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Assessment of Domestic Energy Preference in Lafia Local Government Area of Nasarawa State, Nigeria

David Oriabure Ekhuemelo[*], Felicity Amuche Ugwueze, Emmanuel Terzungwue Tembe

Department of Forest Production and Products, University of Agriculture, Makurdi, Nigeria

Email address:

davidekhuemelo@gmail.com (D. O. Ekhuemelo)

Abstract: This study appraised household energy utilization in Lafia Local Government Area of Nasarawa state. Out of the 86 streets in Lafia LGA, 30% of streets were randomly selected for the study. Five households and one targeted audience were systematically selected from each street, and 6 copies of questionnaire were administered to each household head. Data obtained were analyzed with descriptive statistics. Results revealed single energy type used as charcoal (32%), gas (24%) fuelwood (22%) and kerosene (12%), Electricity (9%) and sawdust/ sawdust stove (2%). Two combined energy use were fuelwood and charcoal (25%), charcoal and kerosene (24%), gas and kerosene (15%). Multiple energy use were fuelwood, charcoal and kerosene (18%) being highest, while the least was sawdust stove, fuelwood and charcoal (2%). Preference of energy sources were charcoal (35.4%) > gas (29%) > fuelwood (17%) > electricity (12%) > kerosene (6%). Energy was used for domestic purposes (56%) > business (36%) > domestic and business (8%). On weekly bases, 56%, 18%, 12%, 2% of respondents spent between ₦600 - ₦1,000, ₦ 0 - ₦500, ₦1,100 - ₦2,000 and ₦2,100 - ₦3,00 respectively on household. The highest earnings from energy sales per week was charcaol (N10,001- N20,000) fuelwood (₦3,000 - ₦10,000, and ₦10,001 and ₦20,000), kerosene (₦3,000 - ₦1,000) gas (₦10,001 - ₦20,000) respectively. Charcoal was the most preferred energy source for domestic purposes among the households in Lafia LGA. It is recommended that the use of bioenergy from wastes should be encouraged while availability of kerosene, cooking gas and efficient electricity should be improved.

Keywords: Charcoal, Energy, Fuelwood, Household, Gas, Kerosene

1. Introduction

Household energy consumption refers to the amount of energy resources that are being consumed by households on various purposes. Energy and fuel use are important for the welfare of households in developing countries [1]. Using an energy source for lighting and cooking is essential to human life and part of what first define the human race as separate from animals in pre-historic time [1]. Household energy consumption is a necessity considering its importance on household welfare, public investments, and environments. The pattern of household energy consumption indicates the state of welfare and economic development of an individual and of a particular country [2]. There are various energy resources available for human use. They comprise biomass (fuelwood, charcoal, sawdust), fossil fuel (kerosene, gas, diesel), and others which include solar, and electricity, wind among others [3]. Energy constitutes one of the most important aspects of human life. It is a commodity that is vital for the existence of modern life [4].

Household fuels constitute energy sources used for domestic cooking, space heating and lighting. However, this excludes fuels for transportation [5]. Many of different types of households' fuels in use in developing countries come under the category of "traditional", which include animal dung and agricultural residues, as well as wood fuel. Typically, a household may shift from biomass to kerosene, gas, and finally to electricity for specialized cooking. This shift phenomenon is often referred to as 'fuel transition' from traditional (biomass−based) to modern household fuels [6]. Also, even within the biomass−based fuel, there is a shift from one to another

for a number of developing countries, including Nigeria. Issues relating to household energy choice and transitions are important from a policy standpoint [6].

This is because in every economy, all sectors ranging from residential, manufacturing, agriculture, transport as well as services sectors depend to a large extent on various energy sources to function. However, despite that the different end uses for energy varies significantly from country to country because of differences in climatic conditions, policies, level of economic development and other factors [7], it is generally agreed that the household sector is one of the most important energy consumption sector [8]. For instance, energy consumption of the residential sector accounts for about approximately 30% of the total world energy consumption [9].

