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QUANTIFICATION OF FUELWOOD SUPPLY TO KANO METROPOLIS, NIGERIA

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Abstract
The high demand of fuelwood, especially for domestic use in sub-Saharan Africa, means the need for cutting down trees to augment such demand. This in turn leads to forest degradation and thus destruction of carbon sinks, that further aggravates climate change. This paper thus sets out to quantify the trees lost to fuelwood supply to Kano metropolis. This was achieved by the following objectives; a) examining the amount of fuelwood supplied to the metropolis on a daily and monthly basis over a 90-day period, and b) mapping the source regions by the quantity of fuelwood they supply. The methods employed include monitoring the number of vehicles that supply fuelwood to the fuelwood main depot (vehicular data monitoring), 6 in-depth interviews were conducted with the members of Fuelwood Association that comprised of the truck drivers (yan gudubale), sellers, the chairman and secretary of the association, 3 transect walks were conducted at 3 of the major source regions with forest extension workers, and the review of relevant secondary data. From the vehicular data monitoring at the Mariri fuelwood depot in Kano metropolis, over the 90-day period 20,497 tonnes of fuelwood was supplied to the metropolis, with the most coming from Bauchi (66.8%), Kano (20.1%) and Gombe states (9.8%), and the least from Katsina state (0.1%). 12,736 tonnes was supplied for the first 30-day period (Dec, 2017/Jan, 2018), 6,768 tonnes for the second (March/April, 2018) and 9,313 tonnes for the third period (July/August, 2018). For every 17 tonnes of fuelwood, about 50-55 trees are lost. It is concluded therefore, that a significant number of trees are lost to fuelwood utilization in kano metropolis.

Keywords: Quantification, Fuelwood, Kano Metropolis, Fuelwood Association, Mariri fuelwood depot

Introduction

There is a high demand for fuelwood due to its wide acceptance and preference by users as established in literature for cooking, boiling water, preparing animal feeds, food processing and preservation, ritual celebration, roasting, preparing alcoholic beverages and wedding ceremonies alongside other fuel sources in much smaller proportion to fuelwood such as kerosene, LPG, cow dung, crop residues and biogas among others (Bello, 2011; Onoja & Idoku, 2012; San et al., 2012; Egeru, 2014; Itanyi, 2014; Subedi & Shakya, 2016; Iheke, 2016; Puentes-Rodriguez, et al., 2016; Bhatt et al., 2017; Kegode et al., 2017; Negi et al., 2018; Koffi et al., 2018; Mohammed & Tanko, 2018; Mohammed, 2021). In Nigeria, fuelwood has become a better alternative as fuel due to its availability, affordability, traditional beliefs, income level, level of development and educational background, house type and household size, among many others (Cline-Cole et al., 1990; Silviconsult, 1991; Odihi, 2003; Maconachie et al., 2009; Yakubu, 2014; Onoja & Idoko, 2015; Zaku et al, 2013; Kiyawa, 2016; Kegode et al., 2017; Bello, 2018).

Increased fuelwood harvest, combined with low tree density, high population growth and severe climatic conditions, is expected to further enhance forest destruction and associated biodiversity loss (Shaheen et al., 2016). In Nigeria the rapid rate of deforestation is a key driving force in the yearly increase of flood disasters, global warming, ozone layer depletion, land degradation, impact on forest structure, function and biodiversity and soil erosion (San et al., 2012; Kelechi, 2015). The release of greenhouse gases (GHGs) due to combustion of fuelwood has a cumulative effect on total GHGs and climate change in the future, the emission of carbon dioxide ($CO_{2)}$ is directly proportional to fuelwood consumption (Bhatt et al., 2017).

There is a plethora of information on fuelwood in cities of developing countries similar to the case in Kano that focused on consumption patterns, characteristics, spatial distribution, factors controlling the choice of energy used, and ways out for efficient and conservative energy use (Cline-Cole et al, 1990; SEI, 2002; Arnold & Persson, 2003;Odihi, 2003; Mohammed, 2008; Maconachie et al., 2009; Onoja & Idoko, 2012; San et al., 2012; Zaku et al, 2013; Egeru, 2014; Ihekei, 2015; Masera & Navia, 2015; Kiyawa, 2016; Abdul-Hadi, 2016; Kegode et al., 2017; Hussein, 2017; FAO, 2017; Negi et al., 2018; Koffi et al., 2018; Jagadish & Dwivedi, 2018).

