

## ANALYSIS OF WOODFUEL UTILIZATION IN ZARIA AND ITS ENVIRONS

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### Abstract

*The study analyzed wood fuel utilization in Zaria and its environs. The data used included: administrative map and structured questionnaire to acquire data from the systematically selected respondents in the study area. The sample size of 400 was used for the study and descriptive statistics was used to identify the source of wood fuel. The results of descriptive statistics showed that wood vendor was the major source of wood fuel, as attested by about 13.34% and 11.35% in Kwarbai B and Kaura respectively. Cheapness and availability of wood fuel are the main factors that influence the utilization of wood fuel as they accounted for 50.52% and 45.45%. Also, 84.63% account for highest on the average quantity of daily wood fuel usage which fall on the range of 1-5 bundles per day. 61.20% accounted for the daily utilization of wood fuel. Result also showed that Marke (*Anogeisus leocarpus*) was ranked 1<sup>st</sup> as the most preferred tree species for Wood fuel in the study area with mean score of ( $\bar{x} = 0.61$ ). The study recommends that, there is urgent need for concerned authorities to provide available, affordable and cleaner alternative sources of cooking/heating energy. There is also need for afforestation and reforestation programs.*

**Key words:** Wood fuel, Utilization, Cooking/Heating energy, Bundles

### Introduction

Energy use is an essential requirement for socioeconomic development of any society. It is required for lighting, stationary/mobile engines operation, and cooking, heating and other socioeconomic activities. The use of wood fuel as a source of energy is as old as civilization itself. It is considered as humankind's very first source of energy and still serves as the most important single source of renewable energy of the global primary energy supply (Food and Agricultural Organization [FAO], 2016).

Burning of wood is currently the largest use of energy derived from a solid fuel biomass (FAO, 2016). Wood fuel can be used for cooking and heating, and occasionally for fuelling steam engines and steam turbines that generate electricity. Wood fuels represents one third of the global renewable energy consumption, where more than two billion people depends on (FAO, 2016). Generally, wood fuel shared an estimate of 60 percent (%) to 86% of African primary energy consumption, except in North African and South Africa countries, where wood contribution was less significant (David, Mitchell, Henry and Osazuwa, 2013). It was further estimated in a report by IEA (2006) that, wood fuel usage accounts for 90 to 98% of residential energy consumption in

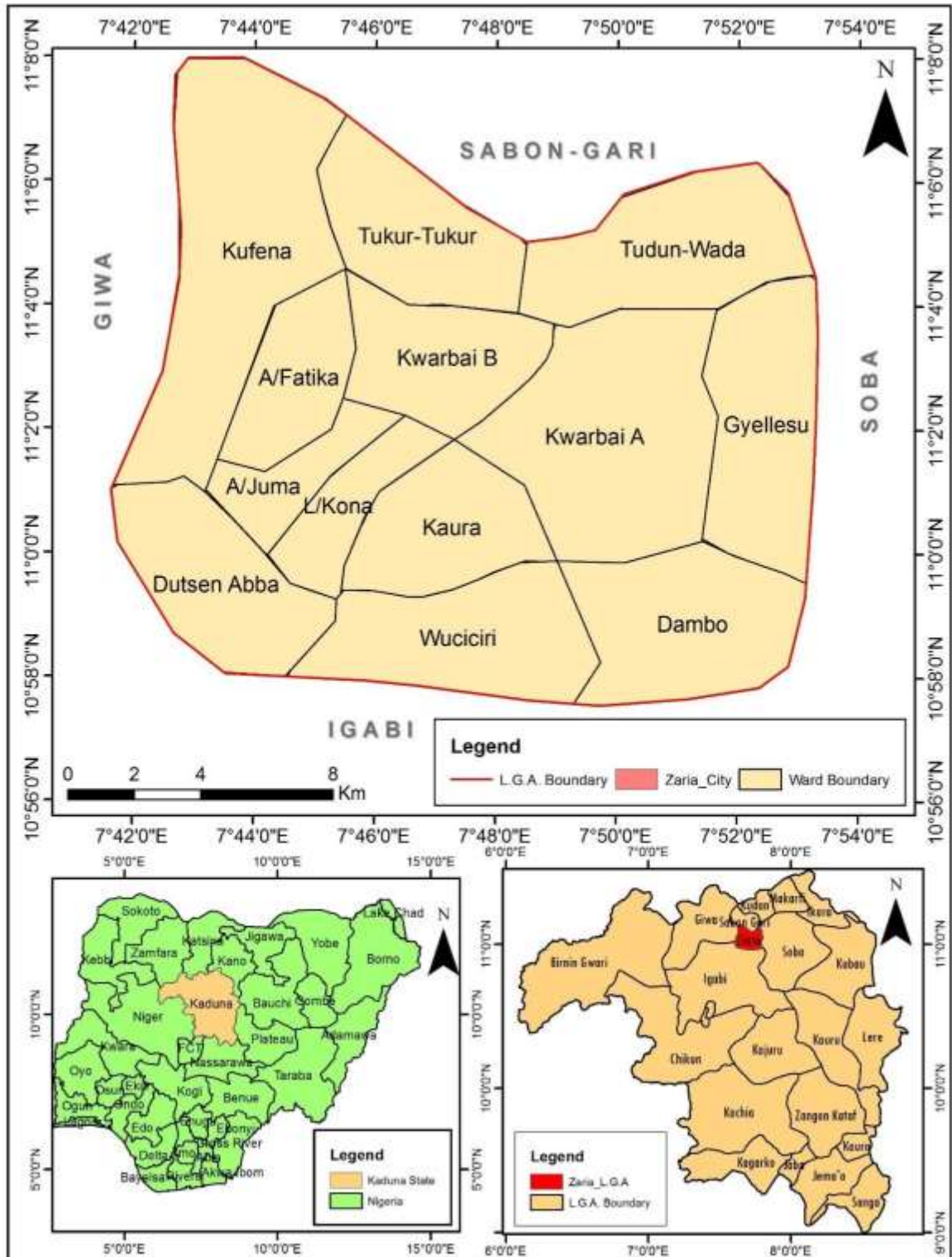
most of sub-Saharan Africa, out of which about 70% was found in rural households. This makes wood the most decentralized energy in the world.

