CARD International Journal of Agricultural Research and Food Production (IJARFP)
ISSN: 2536-7293 (Print): 2536-7307 (Online)
Volume 2, Number 2, June 2017
http://www.casirmediapublishing.com

Stand Population and Regeneration of Trees producing Non-Timber products of Economic Values in a Rainforest Estate in Cross River State, Nigeria

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ABSTRACT

The dearth of data is a major factor militating against sustainable multiple-value management of natural forest in Nigeria. Accordingly, stand population and regeneration assessment of tree species producing economically valued non-timber forest products was carried out in Ukpon River Forest Reserve, Cross River State, Nigeria using systematic cluster sampling technique. The data collected were subjected to parametric analysis and descriptive statistical analysis. A total of 16 tree species were encountered, with *Xylopia aethiopica* having the highest population density of 13 per/ha. The highest regeneration population density was recorded for *Gambeya albida* (formerly called *Chrysophyllum albidum*). Most of the trees are of small diameter size. The diameter-class 1 (10-19cm) has the highest frequency of 89, while diameter-class 9 (90 – 99cm) has the least of 2. Most of the species encountered are rare and not capable of sustainable natural regeneration. A legal ban should be placed on their exploitation for timber, and enrichment planting of the forest with their sturdy raised seedlings should be carried out to engender the sustainability of production of their economically valued non-timber products.

Keywords: Rainforest, Non-Timber Products, Trees, Regeneration, Sustainability

INTRODUCTION

A forest is a composite renewable natural resource of multiple values, but often times the value of a tract of forest is estimated from the population density or standing volume of timber tree species present, while much more valuable non-timber products are ignored. This is absolutely improper. The predominant forest type in Nigeria is rainforest. Other forest formations are fresh-water swamp forest and mangrove forest. The Nigerian rainforest is an integral part of the

world tropical rainforest, which has been adjudged as the most biologically diverse terrestrial ecosystem on earth (Turner, 2001; Gillespie *et al.*, 2004; Maazou and Wema, 2011). The rainforest occupies only 9.7% (95,372 km^2) of Nigerian landmass of 983,213km^2 and, only 1986km^2 of the rainforest has been constituted into gazette forest reserves (Onyekwelu *et al.*, 2005 and Akindele, 2012).

Not until recently, the Nigerian rainforest has been managed exclusively over the years for timber production. Consequently, large areas of the rainforest poor in timber tree species, but richly stocked with diversity of valuable non-timber produce, have been replaced with less valuable monoculture forests of mostly fast-growing exotic tree species like *Gmelina arborea* and *Tectona grandis*, farmland and pasture. A great number of tree species in the rainforest produce in addition to timber, various non-timber products which in most cases are much more valuable than their timber products. The non-timber products are mostly food, medicinal items and raw materials for small and cottage industries. Non-timber forest products are particularly important part of multiple-use strategies, because they increase the range of income generating options of forest-dependent communities, while avoiding some of the ecological costs of timber cutting (Ford Foundation, 1998 and Olajide *et al.*, 2010). Incomes generated from most of the non-timber products do not get entered into the national economic ledger to calculate the actual total contribution of forestry to the gross domestic product (GDP). Evaluating from long-term standpoint, non-timber products from forest trees are much more valuable than timber, as the former can be harvested for many years without cutting down the trees and in contrast to timber harvesting, their harvesting activity or extraction has imperceptible perturbation on the rainforest ecosystem (Ella and Domingo, 2014; Udo, 2016).

Obviously, the tropical rainforests have been widely indiscriminately exploited for timber, and subsequently, in many areas, converted to other forms of land use aside forestry. As a result of indiscriminate exploitation of rainforest for timber and widespread destruction, many genetic resources have been consigned to extinction and many

species are on the verge of disappearance. Among the species threatened by extinction are trees producing, in addition to timber, economically valuable non-timber products. Regrettably, it is not yet possible to establish most of these trees in plantation environment, because of a number of silvicultural and ecological constraints, which include poor viability of seeds, endemic pests and diseases and very slow growth rate. However, most of these constraints are greatly alleviated while the trees regenerate and grow in the floristically diverse natural habitat (Olajide *et al.*, 2010). It presupposes that the continuous availability of the non-timber products of these trees depend on sustainable management of the remaining areas of the tropical rainforest.

