

Effects of Anthropogenic Activities on Okoklo Forest Reserve in Benue State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Developing countries including Nigeria are saddled with problems emanating from environmental deterioration which has great impact on the forests. This study investigated the anthropogenic activities in Okoklo Forest Reserve Benue State to determine their implication on the sustainable management of forests. Vegetation survey method and questionnaire were employed to determine the effects of human activities on the reserve. A stratified random sampling design was used in the study for *Tectona grandis* and *Gmelina arborea*. Three (3) plots of 20 m x 20 m were randomly laid in each compartment of the plantation. The plots were located at least 50 m apart. A total of six (6) sample plots of 20 m x 20 m totalling 400 m² were laid. In each of the 20x 20 study plots, trees > 20 cm girth at breast height (gbh) were identified, counted and their girth measured. The girth of trees were grouped into six classes and the frequency of each were indicated. The study revealed that urbanization, fuel wood collection, bush burning, logging and land clearing ranked the major anthropogenic activities affecting sustainable forest management. It was observed that the class 41-50 had recorded the highest number of trees for all the species while no tree was recorded in the 20-30 class. The study therefore concluded that there was degradation of forest which could lead to complete loss of forests and recommended

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advocacy on the part of Government about the environmental damage caused by these anthropogenic activities and the strict enforcement of forest laws.

Keywords: Anthropogenic activities; forest management; forest reserve.

1. INTRODUCTION

Forests provide a wide variety of highly valuable ecological and social services including the conservation of biological diversity, carbon storage, soil and water conservation, provision of employment and enhanced livelihood, agricultural production systems, and improvement of urban living conditions [1].

Despite these services provided by forests they are at a risk of disappearing due to several anthropogenic activities. Many primary forests in tropical regions of the world have been deforested and degraded as demand for agricultural land, fuelwood, timber, pasture and shelter keep rising [2].

According to Kelvin, [3], deforestation is occurring around the world at an unprecedented pace. Bbarboul and Sasapradja [4], posited that a species could be threatened with extinction by the following factors namely: loss of its natural habitat, change in the habitat quality, habitat fragmentation, persecution or exploitation of the population and change in the biotic environment. Also increasing urbanisation changes species diversity, overall abundance and more importantly, shifts the species composition of forest wildlife.

The rapid increase in human population coupled with man's quest to live a better life has resulted in clearing of large parcels of forest lands in many parts of the world leading to loss of over 7.3 million hectares of land globally each year [5].

In Nigeria, the country is said to have lost large parcels of her forestlands to human encroachment. According to Mbakwe [6], the Nigerian Forest was estimated at 36 million hectares as at 1951 had depleted to 15.5 million hectares by 1979. While Umeh [7], attributed annual forest loss of about 3% to human activities, Ladipo [8], put the rate of deforestation in the Country at between 250,000-350,000 ha or 3.5% per annum. He said that forests are degraded through selective logging, industrial

uses, grazing, land clearing, bush burning, deforestation and urbanization. The destruction of the forest and its resources has been intensified through the use of effective tools and machines and more importantly, as a result of population growth. Urbanization and agriculture are two of the most important threat to biodiversity worldwide [9].

Urbanization has resulted in the loss of forest habitat and fragmentation of forested landscape. These habitat changes have had the greatest detrimental impacts to tree and wildlife species with narrow habitat requirement. Based on the current trends of urbanization, it is likely that forested habitat will continue to be permanently altered and the amount of available forest habitat will decrease

The problem of deforestation in the country today is being aggravated by desertification especially in Northern Nigeria. Alao [10] reported that Sahara desert has taken over more than 50% of arable land cultivated 50 years ago in eleven states. Adelusi [11] and the Nigeria Environmental Study Team NEST [12], had earlier attributed the wide scale deforestation in Nigeria to increase in demand for agricultural land and urbanization.

Today, report by the United nation's Food and Agriculture Organisation, FAO [13] on deforestation trend in Africa , revealed that Nigeria has lost more than half of her forests within the last fifty years making it one of the countries with the highest rate of deforestation in the world.

In Benue State, the situation could be said to be the same. Sorkwagh [14] reported that many forest reserves and plantations established in the state during the colonial era have overwhelmingly been deforested and degraded as a result of increase in demand for farmland and expansion of urban centres. Using Okoklo Forest Reserve as a case study, this study was undertaken to assess the impact of human activities on forest management in Benue State.

2. METHODOLOGY

Benue state is located between latitude 6° 30'N and 10°N and longitude 8° 4'E and 10° 4'E. The state lies in the transitional

belt between the tropical rainforest of southern Nigeria and the open grassland of savannah vegetation of northern Nigeria with total land mass of 30,955 km².