Ismail, *et al.*, (2014) perceived wood fuel as any tree or wood material which is combustible and can be used as fuel and may be available as firewood. These, according to FAO (2016) may include: logs, bolts, and blocks; charcoal, chips, sheets and sawdust. Wood fuel are source either directly from the family farmlands, plantations, forests etc. or indirectly, which is usually from wood fuel vendors selling at the markets, wood depots or house to house supplies to the consumer (Adeyemi & Ibe, 2014). In most urban centres of developing countries, most wood fuel are conveyed by truck at a central depot, before being split, bundled and distributed through a chain of local wood piles, smaller neighborhood piles and itinerant retailers from where end users buy from. This process is usually uncontrolled, but competitive and cost-efficient to the dealers who usually sell to the end users (Cline-Cole *et al.*, 1988; Ibrahim, Aliyu. & Ibrahim, 2013).

In Zaria, like many urban parts in Nigeria uses indirect source of wood fuel, which is usually from wood fuel vendors selling at their depots. Though, some wards in the Local Government have significant farmlands and forests in which the settlers source the wood fuel directly from the forests and farmlands.

### **Study Area**

Zaria local government area is located between Latitudes 10°56'N and 11°80'N of the equator and Longitudes 7°42'E and 7°53'E of the Greenwich meridian. Zaria is the second largest city in Kaduna State of Nigeria, consisting of thirteen wards, namely: Anguwan Fatika, Anguwan Juma, Kaura, Kwarbai A., Kwarbai B., Limancin kona, Dambo, Dutsen Abba, Gyallesu, Kufena, Tudun Wada, Tukur Tukur and Wucicciri ([the-nigeria.com](http://the-nigeria.com), 2011). The study area covers a total land area of 563Km<sup>2</sup> with an altitude of about 762 meters above sea level (Ogunleye, 2006). Zaria is 170km from Kano, and 70km from Danmagaji to Kaduna. It is a nodal town due to its road and rail transport networks (Arowolo, 2000). The study area is bounded to the South by Igabi LGA, to the North by Sabon Gari LGA, to the West by Giwa LGA and to the East by Soba LGA (Figure 1.1).



