RESIDENTIAL FUELWOOD CONSUMPTION IN JOS METROPOLITAN AREA, PLATEAU STATE, NIGERIA

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Abstract

Consumption of fuelwood has been identified as one of the most significant causes of forest degradation globally. Though fuelwood remains the principal energy service provider to many rural households in Nigeria, a knowledge gap still remains in understanding the fuelwood situation in urban areas. This study examined the extent of dependence on fuelwood as a source of domestic energy among households in Jos metropolis. Two hundred households were selected, through stratified random sampling from: Angwan Daba (Bukuru), Rahol-Kanang (Rayfield), Rusau (Farin Gada), Angwan Rukuba and Tudun Wada. A semi-structured questionnaire was designed and administered to 200 household heads to collect data. The data was analyzed using simple descriptive statistics while Chi-Square was used to test the hypothesis formulated. Results have revealed that most of the respondents: were females (57%); within the active and productive age group of 41-50 years (42%); attained formal school (about 97%); and responsibly married (84%). About two-thirds (59%) of the respondents have 8 household members; with most (44%) of the respondents engaging in petty trading, and three-quarters (75%) of the interviewees earned between ₦100,000 and ₦200,000 as annual income. Further, about 78% of the respondents used fuelwood regularly as a source of domestic energy; and majority (75%) of them had been using it for the past twenty-one years; majorly for heterogeneous (53%) activities such as cooking, heating, food preservation and small-scale business; but only 5% of the respondents used a "good fireplace" (ventilated kitchens with enclosed flame hearth). The frequently (92%) identified reasons for households' dependent on fuelwood was its reliability, availability and cost; as modern energy sources (89%) are opposite. Overall, most (mean=86%) of the respondents agreed that many hazards are associated with using fuelwood for domestic chores; yet only 3.5% of them had ever planted trees to reduce the menace. The Chi-Square test was computed and the value obtained is greater than the table value ($X^2=1.429$>p-value=0.001at alpha 0.05, df=18), hence it was concluded that fuelwood consumption causes significant environmental problems. The paper recommended the need for mass public enlightenment campaigns on tree planting, and the provision of modern alternatives to fuelwood at subsidized rates to the people.

Keywords: Dependence, Energy, Environment, Fuel wood, Metropolis, Residential

INTRODUCTION

Consumption of fuelwood has been identified by scholars (Specht *et al.* 2014; Shaheen *et al.* 2016) as one of the most significant causes of forest degradation globally. One of the most useful energy resources required to meet domestic energy needs in most developing countries of the world is fuelwood. It is the pivot on which the domestic and economic lives of the people in developing countries revolves, as currently, around 2.7 billion people still rely on traditional biomass for heating and cooking in Asia, Africa and Latin America (IEA, 2014;

Naibbi, 2015; Muller and Hujie, 2016; Scheid *et al.* 2018). Today, two-thirds of the energy consumption occurs in urban areas and 50% of the world lives in cities (IEA, 2009; Lucas, 2012). Biofuels amount to almost 80% of the total renewable energy, providing more energy than nuclear source, and about four times as much as hydro power, wind, solar and geothermal combined for domestic chores (Erakhrumen, 2011). The total energy for domestic consumption rate has recently been estimated at 5.6%, which is highest since 1973 (Abdul-Hadi, 2016). At present, more than 2.4

billion people have no access to electricity and other modern energy services for use in homes (IEA, 2011; Kadafa *et al.* 2017). The situation in Nigeria is pathetic such that electricity generating figures are less than half of the Ghanaian average, nine times less than the African average and twenty-two times less than the world average (Research and Market, 2011). Although the National Policy Plan of Nigeria emphasizes the use of alternative energy sources to fuelwood, these energy options such as kerosene, cooking gas, hydro-power, solar and wind are hampered by epileptic power supply, poverty, unemployment, hike in prices of modern energy types and unreliability (Naibbi and Healey, 2014; Kadafa *et al*. 2017). The United Nations Environmental Programme as cited by Jande (2005), reported that energy production, transportation and use is causing acidification of ecosystems, water contamination, loss of biodiversity, global warming and emission of smoke that degrades human health.