The situation in the rural area of the country is that most end users depend on fuelwood. Fuelwood is used by over 70% of Nigerians living in the rural area [10]. Daily consumption of firewood by the rural communities in Nigeria was estimated at 27.5 million kg/day by [11]. Nigeria consumes over 50 million tons of fuelwood annually, a rate which exceeds the replenishment rate through various afforestation programs [10]. Souring fuelwood for domestic and commercial uses is a major cause of desertification in the arid- zone state and erosion in the Southern part of the country. The rate of deforestation is about 35,0000 ha/year, which is equivalent to 3.6% of present area of forests and woodlands, whereas reforestation is only of about 10% of the deforestation rate [12]. The rural areas which are generally inaccessible due to the absence of good road networks, have little access to conventional energy such as electricity and petroleum products. Petroleum products such as kerosene and gasoline are purchased in the rural areas at prices 150% in excess of their official pump prices. The daily needs of the rural populace for heat energy are therefore met almost entirely from fuelwood [13].

The popularity of the transition to charcoal was brought to the fore in Nigeria following the acute scarcity of firewood and kerosene as well as their exorbitant prices. [14] Report that the kerosene scarcity led to the invention of Abacha Coal pot - a locally made stove that use charcoal. Over the years, the cooking technology of the coal pot became widely accepted and used. Also, the high initial investment cost of kerosene stove, gas and electric cooker, coupled with low generation, and cost of electricity discouraged the use of alternative fuel in favor of charcoal. Consequently, African ministers on African preparatory conference for the World Summit on Sustainable Development in 2001, submitted that at least 80% of African population continues to depend on traditional biomass fuels charcoal and firewood for their energy needs [15].

The use of clean cooking fuels can also have positive effects on the external environment by reducing outdoor air population from venting of kitchen smoke as well as combating forest degradation; collection of wood for firewood or charcoal production is thought to contribute to forest degradation in certain locations, especially near cities and major road (Energy Sector Management Assistance Program, 2001; [16]. Household energy consumption is a necessity considering its importance on household welfare, public investments, and environments. The pattern of household energy consumption indicates the state of welfare and economic development of an individual and of a particular country [2]. This study therefore is aimed at surveying household energy choice in lafia LGA.

In Lafia LGA of Nasarawa State, urbanization and economic development are bringing about changes in consumption pattern, which in turn are leading to major changes in the household energy sector. A rapid shift from petroleum products to firewood and charcoal in the area has raised some concern, as witnessed in the increase in a number of traders on charcoal, charcoal shops, as well as charcoal users. The real effect of this problem is that the governments understanding of household fuel sector in the area of minimal, and the ability to predict and plan household fuel agenda is woefully inadequate. The information from this study will be relevant to the scientific community and to policy maker, bioenergy entrepreneurs and other stakeholders for formulating appropriate strategies for the future planning and development of domestic energy resources in Lafia LGA of Nasarawa State.

Exploitation of tree resources and conversion of woodlands to other non−forestry purposes, have potential negative impacts not only on climate change but also on local food and fuel production [17, 18]. Moreover, the rural population is steadily increasing, alternative sources of energy have not been developed and there is an increased pressure on the existing tree resource [18, 19]. Despite these concerns, little is known about the preferences of rural households in terms of biomass fuels and the way of harvesting and growth the feedstock. Therefore, a detailed survey of the preferences and attitudes of consumers with regard to energy use in the study area could assist in developing biomass based rural energy strategies as a solution for sustainable energy services. Objectives of this study therefore, were to identify different (single and combined) energy sources used domestic purposes energy, assess energy preference and factors influencing energy use for domestic purposes and evaluate the cost of energy used for domestic purposes in the study area.