**Figure 1.1: Zaria LGA (Study Area)**

**Source:** Modified From the Administrative Map of Kaduna State, 2023.

**Materials and Methods**

**Data Collection**

**Table 1.1: Types and Sources of Data used for the Study**

S/N	Data	Source	Use
i.	Administrative map (1: 50,000)	Ministry of Land and Physical Survey Kaduna State	Extraction of administrative boundary of Zaria
ii.	Sources of wood fuel	Questionnaire survey and Indepth interview with wood fuel vendors	Obtain data on wood fuel sources

**Source:** Authors’ Compilation, 2023

**Sample Size and Sampling Technique**

Given the availability of 1991 estimated population figure of the study area which provides data at both LGA and ward level, the sample size of the study is drawn from the population of Zaria. The NPC (2006) population projection formula (Equation 1) was adopted to project both the population data to the year 2022 (Table 1.2). This put the population figure of the LGA at 548,493. Table 1.2 is also used to show the wards and their population figures. Yamane (1967) provides a simplified formula to calculate sample size with 95% confidence level and 5% sampling error assumption (Equation 2). The study used it to obtain a total of 399.9 approximately 400 sample size. Therefore a total of 400 copies of questionnaire were administered to the respondents in the study area. The questionnaire was administered proportionate to the population figure (projected) of each of the 13 wards (Equation 3).

$$[Po=P1 (1+r)^n] \dots\dots\dots (1)$$

Where Po= projected population, P1= Initial population, r= Growth rate (at 3%) n= Number of years projected

$$n = \frac{N}{1 + N(e)^2} \dots\dots\dots (2)$$

Where: n= sample size  
 N= NPC Estimated population figure = 548,493 e=level of significance (set at 0.05 for this study)

$$q = \frac{n \times 400}{N} \dots\dots\dots (3)$$

Where n= sample size (copies of questionnaire)  
 n=Population of each ward  
 N=Projected population figure of the study area.

**Table 1: Population Distribution of Study Area by Wards and Number of Samples**

S/N	Wards	1991 Population	Projected Population (2023)	Number of Samples	Percentage (%)
1	AnguwanFatika	17,871	46,019	27	6.75
2	AnguwanJuma	15,065	38,792	23	5.75
3	Kaura	15,065	38,792	23	5.75
4	Kwarbai A	14,697	37,845	22	5.50
5	Kwarbai B	34,663	89,257	53	13.25
6	Limancin Kona	35,834	92,272	54	13.50
7	Dambo	13,119	33,781	20	5.00
8	Dutsen Abba	26,350	67,851	41	10.25
9	Gyellesu	17,805	45,848	27	6.75
10	Kufena	13,361	34,405	21	5.25
11	Tudun Wada	12,998	33,470	20	5.00
12	TukurTukur	30,059	77,402	46	11.5
13	Wuciciri	15,065	38,792	23	5.75
	Total	261,952	674,526	400	100

Source: NPC (1991) (Author’s Compilation)

**Questionnaire Survey**

A structured questionnaire was designed and administered to the respondents residing in the study area. In order to select respondents from each of the thirteen (13) wards, a systematic random sampling technique was used which involved sampling the 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup> 15<sup>th</sup> 20<sup>th</sup> etc. (an interval of 5) houses in each streets of the wards. This was done to ensure an unbiased and proportional spatial coverage of responses across the study area. The data collected include; sources of wood fuel in the study area. Out of the 400 copies of questionnaire administered only 384 are completed and studied

**Data Analysis**

The data collected from the field were analyzed using SPSS/PC+ Version 23 software. The data was analyzed using both descriptive and inferential statistics. All tests were carried out at 0.5 levels of significance to identify the major source of wood fuel in the study area. This was achieved through administration of questionnaires to the respondents to elicit data on the sources of energy. The data was analysed using descriptive statistics such as frequency tables.

**Results and Discussion**

**Socio Demographic Characteristics of Respondents**

The socio-demographic characteristics considered include: age group, gender, nature of household and household size of respondents. Results are summarized and presented in Table 2.

**Table 2: Gender, Age Nature of Household and Household Size**

<b>Age Groups</b>	<b>Frequency (F)</b>	<b>Percentage (%)</b>
21-30	193	50.2
31-40	109	28.4
41-50	47	12.2
51-60	25	6.5
61 – Above	10	2.6
<b>Total</b>	<b>384</b>	<b>100.0</b>
<b>Gender</b>		
Male	207	53.91
Female	177	46.09
<b>Total</b>	<b>384</b>	<b>100.0</b>
<b>Nature of Household</b>		
Nuclear	179	46.6
Extended	205	53.4
<b>Total</b>	<b>384</b>	<b>100.0</b>
<b>Household Size</b>		
1-4	74	19.3
5-9	166	43.2
10 and above	144	37.5
<b>Total</b>	<b>384</b>	<b>100.0</b>

Source: Field Survey, 2023.