The use of fuelwood for domestic energy has a lot of epidemiological problems, including increased respiratory symptoms, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, non-fatal heart attacks and premature death in people with heart and lung diseases (Ordinioha, 2006). As at 1999, Sheila (cited in Kadafa *et al.* 2017) stressed that the use of wood as fuel is responsible for annual deaths of about 1.9 million people in rural areas due to indoor air pollution while 450,000 annual deaths in urban centres were also blamed on fuelwood combustion. Similarly, the World Health Organization (WHO)(cited in Premium Times, 2013), averred that 72% of Nigerians depend solely on fuelwood for cooking and is responsible for the death of 98,000 people annually due to smoke emanating from burning traditional biomass. The report further said 20% of global population lack access to electricity while 40% rely on traditional biomass and warned that if nothing was done to reverse the trend by 2030, 900million people would not have access to electricity; consequently, 3 billion people will still cook with traditional fuels leading to 30 million deaths from smoke-related diseases.

Continuous use of fuelwood in Nigeria, including the study area is currently exerting much pressure on the Savanna Woodlands, predisposing the environment to accelerated soil erosion, soil degradation, changes in climatic condition, destruction of natural habitats and destruction of valuable sink for environmental pollutants (League for Human Rights, LHR, 2001). This is because Nigeria was rated 4th position of fuelwood consumption sometime in 2005, by the United Nations, and still consumes about 80 million m³ of fuelwood annually (Isah *et al.* 2016) The increasing rate of poverty, urbanization, hike in prices of modern energy sources and their irregular supply are contributing immensely to heavy dependence on fuelwood. Despite the fact that a number of scholarly works have been done on fuelwood consumption, including Lucas (2012), Vivan *et.* (2012) and Zaku *et al.* (2013), focusing more on rural and suburb settings, a knowledge gap still exists. Therefore, the present study sets out to examine: who the fuelwood users are, the frequency and duration of using fuelwood, intensity and pattern of fuelwood utilization, the conditions of the fireplace, reasons for using fuelwood as an option for domestic chores, perception of respondents' knowledge of the implications of over-reliance on fuelwood consumption and respondents' attitudes toward tree planting to reduce the environmental problems associated with fuelwood consumption.

MATERIALS AND METHODS
Study Area
Jos metropolis transects Jos North and Jos South Local Government Areas (LGAs) of Plateau State, located between latitudes 9º45'00"N and 9º55'00"N of the Equator and 8º45'00"E and 8º58'00"E of Greenwich Meridian. It is situated at an average height of 1,238 m above sea level with River Delimi bifurcating the State capital into West and East. The River flows from Southeast to Northwest before curving Northeast to empty its contents into Lake Chad through River Yobe. It has a near temperate climate with annual rainfall of about 1,400mm and average temperature of 22ºC. Jos falls within the highly ferruginous tropical soil zone formed under savanna climatic conditions of distinct alternate wet and dry seasons, and are derivatives of the basement complex crystalline rocks. These soils are reddish in color, rich in iron compound, low in organic matter, low in phosphorus and are

medium-to-high productivity to support the growth of guinea savanna vegetation and agricultural crops (Odemerho and Onokerhoraye, 1985).

The favorable climatic conditions have encouraged the growth of tall grass and medium-sized tree species. Trees here are hardly higher than 25 m in height, interspersed with mainly elephant grass of between 2 m and 4 m high. The vegetation is less complex and distinct along hill slopes; tall trees occur at the foot of hills where deep moist soils are found and become shorter trees, shrubs and grass towards hill summits. Gallery forests developed along watercourses within the study area and the trees maintain the greenish, luxurious color by the all-season moist hygromorphic soils of the valleys. Some of the useful trees are planted around houses to meet needs like fuelwood, fodder, medical and recreational. According to Oyelade and Ihuma (2013), the commonly exploited trees for fuelwood around Jos are *Prosopis Africana, Eucalyptus calmandulensis, Acacia spp, Gmelina aborea, Pilostigma recticulatum* and *Tectonia grandis,* among others. However, these Woodland areas have been badly degraded through clearing for fuelwood, settlement, mining, road and other infrastructural development.

Jos is a cosmopolitan city with different ethnic groups present. The town started with the discovery of tin and columbite around 1902. The population kept rising from 8,000 in 1920 to 11,000 in 1931, 80,000 in 1960 and 637,036 in 1991(Ihemegbulem and Nyong, 2002). The population is conservatively expected to have reached a million people by now, as the city is daily witnessing an unprecedented urban growth and expansion as a result of immigrants coming to seek for jobs, schooling, trading or to escape the crisis-stricken areas of the Northern parts of the country. This situation is contributing to the culture of dependence on fuelwood as an energy source for both domestic and small-scale business activities. This problem has ensued because as the population of the metropolis increases, the rate of fuelwood consumption equally increases, leading to enlargement of fuelwood hinterlands. It is against this backdrop that the present study is set to investigate the fuelwood consumption situation in Jos metropolis.

