

Full Length Research

Dynamics nature of rural forestland deforestation in Enugu state, Nigeria

Emeka Nzeh¹, Eric Eboh^{1*} and Noble J. Nweze²

¹Department of Agricultural Economics and Extension, Enugu State University of Science and Technology (ESUT), Enugu, Nigeria.

²Department of Agricultural Economics, University of Nigeria, Nsukka, Nigeria.

Accepted 28 January, 2015

The study focused on dynamics nature of rural households' mechanisms in deforestation activities in Enugu State of Nigeria. The study had the following specific objectives to; examine the nature and extent of deforestation; identify and analyze the factors that influence the decision to deforest; evaluate the effect of socioeconomic factors on deforestation; and derive lessons for sustainable management and use of forests. In the sampling procedure, both purposive and random sampling techniques were employed to ensure a good spread of respondents for the study. In the study a total of 240 respondents were used but at the analysis only 216 of them were used. The major findings show that 93% of the respondents agreed that they cleared forest for agricultural activities within the past six (6) years. Also, the study indicated that 62% of the respondents believed that the degree of deforestation in the study area is moderate. Multivariable linear results of farmland clearance of forest for cropping activities show that only size of land, land tenure system and types of cropping were significant at 5% in explaining the observed variabilities in the dependent variable (Y). The study further found out that deforestation experience, household size, total landholdings, educational attainment and gender of respondents were significant at 10% in explaining the observed variabilities for socioeconomic characteristics influencing the decision to clear forest for agricultural activities using farmers level logit regression results. The study recommends among others that forest extension services to the rural households that engage in forestry activities should be strengthened through frequent training. This will help them have adequate and recent information about government policies on environment and communicate the same to the rural stakeholders involve in forestry activities.

Key words: Rural forestland, deforestation, dynamics.

INTRODUCTION

For many developing countries like Nigeria and a state like Enugu State in particular, forests represent an important resource base for economic development. If managed wisely, the forest has the capacity to provide a perpetual stream of income and subsistence products, while supporting other economic activities (such as fisheries and other agricultural activities) through its

ecological services and functions. Meanwhile, Enugu State has land area of about 8,000 square kilometers and population of 3,257,298 according to (NPC 2006). The state has population density of about 406 persons per square kilometres. About 59% of the population lives in the rural areas where agriculture is the predominant economic activity. Agriculture accounts for about 70% of employment in the rural areas while the government employment is only 5% of working-age population as reported by Eboh *et al.* (2006).

Rural forestland may be utilized in many different ways. It can be used for commercial timber extraction; it may be

*Corresponding author. E-mail: nzecelestine@yahoo.com; ecnzeh@gmail.com. Tel: +234 – 8038739788

converted for commercial agriculture purposes such as oil palm or rubber plantations. Furthermore, forest may be used for traditional subsistence activities (for example, traditional agricultural practices such as agroforestry and shifting cultivation, and/or for the extraction of non-timber forest products or it may be afforded various levels of protection through the establishment of a protected area, a national park or wildlife sanctuary among others according to International Institute for Environmental Development (IIED), 1994. In the views of Nzeh (2004), three activities are done in the forests that yield income to the rural households in Enugu State. These activities are gathering, processing and marketing of forest products.

How best to manage forest resources by rural households so that they can make more income and even create more economic position has become a growing concern for policy makers, interest groups and the public due to the following reasons: the increasing scarcity of virgin forest land; greater awareness and understanding of the social and economic implications of destructive forest practices especially at the rural level; and, a growing realization that the significant opportunities for economic development based on forestry activities should not be wasted. Greater attempts are now being made to rationalize the decision making process with respect to the use of forest resources. If the returns from forest resources are to be maximized over the long term, then the forest needs to be managed sustainably (that is, the production of goods and services need to be balanced with the conservation of the resource base of the forest). In order to make sustainable forest management decisions, more reliable information on the environmental, social, and economic value of forests in their own right and relative to other land uses is urgently needed.

According to van Kooten and Bulte (2000), deforestation refers to the removal of trees from a forested site and the conversion of land to another use, most often agriculture. There is growing concern over shrinking areas of forests in the recent time (Barraclough and Ghimire, 2000). The livelihoods of over two hundred million forest dwellers and poor settlers depend directly on food, fibre, fodder, fuel and other resources taken from the forest or produced on recently cleared forest soils. Also, according to Nzeh and Eboh (2007) poor people have thus been able to exploit the forest for food, fuel and other marketable products which create both income and employment for the rural dwellers. Furthermore, deforestation has become an issue of global environmental concern, in particular because of the value of forests in biodiversity conservation and in limiting the greenhouse effect (Angelsen, Shitindi, and Aarrestad, 2013.). This has led economists to increase their efforts to model the process of deforestation and conversion of forests to other land uses.

But, in the view of Enabor (2010), deforestation is the removal or destruction of forest vegetation without any

deliberate attempt at its regeneration. The term thus, includes not only felling of timber trees, but also removal of shrubs, lianes and other plants from the forest. Deforestation is as old as man himself and as Enabor (2010), rightly reported, the early stages of civilization made it essential to destroy and remove some of the abundant forests in order to pave the way for activities such as arable farming and human settlements which advanced human development. Deforestation can therefore be regarded as primarily a result of man's efforts to meet his legitimate needs for social and economic development through expanding agriculture, industrialization and infrastructural development.

Forests in the tropics are being destroyed at an alarmingly high rate in recent years especially in Nigeria and particularly in Enugu State as reported by Eboh *et al* (2006). According to FAO (1981), statistics estimated that between 8million and 20million hectares of tropical forests are removed annually and that the area of plantation in 1980 was about 12million hectares which represent only 10% of the total forest areas deforested annually. Going by this high rate of deforestation and the low level of aforestation, the World Resource Institute (WRI), (1985) projected that about 225million hectares of tropical forests would have been deforested by the year 2000. Meanwhile, FAO 2011 reported that between 1990 and 2005 the loss of forests was highest in the tropics. FAO 2011 further stated that the net losses in this region averaged 6.9 million hectares/year between 1990 and 2005 and that the highest rate of conversion of forest land was in South America, followed by Africa.

In Nigeria, the rate of deforestation appears to have accelerated in recent years. Deforestation estimates for the country has been put at approximately 285,000 hectares annually (Oseni, 1998; Aruofor, 1999). It is believed that at this rate of deforestation about 50% of the nation's forest land area would be destroyed by the year 2000. Going by this trend, deforestation has thus been described as the major problem facing the forest ecosystem in this country. The extent of deforestation in any particular location or region should be viewed with economic, ecological and human consequences in mind. This is because forest degradation may in many ways be irreversible. In the short term, because of the extensive nature of forest, the impact of activities altering their condition is not immediately apparent and as a result they are largely ignored by those who cause them. The forest is often perceived as a stock resource, a free good, with the land as something freely available for conversion to other uses without recognition of the consequences for the production services and environmental roles of the forest, hence many forest ecosystem have been degraded into less diverse and stable ones according to Aruofor, (1999). The economic implications of deforestation in the study area include scarcity of fuelwood for cooking and heating especially among the rural populace. Added to this is the decline in forest-dependent

industries. This accelerating nature of deforestation is also threatening the sustained resources base of the forest raw materials.

In the views of Eboh *et al.* (2005) the forest resources of Enugu State are under pressures from urbanization, infrastructure development, residential construction, population growth and expansion of agricultural crop cultivation. Evidence of these pressures is the growing degradation of both community and state forest. According to Eboh *et al.* (2006), about 25% of forest cover in the study area was lost from 1991-2003 with the remaining forest now standing at about 16-17% of total land area. Forest loss is threatening rural household incomes and consumption of non-wood forest products (NWFPs).

The objectives this paper is to: - examine the nature and extent of deforestation; identify and analyze the factors that influence the decision to deforest; evaluate the effect of socioeconomic factors on deforestation; and derive lessons for sustainable management and use of forests.