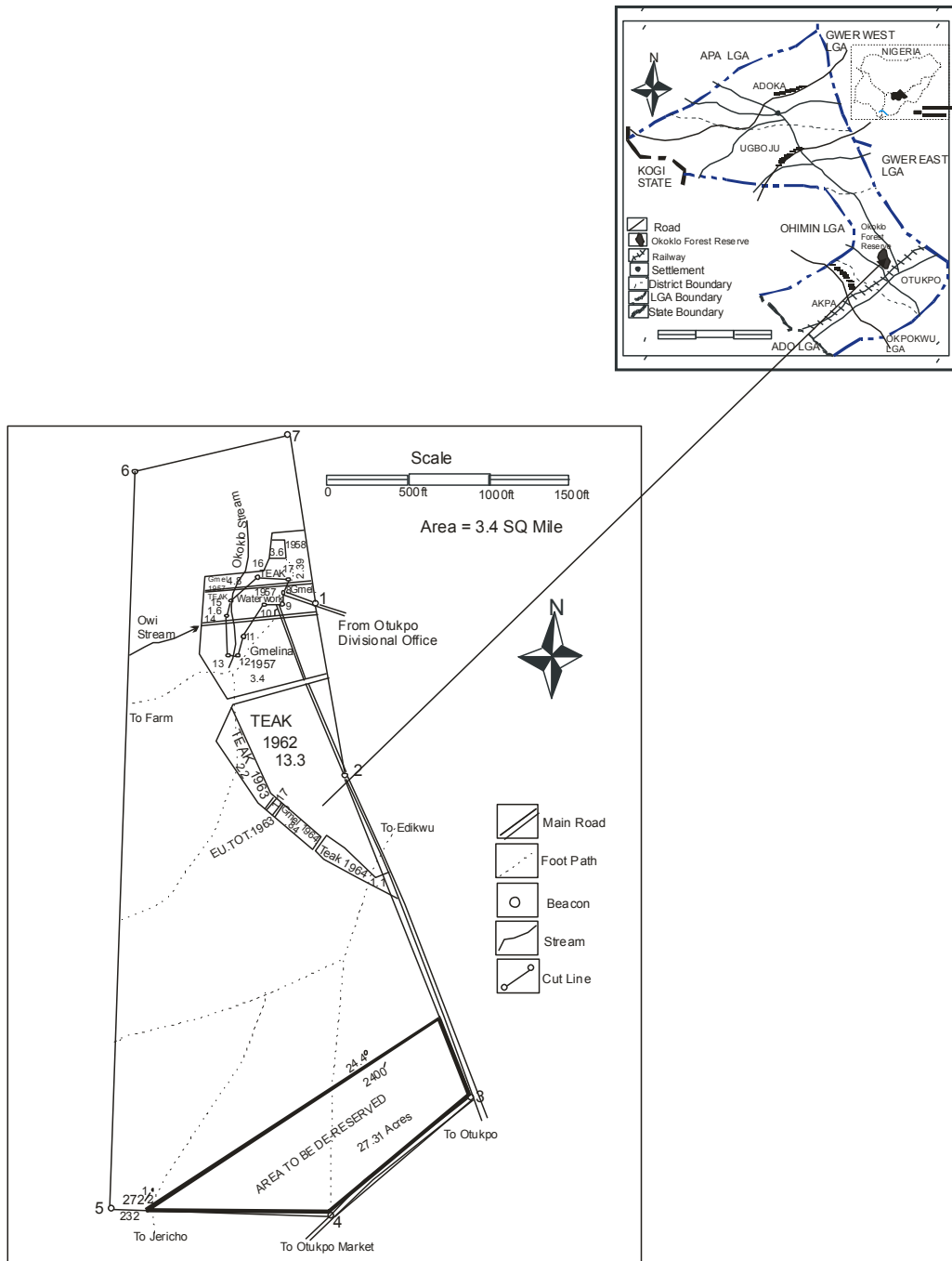


Fig. 1. Map of Okoklo forest reserve in Otukpo LGA, Benue State
 Source: Forestry Dept. Ministry of Water Resources and Environment, Benue State

The climate of Benue State is tropical with two distinct seasons namely rainy and dry seasons. Rainy season starts in April and ends in October while dry season is from November to March. The annual rainfall varies from 1750 mm in southern part to 1250 in the north. The mean annual temperature fluctuates between 23°C to 30°C [15].

The state shares boundaries with Nasarawa State to the North, Taraba State to the east and Cross river to the south. Enugu and Kogi State share borders to the east and west respectively. Benue State has an estimated population of about 4.2 million people according to the 2006 National Population Census, [16].

