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Microeconomic Analysis of Losses from Deforestation in Enugu State, Nigeria

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A R T I C L E I NFO

Key Words

Deforestation,

Forest products,,

Total Economic Value

Ecosystem Service

Valuation

ABSTRACT

The study provided an economic analysis of the losses from deforestation in Enugu State of Nigeria. Specifically, the study evaluated the effects of resource-use patterns and processes associated with cleared forest land in Enugu State. It also identified estimated and analyzed financial and economic losses from deforestation in the state. Primary and secondary data generated were analyzed with descriptive statistics; furthermore, total economic valuation (TEV) model of valuing deforestation was used to achieve aggregate economic loss from different deforestation operations in different sectors of forest use. The major finding of the study shows that bush fire was the highest cause of deforstation in Enugu State. From the study, 69% of the respondents stated that they had no knowledge of any forest extension services. Furthermore, the total economic value (TEV) loss of forests in the last three years were N75,855,558.00 for 2018; N89,674,707.00 for 2017 and N85,683,956.00 for 2016. Among other recommendations, the study recommends that frequent use of workshops, advocacy and seminars are necessary to educate the rural and urban farmers more on the negative consequences of deforestation. This will help the rural stakeholders to have adequate information on the new policies of the government concerning forestry sector

1.0 Introduction

Throughout history, the fate of the world's forests has strongly reflected the pattern and intensity of land use by societies. Demand for agricultural land, timber, and other forest products, as well as technological change in agriculture, significantly impacts the mode and rate of transformation of forested areas especially in developing nation like Nigeria and Enugu state in particular.

Meanwhile, Nigeria's land resources and even that of the study area are being managed at crisis level as reported by Scrieciu (2001). This is

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because increasingly pressure on the land resources has generated conflicts between economic development and resources conservation. Such conflicts are further pronounced by the adopted poor land-use systems which tend to cause environmental degradation. Although several factors might be responsible for the misuse of land, it is commonly centered on the removal of the tree vegetation without any attempts at its regeneration. Thus, the destruction of vegetation results in extinction of valuable wildlife and timber species, siltation of streams and soil degradation through severe erosion in Nigeria.

According to Butler (2015), report shows that 12.2% or about 11,089,000 hectares of Nigeria is forested, of this number, 2.9% or roughly 326,000 hectares is classified as primary forest, the most bio-diverse form of forest. Furthermore, Butler (2015) still reported that between 1990 and 2000, Nigeria lost an average of 409,700 hectares of forest per year. This amounts to an average annual deforestation rate of 2.38%. One could say in recent time what forest position should be. The socio-economic factors and conditions also exert great influence on forest depletion on Nigeria. For instance the economic benefits of timber supply to local and foreign markets have greatly induced the over exploitation of the natural forests. In the view of Enabor (1981), the exploitation of the natural forests in Nigeria started as early as the 1930's when more Nigerian timber species gained acceptance at the international market. Aurson (1998) reported that about one million trees were felled for exported in Nigeria then between 1905 and 1956 of which more than 50% came from forests of South-western Nigeria. Recently, Offorma (2012) reported that rate of fuel wood usage by the rural households in Enugu state is above 75% comparable to 60% in the year 2010.

The forest areas that produce the timber supply in the country is just about 2% of the total forest reserve area. Going by the rapid population increase in Nigeria that stood at 140,033,542 with average annual growth rate of 3.2% according to NPC (2006), the timber resources are inadequate to meet the demand for wood and wood products in the country. As far back as 1981, FAO (1981) estimates thus revealed that log output volume in Nigeria decreased from 52% in 1960 to about 30% in 1975. This shortfall in log output volume is an indication of forest depletion within this period. The annual consumption of fuel wood and charcoal has increased to 80million m3 in 1981 according to FAO (1981) estimate. But in the views of Chiwetaoke, (2016) large market exists in Europe and Asia for charcoal (products of deforestation) with prices ranging from $170 to $300 per MT depending on the mode of packaging. The charcoal production industry is a multi-billion dollar industry and a money spinner for savvy investors to position themselves. This shows that there is an over dependence on biomass for energy requirement in the country as far back as the period in question. Coupled with this is the problem of hunting and grazing of livestock's, unsuitable land use practices such as burning of forests and timber extraction, all these have an overall adverse effect on forest depletion in the country.

