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DOMESTIC WOOD ENERGY UTILIZATION PROCESS AND EFFECT TOWARDS DEFORESTATION IN MAIDUGURI METROPOLITAN COUNCIL AND JERE LOCAL GOVERNMENT OF BORNO STATE, NIGERIA

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ABSTRACT

This study was carried out to investigate the Domestic wood energy utilization process and its effect on deforestation in Maiduguri Metropolitan Council (*MMC) and Jere Local Government among households and to identify common wood species. A random sampling method was employed for the study. Questionnaires and observation checklists were used to gather information for the zoo study. The data generated from the questionnaire and another primary source for this study were analyzed using descriptive statistics. The results reveal that most respondents (60%) use firewood and charcoal (30%). This showed that the major wood used in the study area is charcoal and firewood and that they have easy access to charcoal and firewood. The findings further revealed that most respondents used Azadirachta indica, which had the*

highest frequency (30%) for use as fuel. The result further shows that the utilization of wood resources for firewood is correlated with deforestation in the study area. Also, this has resulted in deforestation in many parts of the study with attendant problems such as soil exposure, leaching, and erosion. Given the study's result, the following are recommended: people's dependence on fuel wood can be reduced if the electricity supply situation is improved and made affordable. The Department of Forestry and the Ministry of Agriculture should help develop woodlots. This will relieve pressure on free areas for fuel wood and reduce deforestation. To this end, the Department should also provide tree seedling subsidies on tree planting input to motivate rural dwellers in the study areas to plant more trees on their private farmland.

Keyword: Domestic wood energy, wood species, deforestation*, Azadirachta indica*

INTRODUCTION

The energy demand has continued to increase in almost all the world's countries due to the increasing population, improved standard of living, and growth of manufacturing industries. In the same vein, the issue of wood energy utilization has consumed an essential dimension in recent years in almost all tropical African countries. This is because the increasing cost and scarcity of fossil (such as coal, kerosene, and gas) have made fuel wood a suitable alternative for domestic cooking. Fuel wood forms about 80% of the total wood requirement and more than 60% of the total energy consumed in tropical Africa (Ogunsanwo and Ajala, 2002a). Thus, fuel wood is the dominant fuel rural dwellers use in tropical African countries mainly because fuel woods are cheap and socially more acceptable to rural people than other low-technology energy sources.

Domestic wood energy (Fuel wood) is derived from burning wood materials like logs and twigs, which are common among rural dwellers. It is a traditional source of energy, which has remained the primary fuel source for over half of the world's population (Ogunsanwo and Ajala, 2002b). Fuel wood, charcoal, animal dung, and sawdust are all biomass products (Sambo, 2009). Most households in developing countries lack access to modern energy; therefore, they rely on traditional biomass fuels like crop waste, dung, and wood to meet their basic energy needs, especially cooking. This statement was emphasized in the 2005 UNDP's Millennium Development Goals (MDGs) assessment report. As noted by Sene (2000), the contribution of forest and tree

sources to household energy supply is high in Africa and will remain so for the foreseeable future. This is because nobody has yet found an alternative to firewood as the source of household energy for the African poor. Consequently, the life of most rural dwellers depends directly or indirectly on fuel wood. However, meeting the country's rural household fuel wood energy needs has become an uphill task due to the enormous quantity of wood required. Rural people strip the land bare vegetation cover to satisfy their fuel wood needs. This has resulted in soil exposure and erosion, burdening the environment and the resource base. In addition, the scramble for firewood has resulted in massive destruction of many wood resources in many parts of the country.

Adebayo (2005) reported that the situation in most rural areas of the country is such that the trees in the forest and land, the people, and the entire rural environment are no longer at ease. Most of the country's wood resources have been overexploited for fuel, while the remaining tree resources are under tremendous pressure. According to the Energy Section Management Assistance Program ESMAP (2003), household fuels constitute energy sources for domestic cooking and space heating programming. Exclude fuel for transportation. Many different types of household fuel used in developing countries come under the category of "traditional, which includes animal dung and agricultural residence, as well as wood fuel. Wood fuel comprises charcoal, firewood, and other wood-derived fuels and constitutes the most important form of household non-fossil energy (Ogwuche and Asoba, 2013).

In urban areas, a wide selection of household fuels and equipment is available for use in all sectors; the household sectors experience the most pronounced changes in their pattern of fuel use over time. Typically, a household may shift from biomass to kerosene, gas, and finally to electricity for specialized cooking. These shift phenomena are often referred to as "fuel traditional from traditional (biomass-based) to modern household fuels (Sathaye and Tayler, 1991). Despite a major shift in household energy use, many households rely solely on charcoal as their primary source of cooking energy, especially in urban areas (Ogwuche and Asobo, 2013).

