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THE PATTERN OF FUEL WOOD SUPPLY TO GOMBE URBAN AREA, GOMBE STATE NIGERIA

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ABSTRACT

The aim of this study was to determine the pattern of, and the factors that influence fuelwood supply to Gombe urban area. The specific objectives were to analyze the daily and seasonal supply of fuelwood into the town, examine the factors that influence the usage of fuelwood as well as the participants in the fuelwood business. The study adopted mix-method research design. Purposive sampling technique was used to select 150 respondents. The instruments used for data collection included Global Positioning System (GPS) and structured interview guide. The results of data analyzed revealed that the mean quantity of fuelwood supply in the dry season was 210 tons while supply in the rainy season was 122 tons. Thus, the prices of fuelwood were found to be higher in the wet season than in the dry season due to shortage of supply. Furthermore, fuelwood business in the study area was dominated by men, a situation that was traceable to socio-cultural factors. Interaction with fuelwood cutters and transporters indicated that fuelwood cutting which started a long time ago has been on the increase. Stakeholders in fuelwood business (forest guards, community leaders, union leaders etc.) expressed worries about decline in the density of trees with the negative environmental consequences. End users were of the opinion that family size, fuelwood availability and price, socio-cultural and safety considerations were among factors that influence use of fuelwood. In order to halt the reckless felling of trees and the attendant environmental degradation, urgent interventions are required from government and non-governmental organization to find alternative sources of domestic energy. This should focus on intensified efforts towards the supply of environmental friendly cooking stoves at affordable prices.

Keywords: Fuelwood, Supply, Pattern, Environment, Deforestation

INTRODUCTION

Fuelwood is a vegetal resource which provides the main source of domestic fuel for the rural and urban households. Its utilization as a source of fuel is as old as man's invention of the use of fire and the development of art and cultivation (FOA 2020). In the past the source of fuelwood was simple and the ecological impacts were minimal due to low human population (Magaji and Areo, 2017). As the human population continues to increase rapidly, man's dependence on fuelwood as a source of energy for cooking and heating is posing dangers to the natural vegetation. Today the level of inadequacy is reflected in the rate at which deforestation is taking place as a result of man's attempt to have a regular supply of fuelwood and other vegetal resources (Omachi & Jenkwe, 2020)

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About two billion people (40%) of the total world population depend on fuelwood and charcoal as their primary source of energy (FOA 2020). Of this, three-quarter (1.5billion) do not have an adequate, affordable supply. And particularly many people are facing daily struggle to find enough fuel for heating and cooking. The cooking problem is intensified because rapid growth of population in many developing countries create increasing demands for fuelwood and charcoal due to high cost of conventional source of energy.

As fuelwood become increasingly scarce, women and children spend more and more hours searching for fuelwood. In some places it takes many hours just to walk to the nearest fuelwood supply and even longer to walk back with a load of sticks and branches that will last for a few days (FAO 2020). Currently about one half of all wood harvested each year worldwide is used as fuel (FAO, 2020). Eighty five percent of that is harvested in developing countries, whereas three-quarter of all industrial round wood (timber, poles, beams and building materials) is harvested and consumed in developed countries (FAO, 2020). The poorest countries such as Ethiopia, Bhutan, Burundi and Bangladesh depend on biomass for 99% of their energy (Wood, 2018) often the harvest is sustainable, consisting of dead wood, branches, trimming and shrubs. In Pakistan for example Wood (2018) reported that some 4.4million tons of twigs and branches and 7.7 million tons of shrubs and crop residues are consumed as fuel each year, with destruction of very few living trees.

It has been estimated that about 1,700 million tons of fuelwood is now harvested each year globally (FAO 2018). There is at least 500 million tons less than what is needed (FAO, 2020). By 2025 the worldwide demand for fuelwood is expected to be about twice the current harvest rates, while supply will not have expanded much beyond current levels some places will be much worse than the average (FAO, 2020).

