

**MANGROVES AND WETLANDS OF
SUB-SAHARAN AFRICA:**
Potential for Sustainable
Livelihoods and Development

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EVALUATION OF FUEL-WOOD EXTRACTION AND CONSUMPTION PATTERNS IN IMO STATE, NIGERIA

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Abstract

The study evaluated the patterns of fuel-wood utilization in Imo State. The three agro-ecological zones (Orlu, Owerri and Okigwe) of the state were covered through a multistage sampling procedure. Three local government areas (LGAs) were selected in each of the zones. A total of 9 LGAs were sampled. Two-hundred and seventy (270) copies of semi-structured questionnaire were administered on households in the selected LGAs. Data were analyzed using descriptive statistics, correlation analysis and one-way analysis of variance (ANOVA). The result revealed that the most active gatherers and consumers of fuel-wood were between the ages of 31 and 40 years. Fuel-woods were consumed directly by up to 82.5% of the respondents, while 16.7% of them utilized fuel-woods for income generations. About 47%, 14%, 11%, 4% and 24% of the respondents in the area sourced fuel-woods from natural forests, plantation, fallow lands, farmlands/home gardens and through purchases respectively. The percentage contributions of fuel-wood to daily domestic cooking were between 62 and 93, with Obowo and Orlu LGAs having the highest and least respectively. However, the mean daily consumption was highest in Okigwe LGA and least Onitsha LGA. The result revealed that household size and cost did not have positive relationships with the mean daily consumption in the area. Nevertheless, daily utilization affects the overall contribution of fuel-wood to domestic energy consumption in positive terms.

Keywords: Fuel-wood utilization, Agro-ecological zones, domestic energy

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Introduction

Fuel-wood provides energy for rural households, employment and income for rural dwellers, and it constitutes a part of the energy requirements for cooking in urban areas throughout Nigeria (Adeyemi and Ibe, 2014). Although, it was generally assumed that rural households in the humid forest zones of Nigeria did not suffer from fuel-wood scarcities (Oguntala, 1986), on the average, an individual consumed an estimated value of between 1.9-4.0 kg of fuel-wood daily in Nigeria (Ikurekon *et al.*, 2009; Audu, 2013; Adeyemi and Ibe, 2014). In general, fuel-wood is the most common source of energy for most of the world rural areas (IEA, 2002). In Sub-Saharan African, wood supplies about 70% of total energy used and fuel-wood collections account for over 85% of the wood removed from the forest and woodlands (Contreras-Hermosilla, 2000). It is also the major source of energy among the rural households and urban poor in Nigeria (Anderson, 1987). As population continually grows, this dependence put more pressure on the wood

resources, which all too often has resulted both in the destruction of the forest and in a worsening of lives of millions of people, whose lives are conditioned by the products of the forest (Akachuku, 2001). Fuel-wood has been reported to be the most widely used forms of biomass. Although in areas where there is natural or human imposed scarcity of fuel-wood, other biomass form, such as crop residues and dung becomes prevalent (Bhatt and Bachan, 2004). Report by Bernades *et al.* (2003) revealed that fuel-woods and charcoals are the major sources of energy for domestic heating and cooking in rural villages and urban cities in the tropical areas.

Fuwape and Onyekwelu (1995) observed that the demand for fuel-wood and charcoal has been on increase both in the rural and urban areas due to high cost of conventional fuel such as kerosene and cooking gas. According to him, fuel-wood scarcity is becoming more acute in the Northern part of Nigeria, which has savannah type of vegetation. With removal of subsidy on petroleum products by the federal government, it was envisaged that the pressure on fuel-wood would be more, since most rural and peri-urban settlements in developing countries enjoy open access to fuel-wood.