2. Materials and Methods

2.1. Study Administrators

Lafia is a LGA in Nasarawa State, Nigeria and it is the capital of Nasarawa State. Lifia has a population of 330,712 inhabitants according to the 2006 census results. It is located on latitude 8.48° and 9° 25" N, longitude 8.52° and 9° 37"E

and 290 meters elevation above the sea level. It has the population of 330, 712 [20]. The major vegetation of Lafia LGA is the guinea savannah. A greater percentage of this vegetation cover has however been influenced through fuelwood extraction and land clearance for cultivation. This has affected the indigenous woody plant species. The result is that most place close to human settlement are now covered with exotic species such as Parkia biglobosa, Vitelleria paradoxa, Anacardium occidentalis and other economics trees [21]. The most abundant woody species are: Drypetes floribunda, Vitex doniana and Entada abyssinica. The common grass species found here include Pennisetum, Andropogon, Hyparrhenia and Ctenium [21].
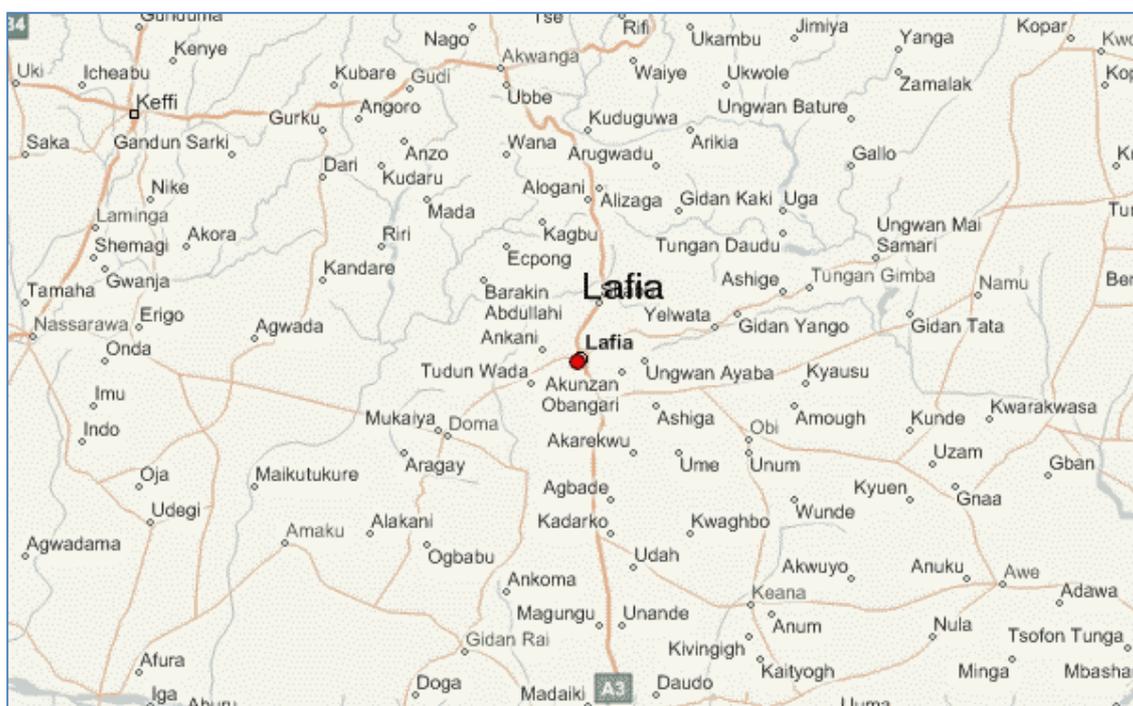
Source: [22]

Figure 1. *Map of Lifia LGA.*

2.2. Sampling Techniques

Lafia LGA was purposively selected in Nasarawa State for the study based on its increasing human population. Stratified Random Sampling Technique was used for the study. Lifia LGA was stratified in to 3 Districts, in each District, 30% of the streets were randomly selected which is approximately twenty six (26) out of the eighty six (86) streets found in the three Districts. In each selected street, five (5) households were chosen using Systematic Sampling Technique. Semi−structured questionnaire was purposively administered to each household heads along the streets. Target places were visited and administered with one questionnaire each to elicit information on their energy source and patronage. The target places which include bakeries, restaurants and household energy vendors or sellers were also purposively selected.