The growth of urbanization and the development of infrastructures such as the establishment of industries, construction of highways, airports, and stadia among other human activities have greatly influence the depletion of forest resources in Nigeria. The construction of highways and the increase in the housing estates are perhaps the major forest depletion factors. In both cases, large areas of forest lands must be converted. Similarly the creation of forest plantations through artificial regeneration method (afforestation projects) has resulted into large scale destruction of existing forest vegetation.

The broad objective of this study is to conduct an economic analysis of losses from deforestation in Enugu State. The specific objectives are to: (i) determine and analyze the resource-use patterns and processes associated with cleared forest land;

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(ii) identify, estimate and analyze financial and economic losses from deforestation; and finally, (iii) derive lessons for sustainable management and use of forests.

2.0 Conceptual Framework

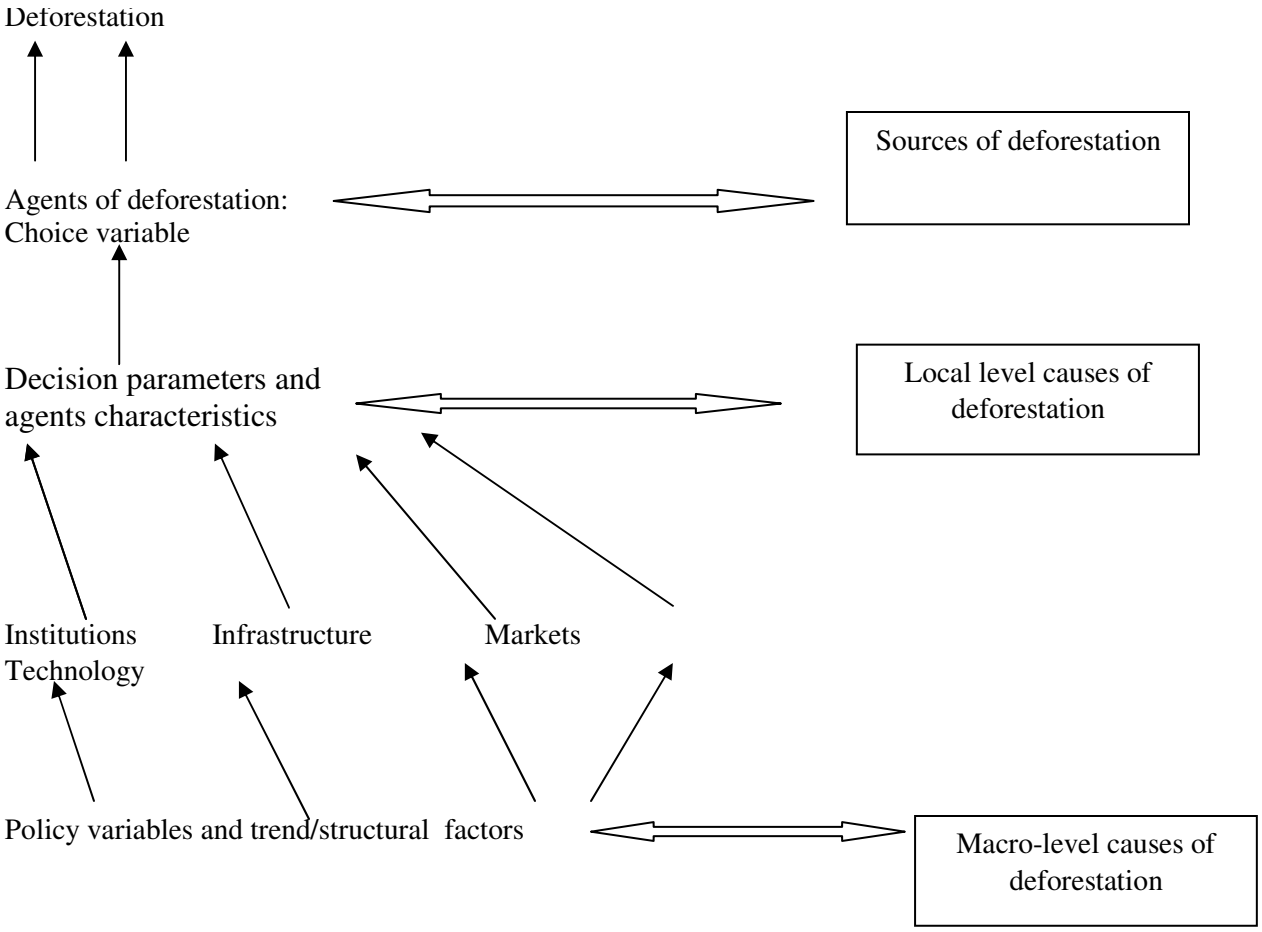

Figure 1: *Flowchart illustration of conceptual framework concerning different types of variables affecting deforestation*