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°56' and 7°06'N and longitudes 6°53' and 7°55'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 (Ezike, 1988). The State occupies an area of about 8,022.95km² (Ezike, 1988) 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 is divided into three agricultural zones namely: Awgu, Enugu and Nsukka Zone.

In Nigeria and Enugu State in particular, the natural vegetation falls into two main divisions, namely, forests (mangrove swamp forest, fresh-water swamp forest and rain forest) and tropical grasslands or savanna (guinea, Sudan and Sahel) according to Iloeje, 1981. Perkins and Stembridge (1959) reported that the forest region of southern Nigeria is divided into mangrove swamp forest, fresh water swamp forest and rain forest. But, Enugu State is characterized by mixture of savanna and rain forest area. The vegetation of Enugu State as reported by (Iloeje 1981) is a by-product of centuries of tree devastation by man and fire, and a continuous attempt by the plants to adapt. These made the trees grow long taproots and develop thick barks which enable it to survive the long dry season and resist bush fires. Most of the trees have umbrella-shaped canopies which not only shade the ground but limit loss of soil moisture. Example of trees found here are the locust bean trees, sheabutter tree, oil bean tree, isoberlina tree among others and the trees grow in clusters, generally not more than 6 metres

high, and are interspaced with elephant grass growing to a height of 3 to 3.6 metres (Iloeje 1981).

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 three agricultural zones – Awgu, Enugu and Nsukka as earlier mentioned two (2) local government areas were purposively selected from each of the zones. This was done so that only local government areas where forests exist will be 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. The questionnaire focuses on factors that influence the decision to deforest, socio-economic characteristics as well as data on nature and extent of rural deforestation. Data were analyzed using descriptive, logit model as well as multiple regression techniques.

Specification of logit models

Logit models and multiple regression analysis were used to achieve objective ii.

Logit model

This model was used to address objective ii which is to identify and analyze the factors that influence the decision to deforest in the study area.

In the multinomial logit model, according to Eboh (2009), a set of coefficients $\beta^{(1)}$, $\beta^{(2)}$, $\beta^{(3)}$, were estimated as:

$$\Pr(Z = 1) = \frac{e^{x\beta^{(1)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + e^{x\beta^{(3)}} \dots} \quad (1).$$

$$\Pr(Z = 2) = \frac{e^{x\beta^{(2)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + e^{x\beta^{(3)}} \dots} \quad (2).$$

$$\Pr(Z = 3) = \frac{e^{x\beta^{(3)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + e^{x\beta^{(3)}} \dots} \quad (3).$$

The model however is unidentified in the sense that there is more than one solution to $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$, that leads to the same probabilities for $Z=1, Z=2$ and $Z=3$. To identify the model, one of $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$, is arbitrarily set to 0. That is, if we arbitrarily set $\beta^{(3)}=0$ the remaining coefficients $\beta^{(1)}, \beta^{(2)}$, would measure the change relative to the $Z=3$ group. This simply means that we will be comparing households that have access to more than 60% of landholdings forest to those that did not have such access (1 and 2). Then setting $\beta^{(3)}=0$, the above equations (1) to (3) become:

$$\Pr(Z = 1) = \frac{e^{x\beta^{(1)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + 1} \dots \quad (4).$$

$$\Pr(Z = 2) = \frac{e^{x\beta^{(2)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + 1} \dots \quad (5).$$

$$\Pr(Z = 3) = \frac{e^{x\beta^{(3)}}}{e^{x\beta^{(1)}} + e^{x\beta^{(2)}} + 1} \dots \quad (6).$$

The relative probability of $Z = 1$ to the base category is given as:

$$\frac{\Pr(Z = 1)}{\Pr(Z = 3)} = e^{x\beta^{(1)}} \dots \quad (7).$$

If we call this, the relative likelihood and assume that X and $\beta^{(1)}_k$ are vectors equal to $(X_1, X_2, X_3, \dots, X_k)$ and $\beta^{(1)}_1, \beta^{(1)}_2, \dots, \beta^{(1)}_k$ respectively. The ratio of relative likelihood for one unit change in X_1 relative to the base category is then:

$$\frac{e^{\beta^{(1)}_1 X_1 + \dots + \beta^{(1)}_k x_k}}{e^{\beta^{(1)}_1 x_1 + \dots + \beta^{(1)}_k x_k}} = e^{\beta^{(1)}_1} \dots \quad (8).$$

Therefore, the exponential value of a coefficient is the relative likelihood ratio for one unit change in the corresponding variable as reported by Eboh (2009).

Definition of variables

From the study, the dependent variable is defined to have two possible values: 1 if the household cleared forest for agricultural and any other activities in the last six (6) years; 0 if the household has not cleared forest for any activity in the last six (6) years. Therefore, deforestation in the study area may be related to the following farmer specific model:

$$\Pr = f(F_x, G_d, A_e, E_d, D_x, H_s, L_c, T_a, C_r) + \mu$$

Where:

- Pr = Clearance of forest for agricultural/other activities within the past six (6) years (ha).
- F_x = Assistance from forest extension agents (1 for assistance, 0 other wise)
- G_d = Gender of respondent (1 for male, 0 for female)
- A_e = Age of household heads (years)
- E_d = Educational attainment of household heads (years of formal schooling)
- D_x = Deforestation experience (Number of years in deforestation operation)
- H_s = Household size (number)
- L_c = Location of land [i.e. distance from home (Km)]
- T_a = Total land holding (ha)
- C_r = Credit access (amount of farm credit obtained last year in Naira)
- μ = error term

Multiple linear model of farm level

But, for the farm specific model of deforestation in the study area using multiple regression analysis, it is represented as:

$$Y = f(D_t, S_x, T_k, L_a, T_e, O_r, A_z) + \mu.$$

Where:

- Y= Number of years since the farmland was first cleared for cropping (years)
- D_t = Distance from home of respondents (Km)
- S_x = Size of land own by respondent (ha)
- T_k = Topography of land own by respondent (1, for flat land, 0, otherwise)
- L_a = Land tenure system use by respondent (1, if inheritance; 0, if otherwise)
- T_e = Types of cropping for the past three (3) years (1, if sole cropping, 0 if otherwise)
- O_r = Output of land per year for the past three (3) years (Percentage of annual farm output)
- A_z = Amount of fertilizer for the past three (3) years (kg)
- μ = Error term

It is important to state here that the above model seeks to ascertain how forestland cleared in different time period is related to current patterns of management and use. This will provide some insights into the dynamics of forestland clearance and give indications as to the incentives and stimuli for deforestation and changing land use patterns.