2.3. Data Collection Procedure

A sample size of 130 respondents (5 households in 26 streets) was administered with semi−structured questionnaire (Table 1). Adult male or female of each household was interview with a questionnaire. Six copies of questionnaire were administered per street, five to five households and one to each of the target places (bakeries, restaurants and household energy vendors or sellers).

2.4. Data Analysis

Descriptive statistics such as tables, percentages, charts and figures were used to present data obtained from the study.

Table 1. *List of Streets in Lafia LGA.*

S/No	Name of Districts	Total Number of Streets	30% of Sampled Streets	Number of Sampled streets
1	Barikin Abdullahi			
		9	Angbako	3
			Ruwaya	
			Takpa−Ozz	
2		49	Abu	14
			Adogi	
			Akura	
			Akuya	
	Assakio Districts		Arikya	
			Assaakio	
			Azuba	
			Barkin Abdullahi	
			Barkin Kogi	
			Jibel	

S/No	Name of Districts	Total Number of Streets	30% of Sampled Streets	Number of Sampled streets
3	Lafia (Rural) District	30	Keffi Wambai Shabu Ugah Zambala Agyarag Yakubu Agyaragu To Akunza Akurba Bassa Bukan Sidi Kan Ashara Kurikyo Mararba	9
Total	3	88	26	26

Source: http://www.nasarawastatenigeria.com/blog/2014/03/24.3.3

3. Results

Socio-economic characteristics of respondents in the study area are presented in Figure 2. The results show more males (52%) than females (48%). The religion of the respondents were Islam (46%), Christian (42%), traditional (8%), and others (4%). The predominate occupation of respondents was business (46%), followed by civil service (16%), farming (15%), schooling, private workers (11%), and other (1%). The highest educational level of respondents was tertiary (34%), then, secondary (31%) and primary (24%) while the least was non-formal (11%). The highest marital status of respondents was married (68%), single (21%), widow (6%), separated (4%) while the least was widower (1%).

Table 2 shows single use of energy source in the study area. It was observed that charcoal (32%) was the highest single used energy source in Lafia LGA, followed by gas (24%), fuelwood (22%), kerosene (12%), electricity (9%), and sawdust/sawdust stove (2%). Fuelwood and charcoal (25%)m was the highest combined energy use from two sources followed by charcoal and kerosene (24% and gas and kerosene (15%). While electricity and kerosene with gas and electricity were 9% respectively. However, gas and charcoal was 4% followed by fuelwood and kerosene (3%). Sawdust/ sawdust stove and charcoal, sawdust stove and fuelwood, charcoal and electricity were the least with 2% respectively. Multiple use of energy sources fuelwood, charcoal and kerosene (18%), fuelwood, kerosene and electricity (12%), while sawdust stove, and fuelwood and charcoal with 2% respectively were the least.
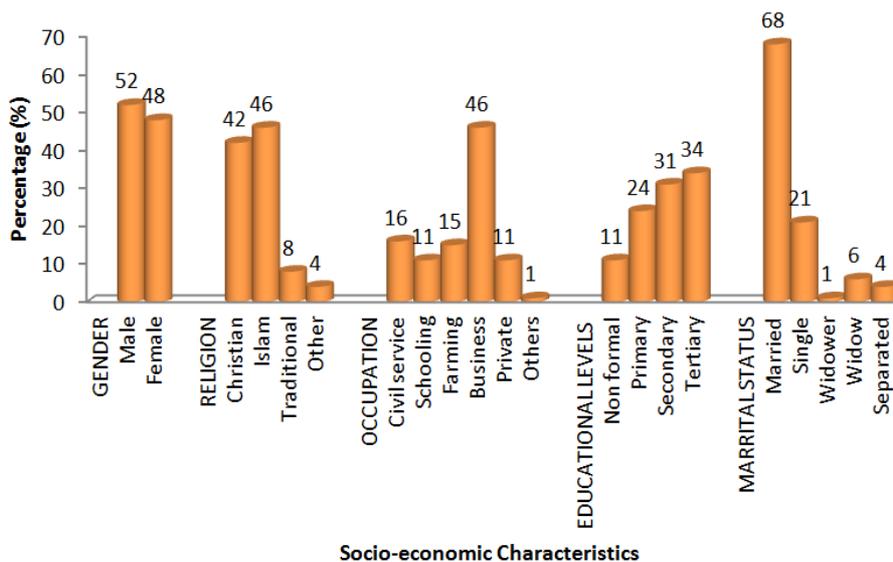