3.0 Analytical Framework

There are approaches that can be used to analyze data from any research work. The first set of common, but important analytical tool used in data analysis is the descriptive statistical tool according FAO (2008). These include tables, graphs, charts,

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frequency distributions, percentages, mean and standard deviation among others. Some specific objectives and some quantitative data require an in-depth analysis and may need extended analytical tools other than the simple descriptive statistical tool for better understanding.

However, the choice of analytical techniques which was used in this study depends on a host of factors which, among others, include the objectives of the study, availability of data, among other reasons.

4.0 Research Methodology

The study was carried out in Enugu State of Nigeria which was created out of the former Anambra State during 1991 creation of States in the Country. The state is located between latitudes $5^{o}56^{1}$ and $7^{o}06^{1}$N and longitudes $6^{o}53^{1}$ and $7^{o}55^{1}$E (Ezike, 1988). Enugu State is bounded on the East by Ebonyi State, on the North by Benue and Kogi States, on the south by Abia State and on the west by Anambra State (op. cit.). The State occupies an area of about 8,022.95km^2 (op. cit.) and has a population of 3,257,298 with average growth rate of 3% according to NPC, 2006. Enugu State with seventeen local government areas was divided into three agricultural zones namely: Awgu, Enugu and Nsukka Zone. But in recent time, the state was divided into six agricultural zones as reported by Nweze and Agwu (2015) which include: Udi, Awgu, Enugu, Agbani, Nsukka and Enugu-ezike zones.

In Enugu state farming is predominately their occupation which is done in a small-scale. Prevalent crops are cassava, yam, maize, rice, melon, groundnut, pepper and economic trees like oil palm, cashew, cocoa, oranges, kola nuts, and pears among other trees are found in the state. There are forests of different density in Enugu state as reported by Nzeh (2004). Crops farm(s) are usually in small holding of about 1 to 3 hectares, but poultry production is carried out in some parts of the state but strictly on subsistence level, together with goat and sheep production (Nduaguba, 2001).

In the sampling procedure, both purposive and random sampling techniques were employed to ensure a good spread of respondents for the study. In the first stage of the sampling procedure, within the six agricultural zones as earlier mentioned one (1) local government area was purposively selected from each of the zones. This was done so that only local government areas where forests exist were covered. This gave a total of six (6) local government areas for the study. The second stage involves selection of communities. Two (2) rural communities were selected purposively from each of the selected six (6) local government areas. This gave a total of twelve (12) communities. Third stage was the selection of respondents (that is, household heads). Twenty (20) household heads were randomly selected to avoid bias from each of the twelve (12) rural communities, making a total number of two hundred and forty (240) household heads but during the analysis, only two hundred and sixteen household-heads were used as twenty four questionnaires from different respondents were discarded because they did not give satisfactory information as required. Primary data were collected through the use of well-structured questionnaires. Data collected were analyzed using relevant econometric and other statistical tools in other to achieve specific objectives. Objectives i and iii were achieved using descriptive statistics as objective ii was realized using total economic valuation (TEV) model.

4.1 Specification of TEV model

For the purpose of this research, total economic valuation (TEV) model for realizing objective ii is represented as follows:

$$TEV = [\sum DV + \sum IDV + \sum EV + \sum BV] \quad \text{.....1}$$

$$TEV = [\sum ADN + \sum ADNN] \quad \text{...……..……....2}$$

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$$ADN = \{\sum DV + \sum IDV\} \quad \text{.....3}$$

$$ADNN = (\sum EV + \sum BV) \quad \text{.....4}$$

$$DV = (\sum CUV + \sum NCUV) \quad \text{.....5}$$

$$CUV = [\sum (CMG + IMG + TM + FR + AN)] \quad \text{.....6}$$

$$NCUV = \sum (SV) \quad \text{.....7}$$

$$IDV = \sum (EPV + CV + Spv) \quad \text{..... 8}$$

$$TEV = \{[\sum (CMG + IMG + TM + FR + AN)] + [\sum (SV + EV)] + [\sum (EPV + CV + Spv)] + [\sum (r)]\} \quad \text{..... 9}$$

Where:
TEV = Total Economic values of deforestation (annual in Naira).