RESULTS AND DISCUSSION

Socio-economic characteristics of rural households

Socio-economic profile of the respondents refers to their personal characteristics and conditions, which influenced

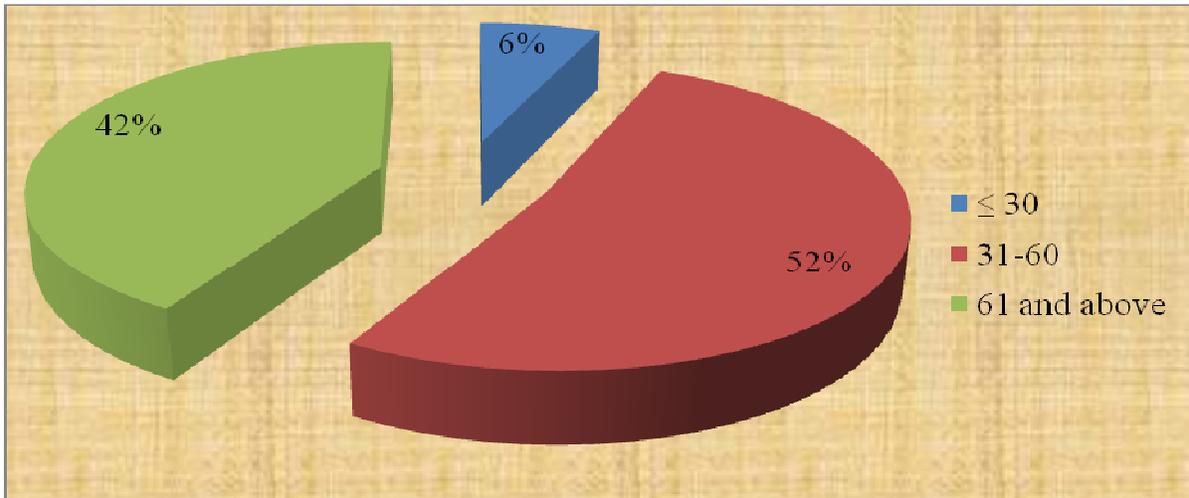


Figure 1. Distribution of respondents according to age
Source: Field survey, 2013

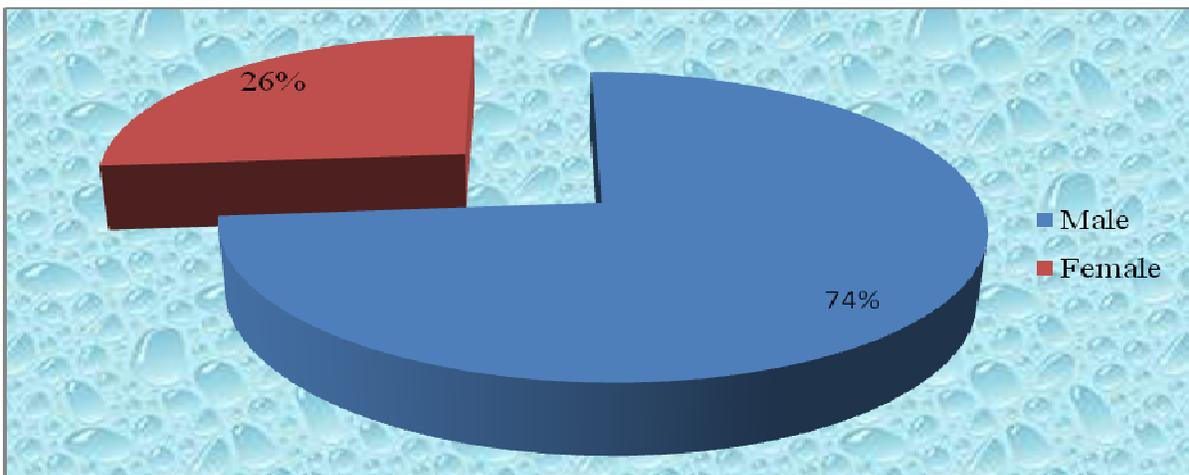


Figure 2. Distribution of respondents according to sex
Source: Field survey, 2013

the decision of the respondents to deforest an environment. The socio-economic status considered in this study include age, sex, marital status, level of education, household size, leadership potential, awareness of extension services, source(s) of income among others.

Age of respondents

In many economic activities including deforestation activities it require little else than physical vigour; that is, muscular strength, a good constitution and energetic habits as reported by (Marshall, 1961). According to Samuelson (1985), muscular efficiency involved in doing a particular work is a function of age, physical and moral conditions of the key player. Figure 1 shows the age

distribution of the respondents in the study area. From the Figure 1, it indicates that the bulk of the respondents fall in the age bracket of (31-60 years) of age and constitute 52%. The old age group (≥ 61 years) formed 42% of the respondents while the youth is made up 6% of the respondents. The results of the analysis show that middle-aged men and women dominate in the deforestation activities in the rural areas. It also suggests that youths are massively leaving deforestation for other economic activities.

Sex of respondents

Figure 2 shows that 74% of the respondents in the study are males, while the rest (26%) are females (that is, more

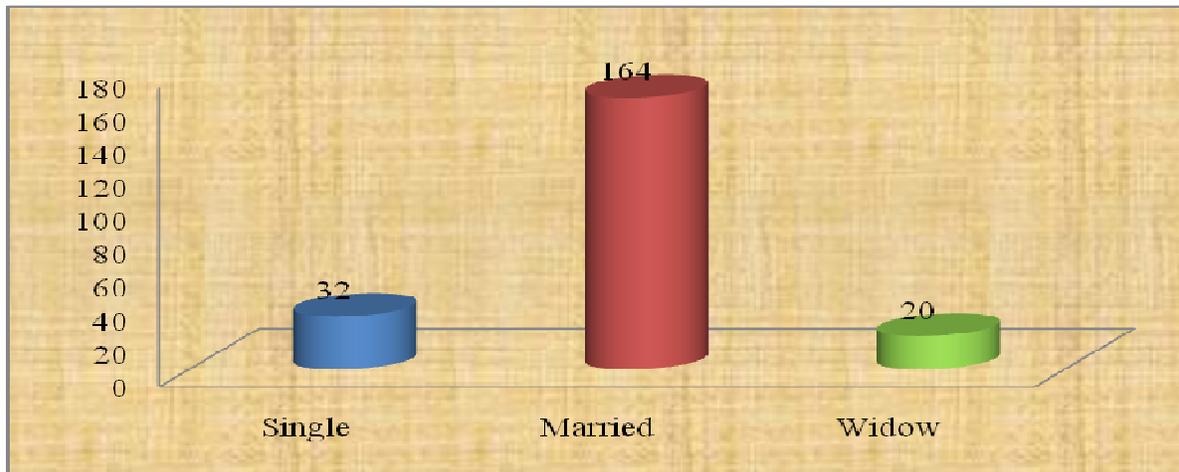


Figure 3. Distribution of respondents according to marital status.
Source: Field survey, 2013

males involve in deforestation than females). The greater number of males does not presuppose out-rightly that males outnumber the females in the study area. Rather, this can be attributed to the fact that males seem to have more access to forest and its deforestation activities than females. This confirms with the finding of Falconer and Arnold (1991) that generally men have greater access to the cash economy from forest product activities and often generate cash as their primary activity, while women's activities revolve more around the subsistence needs of the household, most particularly food production and child care.

Marital status of respondents

From Figure 3, it can be seen that 76% of the respondents are married and are involve in deforestation activities in Enugu State. The same Figure 3 shows that 15% of the respondents are single whereas only 9% of the respondents are widows. The implication of the below result is that many widows in the study area are not involve in deforestation activities. One may suggest that the reason(s) may be connected to the fear of female going into forests for many kinds of activities including deforestation. Furthermore, one may say that the culture of the area may have not allowed females much access to forestry activities.

Number of children of respondents

A household unit comprises the household head, wife or wives, children and other dependants living with them. Explaining the importance of household composition to agriculture, Agu (1995) said that most farm families in Eastern Nigeria are polygamous – a tendency to have

more children to assist the families in various agricultural productions including clearing, stumping of woodland and other deforestation acts. Figure 4 shows the distribution of respondents according to number of children and the trend in deforestation.

The results of the analysis as shown in Figure 4 indicate that 49% of the respondents have children between 4 and 6 in the sampled area. The same Figure 4 equally shows that 32% of the respondents have children of ≥ 7 , whereas only 19% of the respondents reported that they have children of ≤ 3 in number. The implication of the below results might mean that more children will lead to more hands being involved in the deforestation activities in the study area.

Educational status of respondents

Generally, education broadens the horizon of human activities, operation and understanding of his environment. The educated farmer also has better understanding of the importance of forest to the environment (Desai and Mellor, 1993). He has more access to government programmes, production credit, improved technologies and membership of rural institutions (cooperatives). The educated man is also conscious of his environment and tends to preserve forest/wooded vegetation land. In the study area, deforestation is usually appreciated by all for its role as source of fuel wood, furniture and building materials among others. Figure 5 presents the distribution of the respondents according to educational attainment and their corresponding deforestation behaviour.