Figure 2. Socio-economic characteristics of Respondents.

Table 2. Use of Energy Sources in Lafia LGA.

Variable	Frequency	Percent (%)
One use of energy source		
Electricity	11	9
Fuel wood	28	22
Charcoal	42	32
Kerosene	16	12
Gas	31	24
Sawdust/ sawdust stove	2	2
Total	130	100
Combination of two use energy sources		
No response	9	7
Fuelwood and charcoal	32	25
Fuelwood and kerosene	4	3
Charcoal and kerosene	31	24

Variable	Frequency	Percent (%)
Electricity and kerosene	12	9
Gas and kerosene	19	15
Sawdust/sawdust stove and charcoal	3	2
Sawdust/sawdust stove and fuelwood	2	2
Gas and Electricity	11	9
Gas and Charcoal	5	4
Charcoal and Electricity	2	2
Total	130	100
Multiple use of energy source		
No response	89	69
Fuelwood, charcoal and kerosene	23	18
Fuelwood, kerosene and electricity	15	12
Sawdust/sawdust stove, fuelwood and coal	3	2
Total	130	100

Figure 3 shows preference for the energy sources in the study area. The result indicated that charcoal (35.4%) was the most preferred energy source followed by gas (29.2%), fuelwood (16.9%), electricity (12.3%) and kerosene (6.2%) as the least preferred energy. Table 3 shows the reasons of preference for a particular energy source for domestic use. The result indicated that convenience (49%) was the major reason why respondents prefer domestic energy use followed by cost (42%).
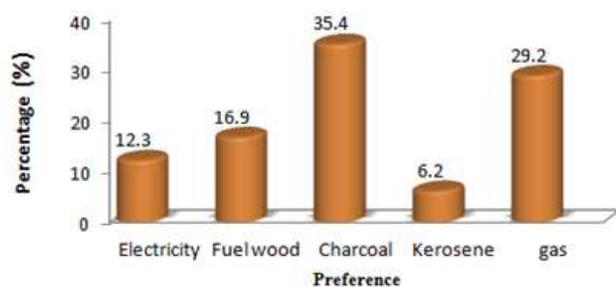

Figure 3. Order of Preference of household energy use.

Table 3. *Reason for Preference of a Particular Energy Source for Domestic Uses.*

Reason for preference	Frequency	Percent (%)
Convenience	63	49
Cost	55	42
Other	12	9
Total	130	100