Most research works that quantify forest cover loss tend to generalize the total amount for all activities, such as fuelwood collection, sand mining, lumbering, clearing for agricultural expansion and the likes (Na'ibbi, 2013; Mohammed, 2014; Badamasi, 2014; Kibon, 2014; Danjuma, 2016; Abdul-hadi, 2016; Suleiman, Abdul-Rahim, Chin & Mohd-Shahwahid, 2017; Suleiman, 2017). Studies are lacking that provide estimates of the amount of vegetation cover or number of trees lost to fuelwood demand alone in the region like that of Sassen, Sheil & Giller, 2015 (Uganda). It is for this reason that this paper quantified the trees lost to fuelwood supply to Kano Metropolis. This was achieved by examining the amount of fuelwood supplied to the metropolis on a daily and monthly basis over a 90-day period, and b) mapping the source regions by the quantity of fuelwood they supply.

Material and Methods

Data sets

The data sets needed for this work included type and number of vehicles supplying fuelwood to kano metropolis, and the source regions.

Data Analysis

To quantify the amount of fuelwood that was supplied to Kano Metropolis on a daily and monthly basis, a report sheet (appendix 1) was designed to cover the source of fuelwood, the type of vehicle, the number of vehicles and the number of tyres on the vehicle. The number of tyres was to aid in identifying the number of axles on each vehicle; an axle is a bar or shaft on which a wheel or pair of wheels rotates. This was collected for a period of 90 days spread over 3 seasons, (December/January-2018, March/April-2018 and July/August-2018) by a trained research assistant at the Mariri fuelwood depot. The Mariri fuelwood depot was purposively selected, because it is the main fuelwood depot in Kano. The reports were then collated in three different tables displaying the different regions with the highest number of vehicles (frequency) for the 90 day-period. From existing literature (Road safety Authority, 2015; TATA steel, 2013) and reports/interviews with the fuelwood truck drivers at the Mariri fuelwood depot, estimates of the maximum load based on the type of vehicles was obtained. From these estimates, the number of each vehicle type was multiplied by the estimated maximum weight to obtain the tonnage for each region for the 90-day period. The data obtained was subjected to some simple descriptive statistics and the results were tabulated. In order to map the quantity supplied by the regions, the synthesized tonnage by each region was imported into ArcGIS software and flow maps were plotted, with varying thickness of lines to differentiate quantities from each region. Transect walks were done with forest extension workers of the fuelwood source regions identified to obtain information on the number and type of trees cut down for fuelwood.

Study Area

Kano Metropolis is located between latitudes 11°59' and 12° 02' N, and longitudes 8°33' and 8°40'E. The study area along north eastern bypass stretches to areas behind Kano state legislative quarters in Tarauni and Kumbotso L.G, Tsamiyar Matasa-Gunduwawa and Rimin Kebe-Gayawa in Nasarawa and Ungogo Local Government. The climate is the tropical wet and dry, classified as AW (wet and dry) by Koppen (Olofin, 1987). The temperature ranges from 21°C in the coldest months (December/January) to 31°C in the hottest months (April/March) (Liman et al., 2013). The metropolitan Kano comprises of six local government areas which include; Kano Municipal, Dala, Nasarawa, Gwale, Tarauni, and Fagge. It covers an area of about 499 square kilometres. Urban Kano has been experiencing rapid growth of population since 1952. Between 1952 and 1962 the rate of increase was almost 100% within the urban centres and indeed throughout Northern Nigeria, Kano showed the highest rate of population increase. Kano Metropolis is projected to have a population of 4,331,790 (2018) at an Inter Censal Growth Rate (ICGR) of 3.4% from 2, 826, 307 based on the 2006 Census (Idris, 2022). Most of the people living around the area are Hausa and Fulani and the dominant language is Hausa.