Figure 5 indicated that the bulk of the respondents (40%) in the study reported that they had primary education as their highest level of education attainment. From the same Figure 5, 25% of the respondents agreed

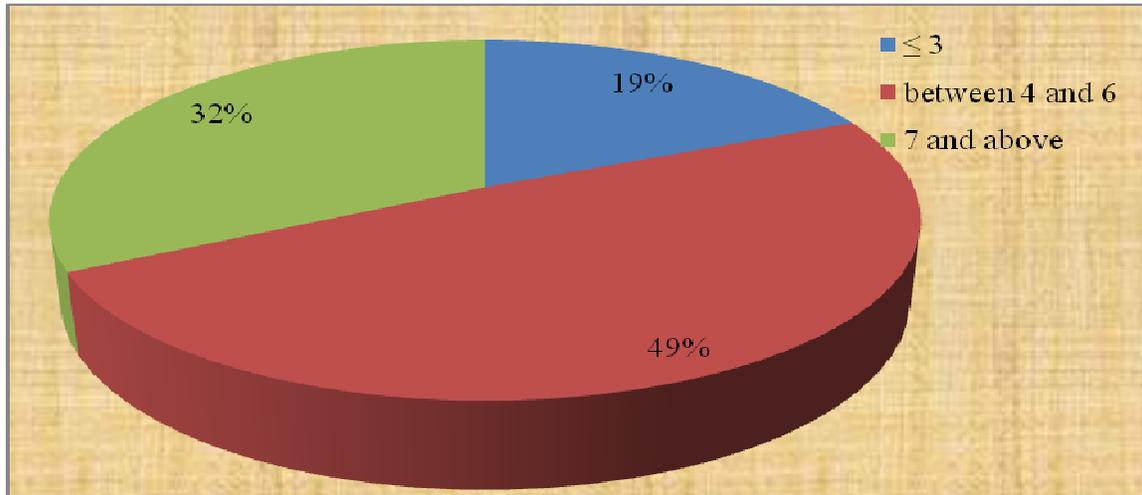


Figure 4. Distribution of respondents according to number of children.
Source: Field survey, 2013

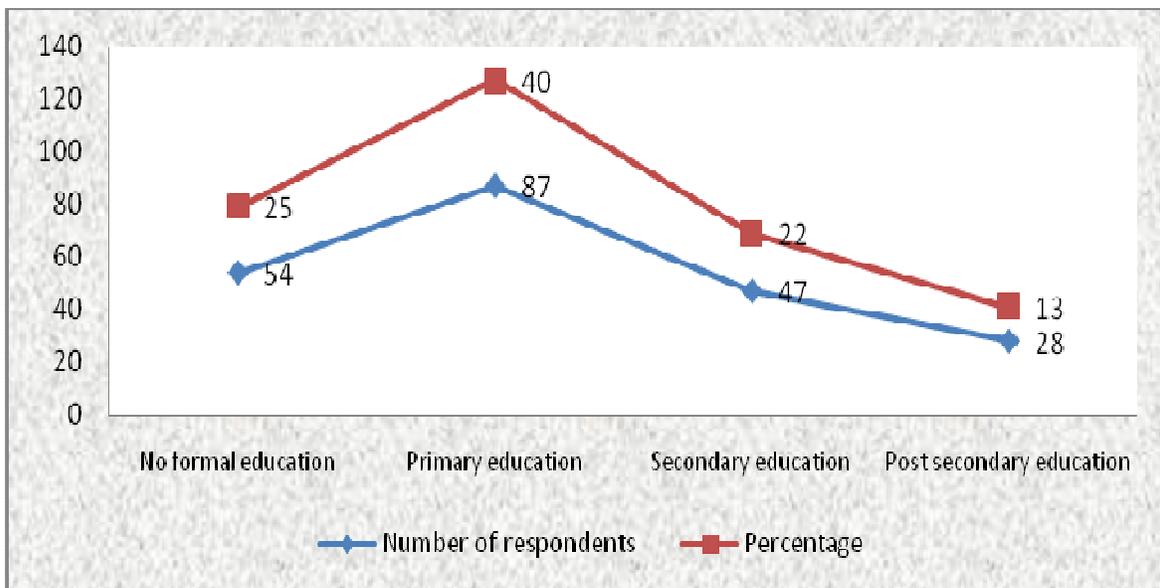


Figure 5. Literacy level of respondents.
Source: Field survey, 2013

that they did not attend any form of formal education. Critical analysis of Figure 5 equally shows that 22% of the respondents reported that their highest level of education is secondary education, whereas only 13% of the respondents had post secondary education in the study area. The scenario above indicates that least deforestation activities in Enugu State were attributed to those with post secondary education. This is because these set of educated respondents understand the negative implications or consequence of deforestation to the state economy and the environment.

Awareness of forest extension services

As can be deciphered from Figure 6, only 31% of the respondents were aware of forest extension services in the sampled size, while the remaining 69% had no knowledge of any forest extension services. This simply indicates that few percentages of respondents with forest extension services knowledge may be those living nearer government forest reserve areas. The implication of the high percentage of the respondents in the sampled size not being aware of forest extension services is that there

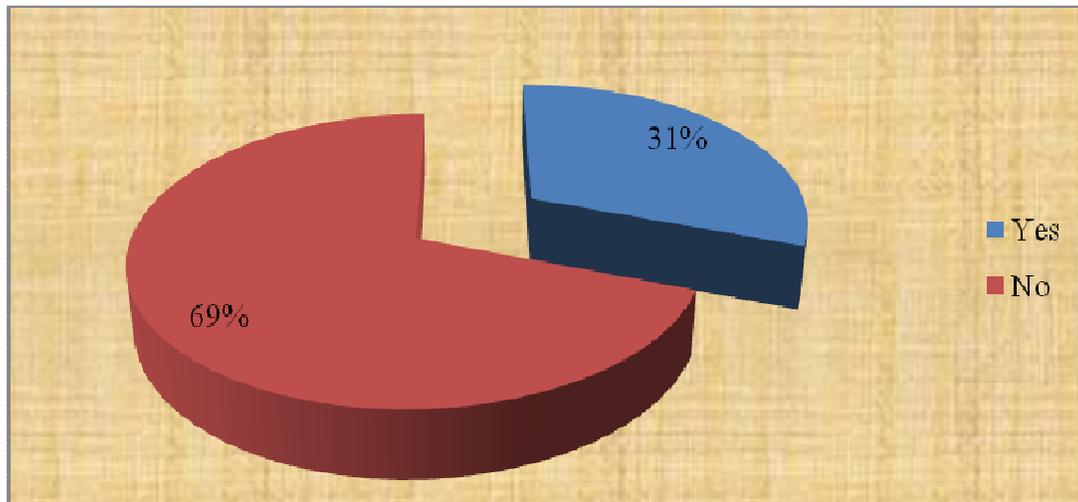


Figure 6. Distribution of respondents according to awareness of extension services.
Source: Field survey, 2009