DV = Monetary value of the forfeited benefits due to direct loss of use of forest

IDV = Monetary value of the forfeited benefits due to indirect loss of use of forest.

EV = Monetary value of the forfeited benefits due to loss of existence use of forest

BV = Monetary value of the forfeited benefits due to loss of bequest use of forest

CUV = Monetary value of the forfeited benefits due to loss of consumptive use of forest

NCUV = Monetary value of the forfeited benefits due to loss of non-consumptive use of forest

CMG = Monetary value of the forfeited benefits due to loss of commercial marketable use of forest

IMG = Monetary value of the forfeited benefits due to loss of industrial marketable use of forest

TM = Monetary value of the forfeited benefits due to loss of timber harvesting

ADN = Monetary value of the forfeited benefits due to loss of annual wood use of forest

ADNN = Monetary value of the forfeited benefits due to loss of annual non-wood use of forest

FR = Monetary value of the forfeited benefits due to loss of fruits gathering use of forest

AN = Monetary value of the forfeited benefits due to loss of animals harvest use of forest

SV = Monetary value of the forfeited benefits due to loss scientific use of forest

EPV = Monetary value of the forfeited benefits due to loss of environmental protection use of forest
CV = Monetary value of the forfeited benefits due to loss of cultural use of forest
Spv = Monetary value of the forfeited benefits due to loss of herbal use of forest
r = any other values not associated with the above values.

5.0 Results and Discussion

5.1.1Activities and processes associated with deforestation
Farmers' behavior and practices regarding forest conversion to other land uses is by this research referred to as the various options and alternative uses of forestland including all the actions involved in such uses. This study identified many activities and processes involved in this act resulting to numerous deforestation occasioned in Enugu State. This is in line with the finding of Adger (1993), which stated that most of the competition for space between human and other species is demonstrated by the conversion of land (including forestry areas) to agriculture, infrastructure, urban development, surface mining, fuel wood collection, industry and unsustainable forest use.

5.1.2 Conducts that cause deforestation
According to figure 2 below several factors are attributable to deforestation in the study area. From the figure 2, one can see that respondents in the sampled size that agreed that bush fire is the highest cause of deforestation recorded 22%. Also the same figure 2 shows that 19% of the

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respondents stated that fuel wood harvesters are the second highest cause of deforestation.

Critical analysis of the figure 2 indicated that 15% of the respondents reported that timber haversters were among the first third major causes of deforestation in the study area. Further more, both agricultural expansion and population growth recorded 13% respectively as the major causes of deforestation as can be seen in figure 2 below.

Finally, from figure 2 it can be seen that the least of the causes of deforestation in Enugu State are miners and pest which accounted for 1% and 2% respectively.

The higher percenatge of the respondents that reported that fuel wood harvesters are second to the major causes of deforestation agreed with Odoemena (2006) which reported that fuel wood is a traditional source of energy for domestic use in Enugu State, and that because of the lean financial resources of the poor rural households in the state, they usually find it economically difficult to resort to other sources of energy for domestic activities (cooking and pressing clothes) except fuelwood thereby resulting to forest exploitation called deforestation.

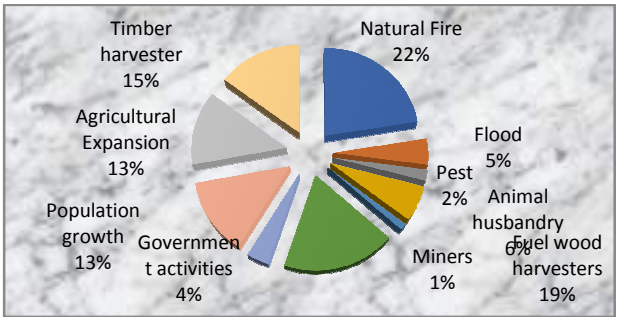

Figure 2: Distribution of respondents according to causes of deforestation
Source: Field survey, 2018