In Africa fuelwood account for about 90% of the total energy use and two-third of this consumption is household energy for the most part procured by women (FAO, 2020). The major reason for deforestation in Africa is the fuelwood collection by the poorer section of the population. Fuelwood use exceeds 1.6 metric cubes per capita per year in Nigeria Kenya, Sudan, Tanzania, Serra Leone, Liberia and Cameroon (FAO, 2020) In some countries particularly developing countries, fuelwood use per capita is on the increase. The story is not different in Nigeria where as high as 86% of low-income earners are primarily dependent on fuelwood as their source of energy (FAO, 2020). A biomass fuel has remained the commonest source of household energy in Nigeria. In 1992 alone, firewood and charcoal production were estimated at 55 million tones (Obueh, 2000 quoted in Nura, Ibrahim , Hamid & Haruna 2011). More than half of the 9.6 million hectares of rain forest belt in southern Nigeria has been used to meet the demand for firewood in rural and urban areas (Obueh, 2000 quoted in Nura *et al*., 2011). Studies on fuel wood supply in developing countries such as that of Nura *et al*, 2011, Bashir, 2015, Naiibi, 2020 have concluded that firewood scarcities are real and will continue to exist, unless appropriate approaches to resource management are undertaken (Arnold 1991; SADCC, 1992 quoted in Nura *et al*., 2011). Increased efficiency of utilization through efficient technologies can therefore be considered as one of the major prerequisites for attaining sustainable development in developing countries (Obueh, 2000 quoted in Nura *et al*., 2011). Over the years, there is compelling evidence which suggests that firewood demand is increasing in Gombe

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State (Bashir 2015). To cope with this growing demand, numerous firewood selling points had emerged, leading to systematic destruction of the State' s forest reserves. Presently, all the State's forest reserves are heavily encroached. Illegal cutting of trees for firewood were the major challenges observed in Wawa Zange, Lombo Daji, Tukulma, Gona, Lembi, and Dirri forest reserves in Gombe State. Undoubtedly, such an overwhelming and persistent dependence on biomass fuels for household energy has given rise to some concerns on the environment and become a serious issue to many developing countries.

The Study Area

Gombe State (the Jewel in the Savannah) is located in the Sudan savannah region of the country at the North-East of river Benue and East of Yankari Game Reserve bordering with Adamawa, Bauchi, Borno and Yobe States covering a total area of 20,256.5sq/km. the approximate altitude of Gombe ranges from 400-500m above mean sea level. Topography is mainly mountainous, undulating and hilly to the Southeast and open plains in the central Northeast, west and northwest (Abbas, 2012) (Figure 1).

Gombe urban area. is located approximately in the center of Gombe State which lies between latitudes $10^{0}0^{1}$ and 10^{0} 20./^{1}N and on longitudes $11^{0}1^{1}$ and $11^{0}19^{1}$E (Gombe State Annual Diary, 2022). Gombe urban area is bounded by Kwami Local Government Area in the North and almost surrounded by Akko Local Government Area in the South East and South West (Figure 1). The study area is linked to other regions by roads like Gombe Biu – Maiduguri Road, Gombe to Bauchi Road, Gombe – Yola Road, Gombe – Patiskum Road and Gombe – Dukku Road. Gombe urban area is delineated into different residential quarters which include, GRA, Federal Low Cost, Arawa, State Low Cost, Kumbiya-kumbiya, Pantami, Jekadafari, Tudun Wada, Madaki, Dawaki, Bolari, Yalanguruza, Shamaki (Abbas 2012).

The population of the study area as at 2006 was 266,844 people. (National Population Commission, 2006). This ethno-linguistic composition of Gombe Urban Area includes among others; the Fulani, Tera, Bolewa, Tangale, Jukun, Hausa, Kanuri, Yoruba, and Igbo. In addition to the speaking of all these various languages, Hausa language serves as a linga-franca in the course of daily interaction among peoples. English language remains the official language as obtains in all part of the country (Abbas 2012).