International Energy Agency (2000) noted that to meet households' energy needs, about 70% of rural households in sub-Saharan Africa rely on fuel wood, charcoal, kerosene, or wood wastes. However, dependence on biomass energy sources constitutes several environmental challenges

associated with deforestation and land degradation (Faye, 2002). It was noted that cooking energy provides bulk energy demand in Nigeria, although about 67% of the population uses unclean energy sources like wood or charcoal. This raises several environmental concerns because of its inefficiency and contributions to indoor air pollution. Similarly, urban and rural households use kerosene as cooking fuel, although it is sometimes adulterated with petrol or diesel and is very expensive (Shaad and Wilson, 2009). According to the United Nations Development Program (UNDP, 2003), the various primary sources of energy supply in Nigeria are made up of oil 10.4%, gas 6%, hydro 0.6%, and commercial renewable energy (wood), and other agricultural wastes constitute the remaining portion 83%. The over-dependence on fuel wood for energy is chiefly due to its relatively low price and easy accessibility (Adebayo, 2005).

MATERIALS AND METHODS

Study area

Borno State is located in the Sahel Savannah region of North-East Nigeria at latitude 11005″North and longitude 13005″East and about 350m above sea level. It occupies an area of 50,778 square kilometers. It is the largest city in North-Eastern Nigeria, bordered by the Republic of Niger to the north, Chad to the northeast, and Cameroun to the east (Thaddaeus, 2015). Maiduguri is located between latitudes 11′ 42N and 12′ 00 N and longitudes 12.54 and 13′ 14 E (Mayomi and Jimme, 2014). They further claimed that Maiduguri covered an area of 543km2. The city is bounded in the north by Jere LGA, in the west, south and south-west by Konduga LGA, in the north-west by Mafa LGA (Fig.3.1). While Jere Geographical Coordinates Latitude: 11.8991, Longitude: 11.8991, Longitude: 13.2915 11° 53′ 57″ North, 13° 17′ 29″ East where East Jere Area covers 86,800 hectares, 868.00km2(335.14sq mi) The Jere altitude is 295m (968ft), and the climate is semi-arid (Koppen Climate Classification System).

Climate

According to the Köppen-Geiger climate classification system, the climate of Maiduguri and Jere is hot and semi-arid. It has average temperatures ranging between 31.9˚C (89.4˚F) in January and 40.1˚C (104.2˚F) in April, whereas the daily mean temperatures range between 21.8˚C (71.2˚F) in January to 32.6˚C (90.7˚F) in April (Mohammed *et al*., 2018). The area is characterized by two distinct seasons: wet and dry. The wet season occurs between April and October, while the dry

season occurs subsequently. The dry season is said to be more pronounced than the wet season within this area (with at least four months of rainfall, it attains its peak between June and August) (Bukar *et al.*, 2020).

