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ASSESSMENT OF DOMESTIC FUELWOOD UTILIZATION IN GIREI LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA

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ABSTRACT

The study investigated domestic fuelwood utilization in Girei Local Government Area (LGA) of Adamawa State, Nigeria. This** was **as a result of high rate of deforestation ongoing in the study area. Multi-stage sampling technique was used in interviewing 150 respondents for this study. Data obtained were analyzed using descriptive and inferential statistics. Results on socio-demographic characteristics revealed that majority (50.7%) of fuelwood utilizers were females within the age range of 36 - 44 years having a mean age of 40 years. The result further revealed that 36% of the respondents are married and having a mean household size of 5 individuals. Most of the respondents were educated and their average monthly income ranged from ₦10,001-₦20,000 and a mean monthly income of ₦20,526. Ziziphus mauritiana was mostly exploited and utilized by the respondents of the study area and has a mean value of 4.0. The results on regression analysis for fuelwood utilization shows that double log was the best determinant with a coefficient of 0.925 and a root mean square of 0.5434. Further findings from this study showed that due to the rate of exploitation of trees in the study area, environmental challenges such as increase in temperature, flooding and erosion has become frequent, intense and having a devastating effects on the livelihood of the people hence the need for affordable alternative sources of energy provided to ease the pressure on logging activities within the area.

Keywords: Domestic fuelwood, utilization, energy

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INTRODUCTION

Forest is a source of livelihood for many farmers and rural household in developing countries, especially in Sub-Saharan Africa (Abebaw, 2007). Approximately 2.5 - 3.0 billion people (40-50%) of the world population rely on wood for fuel, both for warmth and food preparation (Adeniyi and Felix, 2001). In Nigeria, the biomass resources can be identified as wood, forage grasses, shrubs, waste arising from forestry, agricultural, municipal and industrial activities as well as aquatic (Garba and Bashir, 2002). Moss and Morgan (1981) reported that fuelwood provides energy for rural household, employment and income for rural farmers as well as part of the energy requirement for cooking in urban areas throughout the country. A large gap exists between the demand and supply of energy in Nigeria, because nearly 70% of the populace are involved in subsistence-based ventures and live in the rural communities (World Bank, 2004). Thus, reliance on natural resources for food and energy implies that people source for their daily needs from their immediate environment (World Bank, 2002).

The exploitation of fuelwood by the inhabitants of any area is an inevitable consequence of human existence. This is because fuelwood is a source of domestic fuel for both the rural and urban households. It's as a source of fuel is as old as man's inventions of the use of fire and the

development of the art of the cultivation. In the past, the sources of fuelwood were simple, and the environmental impacts arising from its exploitation were minimal due to low population. However, as a result of population increase human dependence on wood as a source of fuel and energy started showing signs of inadequacy. Currently, the level of inadequacy is evident in the alarming rate at which deforestation is taking place all in attempt to have a steady supply of fuelwood and energy Southern African Development Community (SARDC, 1994). Half of the world's population use biomass fuel for cooking and heating, this made the world's production of fuelwood to increase between 1970 and 1995 from 1362.4 million m^3 (Carney, 1998). It is also estimated that about 32 million cubic meters of fuelwood is consumed in the rural areas of Nigeria annually despite the environmental hazards (Federal Ministry of Environment, 2006). As more and more people depend on the use of fuelwood as a source of fuel and energy, the demand for its exploitation has continued to rise. The rate of fuelwood exploitation in Nigeria is huge that the country is already facing a scarcity crises situation. Women, children and men are now involved in the search of fuelwood particularly in Northern Nigeria either as a business venture or due to poverty as they cannot afford the alternative energy sources available. The study area, Girei because of its proximity to Yola, the State capital, a lot of fuelwood logging activities is ongoing in the quest to meet the energy needs of the urban households and as a source of income. This has led to problems such as flooding, environmental pollution, erosion and high temperature been experienced in recent times in the area. This has also altered the basis of life for rural poor as other dangers of extensive biomass fuel use have been found to constitute serious ecological threat. The recent ban of charcoal production by the government of Adamawa State and the unaffordability of alternative energy sources induced by the exorbitant cost of stoves, cookers and cooking fuel such as kerosene, gas, electricity has made the life of the rural poor more difficult hence this study aim at assessing the domestic fuelwood utilization in the study area with the view of providing an understanding and way out of the current trend.