The supply of fuel-wood to those who need it is usually by far less than the demand for it (Akachuku, 2001). There is increasing pressure on fuel-wood in recent times (Ajakaiye, 2001). The need for fuel-wood has been heightened over the years due to the ever-increasing population and decreasing size of the forests in the country. Nowadays, trees and forest products are no longer as easy to obtain as it was the case in the past, and substitutes are often too expensive or too scarce (Audu, 2013; Adeyemi and Ibe, 2014). The wants, destruction and reallocation of forest to other land uses have led to environmental hazards and loss of genetic biodiversity. For instance, about 43-46% of the total forest ecosystem was lost along with useful plants between 1980 and 1982 and about 0.36% of the plants identified in Nigeria are endangered or threatened with extinction (NEST, 1992).

The forest cover in Nigeria decreased by about 20% between 1978 and 1996, and the total forest estate, which was 10% of the country's land area in 1976, was less than 6% in 2001 (Adeyoju, 2001). The figure is far below the 20% globally accepted figure. According to Ajakaiye (2001), the stock of actual forest resources in Nigeria has been declining over the years, with the area of forest per capita, consequently declining from about 390 hectares in 1960 to about 90 hectares in 1999/2000. All these problems threaten the sustainability of forest resources and their ability to contribute positively to development.

Fuel-wood energy is consumed mostly by the low income and lower middle income households, as well as by operators of cottage and small-scale industries and commercial enterprises such as pottery, hotels, schools, banks and hospitals. The consumption is

however concentrated in the rural area and among low income urban populations. Over 90% of the rural/peri-urban populations depend on fuel-wood to meet their domestic energy requirements in Nigeria (FDF and FME, 1999).

Although the exact effects of fuel-wood scarcity on diet is yet to be adequately known, it is said that cooking released the nutrients in grains and fibrous foods, making them edible and appealing some classes of food. For example, certain varieties of cassava and beans can even be poisonous if not properly cooked (Etukudo *et al.*, 1994). In this regard, wood for energy is essential if adequate food supplies are to be converted into adequate diets. Indications are that more and more people will continue to use wood as fuel in preference to commercial fuels like kerosene and gas as these and their appliances are costly and generally beyond the reach of the rural poor (Etukudo *et al.*, 1994). Etukudo (2000) observed that cultural habits of the people will continue to prolong the use of fuel-wood to other energy sources even among the rich and the elites. According to him, some of these people relish roasted yams and maize. In addition, palm oil production and large-scale cooking (at burials, weddings and launchings, etc.) will continue to consume tones of fuel-wood in the rural areas.

The severe depletion of the fuel-wood resources in some parts of the country puts people in such areas in serious energy supply crisis. For instance, people particularly women and their children now walk longer distance to find new supply thus spending much of their time in fuel-wood collection and less in tending crops. Aju *et al.* (2006) reported that women and their children now trek an average of 2 km and spend an average of two hours a day to obtain supplies of fuel-wood. FAO (2008) prediction is that fuel-wood is likely to remain an important energy source in Africa in the coming decades while forecasts made in 2001 even suggested a 34% increase in wood-fuel consumption by the year 2020.

Information on fuel-wood utilization and patterns of extraction in Imo State are yet unknown. Although, Adeyemi and Ibe (2014) documented fuel-wood harvesting and consumption in Owerri West and North LGAs of Imo State, it is obvious that such data cannot represent the entire state. At the moment, most wood energy statistics in the state are based on estimated or unofficial guesses. Hence, this study attempted a specific assessment of the prevailing situation in Imo State with regards to fuel-wood consumption.

Materials and Methods

The study was carried out in Imo State. The state lies between latitudes 5°12' and 5°56'N, and longitudes 6°38' and 7°25'E in the south-eastern part of Nigeria (Fig. 1). It has a population of 4.8 million persons. The population density varies from 230 persons per km² to 243 persons per km², and covers an area of 5,288km² (NPC, 2006). The rainy

season is in April and last until October, with annual rainfall varying from 1,500 mm to 2,300 mm, and an average temperature 20°C. It has an annual relative humidity of 75% with the value reaching up to 90% in the rainy season. The state experiences two months of harmattan, from late December to late February. The hottest months are between January and March.