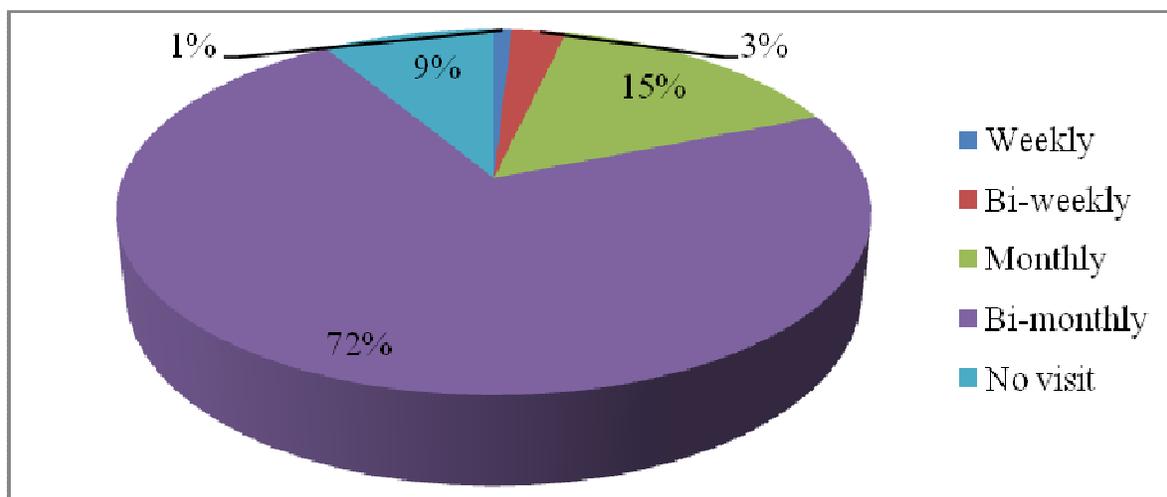


Figure 7. Distribution of respondents according to forest extension agents' number of visit.
Source: Field survey, 2013

will be more deforestation activities by these respondents leading to indiscriminate exploitation of forest resources.

Number of visits by forest extension agents

According to Figure 7, from the few number of respondents that acknowledged visit by forest extension agents, only 72% of the respondents in the study area reported that the visit of those forest extension agents usually occurs bi-monthly. From the same Figure 7, 15% of the respondents reported that forest extension agents visit them monthly. Meanwhile, 9% of the respondents in the study area stated that they had no visit by forest

extension agents. Finally, Figure 7 equally indicated that few respondents 3% and 1% reported of forest extension agents visit to them were bi-weekly and weekly respectively. The non-regular visit by the forest extension agents as showcased in the figure 7 may be attributable to lack of adequate motivation by the government to the change agents and this could account for the constant deforestation being witnessed in the state.

Services received from forest extension agents

From Figure 8, it can be seen that 90% of the respondents in the study area who acknowledged being aware

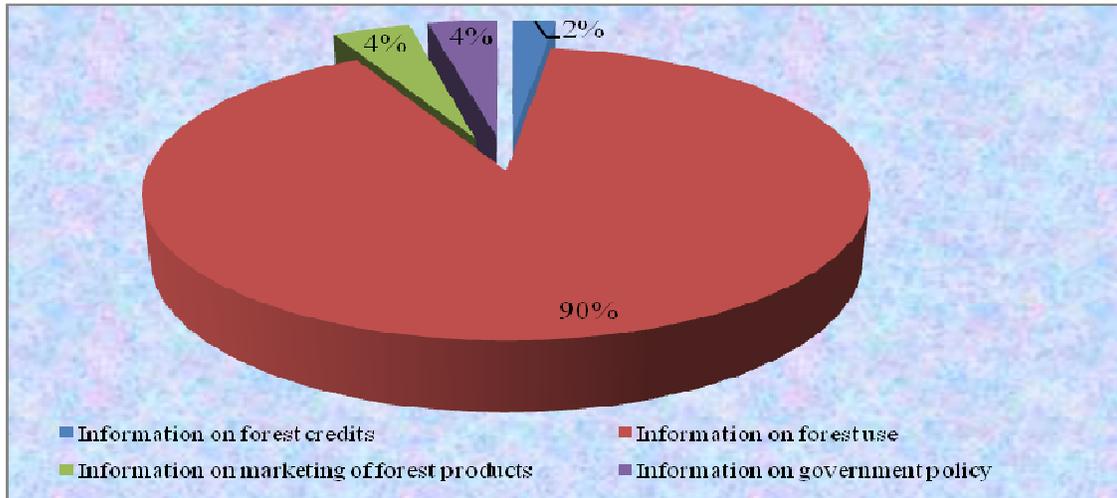


Figure 8. Distribution of respondents according to types of services received from forest extension agents. Source: Field survey, 2013

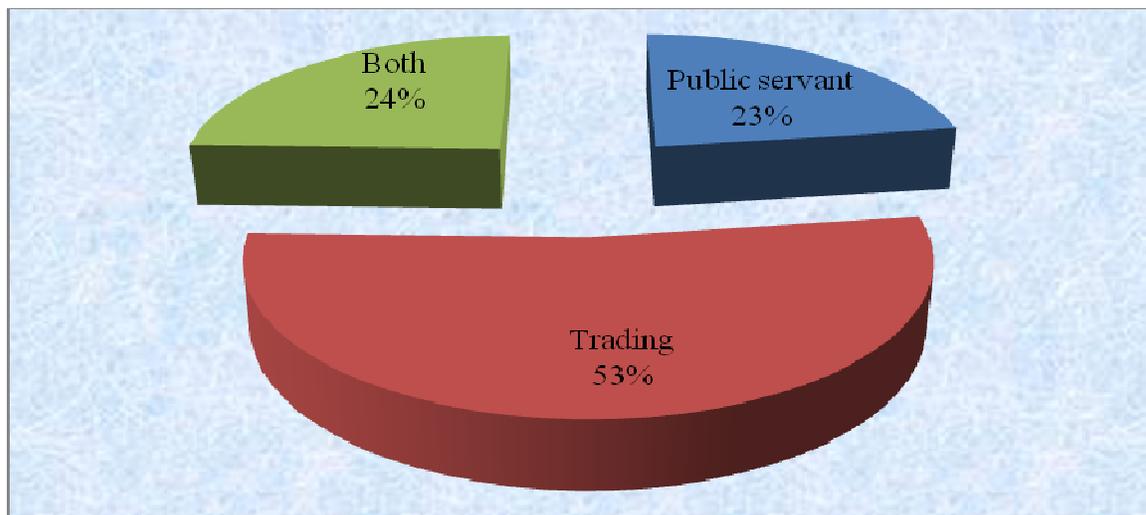


Figure 9. Distribution of respondents according to other sources of income. Source: Field survey, 2013

of forest extension agents agreed that they receive information concerning forest use from these forest extension agents. Furthermore, Figure 8 equally shows that both respondents that receive information on marketing of forest products and information on government policy concerning forest recorded 4% only. Finally, only 2% of the respondents reported that they received information from forest extension agents in the study area on forest credits. The few respondents that receive information about government policies concerning forest still indicate that these respondents may be engaging in deforestation activities within the state due to lack of adequate knowledge about recent government programme concerning forest. These therefore result to negative consequences of deforestation to both humanity

and economy of the state.

Other source(s) of income

Part time income earning activities including trading on forestry resources fall within the category of other sources of income to different households. It usually represents those activities, which occupy less than 30% of the working time of the households to support their financial base as reported by (Deepar and Pritchett, 1977).