Sustainable forest management, particularly for tropical rainforest, will be a mirage without quantitative ecological data relating to stock density of mature tree stands, tree regeneration and tree population structure. This paper, therefore, is a report of a study on the stock density of mature stands and regeneration of tree species producing non-timber products of commerce in a rainforest reserve. It is hoped that the ecological data and information gathered would help conservation of the tree species in particular and sustainable management of forest as a whole.

MATERIALS AND METHODS

Study Area

The study was conducted in Ukpon River Forest Reserve, which is located in Cross River State, Nigeria (Fig. 1) The area lies between latitudes 5°41' and 557'N and longitude 8°13' and 8°31'E. The forest reserve is a secondary rainforest. It covers an area of about 31,380 ha (Dun *et al.*, 1994). The vegetation of the area is the West African lowland evergreen tropical rainforest. Like any other tropical rainforest, the forest reserve has a complex structure, which is stratified both vertically and horizontally. The area has annual rainfall of 2,500 – 4,000mm per annum, mean minimum and mean maximum annual temperatures of 24°C and 30°C respectively, and relative humidity range of 70% - 80%. The soil type is clay-loam,

mixed with gravels in most parts. The topography is undulating, having many hills and valley, with many rivulets, which empty into the Ukpon River.

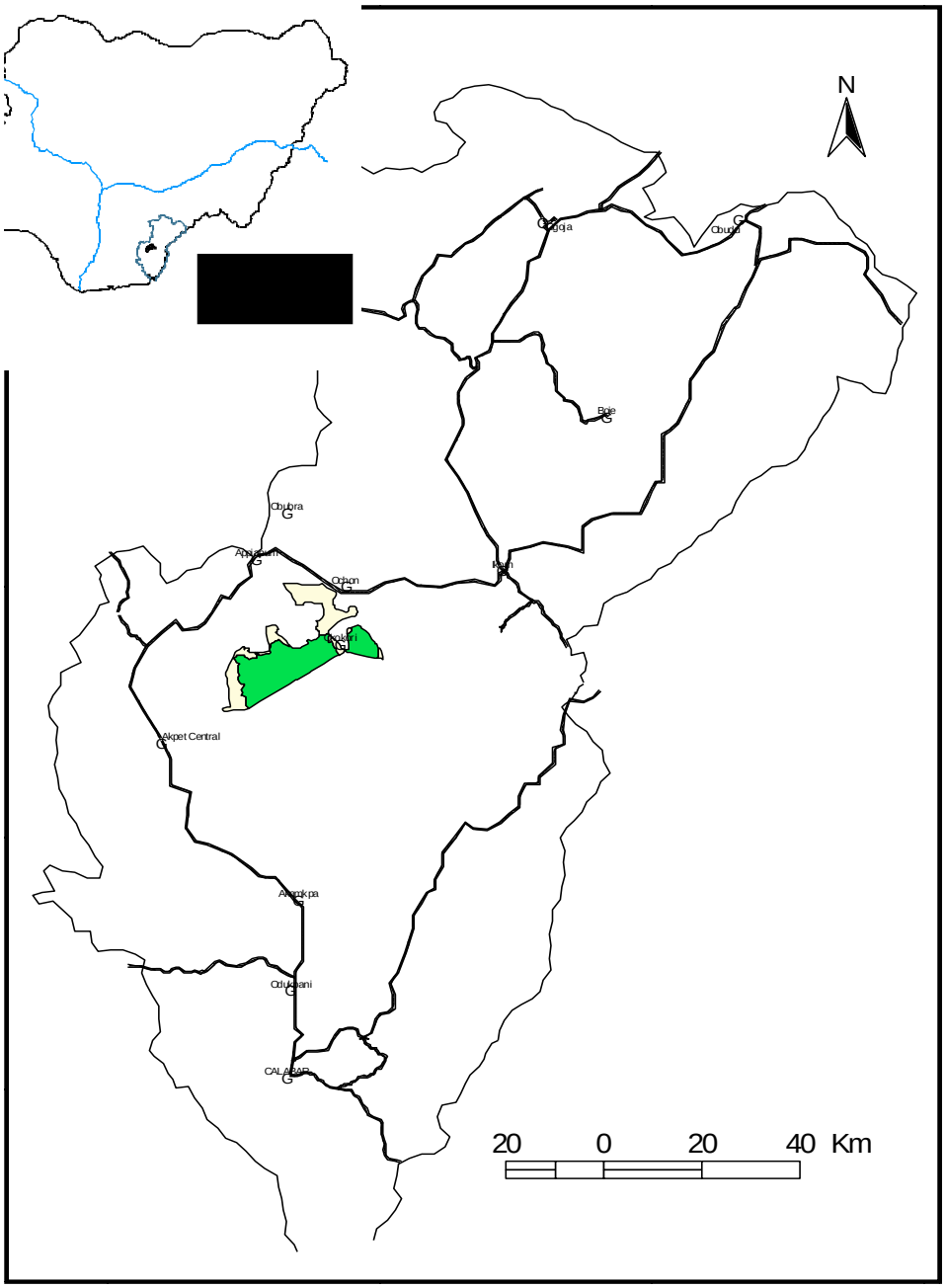

Figure 1: Map of Cross River State showing Ukpon Forest Reserve
Source: Cross River State Vegetation Map of 1991 Aerial Photographs

Data Collection

The systematic cluster sampling technique was adopted for the data collection. This method involved laying two clusters in the forest estate. Each cluster consisted of 1,000 metres (1km) long baseline with 200m x 200m tract at each end (FORMECU, 1997; Abayomi, 2001; Akindele *et al.*, 2001). The two tracts in each cluster were therefore separated by a distance of 600 metres. Every tract consisted of four sample plots of 50m x 50m each, located at the four corners of the tracts for the enumeration of mature trees (Fig. 2). At the right hand corner of each 50m x 50m sample plot, a 10m x 10m sub-plot was laid for the enumeration of tree regeneration (juvenile trees). Each cluster therefore comprised eight sample plots which totaled two hectares, implying that an area of 40,000m^2 (4ha) was assessed for mature trees, while 1,600m^2 (0.16ha) was assessed for the tree regeneration. Trees having diameter at breast height (dbh) ≥ 10cm were considered as mature trees, while those with dbh < 10cm were deemed tree regeneration. Therefore, mature stands of tree species producing economically valued non-timber products were identified and enumerated in the sample plots, while their regeneration were enumerated in the sub-plots (Fig. 2).