A multi-stage (3-stage) sampling technique was adopted for the study. Imo State was grouped into three agro-ecological zones (i.e. Okigwe, Orlu and Owerri). Three LGAs were purposively selected from each of the zones (i.e. Ideato North, Oru West and Orlu in Orlu Zone; Ohaji/Egbema, Ngor Okpala and Ikeduru in Owerri Zone; Onuimo, Okigwe and Obowo in Okigwe Zone) based on the prevalence of collection and consumption of fuel-wood in the LGAs (Fig. 1). Three communities were then randomly selected in each of the LGAs. A total of 270 households were interviewed for collection and utilizations of fuel-woods.

Data were analyzed using descriptive statistics such as frequencies, percentages and means; Karl Pearson's product-moment correlation and one-way analysis of variance.

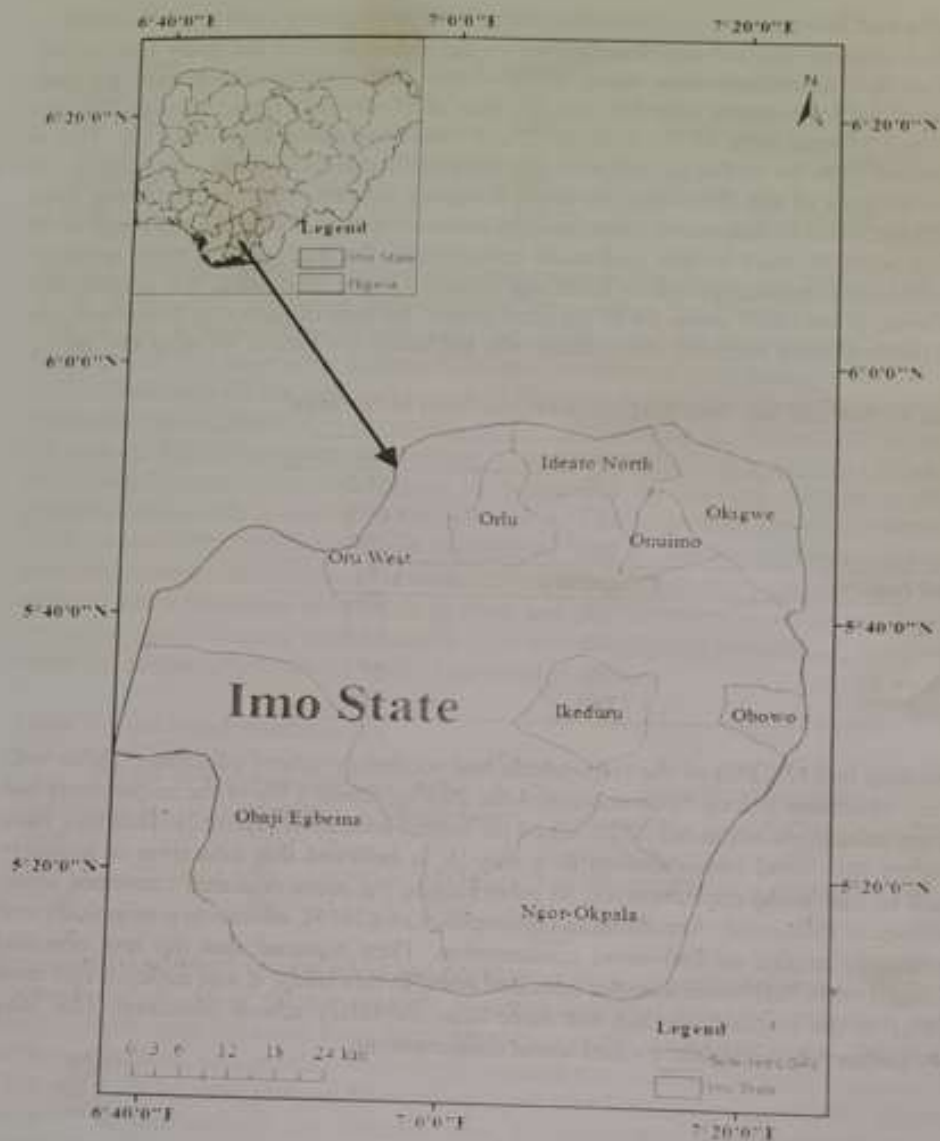


Fig. 1: Map of Imo State showing the selected LGAs

Results and Discussion

Table 1 presents sex and age distributions of the respondents in the study area. About 51% of the respondents were male, while 48.8% were female. Thirty-eight per cent (38%) of the respondents were between the ages of 31-40 years. Those between the ages of 20 and 30 years were 33.3%. Only 29.2% of them were above 41 years of age. This is in contrast with the works of Adeyemi and Ibe (2014) that most of the respondents are above 40 years of age. Similarly, the result disagrees with the report by Webb and Anun (2010) that most of fuel-wood collectors and consumers were within the age range of 40 and 86 years. It could be that fuel-wood extraction in the study area is more lucrative, thus the involvement of people in lesser age classes. On the other hand, it is possible that fuel-wood is not easily come-by in the area; hence, the task of gathering fuel-wood may have required more energetic individuals, who fell below the ages of 40 years and above.

Table 1: Sex and age distribution of respondents in the area

Sex	Frequency	%
Male	123	51.2
Female	117	48.8
Total	240	100
Age (years)	Frequency	%
20-30	80	33.3
31-40	90	37.5
Above 41	70	29.2
Total	240	100