Figure 4 shows the sources of collection/ purchase of energy. Respondents reported that they obtained their household energy from market (60.8%), forest (18.5%), filling station (14.6%) and electricity (6.2%) from Holding Company of Nigeria (PHCN). Table 4 shows areas of domestic use of energy sources as reported by the respondents. The result reveals that 56% use energy for domestic purposes, 36% for business, and 8% for both domestic and business.
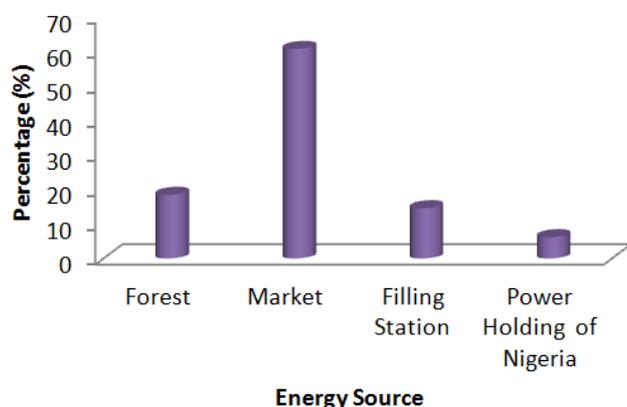

Figure 4. Sources of collection/purchase of domestic energy.

Table 4. *Areas of Domestic Use of Energy.*

Area of energy use	Frequency	Percent (%)
Domestic	73	56
Business	47	36
Domestic and business	10	8
Total	130	100

Figure 5 show frequency of household use energy in the study area. It was observed that 62% of the respondents used energy in the morning, afternoon, and evening, 10% used energy in the morning, 7% used energy in the morning and evening and 21% of the respondents were not frequently using energy.
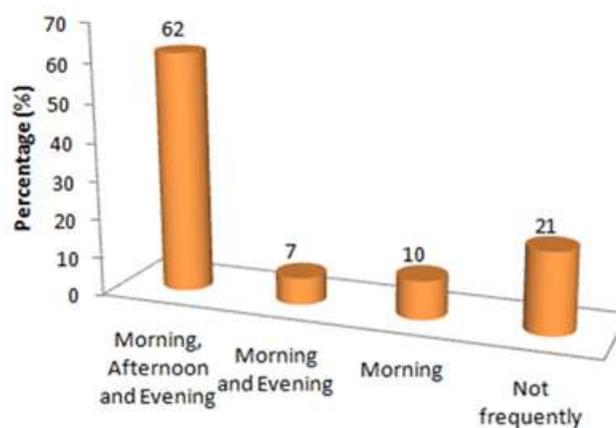

Figure 5. Frequency of Household Energy use.

Factor that influence preferred energy type in the study area as reported by respondents (table 5) were seasonal variation (32%), location (19%), government policy (18%) and fund and income (15%) and 2% did not respond. Table 6 shows the result of accessibilty of preferred energy type. Respondents reported that charcoal was easy and convenience to access while, others asserted that fuelwood was difficult to access. However, some believed gas was difficult, yet, many reported that kerosene was very difficlt yo access.

Table 5. *Factors Infuencing Use of Preferred Energy Type.*

Factors	Frequency	Percent (%)
No respond	2	1.5
Season	41	31.5
Government policy	23	17.7
Funds	19	14.6
Income	20	15.4
Location	25	19.2
Total	130	100

Table 6. *Ease of accessibility for perferred Energy types.*

Perferred energy type	Easy of Accessment
Charcoal	Easy and convenient
Fuelwood	Difficut
Gas	Partially difficult
Kerosene	Very difficult

Challenges faced in accessing preferred domestic energy

sources in the study area are presented Figure 6. The result show that avaliability (40%) to accessing energy was the highest followed by distance (36%) and cost of transportation (24%) was seen the least challenge, in accessing household energy. Table 7 shows estimated cost of energy use per week as reported by respondents in the study area. It was noted that 56% of respondents spent between ₦600 – ₦1,000 weekly on household energy. This was followed by 18% spending between ₦0 – ₦500, 12% and 2% spending between ₦1,100 – ₦2,000 and ₦ 2,001 – ₦ 3,000 respectively.
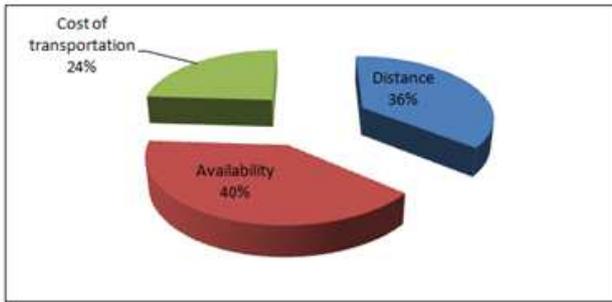