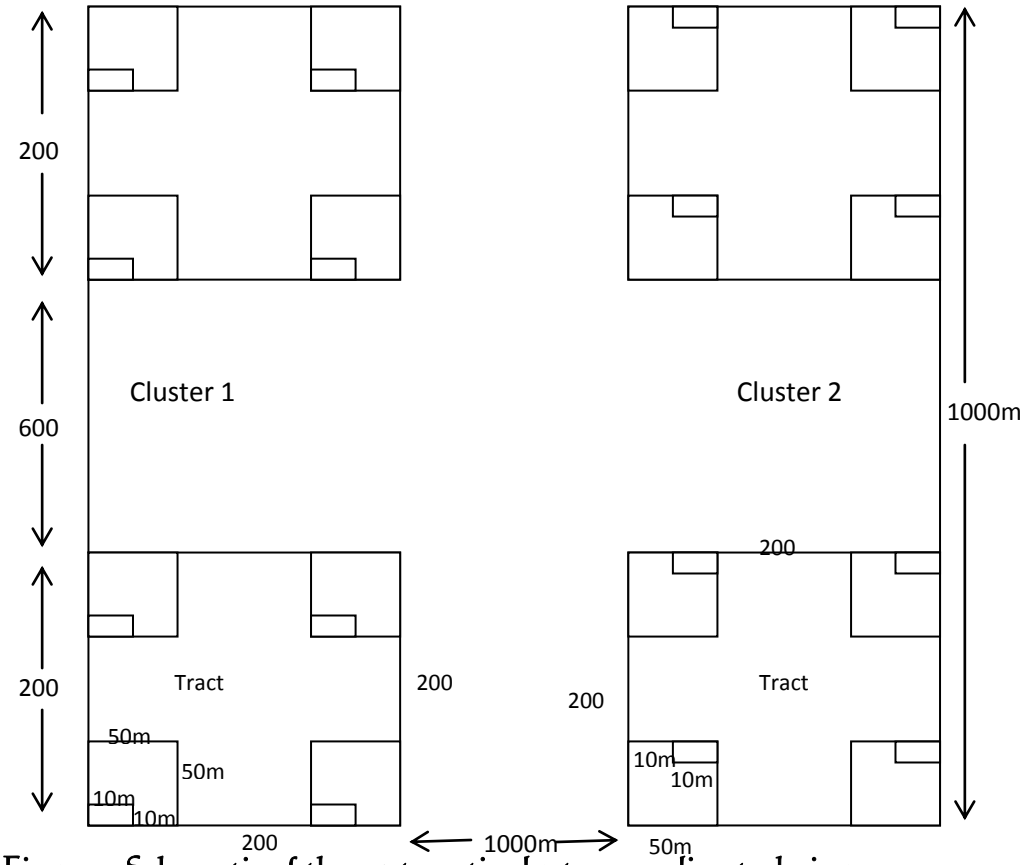

Figure 2: Schematic of the systematic cluster sampling technique

Data Analysis

The population density of mature stand of individual tree species was estimated on per/ha basis from the total area sampled (4ha). The population density of regeneration was extrapolated from 0.16ha being the total area assessed for regeneration. Diameters at breast height (Dbh) distribution frequency of the mature trees was analysed according to the following classification: 10 – 19cm (class 1), 20 – 29cm (class 2), 20 – 39cm (class 3), 40 – 49cm (class 4), 50 – 59cm (class 5), 60 – 69cm (class 6), 70 – 79cm (class 7), 80 – 89cm (class 8), 90 – 99cm (class 9) and 100cm (class 10).

RESULTS

A total of 16 tree species (with or without both mature stand and regeneration) were encountered. *Xylopia aethiopica* had the highest population density of 13 mature stands per/ha, while the mature stand of *Tetrapleura tetraptera* was not encountered (Table 1). The highest

regeneration population density of 131 per/ha was recorded for *Gambeya albida* (formerly called *Chrysophyllum albidum*), while the regeneration of five species were not encountered, namely*; Alstonia boonei, Dacryodes edulis, Dialium guineense, Ricinodendron heudelotii* and *Vitex oxycuspis* (Table 1). Most of the trees are of small size of diameter-classes 1, 2 and 3 (Table 2). Diameter-class 1 (10 – 19cm) has the highest stand frequency of 89, while diameter-class 9 (90 – 99cm) has the least of 2 (Table 2). The non-timber products of economic importance from these trees vary from edible fruit and seeds, medicinal fruit and seeds, edible oil, leafy vegetable, medicinal leaves and bark (Table 1).

Table 1: Population density and non-timber products of tree species in Ukpon river forest reserve, Cross River State, Nigeria

S/N	Tree species	Mature stand (per/ha)	Regeneration (per/ha)	Non-timber product
1.	*Allanblackia floribunda*	4	19	Edible oil from the seeds
2.	*Alstonia boonei*	1	-	Medicinal leaves and bark
3.	*Baillonela toxisperma*	2	38	Edible oil from the seeds
4.	*Brachystegia eurycoma*	2	13	Edible seeds
5.	*Gambeya albida* (formerly *Chrysophyllum albidum*)	6	131**	Edible fruit
6.	*Coula edulis*	2	19	Edible nuts
7.	*Dacryodes edulis*	4	-	Edible fruit
8.	*Dialium guineense*	1	-	Edible fruit
9.	*Enantia Chlorantha*	1	6	Medicinal bark
10.	*Irvingia gabonensis*	7	6	Edible fruit and nuts
11.	*Pentaclethra macrophylla*	1	25	Edible and medicinal seeds
12.	*Pycnanthus angolensis*	6	56	Medicinal leaves
13.	*Ricinodendron heudelotii*	2	-	Edible seeds and leafy vegetable
14.	*Tetrapleura tetraptera*	-	6	Edible and medicinal fruit
15.	*Vitex oxycuspis*	3	-	Edible fruit
16.	*Xylopia aethiopica*	13*	6	Medinal fruit and seeds

