Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 8 ~ Issue 11 (2022) pp: 97-101
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

Resource Exploitation and Tree Species Populations Dynamics in the Rainforest of Southern Nigeria

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ABSTRACT
This study investigated resource exploitation and dynamics in the populations of rainforest tree species (TS) in Ika North-East region (I N-E R), southern Nigeria. This study adopted the use of quasi experimental design approach. The stratified random sampling was utilised in the selection of sample sites, where I N-E R was grouped into 12 strata, from which the experimental and control sites were selected. Therefore, from each stratum, 2 sampling sites were randomly selected making a total of 24 sites. Data collected were on the population of TS of economic importance and sites areas, through the use of 10m x 10m quadrats. Data collected were analysed with descriptive and paired t-test statistics. Findings revealed that the populations and population density of TS varied in both degraded and adjoining mature rainforest (DR and MR) sites thus, implies that the MR has more trees and tree species per unit area than DR. The differences in the mean values (16.83 and 88.33) of TS population for the DR and MR respectively, as well as, the difference in mean the values of 0.0017 and 0. 0089 for the population densities in the DR and MR respectively is significant at the 0. 05 level of confidence. The application of sustainable ecosystem-based management concept to manage and conserve the TS and the rainforest is recommended. The success of which requires the co operation of foresters policy makers and the inhabitants of the region.

KEYWORDS: *Anthropogenic disturbances, biodiversity management, rainforest, resource exploitation, species dynamics.*

***R**eceived 15 Nov., 2022; **R**evised 28 Nov., 2022; **A**ccepted 30 Nov., 2022 © The author(s) 2022.*
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I. INTRODUCTION

Most of the world's tropical rainforest ecosystems have been affected by resource exploitations and use which have implications on the floristic compositions and ecological functions (Ndakara, 2012a). The rainforest covers have been exploited over several centuries as a source of wood and for obtaining land for agricultural use. Due to increasing human population, a corresponding increase in the demand for fuel wood, expansion of settlements and areas under urban development, industrial raw materials, lumbering and agricultural practices, have led to over exploitation of the rainforest (Ndakara, Atuma & Iwegbue, 2022; Salami, Akinyele, Adekola & Odewale, 2016).

Apart from timber resources, the rainforest is also very rich in variety of other plant and animal products that provide food, energy, medicine, shelter and recreational facilities, for people, not only within the rural areas but also for people outside the rural areas (Humphrey, 2015). The rainforest protects biodiversity (Ndakara, et al., 2022), helps in ameliorating the water pattern (Ukoji & Ndakara, 2021), provides clean air and protects the soil and food crops (Hamayun, Beenish, Aroosa & Raja, 2016; Ndakara, 2012b; Laurance & Bierregaard, 2002). The different valuable goods and benefits provided by the rainforest ecosystem (RE) constitute its resource base which presently is threatened by deforestation and other anthropogenic activities (Pant 2013). However, great importance is now coming to be attached to the few remaining areas of natural climax vegetation, not only because they provide tangible resource materials but also to create sites for environmental research and education in resource management and conservation (Hamayun et al., 2016; Pawar & Ravi, 2015; Onwubuya, Ogbonna & Ezeobiora, 2014).

Fuel wood harvesting from the forest is an important source of domestic energy in the rural areas of poor countries (Onwubuya, et al., 2014). It has been estimated that more than 2. 4 billion people rely directly on traditional plant biomass for cooking and heating, while in poor countries, plant biomass use represent half of the residential energy consumption (Salami, et al., 2016). Intense fuel wood extractions have deteriorated the

rainforest TS populations (Hamayun, et al., 2016). In most global sub-regions, fuel wood is the most extensively used form of biomass energy for rural population for lightening, heating and cooking activities. Energy needs at the household level have been fulfilled primarily from forests. Demand and supply for the fuel wood is a serious issue at both local and national levels. The energy consumption pattern varies according to climatic conditions, geographical features, and socio-economic status of the area (Obi & Ndakara, 2020; Demurger & Fournier, 2011). Pakistan is a forest poor country with only 4.72 million hectares (5.36 %) of its land mass covered with forest. Fuel wood is the main source of energy in greater than 80 % of Pakistani households (Shaheen, Qureshi, Ullah & Ahmad, 2011). Satellite imagery analyses have revealed 27 % loss of rainforest cover in Jammu and Kashmir (Singh, Tewari, Jeet & Ram, 2014).