Figure 6. *Challenges Encountered in Accessing Preferred Domestic Energy Source.*

Table 7. *Estimated Cost of Energy Per Week.*

Cost energy (N/ K)	Frequency	Percent (%)
0 – 500	23	18
600 – 1,000	73	56
1,100 – 2,000	15	12
2,100 – 3,000	2	2
Total	130	100

Figure 7 shows the type of energy that was being sold in Lafia LGA. The result shows that charcoal (33%) was the highest sold household energy followed by fuelwood and kerosene (25%) and gas (16%).
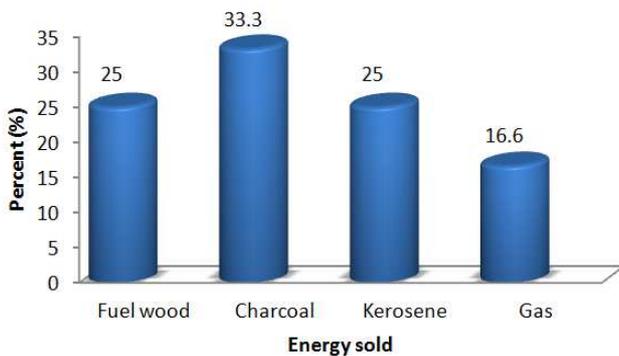
Figure 7. *Types of Energy Sold in Lifia LGA.*

Table 8 shows how often household energy vendor were patronized. On regular sales patronage, charcoal sellers (40%) was highest. This was followed by cooking gas sellers (30%) while kerosene sellers (10%) were least patronized. Similarly, irregular patronage was highest with kerosene seller (45%) then cooking gas sellers (27%), fuelwood (18%) and lowest with charcoal seller (9%). Charcoal vendors regularly (40%) sold charcoal for domestic purpose while

kerosene seller (45%) irregularly sold their products. That infer that there was move sales of charcoal than any other household energy while kerosene was the least sold. Kerosene has become a scarce household energy recently in Nigeria due to fuel subsidy, scarcity, and high price.

Table 8. *Patronage of domestic Energy.*

Household energy vendors	Regular		Irregular	
	F	%	F	%
Fuelwood sellers	2	20	2	18
Charcoal vendors	4	40	1	9
Kerosene sellers	1	10	5	45
Cooking gas sellers	3	30	3	27
Total	10	100	11	100

Table 9 shows the estimated amount of energy sold per week. The highest amount sold by charcoal sellers (33%) was between ₦10,001 – ₦20,000, while fuelwood sellers (33%) sold between ₦3,000 - ₦20,000 amount per week. For kerosene sellers (48%), the highest amount sold was between ₦3,000 – ₦10,000 whereas gas sellers (33%) sold between ₦10,001 – ₦20,000 respectively per week.

Table 9. *Amount Earned by Household Energy Sellers Per Week.*

S/No.	Energy seller	Sales per week (N/ K)	Frequency	Percentage (%)
1	Charcoal			
		3,000 – 10,000	5	24
		10,001 – 20,000	7	33
		20,001 – 30,000	5	24
		30,000 – above	4	19
		Total	21	100
2	Fuelwood			
		3,000 – 10,000	7	33
		10,001 – 20,000	7	33
		20,001 – 30,000	4	19
		30,000 – above	3	14
		Total	21	100
3	Kerosene			
		3,000 – 10,000	10	48
		10,001 – 20,000	5	24
		20,001 – 30,000	4	19
		30,000 – above	2	9
		Total	21	100
4	Gas			
		3,000 – 10,000	6	29
		10,001 – 20,000	7	33
		20,001 – 30,000	5	24
		30,000 – above	3	14
		Total	21	100

4. Discussion

The study indicated that majority of the respondents in the study area were male. This may implies that male used more domestic energy than female. This however may not be true in the real sense because the study area is dominated by Muslim women who were not easily accessed.