Data Collection

In acquiring the data for the study, a semi-structured questionnaire was constructed and validated for reliability prior to its administration to the target population. The instrument was designed to elicit information about the demographic and socio-economic characteristics of the respondents, their dependence on fuelwood as a source of domestic energy, reasons for use of fuelwood, duration and intensity of use pattern, conditions of fireplace, respondents' perceived knowledge about the implications of continued dependence on fuelwood and if they have ever planted trees to reduce the environmental problems. Of the 27 wards in Jos metropolis (14 from Jos North and 13 from Jos South), only 5 were selected through stratified random sampling. The method involved writing the names of wards in Jos North and Jos South LGAs on pieces of paper separately and alphabetically. Numbers were assigned to each of the names, and were pooled in a plastic bucket with cover and thoroughly shuffled. The first piece of paper picked from the basket was the one selected from the LGA, until all the 5 wards were selected namely, Bukuru and Du wards from Jos South LGA; and then Naraguta A, Naraguta B and Tudun Wada wards from Jos North LGA. A settlement each was then chosen from the 5 wards. The settlements and their respective estimated houses are: Angwan Daba (Bukuru, Jos South LGA) 237, Rahol-Kanang (Rayfield) 110, Rusau (Farin Gada) 105, Angwan Rukuba 246 and Tudun Wada 734. The sample size was determined by the application of Krejcie and Morgan's (1970) formula stated as:

$$S = X^2NP(1-P) \div (N-1) + X^2P(1-P)$$

Where s = required sample size; X^2 = the table value of Chi-Square for 1 degree of freedom for the desired confidence level (3.8416); N = the population size; P= the population proportion (0.50); and d = the degree of accuracy expressed as a proportion (0.05).
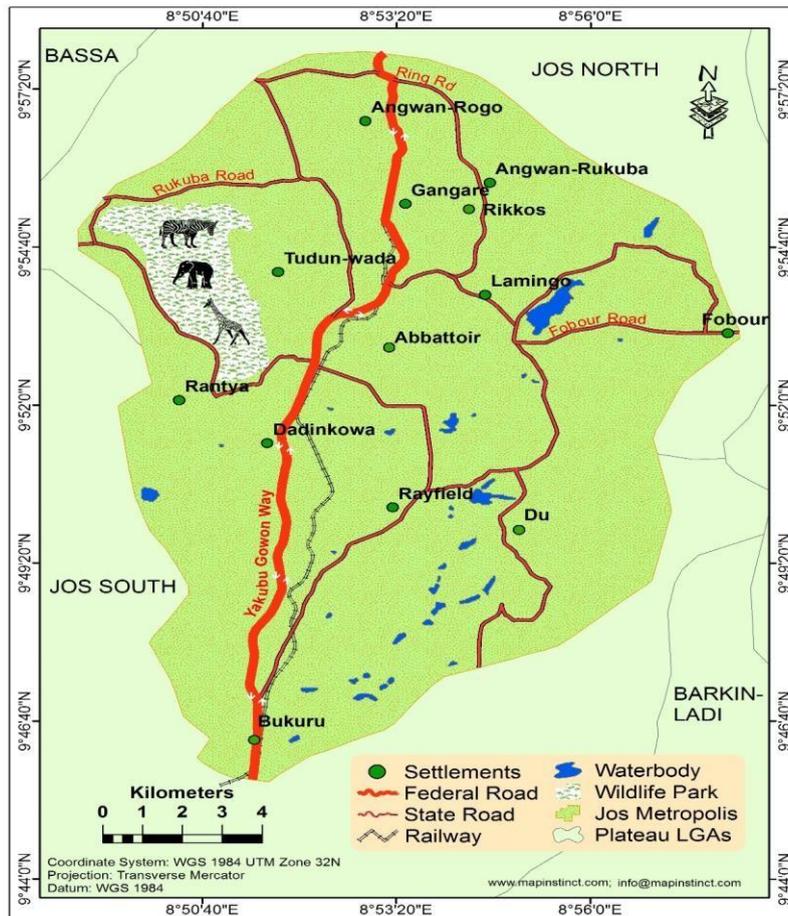
Figure 1 Study Area: Jos Metropolis
Source: National Centre for Remote Sensing, Jos (2018).