Results and Discussions

From the analysis of the in-depth interview data, the number of trucks supplying fuelwood to the metropolis on a daily basis was about 30 trucks. However, this number depends on the demand. From the vehicular data monitoring at the Mariri fuelwood depot in Kano Metropolis, three types of vehicles were used to supply the fuelwood to the metropolis (32-tonne, 22-tonne and 17-tonne). The 32-tonne vehicle was mostly used to convey fuelwood from farther distances (like Bauchi and Gombe states, see Table 1), while the 17-tonne vehicle was used to convey fuelwood from closer places to the metropolis (like Falgore Game reserve in Kano). The table further shows how frequent fuelwood is supplied to kano metropolis from the different source regions. It also tells the forest reserves as well as the states that house the reserves. In terms of tonnage, the fuelwood supplied to the metropolis through the Mariri fuelwood depot over a 90-day period (December/ January, March/April and July/August.2018), was 20,497 tonnes (Table 2), with the most coming from Bauchi (66.8%), Kano (20.1%) and Gombe states (9.8%), and the least from Katsina state (0.1%) as

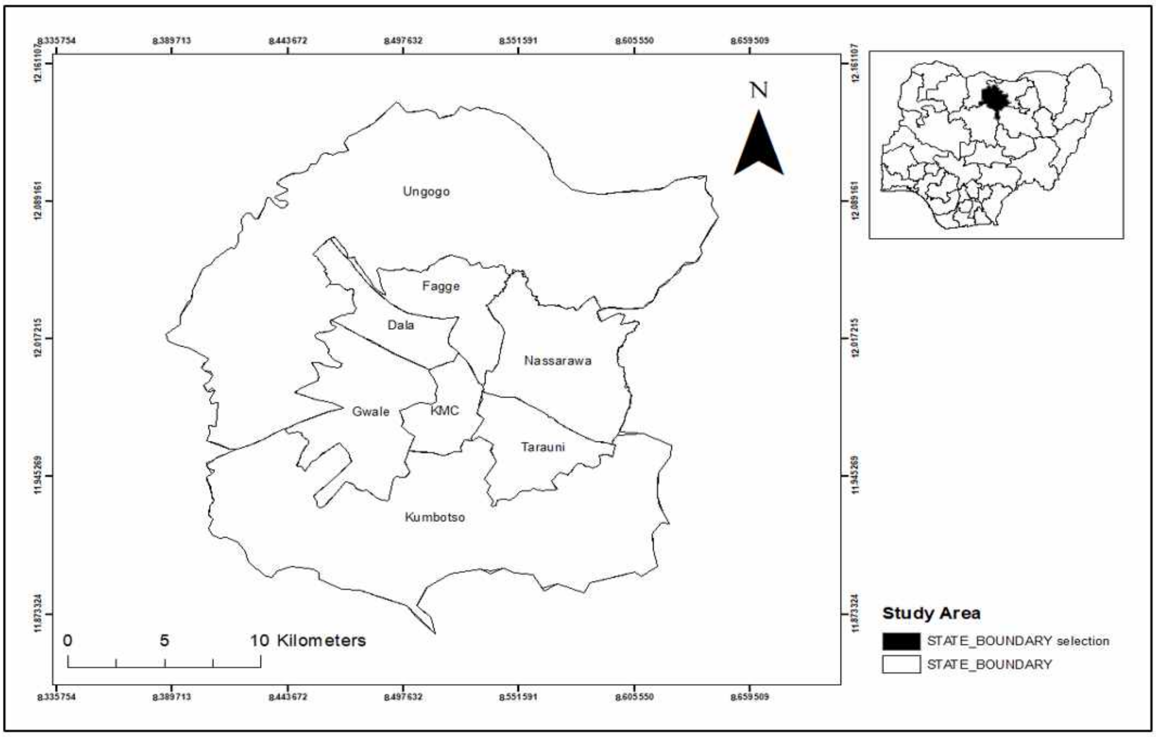

Figure 1: The study area
Source: Geography Department, BUK (2022)