MATERIALS AND METHODS

Study area

The study was carried out in Girei LGA. The Local Government is boarded by Song LGA in the North, Fufore LGA in the East, while River Benue act as a physical boundary between the LGA, Yola North and Demsa LGA (Adebayo and Tukur, 1999). Girei Local Government falls under the Sudan savannah types of vegetation and it experiences dry and wet seasons with temperature and humidity varying with seasons. The wet or rainy season fall between April to November and the average amount of rainfall recorded in the area is 972mm while the dry season is characterized by dry, dusty and lazy Northern trade wind that blows over the area from Sahara Desert (Adebayo and Tukur, 1999). Temperature in the area varies with season. Although the temperature is relatively high almost all the year round, temperature of the area ranges from 27^{o}C - 45^{o}C. December and January are the coolest months with an average temperature of 34^{o}C. The vegetation has a wide variety of savannah tree species among which are *Ziziphus mauritania*, *Adansonia digitata* and *Anogeisus leiocarpus* etc (Adabayo and Tukur, 1999).

Sampling Procedure

Multi-stage and random sampling methods were used in selection of respondents for the study. In the first stage, 5 out of the 10 Council Wards in the study area were randomly selected. In the second stage, 3 villages each out of the 5 wards were also randomly selected making a total of 15 villages. Interviews was conducted with questionnaires among the 150 randomly selected respondents in the study area where information on their socio-demographic characteristics, source of domestic energy, tree species used as fuelwood, effects of logging to the environment among others were obtained.

Data Analysis

Descriptive statistical tools involving the use of frequency tables and percentage were used in analyzing socio-demographic data. Multiple regression model was also used to establish the relationship between the components of socio-demographic characteristics and level of

fuelwood exploitation and utilization in the study area. The model is statistically expressed as:

$Y= a+b_1 X_1+b_2 X_2 + b_3 X_3……b_n X_n + \varepsilon$ (as adopted by Ominikari, 2023)

Where;

Y - dependent variables

a – intercept

$b_1, b_2, b_3……bn$ – regression coefficients

$X_1, X_2, X_3……Xn$ – independent variables

ε – error

RESULTS

Socio-demograhic Characteristics of the Respondents

The result from Table 1 showed the demographic characteristics of respondents in the study area. Most of the respondents' were females (50.7%) and within age range of 36 - 44 years. Majority (36%) of respondents were married and having a household size of 6-10 individuals. The respondents are educated (93.3%).

Table 1: Socio-demographic Characteristics of the Respondents

Variable	Category	Frequency	Percentage (%)
Gender			
	Male	74	49.3
	Female	76	50.7
	Total	150	100.0
Age (yrs)			
	18-26	28	18.7
	27-35	57	30.0
	36-44	58	38.7
	≥ 45	7	4.7
	Total	150	100.0
	Mean	40.4	
Marital Status			
	Married	54	36.0
	Single	43	28.7
	Widow/widower	26	17.3
	Divorced	27	18.0
	Total	150	100.0
Household size			
	1-5	54	36.0
	6-10	85	56.7
	>10	11	7.3
	Total	150	100.0
	Mean	5.3	
Education level			
	No formal	10	6.7
	Primary	14	9.3
	Secondary	50	33.3
	Tertiary	76	50.7
	Total	150	100.0
Income level ₦/monthly			
	2,000-10,000	34	22.7
	10,000-20,000	50	33.3
	20,001-30,000	30	20.0
	30,001-40,000	13	8.7
	>40,000	23	15.3
	Total	150	100.0
	Mean monthly income	20,526	

Source: Field survey, 2023

Trees Exploited in the Study Area

The tree species that was very frequently exploited is *Ziziphus mauritiana. Adansonia digitata* was frequently exploited, *Ficus exparata, Balanite aegytiaca, Parkia biglobosa, Sterculia setigera, Tarmarindus indica, Anona senegalensis, Azadiractha indica, Vitex doniana, Anogeisus leiocarpus, Acacia senegalensis, Prosopis africana, Vitellaria paradoxa, Pterocarpus erinaceus* and Piliostigma *thonningii* were not frequently exploited while *Detarium macrocapum* was seldom exploited (Table 2).