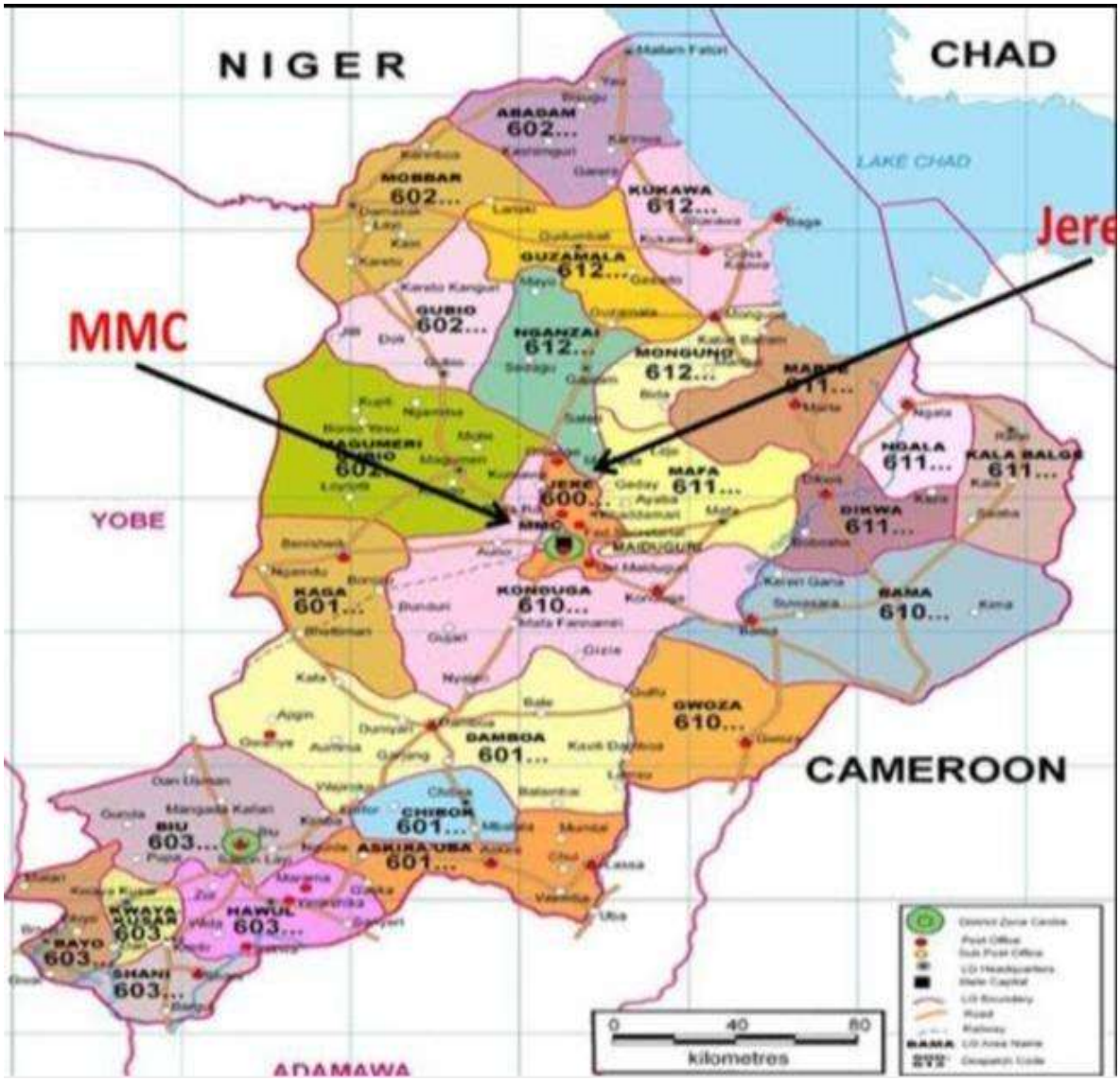

Fig. 1 Map of Borno State Showing Study Area

Source: University of Maiduguri, Department of Geography (2021)

Instruments for Data Collection

The questionnaire was used as a research instrument, along with interviews, personal observation, and GPS to take the coordinates. The questionnaires were made up of close-ended questions and divided into two sections. The first section contains information on the demographic data of the respondents, including age, sex, marital status, educational qualification, and occupation. The second section consists of items on fuel wood availability and spatial distribution in Maiduguri metropolitan council and Jere. The items were used to elicit information from the respondents.

Data Collection

Primary data were collected through the use of a well-structured and pre-tested questionnaire. Four district areas, Maiduguri Tasha Kangalayya, Muna, Tashan Kano, and Umalari Garandan, and two district areas from each local government area were randomly selected. Fifty household heads were randomly selected from each district area. The questionnaires were distributed to the selected household heads. A total of 200 questionnaires were administered.

Method of Data Analysis

The data collected for the study was subjected to statistical analysis for appropriate interpretations. A descriptive statistical technique was used in the analysis of data. SPSS was used to present data in tables and pie charts to calculate the frequencies and percentages.

RESULTS AND DISCUSSION

Major Forms of Wood Fuel Used in the Study Area

The results from Table 1 showed that the major forms of wood used in the study area are charcoal, fuel wood, and briquettes and saw dust. Table I shows that 30% % of the respondents use charcoal, 60% use fuel wood, 6% use saw dust, and 4% use briquets. The majority of the residents of the study area use fuel wood because they see it easily available compared to other fuels and that the method of preparing it is simpler.

Table 1: Respondents Major Forms of Fuel Wood Used in the Study Area

Forms of fuel wood use	Frequency	Percentage %
Charcoal	60	30
Firewood	120	60
Saw dust	12	6
Briquette	8	4

Source: Field survey, 2023

Common Tree Species Used as Fuel

Results from Table 2 indicate that the common fuel wood used by respondents in the study area is *Azadrachta indica, which* has the highest percentage of (30%) usage because the tree species are dominant in the study area and have high resistivity to drought. *Ficus platiphyla* (17.5%), followed by *Prosopis Africana (12.5%), Tamarindus indica, and Detarium macrocarpunt (11%)* respectively, *Vitellaria paradoxa, Parkia biglosa* also belong to the species found with the study location. The lowest result was found in other species, with (3%). These tree species are commonly found in MMC and Jere Local Government Areas of Borno State. The reasons given by the respondents why the above-mentioned tree species are preferred include easy availability (49%), high fuel value (26.5%) followed by burn easily (15.5%), and the least easy (9%), as shown in Table 3.

