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ASSESSMENT OF FUELWOOD UTILIZATION IN YEWA NORTH LOCAL GOVERNMENT OF OGUN STATE, NIGERIA

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ABSTRACT
Energy has become essentially important for individuals, communities and even nations to thrive. Forests are continually being degraded for fuelwood to meet the demand for the needed domestic energy. Sustainable wood production and sustainability of forest ecosystems in general are major concerns of forest managers. This study assessed the status of fuelwood utilization for domestic energy in Yewa North Local Government Area in Ogun State, Nigeria with the view to providing guidelines for sustainable management of fuelwood resources in the area. Two-stage random sampling technique was used to collect data from four (4) purposively selected communities, namely - Ayetoro, Saala, Imasai and Igbogila. Questionnaires were administered to forty (40) randomly selected households from each community. The study revealed that out of the one hundred and sixty (160) sampled respondents across the study area, most of them were females, married, with four (4) to six (6) member–household, without formal education and in self-employment earning less than ₦20,000 per month. There were no statistical differences in the quantity of fuelwood utilization by the respective communities. With stepwise multiple regression analysis, quantity of fuelwood utilization was significantly influenced by age, cost of alternative fuel, family size and monthly earnings of respondents in the study area.

Keywords: *Domestic energy, fuelwood, household, utilization, stepwise regression model.*

INTRODUCTION
During the industrial revolution, availability of energy became the vehicle that drove the growth and development of most industrialized nations leading to significant advancements in their socio-economic and political life. Energy has become essentially important for individuals, communities and even nations to thrive (Bamiro & Ogunjobi, 2015). Most developing countries have not been able to deeply explore alternative energy sources for domestic and industrial uses owing to inadequate energy infrastructure and supply (Momodu, 2013). Therefore, there had been a complete dependence on wood as a cheap source of energy and an exponential increase in its consumption (Omar & Priya, 1996; Nwamani, 2005).

Household domestic energy utilization involves the use of wood fuel (such as coal, wood, charcoal) and other fossil fuel (kerosene and LPG - Liquefied Petroleum Gas).United Nations Development Programme (UNDP) and World Health Organization (WHO) reported that about 3 billion people in developing countries solely depend on wood fuels (wood and charcoal) to meet their cooking needs (ADB, 2007), and close to 2.6 billion of this number are dependent on woody biomass, and up to 400 million use wood fuel such as coal as their major domestic energy source. (Bamiro & Ogunjobi, 2015).

In many developing countries, domestic energy use accounts for 15 to 25 percent of the total energy requirement and it is nine times lower than the energy demand in most developed countries (Bamiro & Ogunjobi, 2015). Fuel wood use for domestic energy in Nigeria is so important that it accounts for nearly 95% of total wood utilization (Ezema, 2001). It is estimated that about 91% of the household energy needs in Nigeria are met by woody biomass (Emagbetere *et al*., 2016; Ezra *et al*., 2012). Fuel wood energy has become the most accessible energy source to rural and many poor urban households for domestic cooking and heating (Ebe, 2014). Coupled with constraints in the supply of other energy sources, relative ease of accessibility and low cost of fuel wood have contributed to over-dependence of rural household on this traditional energy source (Adedayo, 2005). Thus, an upsurge in it's consumption for domestic cooking and heating (Buba *et al*., 2017).

In the face of declining forests, wood supply is reducing, hence energy poverty for the rural dwellers (Nwamani, 2005). Forests are continually being degraded and there is significant decline in wildlife habitat and a complete reversal in wood supply for timber production, production of poles and other production functions (Lohri *et al*., 2016). Sustainable wood production and sustainability of forest ecosystems in general are major concerns of forest managers. However, in the case of users of the forest resources, i.e. the rural dwellers, sustainable practices have not been employed in the management of forests for fuel wood (Momodu, 2013) . This has led to the over-exploitation of forests and its attendant problems on climate change (Sambo, 2005).

In Nigeria, there are no sufficient data to account for the quantity of fuel woods harvested for domestic energy in the savanna and grassland as reasonable estimates are at best derived from oftentimes unavailable and inaccurate figures from neighbouring countries (FAO, 2005). Therefore, this study aims to assess the status of fuel wood utilization for cooking in Yewa North Local Government Area, Ogun State for the management of fuel wood resources in the area. The objectives would describe the demographic characteristics of respondents, evaluate the quantity of fuel wood used as domestic energy and assess the factors that influence their usage as domestic energy.

