BINARY ESTIMATION OF FACTORS INFLUENCING RURAL HOUSEHOLDS' INVOLVEMENT IN FOREST PRODUCTS HARVESTING IN ABIA STATE, NIGERIA

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ABSTRACT

The study examined factors influencing rural farm households' involvement in forest product harvesting for livelihood in Abia State. Through multistage sampling, 180 rural household heads were selected as respondents. Data were collected using a structured questionnaire. The data collected were analyzed using descriptive statistics and inferential statistical tools such as Analysis of Variance (ANOVA) and binary probit model analysis. The results of the study showed that 79.4% of the sampled households' heads were involved in forest product harvesting. Forest products derived as benefits from the forest in the area include firewood, forest leaves, fruits, vegetables, mushrooms, forage for livestock and bush meat among others. Forest resources contribute 31.4% to total rural households' income, while the contributions of agriculture and off-farm income to total household income were 57% and 11.8% respectively. The result of the binary probit model showed an R^2 value of (0.864) which was good. Gender, education, household size, nativity of household head, primary occupation, income and the number of dependent household members significantly influenced household heads' involvement in forest products harvesting. Perceived effects of unrestricted forest products harvesting include loss of biodiversity (3.49), disruption of the water cycle and ecosystem (3.36), increased soil erosion and flooding (3.84), global warming and climate change (3.57), loss of vital forest products (3.44) among others. The study recommended an improved standard of living for families in rural areas through relevant government projects to reduce the current pressure and high dependency on forest bodies.

Keywords: ***Rural households, community, forest products, degradation, rural livelihood.***

INTRODUCTION

The forest is a complex ecosystem of rich biodiversity of life forms. The biodiversity nature of the forest bodies controls the environment and other components of the forest such as the fauna and flora species, plants, animals, microorganisms, the soil, water and climate. According to Williams (2020), forests act as a climate stabilizing agent, maintain biodiversity, contribute to the carbon cycle, support livelihoods, and provide commodities and services that can fuel long-term growth. Forests are reservoirs of benefits to humans, including the production of oxygen, water storage, soil stabilization, food and energy production. The report of the World-Wide Fund for Nature (2020) affirmed that the importance of forests cannot be underestimated as the majority of rural dwellers in developing countries depend on forests for their survival. Apart from the provision of natural habitats for animals and means of livelihood for humans, forests also prevent soil erosion and mitigate harsh climates. Millions of households across developing countries rely heavily on forest resources they harvest, process and trade for income.

Forests provide products for different uses at households and industrial levels some of which include: firewood or wood fuel, mushroom, wild bee honey, timber, roots and leaves for herbs, forage, wild animals/bush

meat, vegetables, fruits and charcoal among others. United Nations Environmental Programme (2002) listed important forest resources for rural households' livelihood to include fuel wood, chewing sticks, timber, poles, rattans, fruits, seeds, pulp wood, leaves, mushroom and wildlife. On a global scale, the value of the net export of forest products between 2019 - 2020 was 244 US$ billion (FAO, 2021). With over 1.6 billion people worldwide depending on the forests for their livelihood and over 750 million people living in forests, the world has lost over 178 million hectares of forest between 1990 and 2020 through degradation, an area equal to the size of Libya (World Wide Fund for Nature, 2020).

Most rural farm households are involved in forest product harvesting for livelihood (Hlain**g**, *et al.*, 2017). Harvesting of both wood and non-wood forest products aggravates the rate of deforestation that is occurring at a rapid pace in Nigeria and other tropical regions where millions of hectares of natural forests are continuously destroyed. The continuous destruction of forests through harvesting of the products for food and livelihood of rural dwellers affects the environment through exposure of the soil to the direct impact of rain, erosion, loss of nutrients, poor air and water quality, loss of natural habitat for animal species, worsened global warming and complete collapse of biodiversity. Hence, the involvement and damaging impact of continuous forest product harvesting by rural dwellers is hypothesized to be a function of the socioeconomic attributes of the people in rural areas.