The gender, age, nature of household and household size of respondents as shown in Table 2 reveal that, out of the 384 reached, there were 53.91% males (which constitutes the majority) and 46.09% females. The age range was 21-61 and above, with the highest number within 21-30 (50.2%) and the least between 61 and above (2.6%). While the representation of both male and female among the sampled respondents might have helped to accommodate the possible variation of opinion on issues explored in the study, the dominance of male respondents is attributed to the function of questionnaire administration in which more males were found and reached.

Gender plays major role in determining wood fuel consumption, women often deals with domestic work especially in the northern Nigeria and are more likely to be properly aware of household energy usage in terms of forms (energy mix) and quantity A similar range was reported by Maina et al (2020).

It can also be deduced that, being in their middle and active age brackets, majority of the respondents might not only be in better position to provide reliable responses to the issues addressed, but also might have positive effects on the general attitude towards adopting more heating energy mix, which could help to avert household energy crisis that usually emanates from over dependent on single energy source.

Table2 further reveals that, 53.4% of the respondents had extended type of household while 46.6% were from nuclear households. Also, respondents from household size of 5-9 members accounted for the highest (43.2%), and this was closely followed by 10 and above members (37.5%). Least household size was 1-4 which accounted for 1.9%. This shows that most respondents are from a relatively large households, which could be attributed to the practice of polygamous system of marriage. However, the implication of this large household size is that there is always high demand for wood fuel. The study of Mangi (2011) agrees that, large families in some rural districts of Tanzania are found to have high demand of forest resources through encroachment for wood fuel gathering and charcoal production. This could alter the pattern of the forest resource use, and accelerate deforestation.

**Sources of Wood fuel**

Table 3 shows percentage distribution of respondent’s sources of wood fuel. It also shows a cross-tabulation of respondent’s places of residence with their source of wood fuel in the study area.

**Table 3: Sources of Wood fuel in the Study Area**

Wards	Forests	Farmlands	Vendors	Scanty
				Trees/Shrubs

	<u>F</u>	<u>%</u>	<u>F</u>	<u>%</u>	<u>F</u>	<u>%</u>	<u>F</u>	<u>%</u>
		%						
Anguwan Fatika	0	-	2	5.41	20	7.09	1	3.85
Anguwan Juma	1	2.56	0	-	25	8.87	0	-
Kaura	0	-	2	5.41	32	11.35	1	3.85
Kwarbai A	0	-	4	10.81	28	9.93	0	-
Kwarbai B	0	-	2	5.41	38	13.48	0	-
Limancin Kona	4	10.26	2	5.41	27	9.57	0	-
Dambo	5	12.82	1	2.70	11	3.90	8	-
Dutsen Abba	9	23.08	6	16.22	20	2.84	2	30.77
Gyellesu	6	10.26	4	5.41	14	7.09	5	7.69
Kufena	0	15.38	1	10.81	26	4.96	0	-
Tudun Wada	3	-	4	2.70	19	9.22	2	-
Tukur Tukur		7.69		10.81		6.74		-
								19.23
								-
								7.69
Wucciciri	7	17.95	7	18.92	14	4.96	7	26.92
<b>Total</b>	<b>39</b>	<b>100</b>	<b>37</b>	<b>100</b>	<b>282</b>	<b>100</b>	<b>26</b>	<b>100</b>

Source: Field Survey, 2023

The result as shown in Table 3 reveal that, wood fuel in the study area, was either sourced from mainly forest, farmland or vendors. Dutsen Abba, Wucciciri and Kufena dominated among those who source their wood fuel from the forest as voted by 23.08%, 17.95% and 15.38% of the respondents respectively. Most of these areas are located close to the outskirts and hilly areas of the city where patches of scanty trees and shrubs are found, and perhaps attracts indiscriminate wood fuel extraction. This according to Adeyemi and Ibe (2014), has been the trend in firewood extractions especially in developing world, where households especially in rural areas are often dependent on natural woodland and forest resources for fuel.

However, among the settlements who sourced wood fuel from farmlands, Wucciciri accounted for the highest (18.92%) and closely followed was Dutsen Abba (16.22%).