The Nigerian rainforest is very fast disappearing as a result of continuous increase in the demand for forest lands and rainforest products. In order to retain its benefits to the population and ensure a stable environment, conserving the rainforest relics is necessary (Ndakara, et al., 2022; Haastrup, Dahunsi & Baba, 2019). Efforts geared towards forest conservation are faced with many obstacles. Despite these obstacles several strategies could still be adopted to ensure the rainforest relics are conserved. Despite an increased recognition of the value of rainforest products at both local and international levels, rainforests continue to be seriously threatened by various forms of encroachments such as harvesting of wood and non wood forest products (Haastrup, et al., 2019), petroleum exploitation activities (Obi & Ndakara, 2020), the conversion of forested land by small holder farmers either temporarily through shifting cultivation or permanently through the establishment of agro-forestry system (Ndakara, 2016).

Different researches have been carried out to investigate different factors that affect rainforest TS populations in different parts of the world. Kafuti, Bolaluembe, Belesi, Ifuta & Bangelesa (2016) looked at how industrial logging affects rainforest floristic composition in Democratic Republic of Congo. Kaysandra, Jean, Claude, Sylvie, Louis & Chris (2014) assessed the impact of logging on micro-sites and plant compositions of Eastern black spruce-moss forest in Quebec, Canada. Singh et al. (2014) analysed the regeneration status of *Pinus roxburghii* Roxb. and *Quercus leucotrichophora* forests, Nainital forest division. Umar et al. (2016) investigated how exploitation of fuel wood affect the environment in Nasarawa, Nigeria. Hamayun et al. (2016) examined how fuel wood utilisation impact on forest structure in Kashmir Himalayas. A review of fuel wood consumption in Niger Republic was taken by Mijitaba and Jing (2013). Fashing, Forrestel, Scully & Cords (2004) investigated the implications of long term dynamics of tree populations on forest and its conservation; while *Pinus wallichiana* response to climate change was evaluated by Pant (2013).

This research therefore, investigated resource exploitation and population dynamics of the rainforest tree species in Ika region, southern Nigeria. This is with the aim of suggesting practicable measures effectively achievable in the management and conservation of the degraded rainforest ecosystem

II. MATERIALS AND METHODS

2.1: Study Area

This study took place in the I N-E R, southern Nigeria. It covers a land area which is approximately 463km^2. The climate of this region falls within the humid tropical and influenced by the tropical maritime (MT) and tropical continental (CT) air masses. This region experiences annual rainfall of about 2000mm, while mean annual temperature averages 31^{0}C (Ukoji & Ndakara, 2021; Ndakara, 2012b). The rainforest is of moist tropical evergreen. However, human influence through agricultural practices and other anthropogenic activities, the rainforest has reduced mainly to secondary vegetation cover. The mature non-degraded covers are now relics of the original ecosystem (Ndakara, et al., 2022).

2.2: Methodology

This study adopted the quasi-experimental design approach. This design is appropriate to this study where mature rainforest cover was used as control to under-study the degraded rainforest cover being the experimental sites. The stratified random sampling was used in the selection of sample sites, where the study area was divided into 12 strata from which the experimental and control sites were selected. Therefore, from each stratum, 2 sampling sites were randomly selected, making a total of 24 sampling sites. The selection of experimental sites was based on degraded sites, while that of the control sites was based on the condition that the established control is mature rainforest cover which are not degraded. Data collected were on the population of tree species of economic importance, population of individual TS, and size of the sites from both experimental and control sites. These were carried out through the quadrant approach in line with Ndakara (2016; 2012a) where each site was divided into quadrant of 10m x 10m. The area of sites was determined through measurement using tape and pins; populations of each TS was determined by counting tree species of a particular kind contained in each quadrant. Data which were collected were further analysed using different statistical techniques. The descriptive statistics was used ascertain the mean and standard deviation values of the data sets; the density of the populations of trees was determined with the ratio of the population size to the unit

area (Ndakara, et al., 2022); while the paired t-test statistics was used to ascertain the differences in populations of the trees and TS between the DR and MR sites.

III. RESULTS AND DISCUSSION

3.1: Tree Populations in DR and MR Sites

TS populations varied in both DR and MR sites. Some TS contained in MR sites were not seen in the DR sites. This could probably be due to the effects of over-exploitation of resources within the DR sites. The indigenous TS are becoming scarce. This finding is in line with the reports in the works of Humphrey (2015) and Fashing et al. (2004).