Table 1: Frequency of Vehicular Fuelwood supply to Kano Metropolis by source regions over a 90-day period

source regions	Forests	17 tonnes		22 tonnes		32 tonnes		Total	
		F	%	F	%	F	%	F	%
Bauchi	Rafin Chiyawa	1	0.4	792	95.2	63	32.8	856	66.8
Gombe	Dukku	0	0	8	1	118	61.5	126	9.8
Jigawa	Martaba	3	1.2	10	1.2	1	0.5	14	1.1
Kaduna	Maidaro	0	0	16	1.9	4	2.1	20	1.6
Kano	Fakgore	252	98.1	6	0.7		0	258	20.1
Katsina	Ruggu	1	0.4		0		0	1	0.1
Sokoto	Gidan Kare	0	0		0	6	3.1	6	0.5
Grand Total		257	100	832	100	192	100	1281	100

Table 2: Tonnage of fuelwood supplied to Kano Metropolis by source regions over a 90-day period

source regions	Forests	17 tonnes	22 tonnes	32 tonnes	Total
Bauchi	Rafin Chiyawa	17	9,504.00	2,016.00	11,537.0
Gombe	Dukku	0	96	3,776.00	3,872.00
Jigawa	Martaba	51	120	32	203
Kaduna	Maidaro	0	192	128	320
Kano	Fakgore	4,284.00	72	0	4,356.00
Katsina	Ruggu	17	0	0	17
Sokoto	Gidan Kare	0	0	192	192
Grand Total		4,369.00	9,984.00	6,144.00	20,497.0

depicted in figure 2, which shows the mapped quantities by the different source regions.

12,736 tonnes was supplied for the first 30-day period (December, 2017/January, 2018), 6,768 tonnes for the second (March/April, 2018) and 9,313 tonnes for the third period (July/August, 2018) as shown in Figures 3, 4 and 5.

The quantity of fuelwood sourced from Kaduna, Zamfara, Sokoto and Katsina states have greatly reduced as a result of security threats from kidnappings, armed robbery, cattle rustling and insurgent activities associated with the forests from which the fuelwood was formally supplied. Cattle rustling has been perpetrated with the aid of forest cover, in north-western Nigeria in most of the recorded deadly rustling cases that took place in the Kamuku and Kuyanbana forests that border the six states of Kaduna, Katsina, Zamfara, Kebbi, Sokoto and Niger. In Katsina State, the forest in Ruma/Kukar Jangarai (known as Rugu Forest) served as a camp for armed (Ladan, 2015; Olaniyan, 2018).