This study, therefore, examined factors influencing rural households' involvement in forest product harvesting in Abia State, Nigeria. Specifically, the study identified forest products derived as benefits from community forests in the study area, the contribution of forest resources to rural households' income, tested the significance in mean contributions of various income sources, estimated the determinants of households' involvement in forest products harvesting and identified the perception of the rural dwellers on the effects of unrestricted forest products harvesting in the area.

METHODOLOGY

The study area is Abia State southeast Nigeria. The state is made up of 17 Local Government Areas (See Figure 1) with administrative headquarters in Umuahia. Multistage sampling was employed in selecting the respondents for the study. The first stage of the sampling involved the selection of the three agricultural zones (Aba, Ohafia and Umuahia) in Abia State. In the second stage, two LGAs were randomly selected from each of the zones, giving a total of six LGAs for the study. The third stage involves the random selection of three rural communities from each of the six LGAs making 18 rural communities for the study. In the fourth stage, random sampling was employed in selecting 10 respondents (i.e., household heads) from each of the 18 earlier selected rural communities making a total number of 180 rural household heads.

Data were collected through a structured close-ended questionnaire. To obtain data on socio-economic attributes such as age, sex, education, households' size, income and various income sources, number of dependent household members, occupation of household heads and involvement of household's head in forest products harvesting. In addition, data were collected on major forest products derived as benefits and possible effects of continuous forest products' harvesting as perceived by rural dwellers. Data collected were analyzed using descriptive statistics such as frequency, percentage, mean, standard deviation and

inferential statistical tools such as Analysis of Variance (ANOVA) and binary probit model analysis.