The observed tree population values in DR and MR sites are presented with graph in figure 1 below.

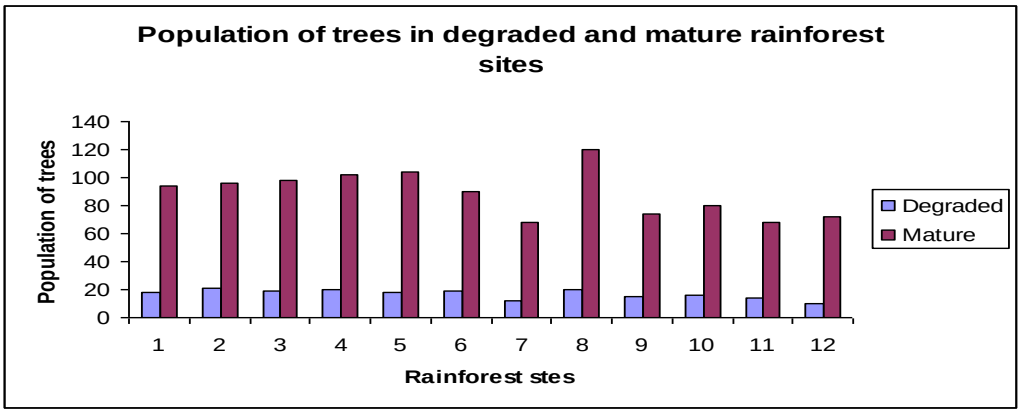

Figure. 1: Populations of Trees in Degraded and Adjoining Mature Rainforest Sites

From figure 1, the populations of trees vary between the DR sites and the adjoining MR sites. Tree populations in the DR sites are generally lower than the populations in adjoining MR sites. This could be accounted for by exploitation effects as reported by Onwugbuya et al (2014). The highest population of trees which is 120 is recorded in site 8 of the adjoining mature rainforest cover while the lowest which is 10 is observed in site 12 of the DR sites. The wide margin in tree populations between DR and MR ecosystems could be the effect of human exploitation on rainforest resources that has been much degraded.

The paired samples t-test statistical techniques was used to test the difference in tree populations between the degraded and adjoining mature rainforest at the 0 05 level of confidence.

Table 3: Paired Samples T-test Statistical Results for the Difference in Populations of Trees between the Degraded and Adjoining Mature Rainforest Sites.

Variables	Mean	S.D	95% Confidence interval		t	df	Sig. (2-tailed)
			Lower	Upper			
Paired Degraded Rainforest Population & Mature Rainforest Population	16.83 88.83	3.46 16.48	-80.71	-63.29	-18.19	11	0.00

Table 3 shows the results of paired t test statistical analysis for the differences in tree populations between the DR and adjoining MR sites. The t-value is -18.19, with a degree of freedom of 11 and significant 2-tailed value of 0.00. The difference observed in the mean values of 16.83 and 88.33 for the degraded and mature rainforests respectively is significant at 0 05 level of confidence. Therefore, tree populations significantly differ between the DR and adjoining MR sites. Significant variation in populations of trees between degraded and conserved sites was reported by Ndakara et al. (2022).

3.2: Populations and Density of Populations of Rainforest Trees in DR and Adjoining MR Sites

Tree populations differed between the DR and adjoining MR. The population densities of the trees also varried between the degraded and adjoining mature rainforest Table 4 presents the population and population densities of the TS seen in the DR and adjoining MR sites.

Table 4: The Populations and Population Densities of Trees in Degraded and Adjoining Mature Rainforest Sites

Sites	Area of Sites (M^2)	Degraded Rainforest Sites		Mature Rainforest Sites	
		Tree Populations	Population Density	Tree Populations	Population Density
1	10,000	18	0.0018	94	0.0094
2	10,000	21	0.0021	96	0.0096
3	10,000	19	0.0019	98	0.0098
4	10,000	20	0.0020	102	0.0102
5	10,000	18	0.0018	104	0.0104
6	10,000	19	0.0019	90	0.0090
7	10,000	12	0.0012	68	0.0068
8	10,000	20	0.0020	120	0.0120
9	10,000	15	0.0015	74	0.0074
10	10,000	16	0.0016	80	0.0080
11	10,000	14	0.0014	68	0.0068
12	10,000	10	0.0010	72	0.0072

Table 4 shows the mean population and population densities of trees in the DR and adjoining MR sites. The population density of trees is higher in adjoining MR sites than the DR sites. This implies that resources exploitation from the rainforest reduced the population of trees within the DR sites so much. The population density of trees in DR is smaller than the density in the adjoining MR. This means that the mature rainforest has more trees than the DR sites. This also confirms that the DR has lost many trees from the rainforest as reported in the study by Ndakara et al. (2022). It has reduced the density of the trees in the area. If the areas are continuously disturbed by resources exploitation, a time will come when it will be difficult to see trees within the DR environment.