More than half (54.2%) of the respondents had secondary school education. Those with tertiary education among them accounted for 20.8%. About 17% of the respondents had primary education, while only 12.5% had no formal education (Table 2). This may have impacted fuel-wood consumptions in a way. It is believed that education is inversely related to fuel-wood consumptions. In other words, the more educated consumed lesser quantities of fuel-wood. According to Onyeneke *et al.* (2015), education is negatively and significantly related to fuel-wood consumption. They reported that the less educated consumed more fuel-wood than the educated ones. In this study, it was gathered that most (83.4%) of the respondents had not more than secondary school education. This may imply further intensification on fuel-wood consumptions.

Table 2: Educational background of the respondents

Education	Frequency	%
Primary	40	16.7
Secondary	130	54.2
Tertiary	50	20.8
No formal	30	12.5
Total	240	100

Table 3 presents household fuel-wood consumption in the study area. Majority (82.5%) of the respondents consumed fuel-woods in their homes for domestic cooking. About 17% of the households rely solely on fuel-wood sales for their income generation. Majority (83.3%) have other sources of income generation apart from the sales of fuel-wood. The reason for the high percentage of fuel-wood users was due to the fact that the alternative cooking fuels were expensive, hence, the increased dependence on fuel-woods for cooking. This corroborates the findings of Dresen *et al.* (2014) and Egeru (2014), who independently noted that alternatives to fuel-woods as cooking fuel are generally expensive and hardly available in Sub-Saharan Africa. As a result, the demand for fuel-wood in rural communities remains inelastic as long as the resource continues to be available to these communities (Momodu, 2013). These increasing demands have further attracted many interested individuals in rural and peri-urban communities to engage in fuel-wood sales in many local markets, and place additional pressure on local forest resources, particularly in places where fuel-wood is scarce.