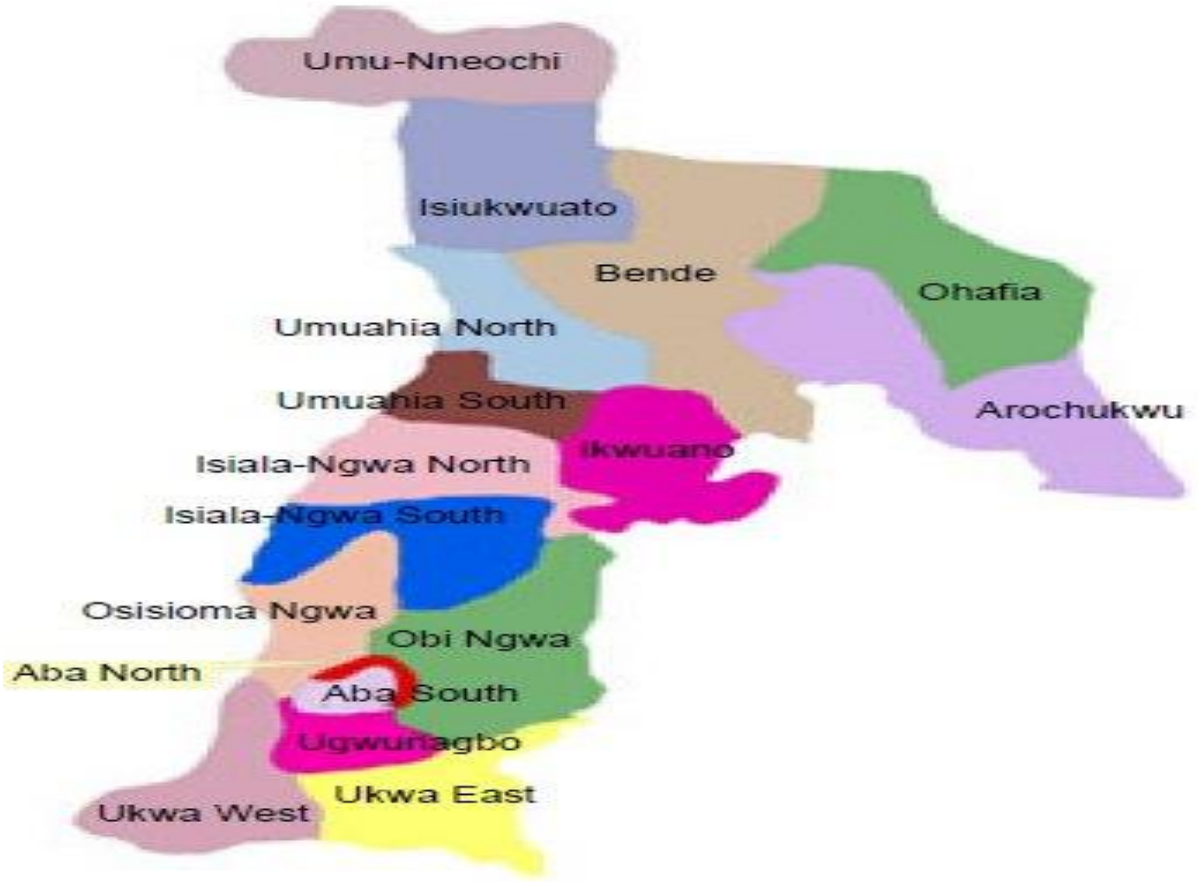

Figure 1: Map of Abia State Showing the 17 Local Government Areas.

The value of total households' incomes was computed following Endamana, et al. (2016):

$THI = OFI + AI + FI$ ... ... (1)

Where:

THI = total household income
OFI = off-farm income
AI = agricultural income
FI = forest income

The per capita rural household monthly income for the ith household was calculated by taking the total gross income (OFI+AI+FI) of the ith household divided by the total number of members of the household. To determine the contribution of forest income (FI) to overall household income, Analysis of Variance (ANOVA) was used for the mean ($\bar{x}$) comparison of the three income sources (off-farm, agriculture and community forest). The means were separated using Fishers' least significant difference procedure as described by Hayter (1986).

To estimate the determinants of involvement in community forest products' harvesting, a binary probit model was used due to the discrete nature of the dependent variable. Hence, the involvement of the household heads in forest products harvesting was obtained from a dichotomous (discrete)

choice question with yes = 1 if involve in community forest products harvesting or No = 0 if not involved in forest products harvesting activities for livelihood. The explicit form of the binary probit model is specified as:

$$\Pr(Y = 1/X = ß0 + ß1X1 + ß2X2 + ß3X3 + ß4X4 + ß5X5 + ß6X6 + ß7X7 \ldots + e \ldots (2)$$

Where:

Y = Discrete (dichotomous) probability with 1, if involved in forest products harvesting and 0 if otherwise.

$ß_0$ = Intercept

$ß_1$, …$ß_{11}$ = Coefficients of the independent variables.

X_1,…X_{11} = Determinants of farm household heads' involvement in forest products harvesting.

Hence, the hypothesized determinants of involvement in forest product harvesting are X_1 to X_{11} below.

Y = 1 if involved in forest degrading activities, if not involved.

X_1 = Age of household head (years)

X_2 = Gender of household head (1 = male, 0 = female)

X_3 = Education in years

X_4 = Household size in number

X_5 = Native of household head (1 = if native of the community, 0 = other)

X_6 = Primary Occupation (1 = if farming, 0 = if otherwise)

X_7 = Distance to urban market in km (1 = if far, 0 = close)

X_8 = Estimated income per month in ₦

X_9 = Awareness of law against deforestation (1 = if yes, 0 = if no)

X_{10} = Distance of family house to forest (1 = if far, 0 = close)

X_{11} = Dependent household member

e = the stochastic error term.

RESULTS

Involvement in community forest product harvesting

The pie chart in Figure 2 presents the percentage distribution of rural household heads' involvement in community forest product harvesting. On the community forest products harvesting for livelihood, 79.4% responded in the affirmative. This clearly showed that the majority of rural households in the area rely on community forest resources as a means of livelihood for food and income earnings. Aderinto, *et al.*. (2018) noted that forests are a part of the environment that is relied on by the majority of rural dwellers to meet their daily needs. Similarly, Adekola and Mbalisi (2015) reported that the majority of Nigeria's population live in rural areas where forests are located and are directly benefiting from the forests and forest products for livelihood.

Forest products derived as benefits from the community forest in the study area

The result in Table 2 identified forest products and the intensity of the products derived by rural households' heads that are involved in community forest resources harvesting to include: wood fuel or firewood (100.0%), forest leaves for medicine (100.0%), fruits from forest trees (100.0%), vegetables (100.0%), mushroom (98.6%), forage for livestock (97.9%), wild animals/bush meat (97.9%), oil bean (ugba) (97.2%), mai-mai/agidi leaves (93.7%), roots and bark of forest trees (89.5%), bamboo (74.1%) and timber (66.4%).