Table 2: Trees Exploited in the Study Area

Family	Species	Mean	Remark
Rhamnaceae	*Ziziphus mauritiana*	4.00	VF
Malvaceae	*Adansonia digitata*	3.90	F
Moraceae	*Ficus exparata*	2.70	NF
Zygophyllaceae	*Balanite aegyptiaca*	2.60	NF
Fabaceae	*Parkia biglobosa*	2.70	NF
Sterculiaceae	*Sterculia setigera*	2.80	NF
Fabaceae	*Tarmarindus indica*	2.70	NF
Annonaceae	*Anona senegalensis*	2.80	NF
Maliaceae	*Azadiractha indica*	2.60	NF
Lamiaceae	*Vitex doniana*	2.70	NF
Combretaceae	*Anogeisus leiocarpus*	2.60	NF
Fabaceae	*Acacia senegalensis*	2.80	NF
Fabaceae	*Prosopis africana*	2.60	NF
Sapotaceae	*Vitellaria paradoxa*	2.70	NF
Fabaceae	*Pterocarpis erinaceus*	2.80	NF
Fabaceae	*Piliostigma thonningii*	2.90	NF
Fabaceae	*Deterium macrocapum*	2.40	S

Source: Field survey, 2023

VF- very frequent, F- frequent, NF- not frequent, S- seldom

Major Source of Domestic Energy

The major source (37.3%) of domestic energy in the study area is firewood. This was followed by kerosene (26%), electricity (20.7%) and cooking gas (16%) (Table 3). Results of multiple regression from Table 4 showed that age and marital status were significant at 1% and 5% respectively. Household size and availability of alternative energy were also both significant at 10% level with negative coefficients. Education of the respondents was not significant at 5%(Table 4).

Table 3: Major Source of Domestic Energy

Source	Frequency	Percentage (%)
Firewood	56	37.3
Kerosene	39	26.0
Cooking gas	24	16.0
Electricity	31	20.7
Total	150	100

Source: Field survey, 2023

Table 4: Summary of Regression Analysis

Variables	Coefficient	Standard error	t-value	Remark
Constant	-9.602	1.551	-6.193***	S
X_1 (age)	3.140	0.599	5.242 ***	S
X_2 (education)	0.39	0.34	1.147	NS
X_3 (monthly income)	0.715	0.229	3.116 ***	S
X_4 (household size)	-0.703	0.387	-1815 *	S
X_5 (alternative energy)	-0.863	0.471	1.833 *	S
X_6 (marital status)	-0.210	0.84	-2.455 **	S
X_7 (cost of alternative energy)	0.390	0.246	1.115	NS
X_8 (cost of fuel wood)	0.558	0.60	9.236 ***	S
R^2	0.926			
Adjusted R^2	0.920			
F- value	216.530 ***			
RMSE	0.54342			