Dambo accounted for the highest on scanty trees and shrubs with 30.77% followed closely by Wucicciri with 26.92%. Majority of these areas are known to be predominantly subsistent farm settlements. Farm settlements according to Adeyemi and Ibe (2014), usually contains some certain species of vegetation that are mostly found in the free areas due to their shrubby nature and reduced canopies, which cast less shade on arable crops. Therefore, some of their stems are usually spared during land clearing for agricultural purposes, hence, they might be present on farm and fallow lands for domestic energy consumption especially around Dambo and Wucicciri.

Table 3 further shows that wood vendor was the most common source of wood fuel in the study area. About 13.48% and 11.35% in Kwarbai B and Kaura depend on vendor respectively. The least is Dutsen Abba with 2.84%. This can be attributed to the proximity of vendor points to residents which guarantees easy access and availability of the commodity. This finding goes in line with Abdul-Hadi, (2016), the study revealed that source areas of wood fuel procurement in Zaria are majorly from wood vendors within the region. This differs from the study of Kafumu (2000) and that of Adeyemi and Ibe (2014), which found that, majority (78%) of the respondents source their wood fuel from the natural forests in Tanzania and in some peri-urban and rural areas of Owerri zone of southern Nigeria respectively. This result agrees with the findings of (Abdulrashid & Ibrahim, 2018).

**Table 4 Average Quantity of daily wood fuel needed**

Bundles used per day	Rural		Urban		Total	
	F	%	F	%	F	%
1-5	129	86	196	83.76	325	84.63
6-10	15	10	16	6.84	31	8.07
11-15	6	4	10	4.27	16	4.17
16-20	-	-	7	2.99	7	1.82
>20	-	-	5	2.14	5	1.30
<b>Total</b>	<b>150</b>		<b>234</b>		<b>384</b>	<b>100</b>

Source: Field Survey, 2023

Table 4 showed that the average quantity of daily wood fuel is higher on the range of 1-5 bundles in both the urban and rural settlements of the study area which accounted for 84.63% followed by 6-10 bundles per day with combination of 8.07%. This can be deduced from the fact that most household demand for wood fuel is mainly for cooking and heating purpose and also majority of users using this energy alternative fall within the low income earners. The least is the range of >20 with 1.30%. This is as a result of the fact that most users that fall within this category are mostly

commercial bakeries and other local processing plants that use wood fuel as their source of energy.

**Table 5 Factors Responsible for the Utilization of Wood Fuel Consumption in the study area**

Factors	Rural		Urban		Total	
	F	%	F	%	F	%
Cheapness	62	41.33	132	88	194	50.52
Availability	81	54	94	62.67	175	45.57
Cultural acceptance	7	4.67	3	2.86	10	2.60
Other	-	-	5	3.33	5	1.30
<b>Total</b>	<b>150</b>		<b>234</b>		<b>384</b>	<b>100</b>

Source: Field Survey, 2023

Table 5 above shows that a total of 50.52% which comprise 41.33% of the rural wards (Wucicciri, Dutsen Abba, Dambo and kufena) and 88% of the urban wards (Anguwan Fatika, Anguwan Juma, Kaura, Kwarbai A., Kwarbai B., Limancin kona, Gyallesu, Tudun Wada and Tukur Tukur) constitute the highest percentage of utilization due to its cheapness followed closely by 45.57% that utilize the wood fuel as a result of its availability. This is as a result of the fact that most wood fuel utilizers fall within the low income earners and consider cheap alternative energy source than other expensive but cleaner source of energy. This goes in line with a study conducted by Audu (2013) on Wood fuel consumption and desertification in Nigeria which revealed that among the determinant factors of Wood fuel consumption in Nigeria are partly due to its availability, accessibility and convenience. More so, the convenience of sourcing Wood fuel over other forms of cooking and heating energy will result to increased consumption which makes the vital resource vulnerable to be over exploited by the consumers who may not care about the consequences of indiscriminate tree harvesting, provided their energy needs are met. The implication is overexploitation of the available woodland and forestry resources.

**Table 6: Regularity of Wood fuel Utilization**

Regularity	Rural		Urban		Total	
	F	%	F	%	F	%
Daily	105	70	130	55.56	235	61.20
Weekly	34	22.67	27	11.54	61	15.89
Monthly	11	7.33	10	4.27	21	7.03

Seasonal	-	-	62	41.33	62	16.15
Others	-	-	5	3.33	5	1.30
<b>Total</b>	<b>150</b>	<b>100</b>	<b>234</b>	<b>100</b>	<b>384</b>	<b>100</b>

Source: Field Survey, 2023.