Table 3: Fuel-wood consumption

Direct Fuel-wood consumption			Income generation		
Response	Frequency	Percentage	Response	Frequency	%
Yes	198	82.5	Others	200	83.3
No	42	17.5	Fuel-wood	40	16.7
Total	240	100	Total	240	100

Sources of fuel-wood consumed in the study area are presented in Table 4. The result revealed that 47.2% of the respondents obtained their fuel-wood directly from natural forests. Those who extracted from forest plantation in the state were 14.4%. About 24% of the respondents sourced their fuel-woods through purchases at the local markets. Only 11% and 3.6% of them sourced from fallow lands and farmlands respectively. The trend observed in this study is not different from the report by Chamshama and Nwonwu (2004) that the supply of fuel-wood in West Africa is still mainly from natural forests and woodlands. The continued exploitation of fuel-wood in the natural forests has, and is still exerting more pressure on the remaining tracts of natural forests. Worst still, it has been projected that as a result of limited availability of suitable land as well as increased

incidences of land-use conflicts, plantation forestry is unlikely to become a major source of fuel-wood supply in Africa (FAO, 2003). Thus, dependence on natural forests and woodlands, and on farm-grown wood, will continue. And the trend in Imo State is not any different, as there were no such plans to establish plantations of any sort, which could cater for the future fuel-wood needs in the state. Another danger is that, when poverty is on the rise, there are tendencies for further deforestation in the quest for survival in the face of dwindling economic situations.

Table 4: Sources of fuel-wood consumed in the study area

Source	Frequency	Percentage
Natural forests	113	47.2
Plantation	35	14.4
Fallow land	26	11.0
Farmland/home gardens	9	3.6
Purchase	57	23.8
Total	240	100

Table 5 presents correlation co-efficient among the determinants of fuel-wood consumption in the study area. The result revealed that household size is negatively correlated with daily consumption. It has positive correlations with cost and fuel-wood percentage of the domestic energy. There were negative and significant correlation between daily consumption and cost of fuel-wood as well as the cost and the percentage of fuel-wood in total domestic energy utilized.

Table 5: Result of correlations among the fuel-wood consumption determinants

	HS	DC	Cost	Percentage
HS	1			
DC	-0.093	1		
Cost	0.08	-0.83*	1	
Percentage	0.57	0.29	-0.42	1

* Significant at $\alpha = 0.05$; HS – household size; DC – daily consumption; Percentage – fuel-wood percentage of domestic energy utilized

The results of one-way analysis of variance for comparing household sizes, daily consumptions, costs of fuel-woods consumed and % of fuel-wood in domestic energy utilized among the selected LGAs are presented in Table 6. The result revealed that there were no significant differences in mean household sizes and the percentage of fuel-wood in domestic energy consumed among the LGAs ($P > 0.05$). With respect to the household

consumptions and costs of fuel-woods, however, there were significant variations among the LGAs ($P < 0.05$).

Table 6: ANOVA for household size, daily consumption and costs, fuel-wood %

Variable	Source	df	SS	MS	F	P-value
Household size	LGA	8	8.49	1.06	0.51	0.844
	Error	81	168.00	2.07		
	Total	89	176.49			
Daily consumption	LGA	8	1038.9	129.9	3.54	0.001
	Error	81	2972.5	36.7		
	Total	89	4011.4			
Cost	LGA	8	29556.0	3694.0	2.80	0.009
	Error	81	107000.0	1321.0		
	Total	89	136556.0			
% of fuel-wood	LGA	8	2868	356	2.18	0.081
	Error	81	2956	164		
	Total	89	5824			