The paired samples t-test statistical techniques was used to test the difference in tree population densities between the degraded and adjoining mature rainforest at the 0.05 level of confidence.

Table 5: Paired Samples T-test Statistical Results for the Differences in Population Density of Trees between the Degraded and Adjoining Mature Rainforest Sites

Variables	Mean	S.D	95% Confidence interval		t	df	Sig. (2-tailed)
			Lower	Upper			
Pair Degraded Population Density & Mature Rainforest Density	.0017 .0089	.00035 .00165	-.0081	-.0063	-18.19	11	.000

Table 5 presents the results of t test statistical analysis for the population density of trees between the DR and adjoining MR sites. The t value is 18.19 with a degree of freedom of 11 and significant 2-tailed value of 0.00. The difference between mean values of 0.0017 and 0.0089 for the degraded and mature rainforests respectively is significant at 0 05 level of confidence. Therefore population density of trees between DR and the adjoining MR sites is significantly different. This finding corroborates the results reported in studies by Haastrup et al (2019), Ndakara et al (2022).

IV. CONCLUSION AND RECOMMENDATIONS

This study investigated rainforest resource exploitation and dynamics in TS populations within Ika N-E region, southern Nigeria. The aim was to suggest practicable measures effectively achievable in the management and conservation of economic trees in the rainforest ecosystem. TS populations varied in both degraded and adjoining mature rainforest covers. Some TS contained in the adjoining mature rainforest cover were not found in many DR sites. This is possibly due to resource exploitation effect, which has limited the presence of such species of trees that were indigenous to the ecosystem. However the wide margin in tree populations between the two ecosystems is due to human exploitation from the rainforest that has been much degraded.

The difference in trees populations between the DR and adjoining MR sites is significant. The population densities of the trees also vary between the degraded and adjoining mature rainforest. The population density of trees in the DR is smaller than the density in the adjoining mature rainforest. This means that the mature rainforest has more trees than the DR. The difference observed in the mean values of 0.0017 and 0.0089 for the degraded and mature rainforests respectively, is significant at 0.05 level of confidence. Therefore, there is a significant difference in the population density of trees between the degraded sites and the adjoining rainforest sites.

The study recommends application of sustainable ecosystem-based management concept, which adopts the process of rational use and skilful management and preservation of natural environment with all its

resources. The success of this approach however requires the co-operation of foresters, policy makers and the inhabitants of rainforest regions.

REFERENCES

[1]. Démurger, S. and Fournier, M. Poverty and firewood consumption: A case study of rural households in northern China. China economic review, 2011. 22(4): p. 512-523.

[2]. Fashing, P. J., Forrestel, A., Scully, C. and Cords, M. Long-term tree population dynamics and their implications for the conservation of the Kakamega Forest, Kenya, Biodiversity and Conservation, 2004. 13: p. 753-771.

[3]. Haastrup, N. O., Dahunsi, O. M. and Baba, G. O. Dive abundance of tree species at Owo Forest Reserve State, South-Western Nigeria Int. J. Res. Appl. Sci., 2019. 4(7): p. 27-32.

[4]. Hamayun, S., Beenish, A., Aroosa, M., Raja, W. and Ahmad, K.. Study of fuelwood consumption pattern and its impact on forest structure in Kashmir Himalayas, 2016. p. 10-19

[5]. Humphrey, I. A.. Tree species composition and diversity in Oban Forest Reserve. Nig. J. Agric. Stud., 2015. 3(1): p. 10-24.

[6]. Kafuti, C., Bolaluembe, P., Belesi, H., Ifuta, S., and Bangelesa, F. Investigated the impact of industrial logging on speciec diversity and floristic composition of a tropical rainforest, case of Cotrefor-Alibuku concession forest in DRC. 2016. 6: p. 34-42.