5.1.3 Perception of deforestation

The table 1 below shows the distribution of respondents according to their perception of deforestation in the study area. According to table 1, timber harvesters (98), agricultural expansion (97), fuel wood harvesters (85), bush fire (81), and population growth (75), are in the major categories of the high causes of deforestation as perceived by the respondents. Furthermore, from the same table 1 below, causes of deforestation perceived by the respondents in the study area as moderate include among others animal husbandry (91), population growth (86), and timber harvesters (71), government activities (69), agricultural expansion, (62) and bush fire (57). Finally, the low perception of causes of deforestation as shown by the respondents in the study area are; pest (117), miners (113), flood (105), animal husbandry (85) and government activities (72). From the analysis below, one can see that major causes of deforestation as perceived by the respondents in the study area agreed with what Nair, (1995) reported that both flooding, erosion, agricultural expansion and timber harvesting are among the peculiar climate change risks especially in the Southeast of the country.

Table 1: Distribution of respondents according to their perception of deforestation

Activities	Perception of deforestation		
	High	Moderate	Low
Timber harvesters	98	71	28
Agricultural Expansion	97	62	24
Fuel wood harvesters	85	72	32
Bush Fire	81	57	58
Population growth	75	86	27
Government activities	23	69	72
Pest	18	24	117
Flood	17	37	105
Animal husbandry	16	91	85
Miners	10	24	113

Source: Field survey, 2018

5.1.4 Number of years engaged in deforestation

Figure 3 stated that 40% of the respondents in the study area agreed that they were enagaged in deforestation activities for period less than or equal to three (≤3years) only. Furthermore, the same figure 3 below indicated that 30% respondents agreed that they were involved in deforestation

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activitives between 4 and 6 years and ≥7years respectively. The implication of figure 3 below shows that the rate of deforestation activities in Enugu State is of recent on the high side. This may be connected to the high population growth rate of the state which stood at 3,257,298 with an annual average growth rate of 3%, according to NPC (2006), but without corresponding increase in employment generation. Therefore, for the households to sustain their livelihood, they usually engage in exploitation of the forest resources.

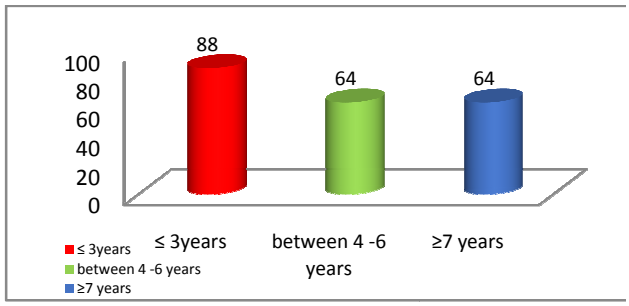

Figure 3: Distribution of respondents according to period engaged in deforestation
Source: Field survey, 2018

5.1.5 Methods of deforestation by households
Figure 4 contains the distribution of respondents according to ways in which households engaged in deforestation in the study area. From the figure 4 below, 62% of the respondents were engaged in deforestation activities in Enugu State through the use of manually operated equipments. Critical analysis of the figure 4 indicated that 25% of the respondents were involved in deforestation by the use of both mechanical and manual means. Finally, from the same figure 4, only 13% of the respondents in the study area agreed that they use mechanical ways for deforestation in Enugu State. The lower percentage recorded by those

respondents that use modern means for deforestation may be linked to lack of modern knowledge concerning forestry activities due to infrequent presence of forest extension agents.

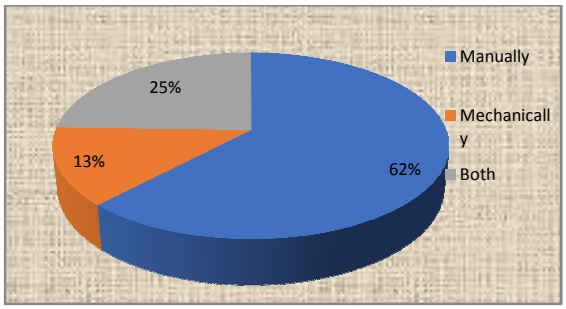

Figure 4: Distribution of respondents according to ways households engage in deforestation.
Source: Field survey, 2018

5.1.6 Marketing of forest products
Figure 5 below indicates that 73% of the respondents reported that they marketed forest products. Some of the forest products marketed by these respondents include food products (nuts, mushroom, oil seed, and fruits), fibre products (bamboos, grasses, and leaf), animal products (honey, bush-meat, shell, and eggs), extractive products (gum, latex, and dyes), medicinal and cosmetic plant products, fuelwood, timber, charcoal among others. From the same figure 5, only 27% of the respondents reported that they did not market their forest products. The implication of higher percentage of the respondents engaged in marketing their forest products in the study area is enough indication to show that much of the forests are under deforestation in recent time in the study area due to economic hardship and other attributes.