This study revealed that charcoal was the most single used energy source in the study area. This disagrees with the study of [23] in Mikang LGA of Plateau state which revealed that firewood was the most single energy used. According to [24],

two out of five people worldwide depend on wood or charcoal as the source of domestic energy. Fuelwood and charcoal as combination of two energy sources, was observed to be most utilized as domestic energy after charcoal. This agrees with the study of [23] in Mikang LGA which reported that fuelwood and charcoal were the most used combined energy sources. Fuelwood, charcoal and kerosene were the commonest multiple use energy sources in Lafia LGA. This support the assertion of [25] that urban population was growing at an average rate of 4% per annum is putting more demand for charcoal and by extension the forests and other biomass services. This also confirm the report by [26] that the percentage of rural population that was using fuelwood and charcoal in 2008 in Nigeria was 90% with national usage being 76.6%. The study further confirms the assertion of [27] as cited by [28] that wood was one of the oldest source of energy and commonest service known to man and has been used for long time.

It was also observed that among the various forms of energy sources available in Lafia LGA, that respondents preferred charcoal to any other source of energy because they believed it was most safe. Some household heads did not permit the use of other form of energy type as they alleged it was serious risk to their houses. Others reported that charcoal was cheaper and last longer than other energy sources. This confirms the reports by various institutions including the World Energy Council in its WEC statement in 2000, the Food and Agriculture Organization [29], and the [30] that it was reasonable to infer that biomass (mainly charcoal) would remain the key source of energy for most of the population in sub African continent for several decades to come.

The major factors limiting energy uses for domestic purposes in Lafia LGA were availability. This was expected since the major source of energy in the area was charcoal. This may be as a result of bad road network especially during rainy season. This may become a problem bringing charcoal from the forest to the main town. This also disagrees with [23] which state that distance was the major limiting factor in Mikang LGA of Plateau state.

At most, respondents spent between ₦501 and ₦1,000 every week on domestic energy consumption which about an average of ₦750 per week. In a month, about ₦3,000 would have been spent on domestic energy alone in a household. This confirms [23] study that the respondent in Mikang LGA of Plateau state spend between ₦600 – ₦1,000 per week. The major type of energy sold in Lafia LGA was charcoal. This was because charcoal was the most use energy source for household and industrial purposes. Such industries include tie and dye industries, blacksmithing, bakeries, among others as reported by [29] that, besides its household uses, charcoal has industrial applications, as well as metallurgical operations, as a reducing agent.

5. Conclusion

Charcoal was found to be the most preferred, easy and convenient energy source for domestic purposes among the households in Lafia LGA followed by gas, fuelwood, electricity, kerosene and sawdust/ stove. Seasonal variation availability was observed a major factor limiting the use of preferred energy in the study area. Serious efforts therefore must be made by Government at all levels, forest and energy stakeholders to mitigate the pressure on the forest and its attendant effects on the environment as result of biomass being the major source of energy for domestic purpose in Lafia LGA of Nasarawa State.

Recommendations

Based on this study, we therefore recommend the following:

i) Adequate forest management, supervision and control practices should be put in place in Lafia LGA so that the increase of charcoal users does not have serious negative impact on forested area. There should be establishment of woodlot, forest plantation, urban forestry and establishment of fast growing wood species in home garden from sawdust.

ii) The use of bioenergy like briquettes and biogas from wastes and sawdust materials should be encouraged and maximized.

iii) Policymakers should take adequate steps to ensure Nigerian household have access to modern and efficient sources of energy. For instance, Power Holding of Nigeria (PHCN), cooking gas, solar energy and kerosene as Nigeria is one of the major oil producing countries in the world.

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