Okoklo forest reserve with a total area of 13.3 ha, in Otukpo Local government of Benue State. It is located between latitude 7° 13" N to 8° 9" E and longitude 7°21" N to 8° 15" E. The relief is 250 ft above sea level and it is characterized by with undifferentiated woodland and savannah type (southern guinea savannah).

2.1 Data Collection

A reconnaissance survey of the study area was conducted in December 2010 to enable the researcher have a good knowledge of the area to decide on a suitable design. A stratified random sample design was used in the study area according to the species of the trees in the reserve; that is *Tectona grandis* and *Gmelina arborea*.

Using vegetation survey, data from both primary and secondary sources were collected. The primary data was collected through personal observation and random administration of a semi – structured questionnaire to residents living in and around the reserve. Secondary data were collected from reports and publications from the Department of Forestry, Ministry of Water Resources and Environment, Benue State.

2.2 Sampling Design and Techniques

A stratified random sampling design was used in the study area according to the species of the trees in the reserve; that is *Tectona grandis* and *Gmelina arborea*. Three (3) plots of 20 m x 20 m were randomly laid in each compartment of the plantation. The plots were located at least 50 m

apart. A total of six (6) sample plots of 20 m x 20 m (totalling 400 m² of area) were laid. In each of the 20x 20 study plots, all trees > 20 cm girth at breast height (gbh) were counted and their actual girth measured [17,18].

The socio-economic attributes of people living around the forest reserve were purposively selected based on nearness of the reserve and administered with questionnaire [19]. Data collected were subjected to both descriptive and inferential statistics such as mean, frequency distribution, and percentages.

Six plots were randomly selected per hectare from the reserve studied. The girths of trees were grouped into six (6) classes and the frequency of each species was indicated.

In each of the six plots selected, a total number of each tree species present was enumerate and recorded. The mean of each species in the six plots was taken and multiplied by the six number of plots to get the estimate of species density per hectare taken.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Respondents

The result of the socio-economic characteristics in Table 1 revealed that majority (40%) of the respondents were above 41 years of age. This was followed by those within the age brackets of 36-40 years (24%), 26 -30 years (18%), while only 6% of the respondents were between the age bracket of 20- 25 years of age.

Majority (76%) of the respondents were males while 13% were females. The results also showed that 36% of the respondents attained primary education, followed by post primary education (30%), post secondary (14%) while 2% had no formal education.

It was observed that 38% of the respondents were married, 24% were single, 18% were divorced, leaving 26% as widows or widowers.

The highest proportion of 46% had family size of between 6 to 10, 36% had between 1to 5, while 18% had family size above 11 persons.

A greater majority of 38% were farmers, followed by civil servants (24%), traders (22%) while the least (16%) were students.

3.2 Anthropogenic Activities Affecting Forest Management in Benue State, Nigeria

The result in Table 2 revealed that urbanization (58%) ranked highest activity in degrading forest followed by non timber forest products (NTFP) collection (18%), bush burning 15% while the least was animal husbandry (5.5%).

3.3 Tree Species Identified and their Densities in the Study Area

A total of six (6) tree species were encountered in the reserve as presented in Table 3. The result showed that *Gmelina arborea* had the highest relative density (R.D) of 40.8. This was followed by *Tectona grandis* with 40. Estimate per hectare shows that with the current stand, *Gmelina arborea* had 392 stands per hectare while *Magnifera indica* is lowest with 8 stands per hectare.

Table 1. Socio- economic characteristics of respondents

Parameters	Frequency	Percentage
Age (years)		
20-25	12	6
26-30	24	12
30-35	36	18
36-40	48	24
Above 41	80	40
Total	200	100
Sex		
Male	148	74
Female	52	26
Total	200	100
Educational status		
No formal education	40	2
Primary education	72	36
Post primary	60	30
Post secondary	28	14
Total	200	100
Marital status		
Married	76	38
Single	48	24
Divorced	24	12
Widow	36	18
Widower	16	8
Total	200	100
Family size		
1 – 5	72	36
6 – 10	92	46
Above 11	36	18
Occupation		
Farming	76	38
Trading	44	22
Students	32	16
Civil servants	48	24
Total	200	100
Income per annum (₦)		
< 400,000	115	57.5
401,000 - 450,000	54	27
451,000 - 500,000	24	12
501,000 - 550,000	5	2.5
> 550,000	2	1

Table 2. Anthropogenic activities affecting forest management in Benue State, Nigeria