Field survey, 2023

*** *- significant at 1%;* ** *- significant at 5%;* * *- significant at 10%*

DISCUSSION

The socio-demographic characteristics of the respondents analyzed in the study area where gender, age, marital status, household size, level of education, and monthly income. The gender distribution of the respondents from implies that fuel wood exploitation activities are most prevalent among females than males in the study area and this could be attributed to the fact that most domestic chores are being carried out among women and one of which is the use of fuelwood to meet the daily energy demand of the family. It has been observed that people particularly women and their children now trek longer distances to find new supplies (fuelwood) thus spending much of their time in fuelwood collection. A survey carried out by Aju *et al* (2006) reported that women and their children now trek on average of two kilometers and spend an average of two hours a day to obtain supplies of fuelwood. This could be to meet the energy need of the family or to argument the income available in the family. Most of the respondents in the study area were relatively young and energetic. These finding are in conformity to that of Ndaghu *et al.,* (2011) that fuelwood exploitation is mostly among youth because it requires a cost of energy for cutting, transportation and distribution to all parts of the country. Adedotun and Ogunbode (2023) also reported the presence of young population with a mean age of 39.9 in Girei communities and this could be easier for the acceptability of any conservation programs that could be introduced to the area. The mean household size of the respondents is 5.3 (Table 1). This result clearly shows that most of the respondents in the study area have a medium household size and this could affect their level of utilization and exploitation of fuelwood. Ikureong *et al.,* (2009) found a positive relationship between the number of individuals occupying a particular household and the rate at which they make use of firewood for the household energy need. Individual living close to or adjacent to the conservation areas tend to claim ownership of conservation sites and consequently engage in illegal exploitation of the resources (Hollings and Maffe, 1996). This claim has made it possible for individuals living in the households, no matter how many engage in cutting of trees to meet the high energy need or as source of income when the fuelwood is sold. Table 1 showed majority of the respondents 93.3% in the study area had primary, secondary school, and tertiary education while 6.7% did not attend conventional education system. This result agrees with the findings of Adedotun and Ogunbode (2023) which reported that majority of the respondents in Girei communities were educated. Since majority of the respondents had formal education, the study areas stand a better chance of accepting for conservation of trees so that they can continue to benefit from it and also for future generations. Awareness should be created among members of the communities on the dangers of over exploitation of their resources

especially trees. Myer *et al.,* 2002 reported that traditional users, if fully enlightened will go a long way in creating awareness in their communities on the importance of sustaining biodiversity.The marital status showed majority of the respondents were married, this is an indication that fuelwood exploitation and utilization is more common among the married individuals as they put more pressure on collection of fuel wood either as source of domestic energy or income in order to meet the demand of their household. The result is in line with the findings of Kwaghe (1999) who reported that married people have more responsibilities such as the provision of food, education, health and well-being of their spouses and children and is the primary reason for domination of the activities by the married people while the case for singles who may not likely have other people to take care of beside themselves. Majority of respondents earned within the income class of ₦10,001 - ₦20,000 monthly. This income class has the highest frequency of 50 (33.3%) followed by those within income class of ₦2,000 - ₦10,000 monthly with the frequency of 34 (22.7%) while those earning above ₦40,000 monthly have a frequency of 23 (15.3%) (Table 1). The mean amount income of respondents is ₦20,526. It was observed from the field survey that majority of the respondents' earnings in the study area is low and this could be the reason for the high pressure on collection and sell of fuelwood to meet the family needs. Monela *et al.,* (2005) reported that 36% of the families assessed, used income from the sales of wood land products for the payment of educational costs, which is an indication of the importance of forest resources to the economics of the rural people. Major trees exploited for use as source of domestic energy by the respondents were analyzed and presented in Table 2. The result was interpreted based on 5-point liker scale of very frequently (5), frequently (4), not frequently (3), seldom (2) and none exploited (1). A mean score response of between 4.5 - 5.0 represent very frequently exploited, 3.5 - 4.9 represents frequently exploited, 2.5-3.49 represents not frequently exploited, 1.5-2.49 represents seldom exploited while mean score of between 0.5 - 1.49 represents none exploited. Results from Table 2 indicated *Ziziphus mauritiana* was very frequently exploited in the study area and has a mean value of 4.0. This could be as a result of high dominance of this tree in the area or as a result of cultural belief where most women prefer to use the species as fuel and its highly inflammable. Etukodo *et al.,* (1994) and Etukundo (2000) also noted that cultural habits of the people will continue to prolong the use of fuelwood even among the rich and enlightened elites. Further results from the Table showed that *Adansonia digitata* was frequently exploited, *Ficus exparata, Balanite aegyptiaca, Parkia biglobosa, Sterculia settigera, Tamarindus indica, Anona senegalensis, Azadiractha indica, Vitex doniana, Anoigesus leiocarpus, Grewian mollis, Prosopis africana, Daniella oliveri, Pterocarpus erinacer, Pilistigma thonningii* were not frequently exploited while *Detarium microcarpum* was seldom exploited. This could be attributed to low dominance of these tree species in the area. The low representative might have resulted due to over exploitation of the trees in the study area over a long time. This agrees with the findings of Zhigilla *et al.,* (2016) who reported that the low representative of some trees could be due to poor regeneration abilities/or anthropogenic activities. Mamman *et al.,* (2023) reported that high energy need of the people may be responsible for some plants species evolving into rare and threatened. It was clear from the result that all trees species were exploited by the respondents in the study area which indicates high rate of fuelwood exploitation and this conform to the findings of Deacon (1999) who reported that fuelwood is the primary source of energy for rural households and a major source of cooking fuel in urban areas. It also confirmed the report of Food and Agriculture Organization (FAO, 2008) which predicted that fuelwood is likely to remain an important energy source in Africa in the coming decades. The results from Table 3 shows that there is high utilization of fuelwood among households in the study area. This agrees with the findings of Hermossila (2001) who reported that majority (61.5%) of households uses fuel wood as a major source of energy. The preference given to wood as fuel could be because it can be used and supplied without many costly equipment while its requisitions involves little costs often no more than cost involved in gathering it. It was also observed that more people continue to use wood