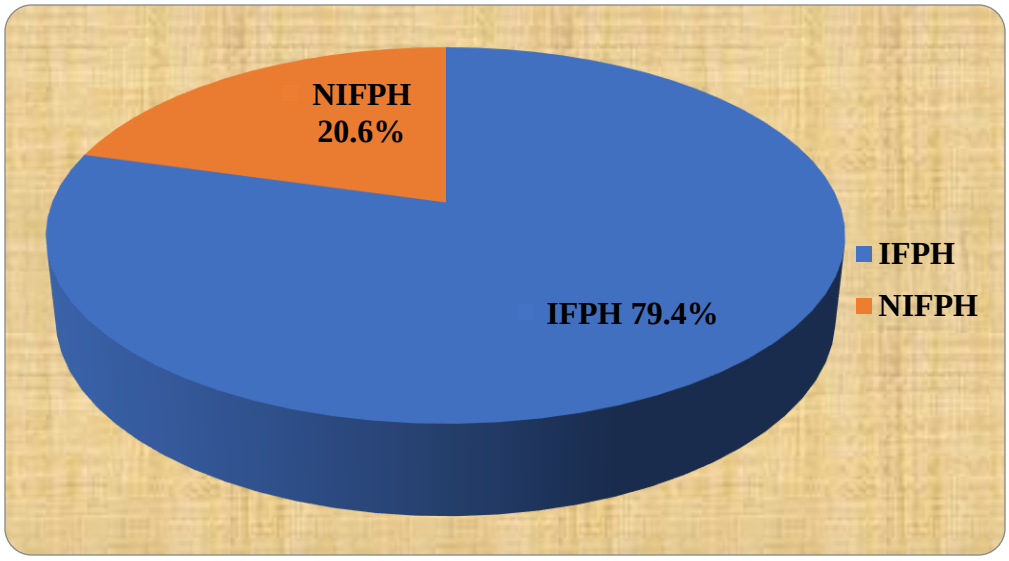

Figure 2: Percentage distribution of household heads' involvement in forest products harvesting
Note: IFPH = Involved in Forest Products' Harvesting, **NIFPH =** Not Involved in Forest Products' Harvesting**, Source: Field Survey Data, 2019.**

Table 1: Frequency and percentage distribution of major forest products derived as benefits by those involved in community forest products harvesting (n = 143)

SN	Community forest products derived as benefits:	Frequency	Percentage (%)
1	Timber	95*	66.4
2	Roots and back of forest trees	128*	89.5
3	Latex from forest trees	3*	2.1
4	Wood pulp	14*	9.8
5	Forage for livestock	140*	97.9
6	Wood fuel or firewood	143*	100.0
7	Mushroom	141*	98.6
8	Wild bee honey	58*	40.6
9	Wild animals/bush meat	140*	97.9
10	Bamboo	106*	74.1
11	Forest leaves for medicine	143*	100.0
12	Burning of hard forest trees for charcoal	66*	46.2
13	Fruits from forest trees	143*	100.0
14	Vegetables	143*	100.0
15	Chewing stick	89*	62.2
16	Mai-mai/agidi leaves	134*	93.7
17	Alligator pepper	41*	28.7
18	Uziza leaf	127*	88.8
19	Oil bean (ugba)	139*	97.2
20	Raffia palm	37*	25.9

***Multiple responses**
Source: Field Survey Data, 2019

Contribution of Forest Resources to Rural Households' Income

The results in Table 2 and Figure 2 present the contributions of forest and other sources to rural households' income. From the result, agriculture income (from livestock, crop farming, agro-processing and marketing) contributed the highest – about 57% of total rural household income, was followed by forest income contributing 31.4% while off-farm income contributed 11.8% to the total rural farm households' income in the study area. Aderinto, *et al.,* (2018) reported that crop farming is the major occupation of rural dwellers who also rely on forest exploitation for livelihood sustenance. Suleiman, *et al.,* (2017) affirmed that farming and forest products play important roles in supporting rural livelihoods, and therefore provide an important safety net for the majority of rural households throughout the year, particularly during periods of hardship. Ojea, *et al.*. (2016) equally noted that forest resources contribute significantly to rural households' income, food security, and households' healthcare as well as, the provision of multiple social and cultural values. Suleiman *et al.*. (2017) equally agreed that forest products contribute a significant proportion of rural households' income in many countries globally, Nigeria inclusive.