MATERIALS AND METHODS

The study adopted mix-method research design. The quantitative data consisted of number of vehicles that convey the fuel woods, weight of fuelwood, the demographic and economic attributes of the respondents and coordinates etc. On the other hand, fuel wood preferences, factors that influence the use of fuelwood, category of people involved in the business of fuelwood, were considered qualitative data. The quantitative data was generated using structured interviews while the qualitative data was collected by non-structured interview method.

All persons that deal with fuelwood directly and indirectly constitute the population for this study. The population is thus comprised of traditional rulers close to the forest, Members of Fuelwood Business Association, government officials, wood cutters, vendors, wholesalers and retailers were the major concern during the interview. No sampling frame since the population of people involved in fuelwood business was unknown. Purposive sampling technique was adopted. The reason for adopting purposive sampling was to avoid contact with non interest groups that do not have any knowledge about the

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subject matter (Lambu 2014). Through the use of convenience interview method, respondents like fuelwood cutters were met because they are not stationary particularly the vendors and the wood cutters.

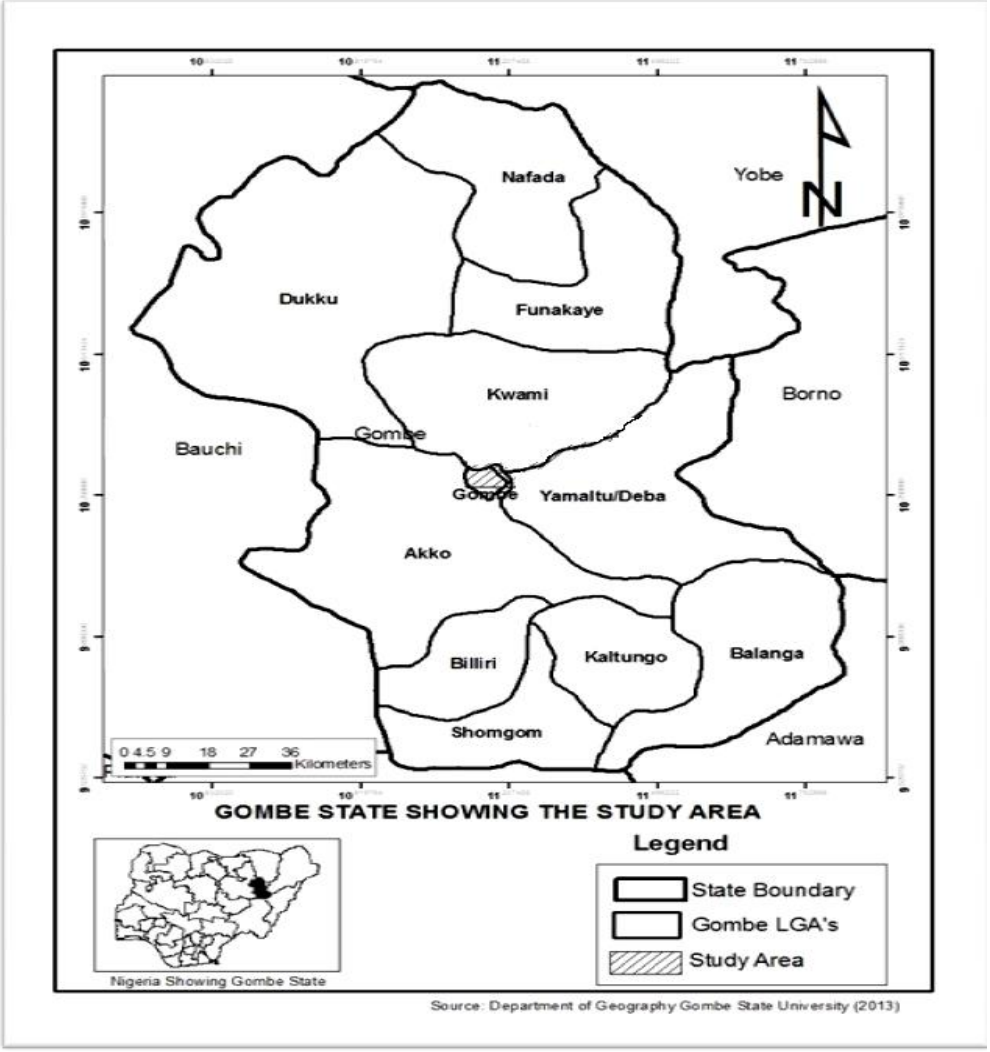

Figure 1: Map of Gombe State showing study area.
Source: Gombe State University Cartography Lab.

