannoa ferruginea	1	0.34	Endangered
Cola gigantean	9	3.05	Threatened
Cola millenii	1	0.34	Endangered
Cola nigerica	6	2.03	Threatened
Mansonia altissima	4	1.36	Threatened
Sterculia rhinopetala	8	2.71	Threatened
Triplochiton scleroxylon	1	0.34	Endangered
Celtis gilgiana	1	0.34	Endangered
Celtis mildbraedii	3	1.02	Threatened
Celtis zenkeri	7	2.37	Threatened
Albizia zygia	2	9.7	Threatened

Endangared species with 22 species comprises of some notable species such as *Cussonia bancoensis* (RD=0.34%), (RD=0.34%), *Alstonia boonei* (RD=1.02%), *Voacanga africana* (0.34%) and *Memecylon candidum* (RD=0.34%).

Tree species status assessment in conservation has its root in the late 1890s when researchers began to use population monitoring as a strategy to determine how populations of different species change over time. Also, the IUCN RED list categorized and criteria are widely used for its authoritative assessment of the global risk for extinction of species (Mace & Lande, 1991).

This study showed great variations in terms of species conservation in the low land forest of Shasha forest reserve. In these findings, only *Strombosia postulata* can be regarded to be stable, this may be as a result of not being currently utilized for sawn timbers.

Majorities of the threatened species are highly demanded for sawn timbers and construction purposes such as *Terminalia superba, Cordia millenii, Alstonia macrophilia, Entandrophragma angolense, Sterculia rhinopetala* etc. all these are referred to as economic tree species and mostly harvested for export purposes. As a result of these, they are always exploited beyond their carrying capacity. Various proportions of conservation status percentage are presented in Figure 2.

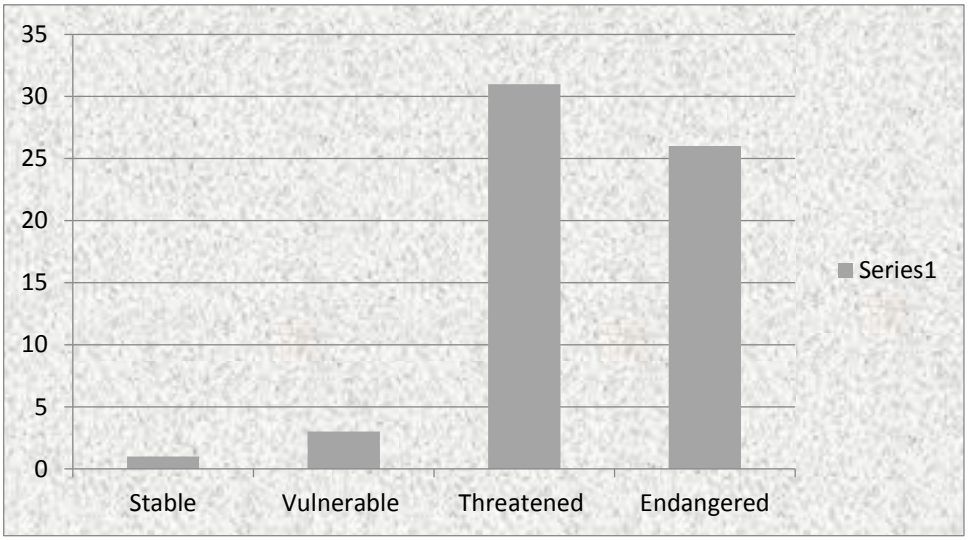

Figure-2. Proportions of tree conservation status. (%).

Tree species encountered in the study site is classified into eight utility classes as presented in Table 3. Utility class 5 had the least distribution (2 species) of trees in the reserve and this is followed by utility class 1 and 7 (4 species each). Utility class 8 had the highest distribution of trees in the reserve and accounted for 39.9% of trees encountered in the reserve.

On the whole, Utility class 1 to 5 accounted for about 40.9% of species utilizable for sawn timber while the remaining 59.1% comprise of tree species with no potential use for timber utility (those in utility classes 7 and 8). Majority of these tree species are not valued for timber due to their maximum size, durability and wood quality (Adekunle, 2002).

Most of the tree species in classes 1 to 5 are generally referred to as economic species and they have been over exploited above the carrying capacity of the ecosystems.

Table-3. Utility Class Distribution.

Utility Class 1	**Tree Species**
Plywood and veneers	Cordia millenii, Terminalia superba Anthonotha macrophylla Sterculia rhinopetala
Utility 2 Furniture and high class joinery	Celtis zenkeri C. mildbraechi Strombosia pustulata, Bosquea angolensis Milicia excelsa Scottelia coriacea Hylodendron gabunense.
Utility 3	
Heavy construction	Sterculia Rhinopetala Mansonia altissima Trichilia, monadelphia Hexalobus crispiflorus.
Utility 4	
Utility timber (General purpose woodwork- crates, form wood and others)	Aningeria robusta, Pycnanthus angolensis, Triplochiton scleroxylon, Macarouga benteri, Lanea ivelwitschii, Cleislopholis patero, Holarrhena floribunda, Zanthoxytheno zanthoxyloidies.
Utility 5 Pulp and matches	Alstonia boonei Diospyros dendo.
Utility 6 Specialised uses (tools and carving mainly).	Corynanthe pachyceras Diospyros caualiculata Diospyros mespiliformis Dusspyros swaveoleus Ricmodendron henedelstu.
Utility 7 Species not commonly utilized as sawn timber Utility 8 Species not utilized as sawn timber	Funtumia africana, Funtumia elastic, Hexalobus crispiflorus, Hunteria umbellate Drypetes gilgiana Drypetes paxii Drypetes pincipun Ekebergia senegalensis Canthium luspaidium Memecylon cauadidum Rauvolfia vomitoria Voacanga africana Buchholzia coriacez Spathodea campavulata Bucholzia coriacea Hunteria unbellata Canthuens inspidium Hylodendron gaburiense Buchholzia coriacea Drypetes fromicipun Scottelia coriacea, Memecylon canadium Ekerbergia senegalense Ficus exasperata Ficus mucuso Myrianthus arboreus Baphia nibda Hexalobus crisififlorus Canthium inspidium.

4. CONCLUSION

The results of this study revealed a habitat that has passed through unsustainable management and over exploitation of forest resources. 66 tree species and 28 families encountered in this study is a proof that the reserve is rich in species diversity. Therefore, it would not be advisable to convert it to monoculture or agricultural plantation due to economic and ecological services derived from natural ecosystem. For the sustainability of the reserve, it could be managed as insitu conservation, while harvesting of the tree species below merchantable size of 48cm dbh should be discouraged. Enrichment of the reserve through introduction of different tree species in all the categories of conservation status is needed in order to restore the diversity status of the reserve.

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