S/No.	Type of anthropogenic activity	Frequency	Percentage	Ranking
1	Urbanization	58	29	1 st
2	NTFP collection	18	9	2 nd
3	Bush burning	30	15	3 rd
4	Hunting	30	15	3 rd
5	Logging	24	12	4 th
6	Road construction	10	5	5 th
7	Land clearing	19	9.5	6 th
8	Animal husbandry	11	5.5	7 th
		200	100	

Source: Field survey, 2011



Plate 1. Buildings activities on the reserve



Plate 2. Opening up of roads in the reserve



Plate 3. Telecommunications structures erected reserve



Plate 4. Land clearing for farming activities in the reserve

Table 3. Species population in the plots

Tree species plot	Number of plots						Total	Total per ha	R.D
	1	2	3	4	5	6			
<i>Gmelina arborea</i>	10	13	12	2	6	4	47	392	40.8
<i>Tectona grandis</i>	3	5	2	11	15	10	46	382	40.0
<i>Khaya senegalensis</i>	1	2	-	3	1	2	9	75	7.8
<i>Danielia oliverii</i>	1	1	-	2	3	2	9	75	7.8
<i>Vitex doniana</i>	-	1	-	1	-	1	3	25	2.6
<i>Magnifera indica</i>	1	-	-	-	-	-	1	8	1

Source: Field survey, 2011.

*RD= Relative Density

3.4 Classification of Tress According to Girth at Breast Height

The result showed that the class of 41 – 50 cm recorded the highest numbers of trees for all the species while no tree was recorded in the class of 20 – 30 cm class as shown in Tables 4 and 5.

3.5 Respondents duration of Residency in the Study Area

The result in Table 6 revealed that majority (28%) of respondents indicated that they stayed in the study area for 16 to 20 years. Those who stayed for between 11-15 years had a frequency of 24%, while only 18% indicated from 0-5 years. The least percentage of 14% stayed for 21 years and above as shown in Table 6.

3.6 Status of Forest Resources in the Reserve before Anthropogenic Activities

The result in Table 7 revealed that majority of the respondents (37%) indicated that timber was the most abundant forest resource in the forest reserve before the anthropogenic activities followed by wildlife. The least (18%) of the forest resource was fruits.

Table 8 showed that 58% of the respondents agreed that the resources were still available while 21% did not agree. Table 9 revealed that majority of the respondents agreed that the resources were depleting fast while (12%) were not sure.

Table 4. Girth distribution in *Gmelina arborea* compartment in Okolo forest reserve

Tree species	20-30	31-40	41-50	51-60	61-70	71-80
<i>Gmelina arborea</i>	-	9	14	6	4	-
<i>Tectona grandis</i>	-	2	5	1	2	-
<i>Khaya senegalensis</i>	-	-	2	-	1	-
<i>Danielia oliverii</i>	-	-	2	-	-	-
<i>Vitex doniana</i>	-	-	-	-	-	-
<i>Magnifera indica</i>	-	-	-	-	-	-

Source: Field survey, 2011

Table 5. Girth distribution in *Tectona grandis* compactment in Okolo forest reserve

Tree species	20-30	31-40	41-50	51-60	61-70	71-80
<i>Gmelina arborea</i>	-	12	16	4	-	-
<i>Tectona grandis</i>	-	3	6	2	1	-
<i>Khaya senegalensis</i>	-	2	3	-	1	-
<i>Daniela olivera</i>	-	2	3	1	1	-
<i>Vitex doniana</i>	-	-	-	-	-	-

Source: Field survey, 2011

3.7 Discussion

The socio-economic attributes of people living around a forest play a great role in modifying vegetation of such forests. The high proportion of the respondents most of whom are farmers and the majority falling within 40 years and above shows that they are within active the age group which is usually engaged in farming and other economic activities that are capable of causing deforestation. The implication of an active age population living close to a forest is that they would exert pressure on such forests in terms of high demand for forest land for farming and also logging activities capable of depleting forest resources. This finding is in agreement with the observation by Oyin [20] that young people tend to engage in forestry activities more than the aged due to the strenuous nature of most forestry activities. Ogunleye [21] also reported that the percentage of young people within the age bracket of 30-40 involved in destructive activities such as conversion of woodland to arable land in Enugu State was more of that of old people.

Table 6. Respondents' duration of residence

Years	Frequency	Percentage
0 – 5	36	18
6 – 10	32	16
11 – 15	48	24
16 – 20	56	28
Above 21	28	14
Total	200	100

Source: Field survey, 2011

Table 7. Forest resources in the reserve when the respondents first arrived

Forest resources	Frequency	Percentage
Fruit tree	15	18
Timber	30	37
Fisheries	16	20
Wildlife	20	25
Total	81	100

Source: Field survey, 2011

Similarly, the high percentage of males over the females among the respondents implies that male sex is the one that is predominantly engaged in strenuous activities like farming, logging, hunting etc, that cause deforestation. This is in agreement with a study by Eboh and Ujah [22] on measurement of sustainability

indicators of forest in Enugu State, Nigeria, which reported that the percentage of men involved in forestry activities is more than that of women.