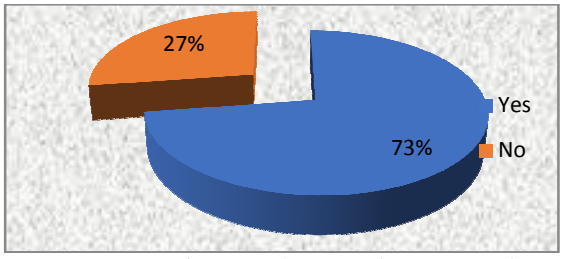

Figure 5: Distribution of respondents according to marketing of forest products
Source: Field survey, 2018

5.1.7 Location for marketing of forest products
From figure 6 below, it shows that 63% of the respondents market their forest products in the rural markets. The same figure 6 indicated that

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30% of the respondents stated that they market their products in urban market of the study area, whereas only 7% of the respondents reported that they market their forest products at both rural and urban markets as reported by Enabor (1986).

According to Youdeowei et al. (1999), the distribution of forest products is a crucial aspect of forestry in providing the link between the resource and user. The implication of the below high percentage of those respondents that market their forest products rurally is that if there are higher returns from any of the marketing out-let, there is tendency that more people will be involved in deforestation activities

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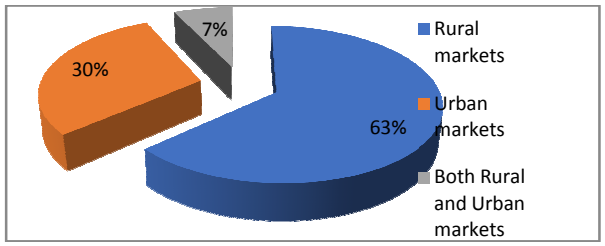

Figure 6: Distribution of respondents according to location for marketing of forest products
Source: Field survey, 2018

5.1.8 Distance of forests from home

From figure 7, it can be seen that higher percentage of respondents (59%) reported that the distance of forest from their home was 4 to 6kilometers. Also from the same figure 7, it can be observed that 17% of the respondents agreed that the distance of forest from their home was ≤ 3kilometers, but other respondents 14% and 10% stated that the distances from their homes to forest were ≥10 kilometers and 7 to 9 kilometers respectively. As can be seen from the below figure 7, the implication of proximity of forest to home will mean that more deforestation will be taking place; hence so many households relied on forest for income, employment and fuel wood.

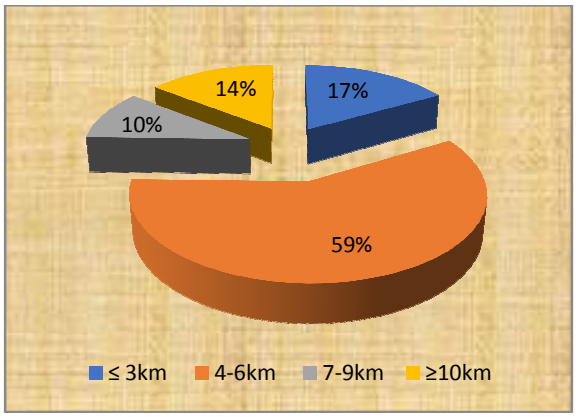

Figure 7: Distribution of respondents according to distance of forest from home
Source: Field survey, 2018

5.1.9 Type(s) of land ownership by household

Findings represented in figure 8 indicate that higher percentage of the respondents (55%) stated that the type(s) of land they own in the study area were cultivable arable land. Also figure 8 below shows that 41% of the respondents and 4% of the respondents reported that the type(s) of land owned by households in the study area were forest/woodland and non-cultivable arable land respectively. The lower percenatge of households that owned forest/woodland in the study area recently as can be seen from the figure 8 below, confirms that there was high rate of deforestation activities in the study area.