METHODOLOGY
The study was carried out in four (4) selected communities (namely, Ayetoro, Saala, Imasayi and Igbogila) within Yewa North Local Government Area in Ogun State (Fig. 1). The Local Government is one of twenty local

government areas in Ogun State with its headquarter in Ayetoro at 7°14′00″N 3°02′00″E (Oduntan*et al*.,2013). The inhabitants are mostly farmers who cultivate arable crops for subsistence. Other settlements include: Oja-Odan, Ohunbe, Ikotun,Mosan, Ebute-Igbooro, Egua, Ibese, Iboro, Sawonjo, Joga-Orile, Igan-okoto, Igan Alade, Idofa, Imeko. Obelle. The topography of the area is undulating with an elevation of between 15m and 75m above the sea level. Yewa River transverses Yewa South and Ado-Odo to Atlantic Ocean (Oduntan *et al*., 2013).

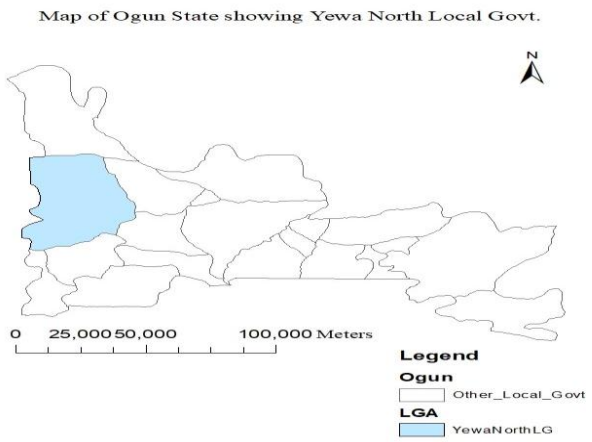

Figure. 1: Map of the study area
Source: Researcher, 2019

Sampling technique and data collection

Two-stage random sampling technique was adopted for this study (Akwa *et al.*, 2013). The first stage was the survey of Yewa North Local Government Area between September and November 2019 to collect data from purposively selected four (4) communities, namely Ayetoro, Imasayi, Saala and Igbogila because of their active status in manufacturing and distribution of firewood and charcoal. The second stage involved a simple random sampling technique to administer forty (40) questionnaires to randomly selected households in each community, making a total of one hundred and sixty (160) questionnaires for the whole study area.

Well-structured questionnaires with personal interviews were used to collect information on the demography and amount of fuel wood utilized for domestic cooking within each community. The questionnaire was designed to collect data on age, sex, marital status, educational level, religion, household size, monthly income (₦), quantity of fuel wood consumed (in kg/month), monthly cost of fuel wood used (₦ per kg), monthly cost of alternative fuel - kerosene (in ₦/kg). The data collected for this study were limited to firewood and charcoal as the fuel wood consumed for domestic cooking by the rural households, including kerosene as the alternative to fuel wood.

Data Analysis

Mean and frequencies were the statistical instruments used to analyze the demographic characteristics of the respondents. Age, gender, marital status, educational level, religion and occupation represented the categorical variables used in the qualitative data analysis for this study. Therefore, proportions of their values in percentages derived from frequencies (measured in relation to sample size) were used as standardized values for comparison.

The study also calculated the average quantity and cost of fuelwood utilized per month, and average monthly cost of alternative fuel. Hypothesis of significant difference in the quantity of fuel wood utilized by the selected rural communities was tested with F statistics.

The significance of relationship between the quantity of fuel wood consumption in the selected rural communities and factors that influence their consumption was assessed with multiple regression analysis. Stepwise (backward) model selection procedure with Akaike Information Criterion (AIC) was used in identifying the variables that significantly influence fuelwood consumption as domestic energy fuel in the area (Akwa *et al*., 2013).

Regression model form is presented as follow:

$Y = a + b_1X_1 + b_2X_2 + ... b_{10}X_{10} + \varepsilon$ .....Equation 1

Y is the response variable, X_1, $X_2...X_{10}$ are the explanatory variables. a, b_1, $b_2...b_{10}$ are regression coefficients and ε represents the random error.

Y = Quantity of fuelwood utilized by household (in kg/month)

X_1 = Age – (in years: 4 classes - 18-24, 25-30, 31-40, 40-80)

X_2 = Sex (2 classes: male, female)

X_3 – Marital status (4 classes – single, married, divorced, and widowed)

X_4 – Household size (4 classes – 1-3, 4-6, 7-9, >9)

X_5 – Education level (4 classes: no formal, primary, secondary and tertiary)

X_6 – Occupation (2 classes: paid-employment and self-employment)

X_7 – Religion (3 classes: Christianity, Islam, traditionalist)

X_8 – Monthly income (3 classes – <₦20000, ₦21000-₦40000, >₦40000)

X_9 – Monthly cost of alternative fuel (₦ per kg)

X_{10} – Communities (4 classes: Igbogila, Ayetoro, Imasayi, Saala).