Table 1: Sample Frame

Categories of respondent	Sampled size
Fuelwood cutters	30
Fuelwood vendors	50
Fuelwood End Users	50
Stakeholders	20
Total	150

Source: Fieldwork, 2023

The end users/retailers were purposively selected, in other to avoid contact with non interest respondents or those without having any knowledge of fuelwood activities. The data on the daily supply of fuelwood were presented in the form of, tables, graphs, maps and photographs to depict significant aspects of the findings.

Data generated were also computed and exported into statistical analysis programmed (SPSS 20) to confirm the accuracy. Inferential statistic such as independent t-test and

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analysis of variance (ANOVA) were used to compare fuelwood supply between seasons from the three routes entering Gombe Urban area.

RESULTS AND DISCUSSION

The interview conducted and responses from the respondents revealed that majority (95.4%) of people involved in the fuelwood business are men, almost hundred percent of the respondents were involved in the cutting of wood logs, resizing, tightening and transporting the product into town. The study found that few women were engaged in the retailing business of fuelwood in their homes in the urban centre. This result is contrary to what is obtainable in some neighboring states like Bauchi and Adamawa states. In their separate studies Nura, *et al*., (2011) in his analyses of fuelwood supply in Bauchi state, found that women constituted about 32 percent and men constituted about 68 percent in the business. Magaji & Areo in their study on fuelwood supply and consumption in Gwagwalada Area Council FCT Abuja revealed that majority of people engaging in the fuelwood business are female constituting 58 percent, while the males' constituted 42 percent. From the study conducted, it was observed that geographical settings, religious and cultural factors play a vital role in tilting the business towards men in Gombe urban area.

It is clear from Table 2 that adults within the age bracket of 30 years and above constitute more than half (42.1%) of the sampled respondents. Information gathered on educational background revealed that more than half (60.7%) of the participants in fuelwood related business in the study area are people with Islamic education or non formal education. This finding is contrary to that of Magaji and Areo (2017) in Gwagwalada Abuja where they discovered that majority of respondents (70%) have secondary education.

Table 2: Socio-Economic Characteristics of Respondents

*Gender	Respondent	Percentage
Male	137	94.5%
Female	8	5.5%
***Marital Status**		
Married	139	95.9%
Single	6	4.1%
***Age**		
Bellow30yrs	14	9.7%
30--39yrs	61	42.1%
40--49yrs	44	30.3%
50yrs and above	26	17.9%
***Level of Education**		
Islamic	88	60.7%
Primary	24	16.5%
Secondary	21	14.5%
Tertiary	12	8.3%
***Occupation**		
Business (fuelwood)	131	90.3%
Civil Servant	14	9.7%
***Income Level Per Month**		
Below₦, 30,000	58	40%
₦ 40,000-₦ 50000	45	31%
₦60000--₦70,000	29	20%
Above ₦50,000	13	9%

Source: Field Survey, February 2023

The findings here revealed that the general income is below the national average of ₦30,000 per month, which is too low for the participants to afford another alternative energy like cooking gas and electric cooker. The proper maintenance of such alternative sources of energy is costly compared to wood fuel which requires little or no maintenance. Besides this, the household size also determine the kind of energy needed for cooking. For example, for a house that has more than 15 people, it is difficult to use modern method of cooking i.e. gas, kerosene or electric cooker to satisfy the need.