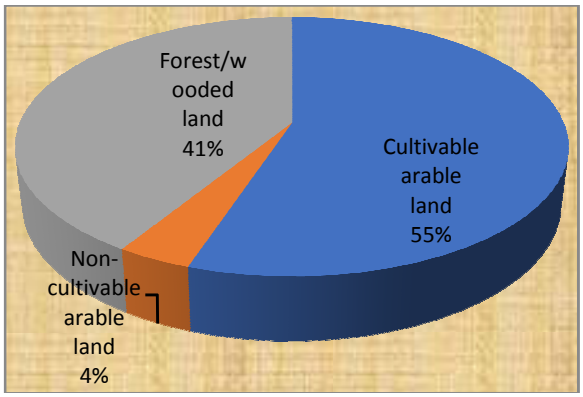

Figure 8: Distribution of respondents according to types of land owned by houeshold.
Source: Field survey, 2018

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5.1.10 First clearing of farmland by household

The gradual activities of deforestation in the study has negative implcations to the environment in Enugu State, because this deforestation, according to Nair (1995) is one of the major causes of climate change in sub-Saharan Africa. Figure 9 below indicates that 67% of the respondents stated that their household farmland was first clearned in ≤ 40years. Furthermore, figure 9 shows that 24% of the respondents agreed that their household farmland was first cleared for cropping activities between 41 to 80 years ago. But, only 9% of the respondents reported that their household farmland was first cleared ≥ 81years ago.

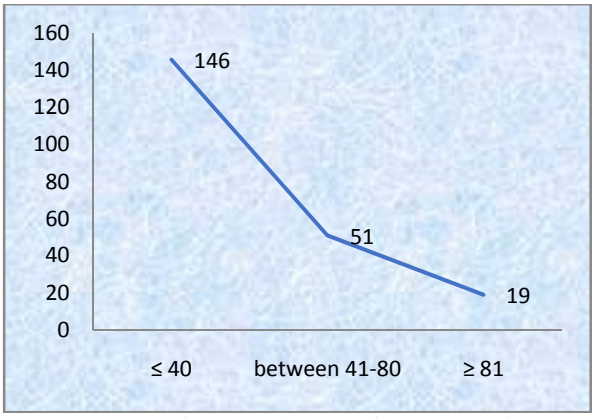

Figure 9: Distribution of respondents according to number of years since farmland was first cleared for cropping
Source: Field survey, 2018

5.2 Economic Losses from deforestation

The global economy is losing more money from the disappearance of forests (called deforestation) than through the recent global financial crisis, according to an EU-commissioned study as reported by Black (2018). Black (2018) further puts the annual cost of forest loss at between $2 trillion and $5 trillion. The figure comes from adding the value of the various services that forests perform, such as providing clean water and absorbing carbon dioxide among others according to Black (2018).

5.2.1 Total amount of money lost (N) from forest exploitation in the past three years

Figure 10 indicated that thirteen million, three hundred and sixty-nine thousand naria (N13,369,000.00) only was the amount of money lost due to forest exploitation in the study area in the year 2018. Crictical analysis of figure 10, also shows that thirteen million, one hundred and thrity-seven thousand naria (N13,137,000.00) only was the amount of money lost to forest exploitation in Enugu State in the year 2017. Finally, as shown in the below figure 10, nine million, six hundred and seventeen thousand, four hundred naria (N9,617,400.00) only was the amount of money lost in 2016 due to forest exploitation. The above figures were obtained from respondents replies to questionnaries on the amount of money losses for different years in different deforestation activities.

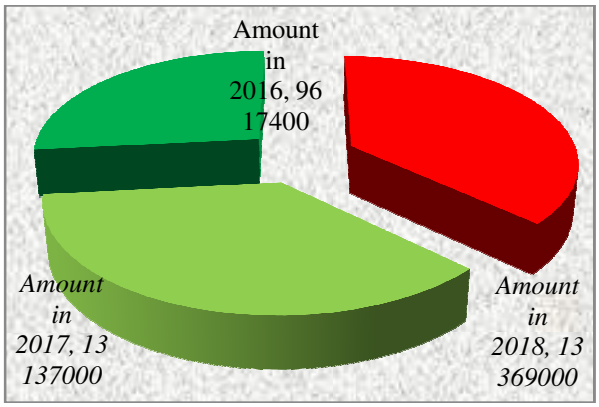

Figure 4.15: Distribution according to total amount of money lost from forest exploitation for the past three years
Source: Field survey, 2018

Like in other developing areas, rural communities and households in sub-Saharan Africa including Nigeria especially in Enugu State depend on forest resources to meet up a variety of livelihood objectives including food security, social security, income and employment generation, risk

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management and essential subsistence goods as reported by Nair (1995) and Adepoju and Salau (2017). Forest activities through deforestation, provide household inputs, such as fuel, fodder and food that is used directly by the household; input into agricultural system such as fodder and mulch and these products were sources of household income.