The response data (i.e. quantity of wood utilized per month) collected for multiple regression analysis were first explored to ascertain if there was no violation of statistical assumptions of normality, homoscedacity and independence of observations. It was discovered that the response variable violated the assumption of normality. Therefore, the quantity of fuel wood consumed was log-transformed. The log-transformed response variable was fitted to a full model that comprised of ten (10) explanatory variables described in the regression Equation 1. Model with the lowest Akaike Information Criterion (AIC) value was selected to identify the variable(s) that significantly influence fuel wood utilization following an iterative stepwise backward selection procedure of the full regression model.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents in the selected communities

Demographic features of individuals are measures of their social and economic status as indicated by age, gender, marital status, religion, educational level, occupation and household size (Maurice, *et al*., 2015). The demographic characteristics of the respondents in the study area are presented in Table 1. The average age of respondents in the selected communities was 36.44 years. 72.2% of the respondents falls within the age bracket (25 to 40) years while the remaining 27.8% constitutes the young and the elderly. This implies that majority of the direct fuelwood consumers in the rural communities fall within the physically and economically active age group, a position also supported by Maurice *et al*., 2015.

In terms of sex distribution, majority of the respondents are females at 81.2% while the males constitute just 18.8%, a probable indication of female-controlled households where females are most times at home to cater for the family. The proportion of married people is 61.9% as against others at 38.1% comprising of the single, divorced and widowed, an indication of high fuel wood consumption because of the

high child-parent dependency ratio (Ebe, 2014). Apart from 1-3, 7-9 and more than 9 – member household constituting 33.1%, 14.3% and 3.8% family sizes respectively, 4-6-person household appears to have the largest percentage of family size at 48.8% of which the average household size per family within the communities is estimated at 4.36. This implies that a typically large-member household in the rural communities would tend to consume more fuel wood on one hand, and on the other hand leverage on its numerical strength to better access cheap fuel wood source by gathering more firewood (Danlami *et al*., 2015).

The religious inclination of respondents in the two prominent religions (Christianity and Islam) appears almost balanced at 48.8% and 43.7% respectively with the remaining 7.5% being traditionalist. The study recorded that 18.1%, 26.2% and 13.8% of the respondents attained primary, secondary and tertiary education respectively. The rest of the respondents (41.9%) had no formal education engaging mostly in self-employment (87.5%) as masons and artisans, as against 12.5% in paid-employment with the government. Most of the respondents (69.4%) earned monthly income of less than ₦20,000 followed by 22.5% in (₦21,000 - ₦40,000) bracket, and the remaining 8.1% above ₦40,000 monthly earning.

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Table 1: Socio-economic characteristics of respondents

Variables	Frequency	Parentage
Age		
18-24 years	27	16.9
25-30 years	63	39.4
31-40 years	53	33.1
40-80 years	17	10.6
Mean	36.44	
Sex		
Male	30	18.8
Female	130	81.2
Marital Status		
Married	99	61.9
Others	61	38.1
Household size		
1 – 3	53	33.1
4 – 6	78	48.8
7 – 9	23	14.3
> 9	6	3.8
Mean	4.36	
Education level		
No formal education	67	41.9
Primary school	29	18.1
Secondary school	42	26.2
Tertiary education	22	13.8
Occupation		
Paid employment	20	12.5
self-employed	140	87.5
Religion		
Christianity	78	48.8
Islamic	70	43.7
Traditional	12	7.5
Monthly income(₦)		
1,000 – 20,000	111	69.4
21,000 – 40,000	36	22.5
>40,000	13	8.1

Source: Field Survey, 2019

Fuel wood consumption by respective communities

The quantities of fuel wood consumed were not significantly different among the selected communities (Figure 2). It was discovered that typical households in Ayetoro, Igbogila, Imasayi and Saala communities utilized average of 450.00, 470.75, 420.75 and 390.00 kg (SE ± 4.05) of fuel wood per month, respectively.

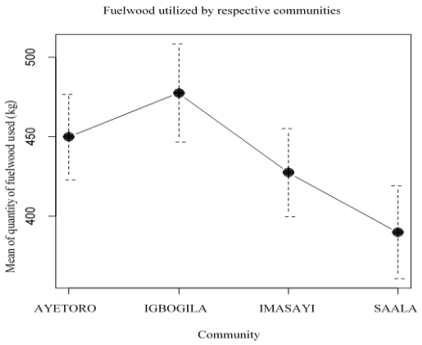

Fig. 2: Quantity of fuelwood usage (kg/month) by respective communities

Factors influencing fuel wood utilization in the selected communities

Table 2 shows the multiple regression estimates of factors that affect utilization of fuel wood in selected communities in Yewa North Local Government Area of Ogun State ($F_{17, 142}$ = 118.3, p-value = <0.05, Adjusted R^2 = 0.93). The result of the full model reveals that it was statistically significant at 5% level with 93% variation in the data explained by the model. The result of an iterative stepwise model selection procedure with AIC as shown in Table 3 indicates that Model 7 which includes age, household size, monthly income and cost of alternative fuel (lowest AIC value) were the most influential variables that best describe the quantity of fuel wood consumed by the selected communities within the study area.