Table 2: Mean Contributions and Analysis of Variance Comparison of Rural Households' Income Sources

Income Sources	Mean (₦)	Percentage (%)	Total Sum of Square	F-cal	p-value (sig.)	Rmks
Off-farm Income (OFI)	8,248.7	11.8	1.985	55.92	0.000	S*
Agricultural Income (AI)	39,543.5	56.8				
Forest Income (FI)*	21,836.9	31.4				
Total Household Income (THI)	**69,629.1**	**100.00**				

Source: Field Survey Data, 2019

S* = Significant.

The results of the analysis of variance in Table 2 equally showed a very high F-calculated (F-cal) value of 55.92 and p-value (sig.) of 0.000 which indicate a significant difference in the mean contributions of off-farm, agriculture and forest incomes to the total rural farm households in the study area. Bila, *et al.,* (2015) noted that agricultural activities contribute significantly to the source of livelihood of rural households who in addition engage in off-farm activities to generate more income to cushion the effects of poverty. Similarly, Suleiman, *et al.*. (2017) found that the average monthly income contribution from crop and livestock farming activities was significantly higher than incomes from non-wood forest products and off-farm activities. Though, Astatike and Gazuma (2019) found that off-farm activities significantly contributed to the total income of rural households. The slight discrepancy in the findings of Astatike and Gazuma and the present study may be due to the differences in location, cultural practices and forest resources management laws. The pie chart of the contribution of forests and other major sources of rural households' income is shown in Figure 3 below.

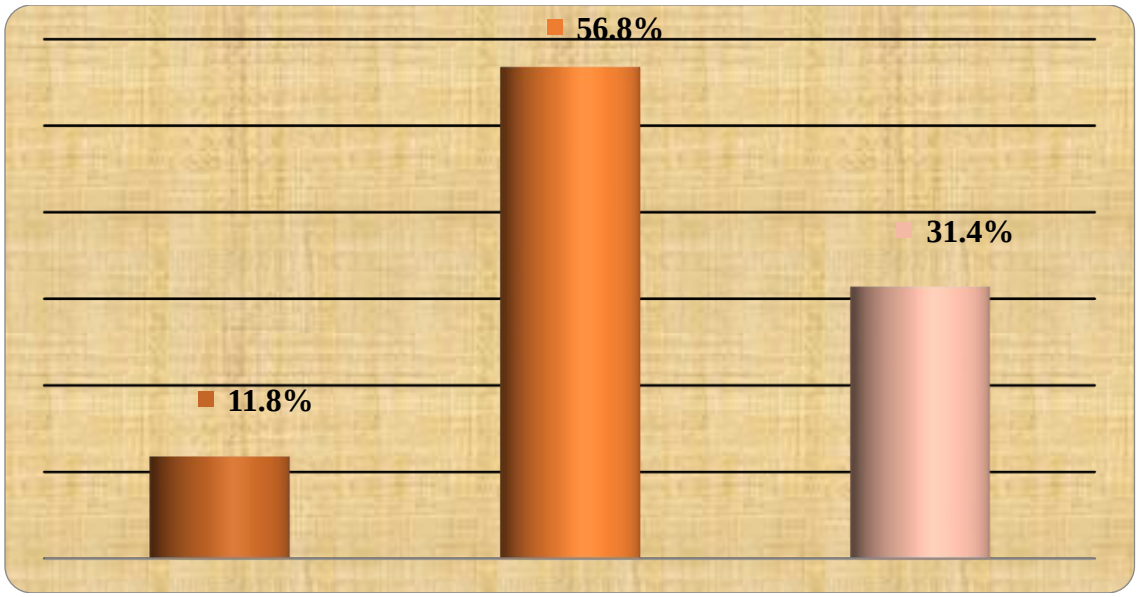

Figure 3: Percentage distribution of rural households' income sources
Source: Field Survey Data, 2019.