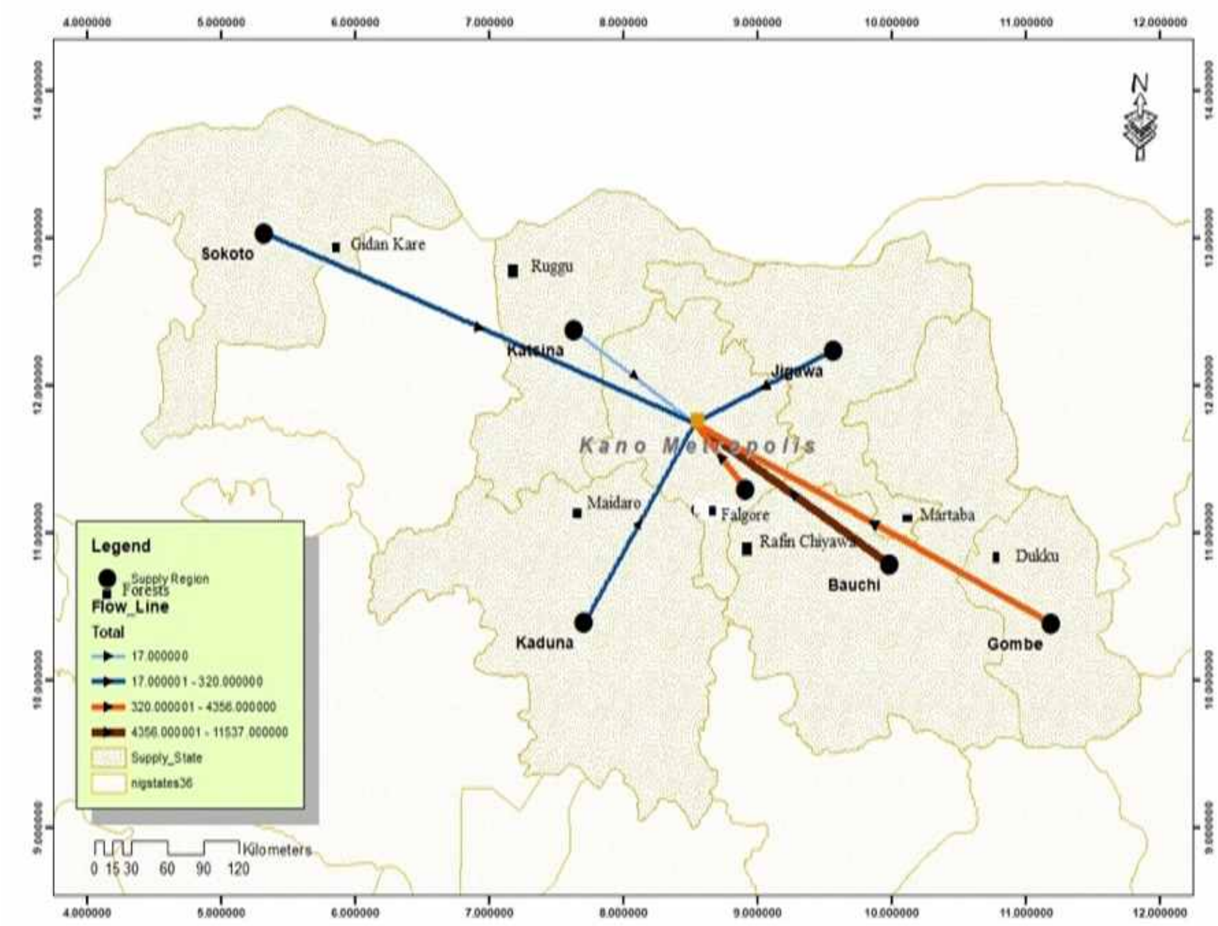

Figure 2: Volume of fuelwood supply by regions

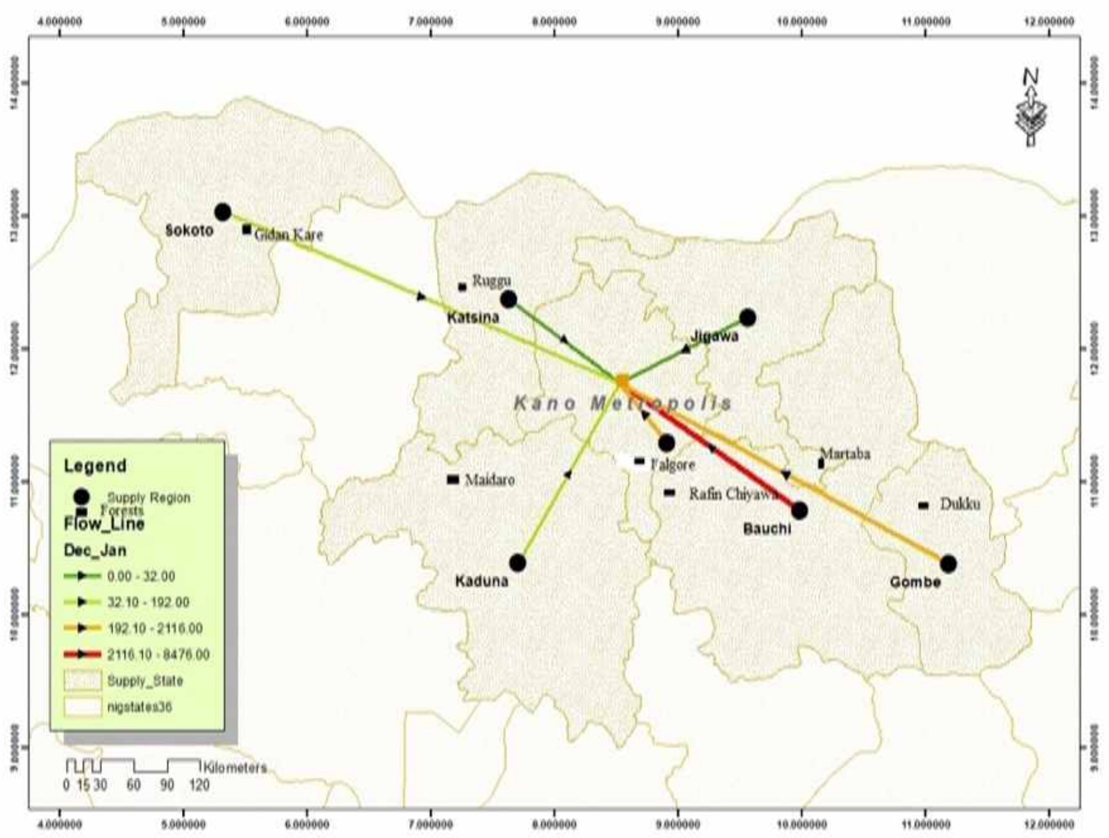

Figure 3: Fuelwood supply for Dec/January, 2017/2018

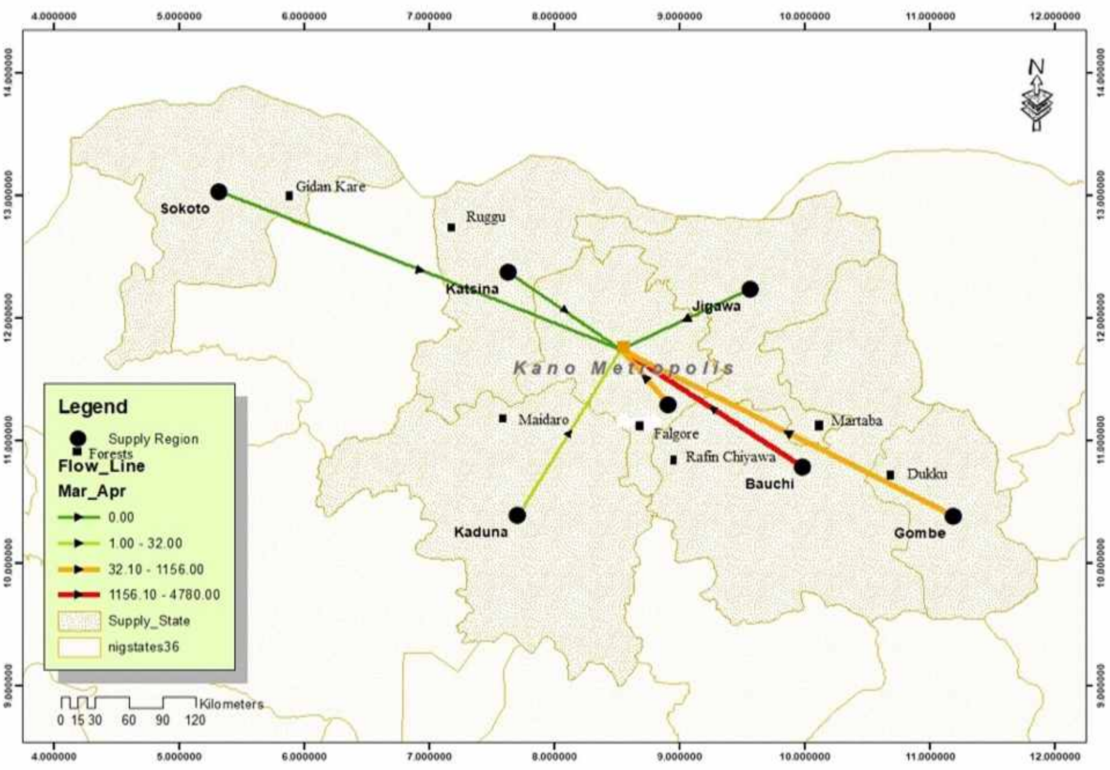

Figure 4: Fuelwood supply March/April, 2018

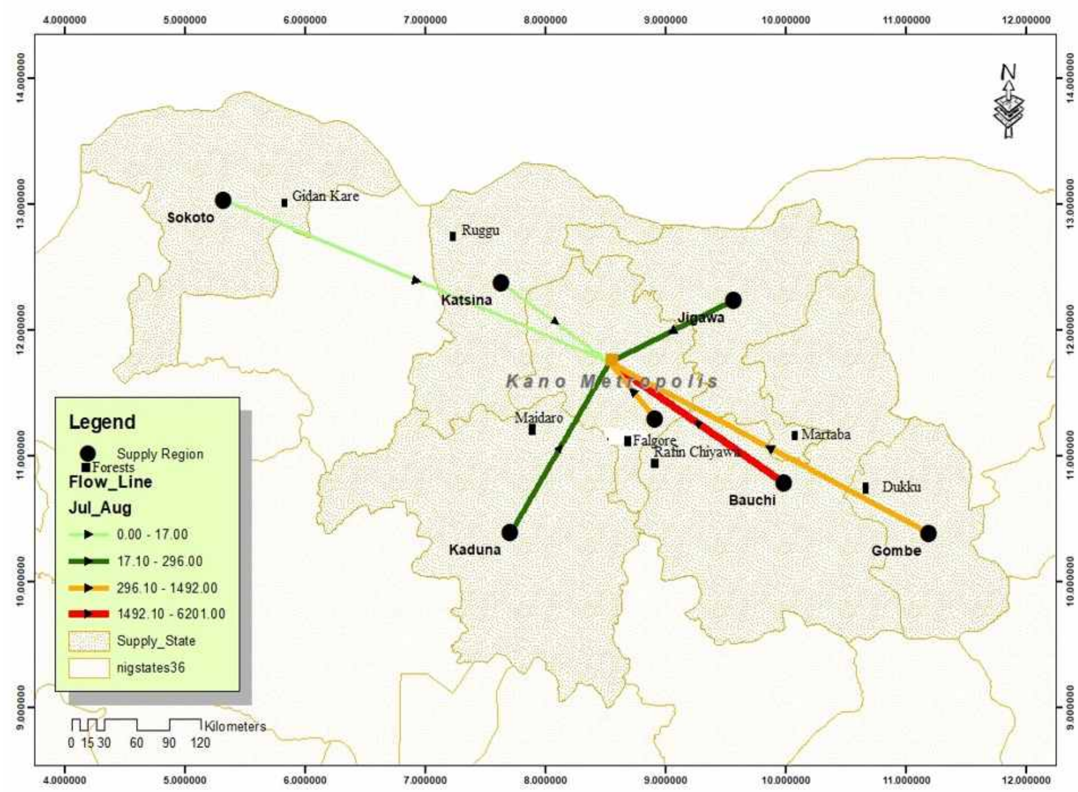

Figure 5: Fuelwood supply July/August, 2018

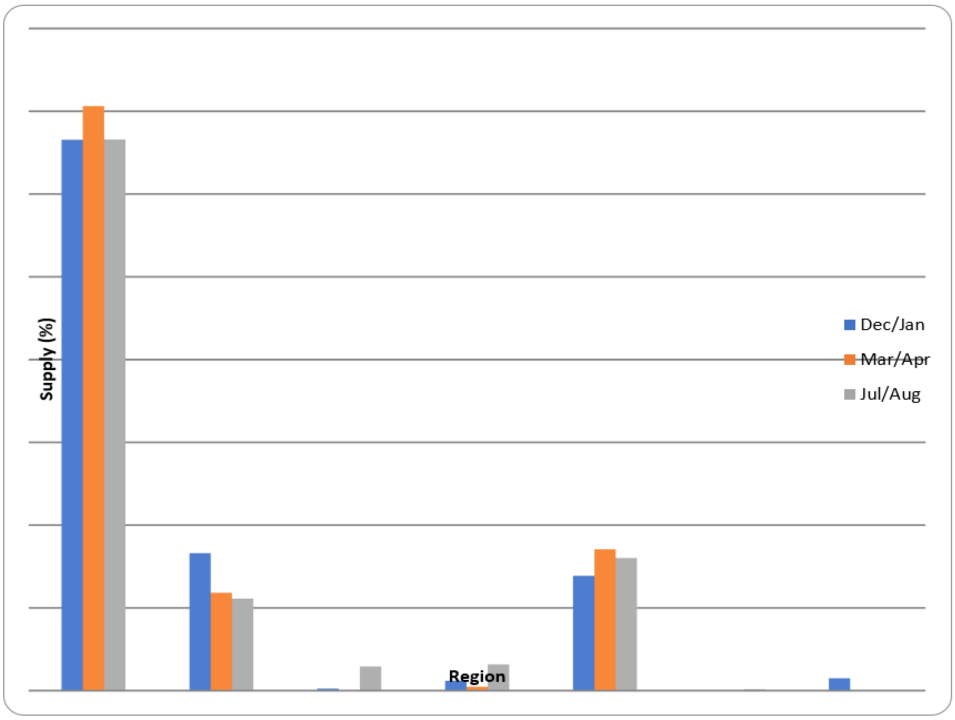

Figure 7: Volume of fuelwood supply by seasons

The highest tonnage of fuelwood was received during the first 30 days (Dec/Jan) that represents the cold season in the metropolis (figure 7), owing to the additional need for heating to keep warm and boiling bathing water. This agrees with a study by Fox (1984) and Koffi et al., (2018) that reported higher consumption of fuelwood during the cold and wet seasons for heating and boiling water, than it has also been observed by Bhatt et al., (2017) that fuelwood consumption is influenced by climate and season of the year, besides family size.

Plate 1: A truck full of fuelwood at Dukku Forest Reserve (Gombe state, 2018)