The result of the computation was 275, representing 19% of the total houses in the chosen settlements, which were 1,432. Questionnaire were distributed to the settlements as follows: Angwan Daba (Bukuru) 45, Rahol-kanang (Rayfield) 21, Rusau (Farin Gada) 20, Angwan Rukuba 47 and Tudun Wada 142. Based on the result, 275 copies of the questionnaire were distributed through the assistants of three students of the Department of Geography and Planning, University of Jos. Questionnaire admistration was done between March 8-15th, 2019. Heads of households were the target respondents, and whenever they were not available, any mature member of the households were given the questionnaire to fill. However, of the 275 copies of the questionnaire distributed only 200 were correctly filled and returned on time, while the remaining 75 copies were either not returned or partially filled. Hence, the 200 copies returned were summarized with the aid of Statistical Package for Social Sciences (SPSS) version 22 software. Results were analyzed and presented in frequency tables, percentages and charts, Chi-Square test was applied in testing the hypothesis thus: "Fuelwood consumption does not cause significantly environmental problems".

RESULTS AND DISCUSSION
Demographic and Socio-economic Characteristics of Respondents
The general survey results of personal demographic and socio-economic status of household heads are presented in table 1. More (57%) female gender participated in the survey than their male counterparts, accounting for 57%. This may be due to the fact that women are more involved in household duties, of which sourcing of energy to cook is a key aspect, hence they made themselves available for the interview, compared to their male counterparts.

Table 1 Demographic and socio-economic characteristics of respondents

Variable	Response	Percentage (%)	Remarks
Gender			More females
Male	86	43.0	participated
Female	114	57.0	than males
Total	200	100	
Age (Years)			Modal age of
< 20	6	3.0	respondents was
20 -30	14	7.0	the 41 – 50 age
31 -40	31	15.5	bracket
41 -50	83	41.5	
>50	66	33.0	
Educational Level			
Non-formal	5	2.5	
Primary	68	34.0	
Secondary	108	54.0	Majority
Post-secondary	19	9.5	
Total	200	100	
Marital Status			Majority of the
Presently Married	168	84.0	subjects were
Not Married	32	16.0	married
Occupation			
Petty Trading	87	43.5	More of the
Commercial Business	25	12.5	subjects were
Public Service	45	22.5	petty traders
Artisantry & other	33	21.5	
Total	200	100	
Household size			
<3	8	4.0	Modal
3 – 6	24	12.0	household size
7 – 10	118	59.0	is the 7 – 10
>10	>50	25.0	category
Annual Income (₦)			
< 100,000	12	6.0	Majority have
100,000-150,000	69	34.5	annual income
150,001 – 200,000	80	40.0	below
200,001-250,000	26	13.0	₦200,001
250,001-300,000	9	4.5	
>300,000	4	2.0	

Source: Researchers' Field Survey.

Majority (41.5%) of the respondents were within 41-50 age bracket, implying that many of them are within the active age to fend for themselves, including sourcing for energy they can afford the cost for domestic chores.The table has also revealed that all but 2.5% had attended formal education, which imply that 97.5% of them are literate, hence could influence the level of fuelwood consumption in the household. Over four-fifths (84%) of the respondents were married. This means they have some responsibilities to

perform including choice of energy types to use for preparing food for their respective families.

It was also discovered that nearly three-fifths (59%) of the respondents had between 7-10 members per household. Mean household size of 8 members implies that most of the respondents have the responsibility to cater for all the people under them, which may push them to use fuelwood for domestic chores, since it is comparatively more economical to use than the clean energy sources. The table further shows that majority (43.5%) of the

respondents engaged in petty trading. This implies that many respondents belong to the service sector that makes goods and services available including the sale of fuelwood to users. The distribution of respondents by income groups shows that nearly 75% of the respondents earned between ₦100,000 and ₦200,000 as annual income. Mean income of about ₦150,000 implies that many households belong to the low-income category, hence are likely to to depend more on fuelwood which is sometimes a free gift of nature that can be harvested from the bush without any financial cost.