Figure 9 contains the distribution of respondents according to other sources of income by the respondents in the study area. The Figure shows that 53% of the

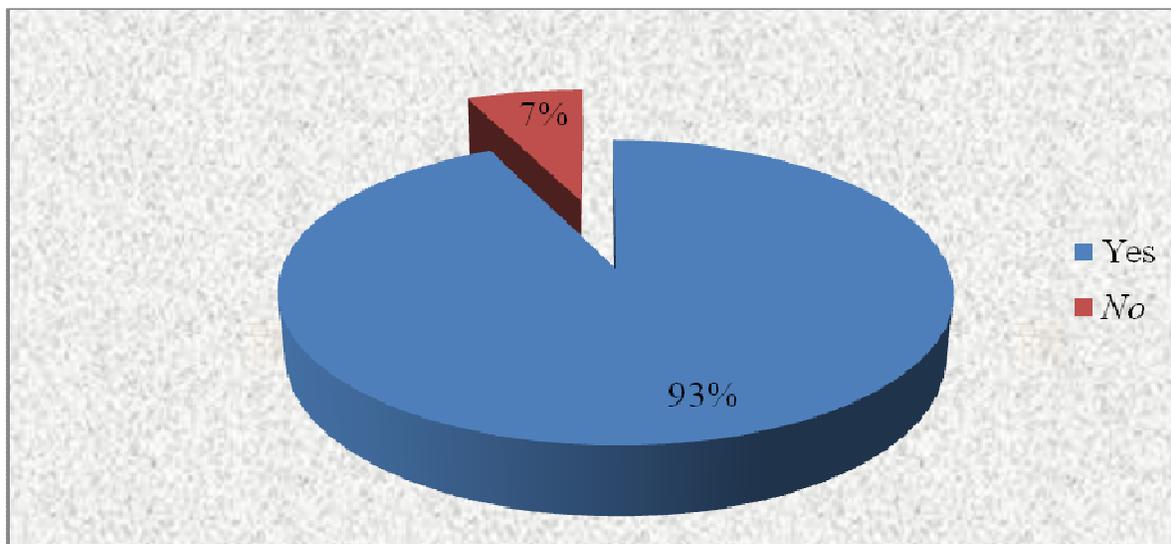


Figure 10. Distribution of respondents according to clearing of forest for agricultural activities within the past six (6) years. Source: Field survey, 2013

respondents reported that their other source(s) of income is trading on the forestry resources. Also, the same Figure 9 indicates that 24% of the respondents reported that their other source(s) of income are both trading on the forestry resources and public service. Further analysis of the same Figure 9 shows that only 23% of the respondents stated that their other source(s) of income is through public service.

Nature and extent of deforestation

Clearing of forest for agricultural activities

Figure 10 shows that 93% of the respondents reported that they cleared forest for agricultural activities within the past six (6) years. Furthermore, from the same Figure 10, only 7% of the respondents agreed that they did not clear forest for any agricultural activities within the last six(6) years.

The implication of the high percentage of the respondents being involved in clearing forests for agricultural activities within the last six (6) years indicated that there is constant deforestation occurring in the study area. This equally implies that there will be higher rate of climate change in Enugu State since deforestation, as reported by Adesina and Adejuwom (1994), is one of the major causes of climate change.

Use patterns of deforested land

Figure 11 indicated that there are different historical dynamics of deforested land in Enugu State in which different crops are grown in different year period. From the Figure, higher percentage of the respondents 36%

reported that in the first 5years or less of their deforestation of land; they grew mixed crops of yam/cassava/maize/okro. From the same figure, 23% of the respondents reported that in the first 5years or less of their deforestation of land they crop yam/cassava/melon; whereas 18% of the respondents said that they grew combined crops of yam/cocoyam/cassava/maize. The figure below also shows that 9% each of the respondents reported that they grew combined arable crops of cassava/groundnut/okro and other crops like soybean respectively at their first 5years or less of deforestation of land. Finally, as 9% of the respondents reported that in the first 5years or less of their deforestation of land they grew other crops like soybean among others, only 5% of the respondents agreed that they grew combined tree crops like oil palm/cashew/cocoa/oranges in the first 5years or less of deforestation of land in their community.

From the aforementioned analysis, one can see the switch in resource allocation preference of the farming households in Enugu State in which much of the arable crops and few of the tree crops are used to replace the forest. The lower percentage of respondents that reported that they grew tree crops as listed above to replace forest is expected because these farmers engage in farming activities to make quick returns to their capital investment and it takes higher years for tree crops to mature and yield revenues to these rural farmers. Due to this reasons, these farmers engage in growing mainly arable crops in any deforested land of the state; be it at the earlier years of deforestation or later years.

Number of hectare(s) of land cleared for agricultural activities

From Figure 12, 50% of the respondents in the study

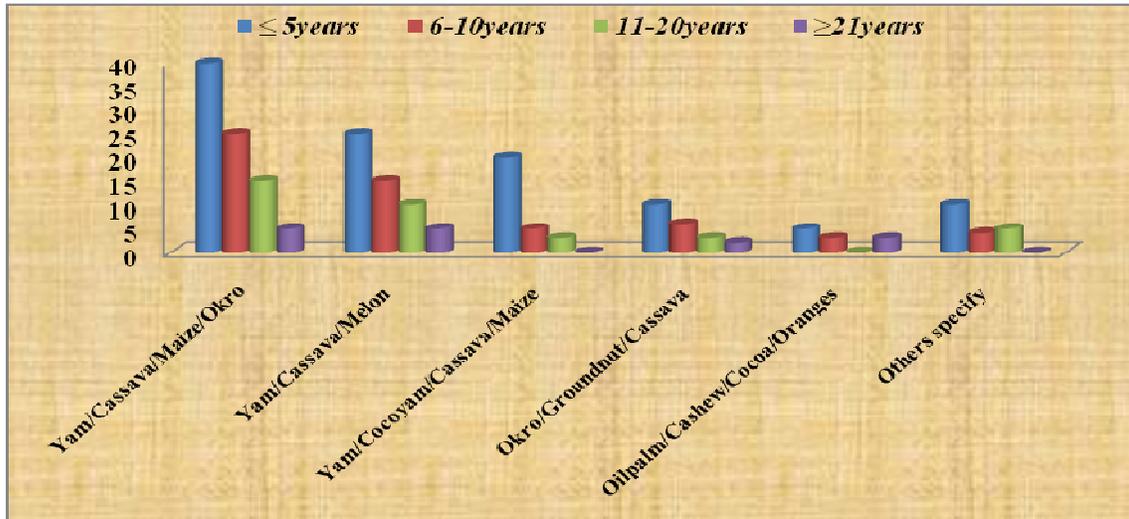


Figure 11. Distribution of respondents according to types of crops grown in different years
Source: Field survey, 2013

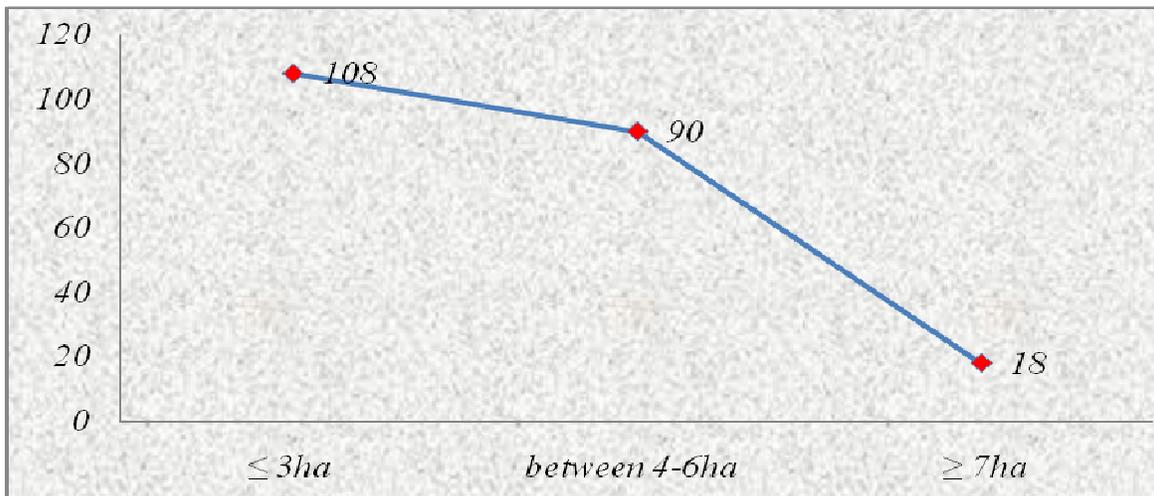


Figure 12. Distribution of respondents according to hectares of land cleared for agricultural activities
Source: Field survey, 2013

area agreed that they cleared ≤ 3 hectare(s) of land for agricultural activities within the past six (6) years. Also the same Figure 12 indicated that 42% of the respondents stated that they cleared between 4 and 6 hectares of land for agricultural activities. Finally, only 8% of respondents cleared ≥ 7 hectares of land for the same purposes within the past six (6) years as seen in Figure 12.