Table 8. Are the resources still available

	Frequency	Percentage
Yes	116	58
No	84	42
Total	200	100

Source: Field survey, 2011

Table 9. Status of forest resources in the study area

	Frequency	Percentage
Resources before	4	2
Resources depleting	172	86
Not sure	24	12
Total	200	100

Source: Field survey, 2011

The educational status of the respondents showed that majority are low income earners with senior school certificate as their highest academic qualification. The consequence of this category of people living around a forest is that they depended on such forest for survival. The considerable percentage of people with higher level of educational attainment of the people living around plantations which is against *apriori* expectations is probably because in Nigeria especially Benue State, a good number of rich people and highly educated people still use fire wood and charcoal in their homes as sources of energy. For instance, a walk around Makurdi official quarters of some top government officials shows that firewood was being used for cooking in the houses of many. This is contrary to Umeh [23], who said that higher the income, the lesser the person's level of dependence on forest for survival. This could be explained by the fact that government has not provided alternative sources of energy or their supplies are not constant. In some case their costs are prohibitory.

The largest proportion of respondents being married and large family size implies that the demand for fuel, timber and other forest of forest resources is more. Thus there will be more households tampering with the reserve in order to meet their needs.

The indication of a larger proportion of respondents as farming as their primary occupation implies that there will be demand for

farmland hence more occupation of the forest reserve for farm land. This is compounded by the use of unscientific farming methods which do not have regard for conservation. This therefore leads to large scale deforestation to destruction of habitats for wildlife, leading to loss of biodiversity and by extension wildlife.

Urbanization and non fuelwood collection and land clearing were identified and ranked as the major anthropogenic activities contributory factors to deforestation. This supports the views of Udo, [24,25] and [26] that clearing of forest reserves and plantations to pave the way for farming and urbanization account for over 80% of the factors responsible for the depletion of forest resources in Nigeria. According to Ogunwale, [27] in developing communities, social amenities such as roads, hospital, water plants etc. are regularly provided by the government and or the communities themselves. Most times without proper planning, primary forests are cleared to site such projects.

Findings from the study also revealed that logging and bush burning have negative effect on the forest reserves and plantations in the State. This is because farming is the main occupation of people in Benue state and a good number of farmers still practice shifting cultivation which involves bush burning and land clearing of large parcels of land each time a farmer moves to a new piece of land thereby causing wide scale deforestation. This observation is in agreement with that of NFPR [28] which rated farming and logging as the leading cases of deforestation in Nigeria.

The observed higher densities of *Gmelina arborea* and *Tectona grandis* species may be because conscious efforts are been made to plant exotic species in the reserve areas by the Forestry Department while little or no efforts are made to plant the indigenous species such as *Khaya senegalensis*, *Daniellia olliverii*, *Vitex doniana* and *Mangifera indica*.

The observed absence of girth below 20-30, between 71-80 and very few trees between 61 and above may be because these species are harvested before attaining those classes. This leads to deforestation hence negative impact on sustainable development. It was observed that trees with 20 - 30 girth at breast height are most preferred by loggers as they are more economical.

Respondents living around the reserve agreed that there is a decline of forest resources in the study area compared with the period there were less anthropogenic activities. It was also observed that biodiversity was generally on the decline. Some animal species which were abundant have become very scarce or extinct.

4. CONCLUSION

Findings from this study show that the main anthropogenic activities include urbanization, fuelwood collection, bush burning, logging, land clearing. If this trend continues, then Benue State will be left with no forest in the nearest possible time. The densities of exotic tree species such as *Gmelina arborea*, and *Tectona grandis* have declined due to continuous exploitation. The study concluded that there was degradation of the forest reserve through anthropogenic activities such that if not checked could result to complete loss of forests.

To prevent the degradation of forest areas in Benue State, the following measures are recommended.

Government should develop and encourage the use of alternative energy sources to discourage people from using fuel wood as a source of energy which cause the depletion of forest resources.

Government should provide cheap and accessible sources of energy for the rural dwellers.

Extension managers should be increased (Intensified) to educate the people about the dangers of deforestation. People should plant trees to replace those cut down.

Alternative livelihood sources should be provided enable the meeting of human needs without necessarily resulting to over exploitation of our forests to provide income.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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