Table 6 indicated that 61.20% of both respondents from the urban and rural settlement of the study area utilize wood fuel on a daily basis with 70% from the rural wards while 55.56% from the urban wards. This is because those in the rural settlements use wood fuel often as their main source of energy while the urban dwellers have more alternative source of energy at their disposal. The seasonality factor is the second highest which accounted for 16.15% and is mostly from urban wards respondents who utilize wood fuel during festive periods or special occasions like wedding, naming ceremony, meetings and other get together. 15.89% of the respondents utilize wood fuel on a weekly basis due to the fact that some household use wood fuel in the weekend for cooking heating and other uses.

**Table 7: Most Preferred Species of Wood fuel**

Preferred species of Wood fuel	Less Preferred (1)	Preferred (2)	Most preferred (3)	Mean score	RANK
Marke ( <i>Anogeisus leocarpus</i> )	20	30	51 24	0.61	1
Tsamia ( <i>Tamarindus indica</i> )	10	18		0.31	3
Kadanya ( <i>Vitellaria paradox</i> )	11	15	25	0.30	4
Samji ( <i>Ficus platiphyla</i> )	5	8	11	0.14	7
Kiriya ( <i>Prosopis Africana</i> )	5	10	15	0.18	5
Dorowa ( <i>Perkia biglobossa</i> )	1	6	9	0.10	8
Doka ( <i>Isobertinia doka</i> )	17	26	36	0.51	2
Taura ( <i>Detarium macrocarpu</i> )	4	6	16	0.17	6
Kaiwa ( <i>Diosperus mesphiliformis</i> )	0	1	4	0.04	9
<b>Aggregate score</b>				<b>0.26</b>	

Source: Field Survey, 202

The result from Table 7 shows that Marke (*Anogeisus leocarpus*) was ranked 1<sup>st</sup> as the most preferred tree species for Wood fuel in the study area with mean score of ( $\bar{x}$  = 0.61). This is followed by Doka (*Isobertinia doka*) with mean score of ( $\bar{x}$  = 0.51). Tree species such as Kaiwa (*Diosperus mesphiliformis*) was the least preferred mean score of ( $\bar{x}$  = 0.04).

Findings from aggregate mean score also indicated that all species found in the study area are important and could be essentially used as wood fuel. However, the dominance

of Marke (*Anogeisus leocarpus*) tree species as the most preferred for Wood fuel is not surprising as it is known to be a hard species of wood and as such has high burning efficiency compared to other species. This means that if this trend is left unchecked through massive tree replacement or total discouragement of its usage, these trees could go into extinction in no distant time. This finding agrees with the submission by Akpan. Wakili and Akosim (2007) in a study on Wood fuel consumption pattern in Bauchi State which revealed that Marke (*Anogeisus leocarpus*) species of tree is most preferred for Wood fuel due to reasons like burning efficiency, availability and affordability to most households.

### **Conclusion**

Increasing consumption levels of wood fuel have led to more pressure on natural forest resources in many parts of the country. This is believed to be as a result of unavailability or high cost of alternative sources of energy for poor households, hence, forcing many households to rely on locally available source (wood fuel) as their main form of energy for cooking and heating. Therefore this research attempted to determine the source of wood fuel in the study area. Findings revealed that, wood fuels were sourced from forest, farmland and vendors. However wood vendor was the most dominant source of wood fuel in the study area with Kwarbai B and Kaura wards being the major consumers. Nevertheless, among the inhabitants who source their wood fuel from forest, Dutsen Abba, Wucicciri and Kufena dominated; whereas from farmlands, Wucicciri is ranked the topmost.

### **Recommendations**

The study suggests the following recommendations:

- 13 Both government and environmental protection agencies should embark on massive campaign against indiscriminate felling of trees for wood fuel by members of the public so as to reduce deforestation/biodiversity loss in and around the study area.
- 14 Efforts should be made by both government and stakeholders to make available and affordable cleaner alternative sources of cooking and heating energy like electricity, gas and solar power cookers to households to mitigate high dependence on wood fuel by households.
- 15 There is need for afforestation and reforestation programmes by Government especially on the most preferred wood fuel specie (Marke;*Anogeisus leocarpus*).

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