$\alpha = 0.05$

Table 7 presents the results of mean separations (LSD tests) for household sizes, daily consumptions per households, costs of fuel-wood consumed and percentage of fuel-wood in domestic energy consumption. With respect to household size, Ideato North and South, and Orlu LGAs had the highest mean household size of 5 ± 2 . Other LGAs had means of 4 ± 1 persons each. Nevertheless, there were no significant differences in mean household sizes among the selected LGAs. Most of the LGAs sampled had mean household sizes within the range (of 4 to 5 persons) reported for Imo State by NBS (2012). The result of the correlation showed that household size has negative relationships with the daily consumption of fuel-wood in the study area, which implies that an increase in household size does not amount to an increase in the quantities of fuel-wood consumed. It is possible that where the household size is large, other alternatives may be available and affordable, hence, lesser dependence on fuel-wood as a domestic energy option. Specifically, consumption was highest in Okigwe LGA, which is one of the LGAs with minimum household sizes. This may be due to the fact that lesser domestic energy alternatives were available in the area compared to the rest of the LGAs studied, hence, more dependence on fuel-wood as a domestic energy for cooking. This disagrees with the finding of Helberg *et al.* (2000), who noted that household size is an important factor in fuel-wood consumptions as it has a direct relationship with fuel-wood consumption. In other words, the more the household size, the more intensified the extraction of the resources as well as its eventual consumption.

According to Knight and Rosa (2011), the number of households is a better predictor of total fuel-wood consumption than average household size suggesting a greater relative contribution to consumption levels. Thus, insofar as declining average household sizes result in increased number of households and higher per capita consumption, this trend may be a signal of serious threats to biodiversity and resource conservation (Knight and Rosa, 2011). Liu *et al.* (2001) noted that a reduction in household size, and the associated increase in the number of households, resulted in increased fuel-wood consumption, thereby decreasing the size of the giant panda habitat in a natural forest of China.

With respect to daily consumptions of fuel-wood in the area, Ideato North, Oru West, Ohaji/Egbema, Ngor Okpala, Orlu and Obowo LGAs were not significantly different from one another. Similarly, Ikeduru and Onuimo LGAs were not significantly different from each other. However, these two LGAs were significantly from Okigwe LGA in terms of daily consumption of fuel-wood. Nevertheless, Okigwe was not significantly different from Ideato North, Oru West, Ohaji/Egbema, Ngor Okpala, Orlu and Obowo LGAs. In general, mean household daily consumption was highest in Okigwe and least in Onuimo LGAs. This may be due to the lesser availability of other energy sources in Okigwe LGA compared to others, or it may be a result of higher population in the area compared to the other LGAs. Considering the nature and household sizes, Okigwe LGA is more mixed with rural and urban lives than the other LGAs studied.

The result of mean separations for the cost/kg of fuel-wood consumed in the study area revealed that Ideato North, Oru West, Ngor Okpala, Ikeduru, Orluto and Okigwe LGAs were not significantly different from one another, but significantly different from Ohaji/Egbema, Onuimo and Obowo LGAs in terms of cost of fuel-wood consumed. Ohaji/Egbema and Obowo LGAs were not also significantly different from each other with respect to cost/kg. Nevertheless, the two LGAs were significantly different from Onuimo LGA. The highest cost/kg of fuel-wood was recorded in Onuimo LGA, and least in Ideato North LGA.

The highest cost recorded at Onuimo may be due to the scarcity of the resources in the area, or perhaps the fuel-wood is not readily available, hence, the hike in price of the resource. It is also possible that there are restrictions to fuel-wood collection in the natural forests in that axis of the study area. For instance, where forests are constituted into reserve areas, there are usually bans on commercial fuel-wood exploitation, since this has been recognized as a major driver of biodiversity loss. According to Rose *et al.* (2009), there is a general concern that increased woodfuel use may cause additional pressure on already dwindling supply sources leading to additional deforestation and devegetation. Moreover, cost and daily consumption have negative correlation. This implies that the more expensive the product in the market, the lesser the fuel-wood consumption in the study area.