as fuel in preference to other alternative source of energy such as gas, kerosene, electricity because the later is simply not affordable and far beyond the reach of most people living in both rural and urban areas. The determinant factors for fuelwood utilization in the study area was analysed using multiple regression. Four functional forms namely; linear, semi-log, exponential and double-log were tried out of which the double-log model gave the best fit based on Priori theoretical expectations as well as the significance of the entire model as shown by the F-statistic. The explicit functional form of the model is expressed as;

$LogY = -9.602+3.140\ X_1 + 0.39X_2 + 0.715X_3 - 0.703X_4 -0.863X_5 -0.210X_6 +0.246X_7 +0.558X_8$

From results in Table 4, the coefficient of multiple determinations R^2 (0.925) shows that 92.5% of the variation in fuel wood utilization in the study area is explained by the variation in the independent variables included in the model namely; age (X_1), education (X_2), monthly income of respondents (X_3), household size (X_4), marital status (X_6) cost of alternative energy (X_7) and cost of firewood/bundle (X_8) while the remaining 7.5% of the variation is accounted for by the random error. Age of the respondents has a positive coefficient of 0.599 and was significant at 1%. This shows that an increase in the age of respondents will increase the rate of fuel utilization, however result from the field indicated that fuelwood is more utilized among respondents within the age category of 36 - 44years in the study area. Marital status is significant at 5% with a negative coefficient of -0.210 which indicates an inverse relationship between marital status and fuel wood exploitation. This implies that 1% chance of individuals that are not married will decrease the utilization of fuelwood for domestic energy by about 0.0021%. This shows that fuel wood utilization as a source of domestic energy is more common among married persons who are believe to be more responsible and would go to any extent to provide for their families than single individuals in the study area. This result agrees with the findings of Kwaghe (1999) who reported that married people have more responsibilities such as the provision of food, education, health and well-being of their spouses and children and is the primary reason for domination of the activities by the married people unlike the case for singles who may not likely have other people to take care beside themselves. Household size and availability of alternative energy are also both significant at 10% level with negative coefficients of -0.703 and -0.863 respectively which indicates an inverse relationship bet fuelwood exploitation/utilization and the affected variables. This result implied that as household size and availability of alternative domestic energy like kerosene, cooking gas and electricity are available and affordable to the respondents, the quantity of fuel wood exploited and utilized will decrease and vice versa. This agrees with the finding of Ikurekong *et al.*, (2009) who observed and reported that in the face of kerosene scarcity, the price of fuelwood could be higher.

CONCLUSION

A lot of trees such as *Ziziphus mauritiana, Adansonia digitata, Ficus exparata, Parkia biglobosa, Balanite aegyptiaca, Sterculia setigera, Tamarindus indica, Anona senegalenis, Prosopis africana, Vitelleria paradoxa, Pterocarpus erinaceus, Piliostigma thoningii* and *Detarium microcarpum* are exploited and used to supply household energy need of the inhabitants of Girei communities. The rate of fuelwood exploitation and utilization in the study area was due to high cost of alternative energy sources like kerosene, cooking gas and electricity. Result from this study further showed that socio-demographic factors such as age, household size, marital status and monthly income were found to affect fuelwood utilization hence the need for government to subsidized the cost of alternative energy sources (kerosene, cooking gas and electricity) in order to reduce the pressure of fuelwood exploitation while also embarking on afforestation and reforestation projects in the area.

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