Proportion of Households Depending on Fuelwood

Data on the proportion of respondents using fuelwood is analyzed and presented in figure 1. Result has shown that 78% of the respondents that participated in the survey used fuelwood always (daily) for such domestic chores like cooking, heating, and small-scale business enterprises. This result compares with the findings by the report by Vivan *et al.* (2012) where 78% of the residents of Zangon Kataf, Kaduna State were found to be depending on fuelwood and charcoal to meet domestic energy needs. Similarly, in Nakuru city of Kenya, Lucas (2012) reported that 74% of the residents were found depending heavily on traditional biomass for domestic work.
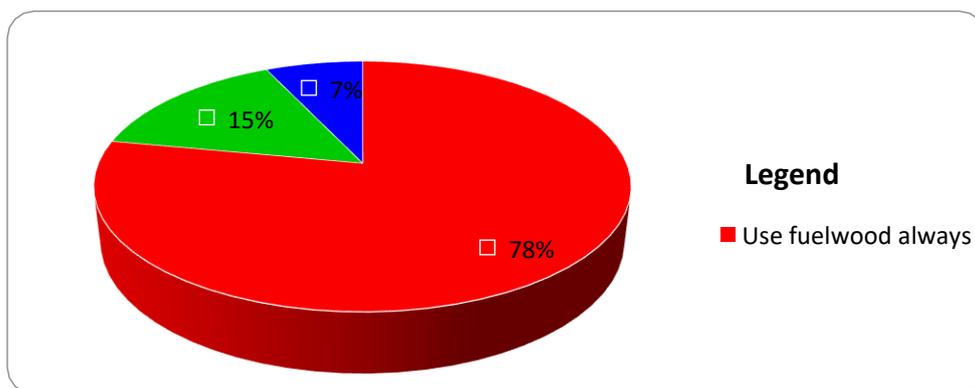

Figure 1 Proportion of the Population Depending on Fuelwood
Source: Researchers' Field Survey.
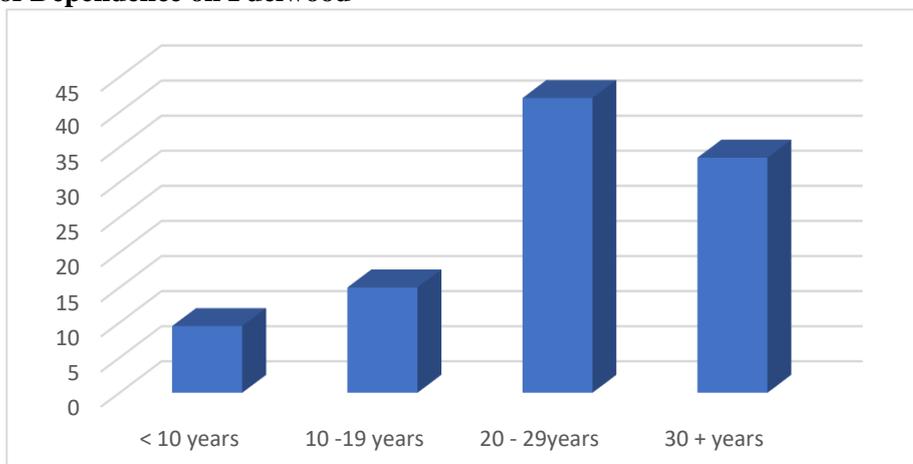
Duration of Dependence on Fuelwood

Figure 2 Duration of Fuelwood Usage
Source: Researchers' Field Survey.

The need to ascertain how long the respondents in the study area have been using fuelwood as a source of domestic energy was one of the objectives of this study. Figure 2 shows that about three-quarters (76%) of the respondents have been using fuelwood for the past 21 years, implying that fuelwood users in the study area are liable to suffer from biomass smoke-related diseases that can lead to death. The duration of fuelwood usage in Jos is in concord with Jande's (2005) findings, where he found that 86% of the residents in Makurdi suburbs had been patronizing this traditional energy source for many years without knowing the implications.