Determinants of Households' Heads Involvement in Forest Products Harvesting

The result of the binary probit model analysis presented in Table 3 showed that the explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.864) was relatively high and good. This showed that the estimated independent variables are responsible for about 86% variation in household heads' involvement in forest product harvesting activities for food and other livelihood benefits. The overall goodness of fit as reflected by Prob>Chi^2 (0.000) was also good. Out of the 11 explanatory variables specified in the model, seven were statistically significant at 1 and 5%. The significant variables are the gender of household heads, education, household size, native of household head (1 if native of the community, 0 otherwise), the primary occupation of household heads (1 if farming, 0 otherwise), the income of household heads and the number of dependent members of the farm household.

Gender of the households' heads (1 if male, 0 if female) was positively and significantly related to involvement in forest product harvesting activities at 1%. This implies that male household heads in rural areas are more likely to be involved in forest exploitation for livelihood than female household heads. Waruingi *et al.*, (2021) admitted that participation in forest resource management and harvesting is linked with the age and gender of the household heads. The year of education of the households' heads was significant though negatively related to involvement in forest exploitation activities at 5%. The implication of the negative relationship of education with involvement in forest product harvesting is that the more educated a household head, the less likely he or she get involved in forest product harvesting for livelihood. Garekae, *et al.*, (2017) equally found that forest dependency for livelihood was observed to be decreasing with an increase in educational level.

The coefficient of household size was positively and significantly related to involvement in forest resources harvesting at 1%. This result suggests that larger households are more involved in forest product harvesting possibly to meet the huge food and other resource demands of the

members. Native of households' heads (1 if native of the community, 0 if non-native) was positive and significantly (1%) related to the probability of being involved in forest products harvesting as a livelihood strategy. This was expected due to the land tenure system in Nigeria in which non-indigenes are not allowed access to community natural resources for any form of personal gain. Dash, et al, (2016) found that level of education, age of household heads and landholding (access to land) influence the intensity of household collection of forest products.

Table 3: Parameter Estimates of Probit Model Analysis of Determinants of Households' Heads Involvement in Forest Products Harvesting for Livelihood.

Variables	Coefficients	Std. Error	z-ratios
Age (X_1)	0.3948815	0.6549544	0.60
Gender (X_2)	0.1897139	0.0588828	3.22***
Education (X_3)	-0.1086972	0.040289	-2.70**
Household Size (X_4)	0.8463334	0.196048	4.32***
Native of HHHead (X_5)	1.3349214	0.3093952	4.31***
Primary Occupation (X_6)	0.4375841	0.2007389	2.18**
Distance to Urban Market (X_7)	0.008445	0.0052324	1.61
Income (X_8)	-1.756197	0.356451	-4.93***
Awareness of Law (X_9)	0.77922	0.721157	1.08
Distance to Forest (X_{10})	-0.763107	0.616706	-1.23
No of dependent member (X_{11})	0.69158	0.153098	4.52***
CONSTANT	-14.46132	4.114643	-3.51***

Note: *** denotes 1%; ** denotes 5%; *denotes 10%, R chi^2 = 384.22; Pseudo R^2 = 0.8646, Prob> chi^2 = 0.000, Number of Observation = 180

Source: Field Survey, 2019.

Primary occupation (1 if farming, 0 if otherwise) was positive and significantly related to involvement in forest harvesting activities at 5%. The significant and positive relationship implies that farming households are more likely to be involved in forest resources harvesting for food and other economic benefits than non-farm households. The income of the households' heads was significantly and negatively related to the probability of being involved in forest degradation at 1%. This suggests that household heads with higher incomes are less likely to be involved in forest product harvesting for food and economic benefits. The number of dependent members of households was positive and significantly related to involvement in forest product harvesting at 1%. The implication of this positive relationship is that, the more the number of dependent populations in a household, the more the likely pressure to diversify into forest products harvesting to meet the rising needs of non-contributing members. Sands (2005) reported that forest degradation and mining are very destructive to forests and worsened by the growing population. Dash, *et al.,* (2016) established that household size and number of children which constitute dependent populations positively influence the intensity of household collection of forest resources for livelihood.