Table 2: Common Tree Species Used as Fuel by Respondents in the Study Area

Species	Frequency	Percentage %
Azadrachta indica	60	30
Tamarindus indica	22	11
Vitellaria paradoxa	18	9
Ficus platiphyla	35	17.5
Prosopis Africana	25	12.5
Parkia biglobosa	12	6
Detarium macrocarpum	22	11
Others	6	3

Source: Field survey, 2023

Table 3: Respondents reason(s) for the preferred fuel wood species

Reason	Frequency	Percentage %
Easy Availability	98	49
High Fuel Value	53	26.5
Burn Easily	31	15.5
Easy	18	9

Source: Field survey, 2023

Pattern of Wood Energy Utilization

Results from Table 4 below show that 70% of the respondents use fuel wood for cooking, 10.5% for fencing gardens, 11.5% for smoking meat and fish, and 8% for charcoal production. This indicates that people in MMC and Jere local Government Areas largely depend on fuel wood for cooking. This showed that the majority of rural dwellers in Nigeria rely on firewood as their primary source of cooking energy.

Table 4: Respondents' Household use of fuel wood in the study area

Household Uses of Firewood	**Frequency**	**Percentage %**
Cooking	140	70
Fencing of Garden	21	10.5
Smoking of Meat/Fish	23	11.5
Charcoal Production	16	8

Source: Field survey, 2023

Results from Table 5 below show that more than 70% of the respondents stated that fuel wood meets more than 60% of their household energy requirements. According to the respondents, they strive hard almost daily to meet this 60% energy need of their household's consumption. However, deforestation in the study area causes profound socio-economic and ecological implications. To meet their wood energy requirement, most people in this area spend considerable time searching for fuel wood, depriving them of the opportunity to get involved in other productive activities and income generation/other forms of domestic energy. In addition, to meet their wood energy requirement, households most often over-exploit the wood resources, thus resulting in forest degradation and biodiversity loss. 50.5% of the respondents utilize less than one headload of fuel wood (about 13.80) daily.

In comparison, 32.5% use between 1-2 head loads (between 13.80-27.6Kg) of fuel wood per day, 10.5% use between 3-4 head loads (41.44%-55.2%), while only 6.5%% use more than 4 head loads (>55.2Kg) of fuel wood per day (Table 6) as such large quantities of wood are exploited daily in

the study area. Adebayo (2005) showed that rural households use more wood fuel than their urban counterparts. This is because more rural households are involved in wasteful use of wood fuel since it is obtained freely and is abundant in the study area.

Table 5: Extent to which firewood meet respondents' household energy needs

Extend of energy need met	Frequency	Percentage %
<50%	33	16.5
51-60	57	28.5
61-70	35	17.5
71-80	56	28
>80%	19	9.5

Source: Field survey, 2023

Results from Table 7 below show that most respondents obtained their firewood from free areas (open access areas), family farmland, and forest reserves, respectively. This explains why the wood resources in the open-access area have been under enormous pressure. About 18% of respondents search theirs within 11cm. About 34% of the respondents obtained their firewood within a 2km radius of their residence, 38% extended their search to a 3km radius, and 10% moved beyond 4km. This indicates that more people in the study area progressively increase their search for firewood further away from their residence to meet their wood energy requirement. It, therefore, follows that forest degradation and deforestation have been very intense in areas close to human settlements, and this degradation and deforestation is progressively increasing farther away from the settlements.

Table 6: Respondents' Average Quantity of firewood used per day

Head Load	(KG)	Frequency	Percentage %
<1	<13.80	101	50.5
1-2	13.8-27.6	65	32.5
3-4	41.44-55.2	21	10.5
>4	>55.2	3	6.5

Source: Field survey, 2023

Table 7: Distance of Respondents' source of fuel wood in the study area

Distance	Frequency	Percentage %
<1km	36	18
1-2km	68	34
3-4km	76	38
>4km	20	10

Source: Field survey, 2023

Results from Table 8 below in the study area show that women are more involved in the exploitation of fuel wood than men. About 59% of those who collect fuel wood are women, while 41% are men because women use the fuel wood for domestic purposes (cooking, smoking of fish). Records have shown that women are the major users and managers of non-timber forest products (NTFP), including firewood Food and Agricultural Organization (FAO, 2001, 2003).