[7]. Kaysandra, W., Jean-Claude, R., Sylvie, G., Louis De Grandpré, and Chris, J. P. Studies of the effects of post-windthrow salvage logging on microsites, plant composition and regeneration of Eastern black spruce–moss forest, Quebec, Canada. 2014.

[8]. Laurance, W. F. and Bierregaard, R. O. Ecosystem decay of Amazonian forest fragments: a 22-year investigation. Conserve. Biol. 2002. 16: p. 605–618.

[9]. Mijitaba, M. M and Jing, F. J. Fuelwood consumption in Niger: A review. International Journal of Research Studies in Management, 2013. 2(2): p. 67-76.

[10]. Ndakara, O. E. Hydrological Nutrient Flux in Isolated Exotic Stands of Mangifera indica Linn: Implications for sustainable Rainforest Ecosystem Management in South-Southern Nigeria. Nigerian Journal of Science and Environment, 2016. 14: p. 125-131.

[12]. Ndakara, O. E. Biogeochemical Consequences of Hydrologic Conditions in Isolated Stands of Terminalia cattapa in the Rainforest Zone of Southern Nigeria. In: Proceedings in Hydrology for Disaster Management, Martins et al. (ed.). Special Publication of the Nigerian Association of Hydrological Sciences. 2012a. p. 134-144.

[13]. Ndakara, O. E. Throughfall, Stemflow and Litterfall Nutrient Flux in Isolated Stands of Persea gratissima in a Moist Tropical Rainforest Region, Southern Nigeria. Journal of Physical and Environmental Science research, 2012b. 1 (1): p. 5-14.

[14]. Ndakara, O. E., Atuma, I. M., and Iwegbue, C. M. A. Ecological Impact of Fragmentation on the Diversity and Distributions of Indigenous Tree Species in Tropical Rainforest of Nigeria. Journal of Biodiversity and Environmental Sciences (JBES), 2022. 21 (4): p. 22-34. https://innspub.net/ecological-impacts-of-fragmentation-on-the-diversity-and-distributions-of-indigenous-tree-species-in-tropical-rainforest-of-nigeria/

[15]. Obi, C. K. & Ndakara, O. E. The Effect of COVID-19 Pandemic on OPEC Spatial Oil Production: A Macro Analysis, Journal of Advanced Research in Dynamical and Control Systems, 2020. 12 (8): p. 393-402. DOI: 10.5373/JARDCS/V12I8/20202487

[16]. Onwubuya, E.A, Ogbonna, O. I. and Ezeobiora, O. C. Conservation of forest resources by rural farmers in Anambra State, Nigeria. Journal of Agricultural Extension, 2014. 8(2): p. 177-184.

[17]. Pant, S.. Response of Pinus wallichiana to climate change, a study from Manaslu conservation area, Western Nepal. Master's Thesis in Environmental Science. Kathmandu, Nepal. Central Department of Environmental Science, Tribhuvan University. 2013. p. 61.

[18]. Pawar, K. V. and Ravi V. R. Forest Conservation & Environmental Awareness. Procedia Earth and Planetary Science, 2015. 11: p. 212 – 215.

[19]. Salami KD, Akinyele AO, Adekola PJ and Odewale MA. Tree species composition and regeneration potential of Onigambari Forest Reserve, Oyo State. Direct Res. J. Agric. and Food Sci., 2016. 4(3): p. 39-47.

[20]. Shaheen, H., Qureshi, R. A., Ullah, Z., and Ahmad, T. Anthropogenic pressure on the western Himalayan moist temperate forests of Bagh, Azad Jammu & Kashmir. Pakistan Journal of Botany, 2011. 43(1): p. 695-703.

[21]. Singh, K., Tewari, A and Ram, N. J. Studies on Vegetational Analysis and Regeneration Status of Pinus roxburghii Roxb. and Quercus leucotrichophora Forests of Nainital Forest Division. Global Journal of Science Frontier Research, 2014. 14(3). P. 22-34.

[23]. Ukoji, C and Ndakara, O. E. Abattoir Waste Discharge and Water Quality in Anwai River, Nigeria; Hmlyn J Agr, 2021. 2(4): p. 8-14. DOI:10.47310/Hja.2021.v02i04.002

[24]. Umar, O. U., Nura, S., Dahiru, M. M., and Isa, M. A. Effects of fuel wood exploitation on the environment: a case study of Nasarawa local government area, Nasarawa State, Nigeria. 2016.