Nature of deforestation

Figure 13 shows that 62% of the respondents agreed that the degree of deforestation in the study area is moderate. Futhermore, 28% of the repondents stated that the degree of deforestation in Enugu State is high but only

10% of the respondents reported that the degree of deforestation in the study area is very high. The implication of both high and very high nature of deforestation in the study area is that the economy from forestry resources will be further depleted thereby creating a reduced income and employment for rural households who dependent in forestry earning for their livelihood.

Factors that influence decision to deforest

Determinants of rural household heads farmland clearing for cropping activities

To ascertain the determinants of farmland clearing for cropping activities, a multiple regression analysis was

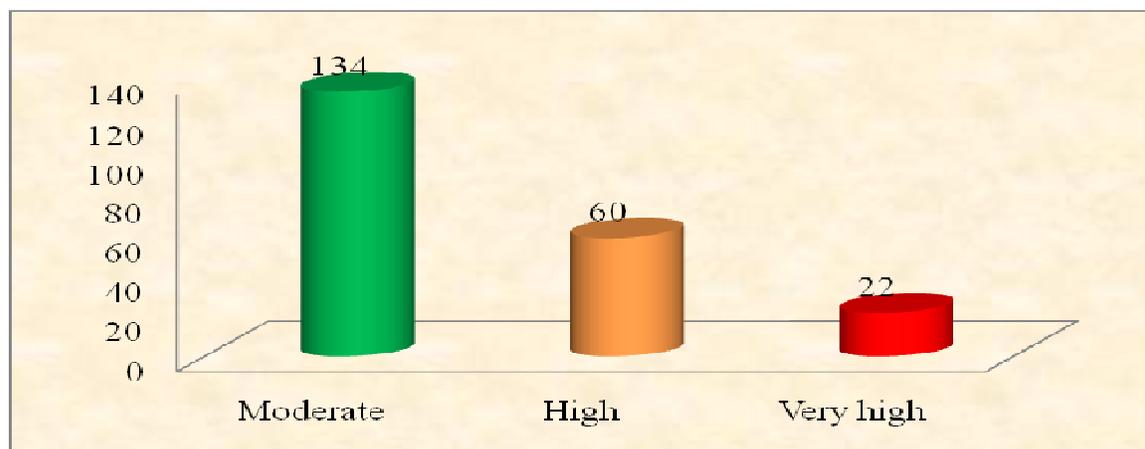


Figure 13. Distribution of respondents according to nature of deforestation.
Source: Field survey, 2013

Table 1. Linear regression results of the determinants of the forest clearing for cropping activities.

S/N	Explanatory Variables	Coefficients	t-ratios
1.	Distance from home(D_t)	-1.218884	-0.65
2.	Size of land (S_x)	3.821211	(1.72)**
3.	Topography of land (T_k)	-1.42735	-0.27
4.	Land tenure system (L_a)	0.509881	(2.03)**
5.	Types of cropping (T_e)	17.61003	(3.19)**
6.	Output of land per year (O_r)	0.0040607	0.04
7.	Amount of fertilizer (A_z)	0.0013264	0.02
8.	Constant term	4.58664	
9.	R^2	(0.4726)	
10.	F-Value	(12.21)**	
11.	N	216	

** Significant at 5%

Source: Computer Analysis of the field survey Data, (2013)

carried out. The four functional forms – linear, double-log, semi-log and exponential were used. The linear functional forms was chosen since it provided higher number of variables with significant levels and also based on its records of having best R^2 , F-ratios and also the best coefficients when signs and significant are considered. The F-test was statistically significant at 5% level, suggesting a relationship between the characteristics of farmland clearance for cropping activities and the independent variables.

Analysis of regression results

From the results in the Table 1, based on the linear functional form model, the R^2 value of the model is 0.4726 implying that the independent variables in the model explained only about 47% of the variability in farmland clearance effect. This means that outside the

tested variables, some variables which may be relevant in the regression model were omitted. Such variables may include farming experience, leadership status of households, economic orientation of household heads (that is, the percentage of total household output from farming clearance activities that is marketed), technology use for the clearance of the farming activities, off-farm employment, educational levels of respondents, etc. Outside the above factors, the remaining variables are those assumed to have no significant effect on the level of R^2 and can be justified by the nature of the study. Specific deductions were made using the T-ratios.

The coefficients of both size of land (S_x), land tenure system (L_a), and types of cropping (T_e) were both positively signed and significant at 5% in conformity with the *a priori* expectations. This implies that both variables are significantly related to the level of farm land clearance (that is, they are the major determinants of farmland clearance for cropping activities in the study area).

Table 2. Model estimates of socioeconomic factors influencing the decision to clear forest for agricultural/other activities.

S/N	Variables	Coefficients	Z
1.	Assistance from forest extension agents (F_x)	-0.0056531	-0.01
2.	Gender of respondent (G_d)	-3.159365	-(2.33)**
3.	Age of household heads (A_e)	0.0024837	0.08
4.	Educational attainment (E_d)	-0.55427	-(4.77)**
5.	Deforestation experience (D_x)	1.247557	(3.43)**
6.	Household size (H_s)	0.2491188	(2.19)**
7.	Location of land (L_c)	0.0460843	0.21
8.	Total land holding (T_a)	0.54655	(2.87)**
9.	Credit access (Cr)	0.0003239	1.63
10.	Constant term	-4.56821	-1.51
11.	N	216	

$$y = \text{Pr}(\text{pr}) (\text{predict}) \\ = .94678812$$

** Significant at 10%

Source: Computer Analysis of the field survey Data, (2013).

Coefficients of distance from home (D_t), topography of land (T_k), output of land per year (O_r), and amount of fertilizer used (A_z) are insignificant at 5%. They were therefore ignored. Since the variables were not significant at 5% level when their coefficients were compared, it implies that no significant relationship exists between them and level the of farm land clearance (that is, they are minor or no determinants to farmland clearance for cropping activities in the study area) when considered separately but the F-test confirms that in combination these factors affect level of farmland clearance by rural households significantly.

Plot-level analysis of factors influencing the decision to clear forest for agricultural/other activities

A set of socioeconomic characteristics of forest clearance to determine the decision of the farmers as regards whether to clear or not clear plots of land for agricultural/other activities was analyzed. These are: information from change agents, years of experience acquired in deforestation, educational attainment of households, credit acquisition, size of household, proximity of land location, land holding, age of household and gender of respondents. The study applied logit model to determine the effect of forest clearance by agricultural/other activities in the past six (6) years. The essence was to determine the key socioeconomic characteristics of deforestation that influences their conversion to agricultural and other uses. The result of the analysis is presented in Table 2

As shown in the Table 2, part of objective ii was realized using logit model to determine the effect of socioeconomic factors on deforestation. From the result above, the overall goodness of fit as reflected by $\text{Pro} > \text{Chi}^2$ value was good (0.946). In terms of consistency

with *a priori* expectations on the relationship between the dependent variable and the explanatory variables, the model appears to have performed well.