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Fuel-wood Supply

To conceptualize the deforestation scenario of the rural areas, it is necessary to understand the urban demand system for fuelwood. The study discovered that urban fuelwood supply and distribution is organized hierarchically from forest reserves, to fuelwood deports at Tashan Dukku and Nepa Sub-station before moving into the town. Most fuelwood product arrives Gombe town by pick-up van and each car carries in with a load of 400-500 bundles at the three central depots (Daban Icche Tashan Dukku, Sabuwar Daban Icche NEPA, Jekada-Fari Daban Icche). Those coming from Dukku and Bajoga Roads station and Tashan Dukku Fuelwood depot to register with the union to pay union dues before proceeding to town for selling the product. Some of those coming through Bauchi and Yola Roads stop at Jekadafari before proceeding to the town. But some of them follow bye-pass and enter the town without registering with the union claiming that they have already paid their taxes to local government officials.

The fuelwood arrives in small size bundles of 5-6kg (as shown on plate 1) and are distributed through a chain of fuelwood vendors, local wood piles, and small neighborhoods piles retailers and subsequently to final consumers. Some pick-up vans arrive town with big wood logs which are normally used by bakeries, boarding schools, prison yard and other institutions. The organization and cost of local fuelwood pile operators showed that the entire system falls within the urban informal sector. It is uncontrolled, but very competitive and cost efficient from the consumers point of view, and effective in meeting the spatial and temporal distribution of demand.

Plate 1: 5-6kg Bundle of Fuelwood

Source: Fieldwork 2023

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Volume of Fuelwood from Gombe State Forest

The study discovered that an average of 111 trips of vehicles of different sizes carrying 210 tons of fuelwood entered into Gombe Urban centre on daily basis during the dry season period (Table 3). But during the rainy season the number of trips dropped sharply to an average of 60 trips (122 tons) due to some factors such as abandonment of fuelwood business by many for farming activities, inaccessibility of some routes leading to the woodland areas, as well as rainfall disturbance among others.

Table 3: DailyTrips of Pick up Van and Tonnage of Fuelwood during Wet Season

		DUKKU		BAUCHI		KUMO	
		Trips	Tons	Trips	Tons	Trips	Tons
Monday	5/8/2013	38	76	11	22	9	18
Tuesday	6/8/2013	40	80	10	20	10	20
Wednesday	7/8/2013	41	82	12	24	9	18
Thursday	8/8/2013	47	94	15	30	8	16
Friday	9/8/2013	28	56	9	18	7	14
Saturday	10/8/2013	41	82	11	22	8	16
Sunday	11/8/2013	40	80	13	26	10	20
		275	550	81	162	61	122
	Mean	39.29	78.57	11.57	23.14	8.71	17.43
	S.D	5.71	11.41	1.99	3.98	1.11	2.23
	C.V	14.53	14.53	17.18	17.18	12.77	12.77

Source: Field work, 2023

Table 4: DailyTrips of Pick up Van and Tonnage of Fuelwood during Dry Season

		DUKKU		BAUCHI		KUMO	
		Trips	Tons	Trips	Tons	Trips	Tons
Monday	6/1/2014	71	142	28	56	13	26
Tuesday	7/1/2014	81	162	30	60	14	28
Wednesday	8/1/2014	63	126	24	48	13	26
Thursday	9/1/2014	70	140	27	54	16	32
Friday	10/1/2014	51	102	31	62	15	30
Saturday	11/1/2014	70	140	28	56	17	34
Sunday	12/1/2014	82	144	27	54	17	34
		488	956	195	390	105	210
	Mean	69.71	136.57	27.86	55.71	15	30
	S.D	10.61	18.54	2.27	4.54	1.73	3.46
	C.V	15.22	13.57	8.14	8.14	11.55	11.55

Source: Field work, 2023

Tables 3 and 4 give a summary of daily import of fuelwood for seven consecutive days from various sources based on season and routes. The drop in supply during rainy season led to scarcity of the product. This is manifested in the way retailers are going to fuelwood deports and entry routes to wait for suppliers which is contrary to what is happening during the dry season.

The Temporal Variation of Fuel-wood Supply between Seasons

This section deals with the statistical analyses of fuelwood supply between the dry and rainy season. Analyses of Variance and T-test were used in this section to evaluate the difference in fuelwood supply between the seasons and between the three routes through which fuelwood is imported into Gombe.