Table 8: Gender of firewood collector in the study area

Gender	Frequency	Percentage %
Women	118	59
Men	82	41

Source: Field survey, 2023

Results from Table 9 below show that about 21% of the respondents are involved in the sale of firewood in the study area, which amounts to < 40,000 per annum. Meanwhile, other respondents (33%, 23.5%, 11%, 11.5%) indicated that they realized between 40,000 – 60,000. 61,000 – 80,000. 81,000 – 100,000 >100000 per annum, respectively, from the sale of fuel wood. Most respondents indicated N40,000- N60,000 per annum from the sale of fuel wood (Table 9), which has the highest percentage (33%).

Table 9: Estimate of Respondents' annual income realized from the sale of fuel wood

~~₦~~ Amount	Frequency	Percentage %
<40,000.00	42	21
40,000.00-60,000.00	66	33
61,000.00-80,000.00	47	23.5
81,000.00-100,000.00	22	11
>100,000.00	23	11.5

Source: Field survey, 2023

Socio- Economic Indices and Variation in the Quantity of Fuel Wood Utilized

The result obtained from Table 10 below shows a great variation observed in the quantity of wood utilized as fuel by rural households in the study area. Four socio-economic variables were identified as the major factors responsible for these variations. These indices are household size and gender of the firewood collector. Rural household size influenced the quantity of fuel wood

utilized in the study area. These are small households between 2-4 persons, 12% of firewood per day. These are respondents with medium or fairly large household sizes of 5-7 persons, 31.5% of fuel wood daily. Large households of more >10 persons use 5% (Table 10) of fuel wood daily. However, more women are involved in the exploitation of firewood in the study area (Table 9).

The reason for this IS not unconnected with the fact that most men use motorcycles and bicycles to carry firewood from the forest. Thus, though fewer men are involved in the exploitation of firewood, the quantity of firewood they exploit can be compared favorably with that of women because the male gender tends to collect more than the women at any given time. This shows that the increasing profit from the sale of firewood has continued to play a significant role in exploiting wood resources for fuel. Results indicate that the source of fuel wood significantly impacts the quantity of firewood utilized by rural households. This is because most respondents obtained fuel wood from open-access areas in the study area. In the open access area, there is no restriction to wood utilization. Therefore, residents or the study area exploits large quantities of wood for fuel without any limitation, unlike the protected areas where access is restricted.

Table 10: Respondents' Household Size

Household Size	Frequency	Percentage %
2-4 Persons	24	12
5-7 Persons	63	31.5
8-10 Persons	103	51.5
>10 Persons	10	5

Source: Field survey, 2023

Impact of firewood Utilization on Deforestation

The result of the study shows that the utilization of wood resources for firewood is correlated with the level of deforestation in the study area. The large quantity of fuel wood most rural households utilize daily indicates that they utilize a substantial amount of firewood. Adebayo (2005) showed that rural households use more than double the quantity of wood used by urban households for firewood. The enormous amount of timber taken daily from the forest has resulted in extensive deforestation in many parts of the study area. The savanna ecosystem has, therefore, been grossly accused and highly degraded.

Deforestation is very high in areas closer to human settlement than in areas farther away. This is partly because the wood resources of the areas close to settlements in the study area have been massively exploited for fuel and other uses. As such, there is an increasing scarcity of forest resources, including firewood, in areas close to rural settlements. People now walk further away from their residences into the forest daily in search of firewood. Deforestation due to the exploitation of wood resources for firewood has been progressively increasing in the rural areas of the study area. Threatening the livelihood of many inhabitants of the study area. Lapido *et al.* (2002) noted that the scarcity and exhaustion of fuel wood supply present an energy crisis that threatens the existence of most rural communities in Nigeria. This is because each rural household strives to meet its wood energy needs. They destroyed many valuable forest resources essential for their survival and good living. They also expose many land areas to erosion and leaching, threatening the livelihood of many rural households.

CONCLUSION

This study has shown that rural households in MMC and Jere Local Government Areas utilized large quantities of wood as fuel wood as an alternative source for domestic usage. They massively exploit the wood resources for fuel in the open access areas to meet their daily fuel wood consumption. This has resulted in deforestation, desertification, drought in many parts of the study area, and attendant problems such as soil exposure, leaching, and erosion occurring in the study location. Rural households go further away from their residence in search of fuel wood, thus further increasing and expanding deforestation.

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