Plate 2: A full cart of fuelwood at Dukku Forest Reserve (Gombe state, 2018)

The labor for cutting down a truck full is ₦1500 ($3.6), while transporting it out of the forest reserve is ₦2,000 to ₦2,500 ($4.8 to $6) (Plate 1). The size of the truck is equivalent to the 17-tonne truck, that is estimated to take about 50-55 trees of the commonest tree species used for fuelwood *(Pterocarpus erinaceus,* locally known as *Marke* in Hausa). On the hand the fuelwood collected by the women and children cost between ₦500 to ₦1,500 ($1.2 to $3.6), depending on how full the cart is (Plate 2). The women and children can make up to 5-7 trips per day.

From the transect walks with the forest extension workers, it was estimated that it takes about 50-55 trees of 1.0 to 1.5m diameter to fill up a truck of fuelwood (equivalent to 17 tonnes of weight). Thus, it can be concluded that for every 17 tonnes of fuelwood, about 50-55 trees were lost. From the quantification analysis, approximately 66,314 trees are lost to 20,497 tonnes of fuelwood supplied to Kano metropolis over a 90-day period. The three most preferred species; *Anogeissus leiocarpus, Isoberlinia doka* and *Pterocarpus erinaceus* (Mohammed & Tanko, 2018) all fit into this category with a tree diameter ranging from 1.0m to 1.8m (Burkill, 1985; Arbab, 2014; Novinyo, Kossi, Habou, Raoufou, Dzifa, André & Kouami, 2015). In the three major fuelwood source regions identified by Mohammed &

Tanko (2018). These protected areas; Falgore Game Reserve (Kano state), Dukku Forest Reserve (Gombe state) and Rafin Chiyawa Forest Reserve (Bauchi state) lack adequate protection and management; hence, they face the problems of illegal logging, encroachment by farmers, overgrazing by livestock, and excessive fuelwood collection, gum Arabic, honey, and medicinal plants collection among others.

Conclusion

From the results obtained, approximately 66,314 trees are lost to fuelwood supply to Kano Metropolis (20,497 tonnes), with the most coming from Dukku (Gombe State), Falgore Game (Kano State) and Rafin Chiyawa Forest Reserves. Thus, a significant level of degradation set in motion in the forest reserves.

Recommendations

- All relevant stakeholders (such as government, research institutes, university communities, community heads) need to come together in order to find a way come up with alternatives that are desirable, renewable and affordable energy source, by adopting sustainable management practices such as energy efficient stoves, briquettes, biogas, electricity, solar energy, and invest in afforestation programmes and initiatives towards the utilization of set-aside lands for wood energy.
- Arising from the transect walks had with forest extension officers about the attitude of the neighboring communities around the Game and Forest Reserves towards forest resources, there should be more enlightenment programs sponsored by the government, university communities, energy research institutes, forestry management bodies and other stakeholders, especially on radio stations and social media platform to educate the general public on the importance of using forest resources in a sustainable way and the dangers of land degradation.

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