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Table 5: Difference of Mean test between Wet and Dry Seasons

Road	Mean		Standard deviation		Standard error		t-value	Significant (2-tailed)
	Dry	Wet	Dry	Wet	Dry	Wet		Dry & wet season
Dukku	136.57	78.29	18.537	10.981	7.006	4.150	11.310	.000
Bauchi	53.71	23.14	4.536	3.976	1.714	1.503	11.161	.000
Kumo	30.00	17.43	3.464	2.225	1.309	0.841	7.509	0.000

Source: Fieldwork 2023

Table 5 shows that there is highly significant difference between the two seasons in terms of fuelwood supply given that all values of t are significant at 0.001 levels. This difference is attributed to impact of seasonal migrants who normally come to the study area during the dry season and engage in fuelwood exploitation and return to their places of origin for farming during the rainy season. Even those within the neighborhood to take up jobs apart from fuelwood related activities during the rainy season.

Table 6: Analysis of variance result for wet and dry season fuelwood supply

Season		Sum of Squares	Df	Mean Square	F	Sig.
Dry season	Between Groups	43298.667	2	21649.333	172.647	.000
	Within Groups	2257.143	18	125.397		
	Total	45555.810	20			
Rainy season	Between Groups	15968.000	2	7984.000	158.573	.000
	Within Groups	906.286	18	50.349		
	Total	16874.286	20			

Source: Fieldwork 2023

Table 6 shows the F values for both dry and rainy seasons which are significant at 0.001 level. Similarly, the analyses of variance carried out showed that the F values are significant both for the dry and the rainy seasons among the three routes. Thus, the conclusion was reached that there is a significant difference in fuelwood supply through the three routes in the two seasons.

The result obtained further revealed that mean quantity of fuelwood supply per road was found to be more in the dry season than in rainy season. Similar findings were reported by Silvi-consult (1991) and Nura et-al (2011); perhaps, the likely reason for this difference primarily may be due to labor-supply factor as excess labor are usually released for other income generation activities after each agricultural season.

CONCLUSION

The supply of fuelwood holds a great potential for income generation as it was found to be a very profitable business owing to an ever-increasing demand for the product. While supply differs between the rainy and the dry seasons, the overall impression is that put together fuelwood exploitation in the study area which have been taking place for quite a long time and has been on the increase will result to severe damage to the natural forest in the State. With current dependence of the people on the forests for fuelwood and with the existing population growth rate this situation will worsen unless measures are taken to improve forest resources management and work both devise strategies for conserving fuelwood and to find alternatives for fuelwood in the domestic energy supply system.

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Recommendations

1) The rate of fuelwood supply is increasing with an estimated average of 39,156 tons imported annually into Gombe urban, excluding the unrecorded ones from the surrounding communities. As it continues over time, the forest reserves in Gombe State might get exhausted. There is therefore the need for an urgent intervention from both government and non-governmental organizations to find a lasting solution to this problem. This can be achieved through wider adoption of agro-forestry system throughout the state, establishment of community fuelwood lots and plantation and regulating the exploitation of existing forest reserves by placing a limit on the sizes and age of trees that can be exploited.

2) Despite the fact that people indicated that they are aware of the dangers associated with forest destruction in the name of fuelwood they have continued the activity relentlessly. Hence there is need for public enlightenment campaigns to be intensified to sensitize general public on the effect of deforestation and this should be done through organizing seminars, symposiums and social gatherings to convey the devastating effects of deforestation thereby highlighting the hazards associated the use of fuelwood.

3) Problem of inadequate alternative sources of energy like cooking gas, kerosene and electricity supply has compounded the situation and forced people to depend on fuelwood for cooking and heating. Therefore, the study recommends that, government at all levels should intensify effort on improved modern and efficient cooking stoves, ensure steady and affordable supply of kerosene and cooking gas in order to reduce the demand for fuelwood. The current efforts of federal government in procurement of improved modern cooking stoves should be encouraged and embraced by all tiers of government.

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