According to table 2 below, monetary value of the forfeited benefits due to loss of commercial marketable use of forest (e.g. fuel wood) in the last three years – 2018, 2017 and 2016 recorded the highest amount of N5,796,000.00, N33,967,000.00 and N43,207,600.00 respectively against all other different deforestation operations carried out in the study area. Critical analysis of the monetary value of the forfeited benefits due to loss of commercial marketable use of forest indicated that the highest amount was loss in the year 2016. Furthermore, table 2 equally shows that losses in monetary value of the forfeited benefits due to loss of timber harvesting recorded huge amount of money as N19, 515,400.00 in 2018; N16,627,000.00 in 2017 and N12,480,400.00 in 2016. This (forest timber harvesting) ranked second amongst losses due to deforestation after after fuel woods/other non-timber materials were harvested from the forest in the study area possibly within the years 2016 and 2017 when the rural roads leading to heavy forested land were opened up for the harvesting of timber in the year 2018.

Finally, from table 2, it is obvious that monetary value of the forfeited benefits due to loss of herbal use of forest recorded N15, 312,008.00 in 2018; N12, 978,607.00 in 2017 and N9, 861,506.00 in 2016.

Table 2: Distribution of respondents according to amount of finanical loss from different sectors of forest use from different operations in the last three years

Activities	Aggregate economic loss from different deforestation operations in different sectors of forest use in the last three years in Naira (N)		
	2016	*2017*	*2018*
1) Monetary value of the forfeited benefits due to loss of commercial marketable use of forest (fuel woods etc) (CMG)	5,796,000	33,967,000	43,207,600
2) Monetary value of the forfeited benefits due to loss of industrial marketable use of forest			
3) (paper woods etc) (IMG)	13,564,800	11,380,500	7,855,000
4) Monetary value of the forfeited benefits due to loss of timber harvesting (TM)	19,515,400	16,627,000	12,480,400
5) Monetary value of the forfeited benefits due to loss of fruits gathering use of forest (FR)	5,965,900	4,422,500	2,929,700
6) Monetary value of the forfeited benefits due to loss of animals harvest use of forest (AN)	8,581,000	4,411,200	3,922,100
7) Monetary value of the forfeited benefits due to loss scientific use of forest (SV)	1,992,000	1,676,150	1,603,950
8) Monetary value of the forfeited benefits due to loss of existence use of forest (EV)	1,149,800	874,300	866,300
9) Monetary value of the forfeited benefits due to loss of environmental protection use of forest (Epv).	2,222,100	1,650,900	1,472,200
10) Monetary value of the forfeited benefits due to loss of cultural use of forest (CV).	1,756,550	1,686,550	1,485,200
11) Monetary value of the forfeited benefits due to loss of herbal use of forest (Spv).	15,312,008	12,978,607	9,861,506
Total economic loss value (TEV)	75,855,558	89,674,707	85,683,956
Total number across all households	1080	1080	1080
Per capita TEV	70,236.63	83,032.14	79,337.00

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6.0 Conclusion

It has clearly been established that, deforestation and degradation of forest across the country and Enugu State in particular is an ongoing problem in most communities especially in the recent time. The tragedy is seriously crippling human development in the rural area of Enugu State due to the loss of income and employment generation from this sector.

Furthermore, there exist very little and vague empirical understanding of roles of factors of deforestation in Enugu state. Meanwhile, this study has helped to expose the interaction of these factors and the magnitude of their effects in the state especially in the rural settings where such knowledge are not fully yet in existence. To both policy makers and other major stakeholders in the forestry sector, this research highlighted core aggregate economic loss from different forestry operation that need to be monitored so that such economic resources can be channelled toward improvement of rural and urban livelihoods of the citizenry.

Therefore, it is hereby recommended that proper identification of preventive and control measures which include among others adequate advocacy in this area of the negative effects of deforestation activities, aforestation projects across the state would be very useful.

Finally, the study further recommends that frequent use of workshops, advocacy and seminars are necessary to educate the rural and urban farmers more on the negative consequences of deforestation. This will help the rural stakeholders to have adequate information on the new policies of the government concerning forestry sector.

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