With respect to the contribution of fuel-wood to household energy (% of energy consumed), there were no significant variations among the LGAs. The result revealed that fuel-woods contributed about 62 to 93% of the domestic energy consumptions in the study area. The average consumption of fuel-wood was highest (93 ± 6) in Obowo LGA and least (62 ± 13) in Orlu LGA. This is in line with the finding of Momodu (2013), who reported that fuel-wood contributed more than 50% of the total energy consumed in Nigeria. The mean percentage contribution to total domestic energy consumptions recorded in this study also fell within the range reported by Amiebonomo (2003), who observed that fuel-wood accounts for between 50-80% of the overall energy in the domestic sector in Nigeria. Agarwal (1986), Amous (1998) and Adegbulugbe (1995) have reported an annual wood consumption of about 51-88 million cubic meters for Nigeria, 80% of which was said to be utilized as fuel, mainly for cooking in rural areas. The situation in the study area is also similar to what obtains in other parts of Africa. According to Karekezi and Kithyoma (2002), the contribution of fuel-wood to total primary energy is very high in countries in East and Central Africa, where it constitutes 75 to 86 % of total energy. In Kenya, fuel-wood accounted for 78% of total energy consumption while it constituted 82% in Tanzania.

Table 7: LSD results for household size, consumption, cost and % of household energy

LGA	Household size	Daily consumption (kg)	Cost (N)/kg	% of energy consumed
Ideato North	5 $\pm$ 2 ^a	14.00 $\pm$ 6.15 ^{ab}	7.50 $\pm$ 2.57 ^a	83 $\pm$ 16 ^a
Oru West	5 $\pm$ 2 ^a	13.00 $\pm$ 5.38 ^a	7.31 $\pm$ 5.28 ^a	79 $\pm$ 20 ^a
Orlu	4 $\pm$ 1 ^a	10.50 $\pm$ 5.99 ^{ab}	9.52 $\pm$ 3.93 ^a	62 $\pm$ 13 ^a
Ohaji/Egbema	4 $\pm$ 1 ^a	10.00 $\pm$ 5.77 ^{ab}	13.5 $\pm$ 8.95 ^b	72 $\pm$ 10 ^a
Ngor Okpala	4 $\pm$ 1 ^a	10.50 $\pm$ 4.97 ^{ab}	9.5 $\pm$ 7.42 ^a	68 $\pm$ 14 ^a
Ikeduru	5 $\pm$ 2 ^a	9.00 $\pm$ 6.99 ^b	10.56 $\pm$ 4.06 ^a	87 $\pm$ 11 ^a
Onitsha	5 $\pm$ 2 ^a	7.500 $\pm$ 3.91 ^b	18.67 $\pm$ 14.52 ^c	89 $\pm$ 10 ^a
Okagwe	4 $\pm$ 1 ^a	15.00 $\pm$ 4.74 ^a	7.33 $\pm$ 4.45 ^a	70 $\pm$ 10 ^a
Obowo	4 $\pm$ 1 ^a	10.500 $\pm$ 5.99 ^{ab}	12.38 $\pm$ 7.04 ^b	93 $\pm$ 6 ^a
LSD value	1.29	5.45	3.27	21.02

N.B.: Means with the same alphabet as superscript under each category are not significantly different from each other.

Conclusion

The study has shown that fuel-wood is the dominant domestic energy source in the state, especially in rural and peri-urban areas, as daily energy consumptions reached up to 93%. The fact that alternative energy sources are still unstable and unpredictable in the state

poses further threats to forest resources, especially the already-threatened natural forests in the state. To this effect, the need to provide adequate energy supply through other means becomes a compulsion, if sustainability of the forest resources is to be guaranteed. It is therefore recommended that the various other natural options in the country be explored for meeting domestic energy needs.

In the nearest future, it is predictable that the state would experience a shortfall in fuel-wood supply since the state-own natural forests and plantations are already heavily depleted, and it is hard to find privately-own stands anywhere in the area. Therefore, a shift in the patterns of fuel-wood extractions in the state is strongly advocated. This can be possible through joint-forest management, which involves all stakeholders at all stages of forest development. State government may also wish to consider incentivizing afforestation-related activities, while conventional farmers are provided with seedlings of species mostly extracted as fuel-woods to address the issues of land scarcity.

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