Effects of Unrestricted Forest Products Harvesting

Unrestricted access to forest and its degradation poses serious ecological consequences to the environment (Buochuama, *et al.,* 2018). The results of this

study in Table 4 showed that 11 out of the 13 items in the table have mean values greater than the cut-off point value of 2.50 on a 4-point rating scale. This indicates that the 11 identified items are perceived to be effects of unrestricted access to forest in the study area. The identified effects of unrestricted forest resources harvesting with their corresponding mean values include loss of biodiversity (3.49), disruption of water cycle and ecosystem (3.36), increased soil erosion and flooding (3.84), global warming and climate change (3.57), loss of vital forest products such as fruits, vegetables and herbs (3.44), increased desertification (3.86), poor soil condition and infertility (3.56), shortage of fuelwood/firewood for local energy (3.78), poor air quality due to forest destruction (2.65), extinction of wild animals from forest (3.69) and loss of forest trees for building and construction purposes (3.74). Chakravarty, *et al.*, (2012) identified the effects of forest degradation as worsening climate change effects, global warming, water and soil resources loss and flooding, decreased biodiversity, habitat loss and conflicts and economic losses in tropical forests amounting for a loss in forest capital value of US $ 45 billion per year.

Table 4: Mean Ratings of the Perceptions of Rural Dwellers on Effects of Unrestricted Forest Resources Harvesting. (n = 180)

SN	Effects of unrestricted forest products harvesting include:	$\overline{X}$	SD	Rmks
1	Loss of biodiversity	3.49	0.54	**Agree**
2	Disrupting of water cycle and ecosystem	3.36	0.52	**Agree**
3	Increased soil erosion and flooding	3.84	0.43	**Agree**
4	Global warming and climate change	3.57	0.48	**Agree**
5	Pollution of the environment	2.30	0.84	**Disagree**
6	Loss of vital forest products such as fruits, vegetables and herbs	3.44	0.50	**Agree**
7	Increased desertification	3.86	0.41	**Agree**
8	Increased poverty and food insecurity	2.38	0.75	**Disagree**
9	Poor soil condition and infertility	3.56	0.62	**Agree**
10	Shortage of fuelwood/firewood for local energy	3.78	0.42	**Agree**
11	Poor air quality due to forest destruction	2.65	0.74	**Agree**
12	Extinction of wild animals from forest	3.69	0.53	**Agree**
13	Lost of forest trees for building and construction purposes	3.74	0.44	**Agree**

Note: $\overline{X}$ **=** *Mean,* ***SD*** **=** *Standard Deviation.*
Source: Field Survey Data, 2019.

Deforestation and excessive harvest of forest products without replenishment disrupt the global water cycle (Bruijnzeel, 2004). With removal of part of the forest, the area cannot hold as much water creating a drier climate. Buochuama, *et al.*, (2018) noted that excessive forest products harvesting consequently result in forest degradation, erosion, desertification, wildlife habitat destruction and global warming/ climate change.

CONCLUSION

The quest for food and means of livelihood are responsible for increased pressure and continuous harvesting of forest products by rural dwellers. The findings of this study have broadened the understanding of forest products derived as benefits from community forest and the contribution of forest resources to rural households' income in the study area. In addition, socio-economic factors such as gender, education, household's size, nativity,

primary occupation, household income and dependency play significant roles in households' involvement in forest products harvesting for livelihood are food and income earnings. Also, unabated forest products harvesting by rural dwellers will continue to worsen the loss of biodiversity, soil erosion, flooding, pollution, desertification and consequently global warming and effects of climate change. The study recommended that:

i. Due to high dependency of rural dwellers on forest resources, there should be improved standard of living of families in rural area through relevant government's project and reengineering of existing rural development programmes to reduce the current pressure on the forests for food and livelihood.
ii. There should strategic socioeconomic development and capacity building for rural dwellers to discourage their over dependence on the forest bodies.
iii. There should be strict laws and order within the state and local government restricting access to indiscriminate harvesting of forest resources. Such laws and regulations will be enforced with local forest guards within the locality
iv. Concerted efforts should be made by the state government through ministry of agriculture to address high rate of deforestation in the area through improved tree planting initiatives and agroforestry practices.

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