Age, household size, monthly income and cost of alternative fuel were observed to have positive influence on the quantity of fuel wood utilized in the selected communities. As shown in the back-transformed model (Equation 2), one-year increase in age of respondents translates to 1.06 kg rise in quantity of fuel wood consumed at 1% significance level when other factors are held constant. This is in line with the prior expectation that increase in age of household may force an interest in choice fuel wood over other sources (Nnaji *et al*., 2012). Also, a unit increase in the household size corresponds to rise of 1.13 kg in quantity of fuel wood consumed holding other factors constant. This supports the expectation that due to inexpensive and easy access to fuel wood by rural households, there is the likelihood that larger household will require increased quantity of fuel wood to meet their domestic energy demand (Pundo & Fraser, 2006).

In the same manner when all other factors are held constant, as monthly income increases by one unit the quantity of fuel wood consumed also increase by 1.0 kg. This seemed to conform with the expectation that increase in monthly income of respondents may imply availability of more disposable income for increase in purchasing power of more quantity of fuel wood for cooking (Nnaji *et al.,* 2012). Also, a positive relationship was observed between the quantity of fuel wood utilized and the cost of alternative fuel. As expected, the quantity of fuel wood consumed marginally increased by about 1.0 kg with one unit rise in the cost of alternative fuel (kerosene), implying that respondents would continue to rely on fuel wood as their major source of household energy in spite of the availability of alternative fuel (Momodu, 2013).

Table 2: Estimates of variables influencing fuelwood utilization in the selected communities within Yewa North Local Government Area of Ogun State

Variable	Parameter	Coefficient	Standard Error	t - value
Intercept	a	0.9427	0.042	22.295***
Age, X_1	b_1	0.0655	0.019	4.192***
Community, X_2	b_2	-0.0039	0.014	-0.116
Cost of Alternative Fuel, X_3	b_3	0.0000078	0.0000049	1.787***
Household size, X_4	b_4	0.1177	0.00386	30.471***
Education level, X_5	b_5	0.0120	0.025	0.586
Monthly Income, X_6	b_6	0.0000017	0.0000012	1.409***
Marital Status, X_7	b_7	0.0099	0.017	1.157
Occupation, X_8	b_8	-0.0012	0.012	-0.200
Religion, X_9	b_9	0.010	0.015	0.999
Sex, X_{10}	b_{10}	-0.0074	0.011	-1.394
Multiple R^2		0.9341		
Adjusted R^2		0.9262		
F-statistics		118.3***		

Source: Field Survey, 2019. *Significant at 10% level. ** Significant at 5% level. ***Significant at 1% level

Table 3: Candidate models with variables and their AIC values

Model #	Model variables	AIC
1	Age, community, cost of alternative fuel, education level, household size, monthly income, marital status, occupation, religion, sex	-864.64
2	Age, cost of alternative fuel, education level, household size, monthly income, marital status, occupation, religion, sex	-870.22
3	Age, cost of alternative fuel, household size, monthly income, marital status, occupation, religion, sex	-873.79
4	Age, cost of alternative fuel, household size, monthly income, marital status, occupation, sex	-876.17
5	Age, cost of alternative fuel, household size, monthly income, marital status, sex	-878.10
6	Age, cost of alternative fuel, household size, monthly income, sex	-878.30
7	Age, cost of alternative fuel, household size, monthly income	-878.50

Source: Field survey, 2019

Quantity of fuel wood consumed=$2.64 + 1.06\ X_1 + 0.99\ X_3 + 1.13\ X_4 + 1.00\ X_6$ .....Equation 2

CONCLUSION

The study assessed the amount of fuel wood utilized for domestic cooking in selected rural communities of Yewa North Local Government Area of Ogun State, Nigeria. Descriptive statistic in mean/percentages was used to describe the socio-economic characteristics while F-test statistics was used to establish that there were no differences in quantity of fuel wood utilized by the selected communities. Multiple regressions with stepwise model selection procedure were used to model the factors affecting utilization of fuel wood in Yewa North Local Government Area. Respondents were mostly females, married with four (4) to six (6) - member household without formal education and in self-employment with monthly earnings of less than ₦20,000. There was no statistical difference in the quantity of fuel wood utilized by the respective communities. Age, cost of alternative fuel, household size and monthly income influenced the quantity of fuel wood utilized by households in the study area.

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