*Not-Rare

**Capable of sustainable natural regeneration

Table 2: Dbh distribution frequency of trees of valuable non-timber products in Ukpon river forest reserve, Cross River State, Nigeria

S/N	Tree species	Diameter-class									
		1	2	3	4	5	6	7	8	9	10
1.	*Allanblackia floribunda*	8	-	4	4	-	-	-	-	-	-
2.	*Alstonia boonei*	2	2	-	-	-	-	1	-	-	-
3.	*Baillonela toxisperma*	2	-	-	1	-	1	-	-	1	1
4.	*Brachystegia eurycoma*	2	-	-	-	-	-	-	-	-	4
5.	*Gambeya albida* (formerly *Chrysophyllum albidum*)	7	8	6	3	-	-	-	-	-	-
6.	*Coula edulis*	3	2	1	-	-	-	-	-	-	-
7.	*Dacryodes edulis*	9	3	1	-	-	1	-	-	-	-
8.	*Dialium guineense*	1	3	-	-	-	-	-	-	-	-
9.	*Enantia Chlorantha*	1	2	1	-	2	-	-	-	-	-
10.	*Irvingia gabonensis*	11	11	3	1	-	-	1	-	-	-
11.	*Pentaclethra macrophylla*	-	-	-	-	2	-	1	-	-	-
12.	*Pycnanthus angolensis*	9	1	2	-	3	-	3	2	-	4
13.	*Ricinodendron heudelotii*	1	-	-	-	-	1	-	1	1	2
14.	*Tetrapleura tetraptera*	-	-	-	-	-	-	-	-	-	-
15.	*Vitex oxycuspis*	5	5	1	1	-	-	1	-	-	-
16.	*Xylopia aethiopica*	28	16	5	1	-	-	-	-	-	-
	Total	89	53	24	11	7	3	7	3	2	11

DISCUSSION AND CONCLUSION

The existence, abundance or rarity, population structure and stem-size distribution of a tree species in a tract of tropical rainforest are functions of the intensity of perturbation of the forest and exploitation of such tree species, availability of viable seeds or propagules and favourable micro-climate for growth of regeneration. The fewer population of individual species observed in the study forest estate may be linked to over-exploitation of the trees for timber couple with the collection and harvesting of the seeds of most of the species for food and medicine. This invariably would cause gross inadequacy of seeds for regeneration. Agyeman (2013) and Newin (2014) reported very low population density and high frequencies of small diameter sizes' trees in rainforests subjected to intensive timber exploitation in Ghana and Myannar respectively. Udo *et al.* (2009) reported very low population density of timber tree species producing socio-economically valuable non-timber forest products in a community-managed rainforest in Akwa Ibom State, Nigeria. Moreover, the low population density of virtually all the species and

very high frequency of small-sized diameter stands of even species of commonly big-sized reported in this study are similar to the observations of some previous workers on population density and regeneration potentials of timber tree species producing valuable non-timber forest products in some areas of tropical rainforest (Ganesan and Davidar, 2003; Olajide *et al.*, 2010 and 2015). The results indicated that all the species, with the exception of *Xylopia aethiopica*, are rare because they have less than 10 mature stands per/ha. A tree species with less than 10 mature stands per/ha in a tract of rainforest is deemed as a rare species (Parthasarathy and Karthikeyan, 1997; FORMECU, 1999). Moreover, with the exception of *Gambeya albida*, all other species are not capable of sustainable natural regeneration, because they have less than 100 regeneration per/ha (Nwoboshi, 1982; Agyeman, 2013 and Newin, 2014). Since these tree species are important for timber and non-timber products, it is imperative to ensure their sustainability. Therefore, to forestall their extinction, government should place a legal ban on their exploitation for timber particularly from forest estates or reserves. Adjoining communities to the forest reserve should be incorporated into the conservation programme, which would prevent the exploitation of these tree species for timber to engender sustainable production of their much more valuable non-timber products. Enrichment planting in the forest reserve with the sturdy raised-seedlings of the tree species should be carried out to boost their population density and further enhance the biodiversity of the forest.

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