The analysis of result shown in Table 2, indicates that deforestation experience (D_x), household size (H_s) and total land holding (T_a) were positive and significant at 10%. This is consistent with the *a priori* expectation. This shows that households with deforestation experience, larger household size and even greater total land holding were likely to be involved in more clearance of the forest for agricultural and other activities for the past six (6) years. Also the same Table 2 shows that gender of respondent (G_d) and educational attainment (E_d) of the respondents were significant at 10% and negatively signed. The implication of the above analysis is that those households in the study area with better educational background and where the gender of the household heads are female are most likely not to be involved in much clearance of forest for agricultural/other activities for the last six (6) years. Thus, this leads to decrease in the clearance of forest for agricultural/other activities in the past six (6) years. This agrees with the reports of (Godoy, Groff, and O'Neill, 2012; Moran, 1989; Moran, 1989a and Tongpan, 2000) which confirms that formal education lowers pressure on the forest because it should ease out-migration and the adoption of modern farm technologies that raise the productivity of land and of labor. Furthermore, this agrees with the findings of Phillips (1994) that research in Asia shows that farmers with more than four years of education found it easier to adopt new farm technologies thereby create less negative impact in deforestation of the environment for agricultural/other activities.

Meanwhile, from the Table 2, coefficient of assistance from forest extension agents (F_x), age of household heads (A_e), location of land (L_c) and credit access (Cr) are insignificant at 10% and therefore were ignored.

Since the variables were not significant at 10% level when their coefficients were compared, it implies that no significant relationship exists between them and level of clearance of forest for agricultural/other activities for the past six (6) years in the study area. This means that they are minor or no determinant to the level of clearance of forest for agricultural/other activities in the study area when considered separately but the Z-test confirms that in combination these factors affect level of clearance of forest for agricultural/other activities significantly in the past six (6).

Conclusion and recommendations

From the discussion, it is obvious that the study have found out that the dynamics nature of rural forestland deforestation in the state are caused by but not limited to bush fire, fuel wood harvesting, timber harvesting, agricultural expansion and government activities. Therefore, in the views of this paper, it is evident that there were different dynamics sources of deforestation activities in the study. Based on these findings, it is hereby recommended that forest extension services to rural households should be strengthened in the study area. Also, there is need for community participation in forestry protection initiatives and constant use of electronic and print media in strengthening anti-deforestation. Finally, the use of workshops/seminars to educate the rural dwellers on consequence of deforestation is hereby advocated.

REFERENCES

- Adesina, F.A., Adejuwon, J.O. (1994). Climate Change and potential impact on biomass energy production in Nigeria: A preliminary assessment. Paper Presented at the International Workshop on the Impact of Global Climate Change on Energy Development Lagos Nigeria, March 28-30.
- Agu, V.C. (1995). "The Implications of Campaign for Family Planning among Small Farmers". Paper presented at the Regional Workshop for Small Scale Farmers March 4 – 5, 1994, FACU Enugu.
- Angelsen, A., Shitindi, E.F.K., Aarrestad. J. (2013). "Why do farmers expand their land into forests? Theories and evidence from Tanzania", *Environment and Development Economics* 4 (03): 313-31.
- Aruofor, R.O. (1999). An economic appraisal of pricing policy and tariff systems for *Gmelina arborea* pulpwood and saw-log in Nigeria. An unpublished M.sc thesis submitted to the department of Forest Resources Management, University of Ibadan.
- Barracough, S., Ghimire, K.B. (2000). Agricultural expansion and tropical deforestation, Earthscan.
- Deepa, N., Pritchelt, L. H. (1997). "Household Income and Social Capital in Rural Tanzania". *African in the Development Process*. London Press.
- Desai, B.M., Mellor, J.W. (1993). "Institutional Finance for Agricultural Development: An analytical survey of critical issue" *Food Policy Review 1*. International Food Policy Research Institute Washington D. C.
- Eboh, E.C. (2009). *Social and Economic Research: Principles and Methods*, African Institute for Applied Economics, Enugu, Enugu State, Nigeria.
- Eboh, E.C., Oji, K.O., Achike, A.I., Ujah, O.C., Amakom, U.S., Oduh, M.O., Nzeh C.E.P., Larsen, B.K. (2006). *Renewable Natural Resources, Sustainable Economic Growth and Poverty Reduction in Nigeria*. AIAE Research Paper 1, ISSN 0794-4187, Enugu Nigeria.
- Eboh, E.C., Oji, K.O., Achike, A.I., Ujah, O.C., Amakom, U.S., Oduh, M.O., Nzeh C.E.P., Larsen, B.K. (2005). *Sustainability of economic growth in Enugu state: The role of renewable natural resources*. Final research report submitted to the UK Department for International Development.
- Enabor, E.E. (2010). Socio-economic factors of deforestation in Nigeria. pp 111-125 in the challenge of deforestation in Nigeria (ed. A.B. Oguntala). Processing for FAN conference, Minna.
- Ezike, J.O. (1998). *Delineation of Old and New Enugu State*, Published bulletin, Land and Survey, Ministry of Works, Enugu.
- Falconer, J., Arnold, J.E.M. (1991). Household food security and forestry: an analysis of socio-economic issues. *FAO, Italy*, pages, 12, 34, 46, 51, 75 and 79.
- FAO. (1981). *Tropical forest resources assessment project: Forest resources of tropical Africa*. Country briefs part 11. Pp 35-79.
- FAO. (2011). *Global Forest Resources Assessment 2000*, Food and Agriculture Organization of the United Nations, Rome, Italy, <http://www.fao.org/forestry/site/24690/en>
- Godoy, R., Groff, S, O'Neil, K. (2012). The Role of Education in Neo-tropical Deforestation: Household Evidence from Central American Amerindians. *Economic Development and Cultural Change [under review]*.
- Iloje, N.P. (1981). *A new geography of Nigeria*, New revised edition, Longman Limited, Ikeja, pages 58, 61, 105 and 106.
- International institute for environmental development (IIED). (1994). "Economic Evaluation of Tropical Forest Land Use Options: A Review of Methodology and Applications". International Institute for Environment and Development, Environmental Economics Programme.
- Marshall, A. (1961). *Principles of Economics*. The Macmillan Press Ltd. London.
- Moran, E. (1989). "Adaptation and Maladaptation in Newly Settled Areas". In *Debra A. Schumann and William Partridge, editors. The Human Ecology of Tropical Land Settlement in Latin America*. Boulder,

- Colorado: West view Press, pp. 20-39.
- Moran, E. (1989a). "Government-directed settlements in the 1970s: An assessment of Transamazonian highway colonization". In Debra A. Schumann and William Partridge, editors. *The Human Ecology of Tropical Land Settlement in Latin America*. Boulder, Colorado: West view Press, pp. 172-198.
- National Population Commission (NPC). (2006). Nigeria census figure.
- Nzeh, C.E.P. (2004). Income and employment effects of forest product activities among rural households in Enugu state, Nigeria. An unpublished M.sc. Research thesis, Department of agricultural Economics, University of Nigeria, Nsukka.
- Nzeh, C.E.P., Eboh, E.C. (2007). Analysis of income effects of forest products activities among rural households in Enugu state Nigeria, *Journal of Agriculture and Social Research (JASR)*, Vol. 7(1): 23-33. ISSN 1595-7470. www.ajol.info/journals/jasr.
- Oseni, A.M. (1998). An assessment of Nigerian's wood balance. Paper presented to the 8th annual conference of Farmers Association of Nigeria, (FAN), Ilorin, December, 1978.
- Perkins, W. A., Stembridge, J.H. (1959). Nigeria: A descriptive geography, Oxford University Press, London pages 50 and 56.
- Phillips, J.M. (1994). "Farmer education and farmer efficiency: A meta analysis". *Econ. Dev. Cult. Change*. 43(1): 149-165.
- Samuelson, P. A. (1985). *Essentials of economics*. McGraw-Hill Book Company London.
- Tongpan, S. (2000). Deforestation and poverty: Can commercial and social forestry break the vicious circle? Bangkok, Thailand: Thailand Development Research Institute.
- Van Kooten, G., Bulte, E. H. (2000). *The Economics of Nature*. Blackwell Publishers.
- WRI. (1985). Tropical forests: A call for action. Report of an international task force convened by the World Resources Institute, the World Bank and United Nations Development Programme, Washington, DC.