Intensity of Fuelwood Utilization by Households

Figure three shows the distribution of households by the intensity of fuelwood usage
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for domestic chores. Findings indicate that nearly three-fifths (58.5%) of the respondents frequently use the energy source two times a day. This implies that many households in the study area either cook twice a day or used to combine fuelwood with other clean energy sources such as liquefied petroleum gas, kerosene and electricity. The findings in Jos is much lower than the findings by Ekhuemelo, Gakline and Okochi (2015) who reported that 91.7% of the population in Mikang LGA, Plateau State used fuelwood to cook 2-3 times daily. Daily use of fuelwood to cook however, potent danger to people's health as the World Health Organization asserted that if a woman cooks breakfast, lunch and dinner, it is equivalent to smoking 2-20 packets of cigarette in a day which predisposes her to smoke-related sickness and death (Ordinioha, 2006; Premium Times, 2013)
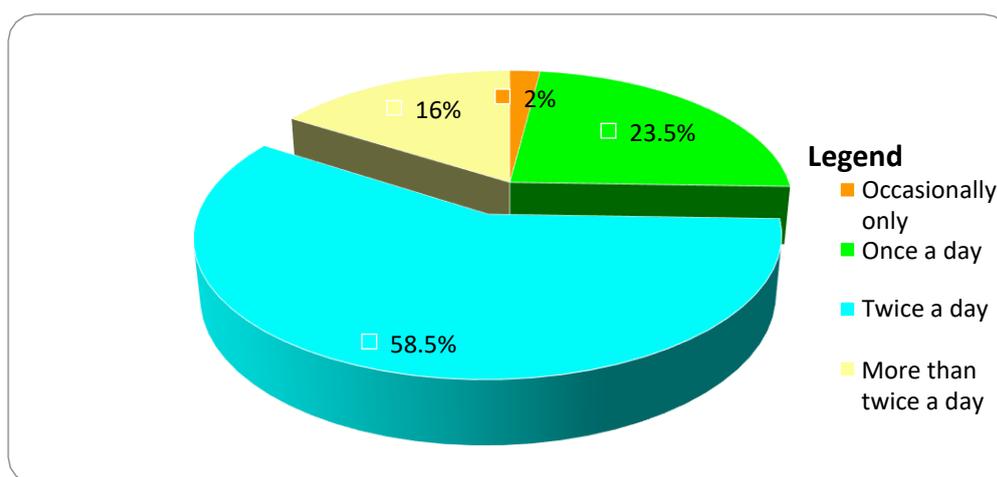

Figure 3 Intensity of Fuel Usage
Source: Researchers' Field Survey.

Distribution of Respondents by Fuelwood Utilization

Figure 4 shows what fuelwood are used for by households in the study area. It was found that over half (53%) of the respondents used fuelwood heterogeneously such as cooking, heating, food preservation, frying of bean cake, mainly in the morning and evening for sale to augment their income-base. This discovery confirms United Nations' Report as cited by

Momodu (2013), that household consumption of fuelwood in Nigeria takes the largest share of total wood production. This implies that unless there is an intervention, the trend is likely to continue. There is need for the Federal Government of Nigeria to restore subsidies on kerosene, cooking gas and electricity to forestall destruction of forest resources in quest of meeting energy needs of households.
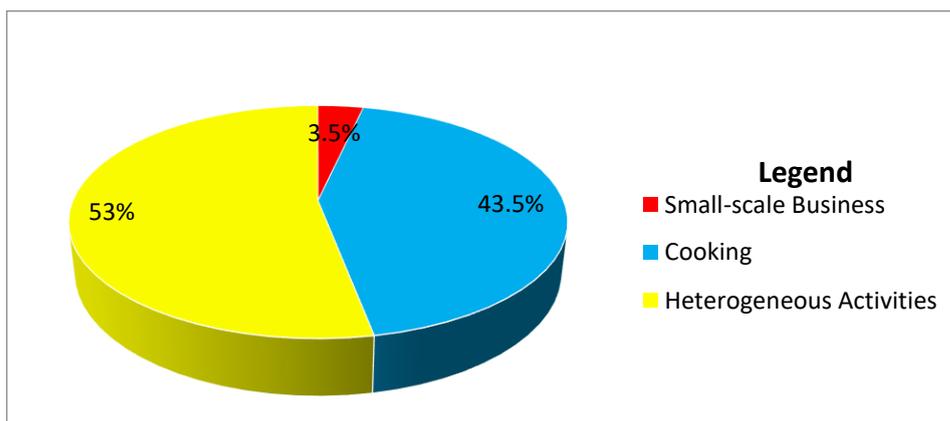
Figure 4 Pattern of Utilization of Fuelwood
Source: Researchers' Field Survey.

Conditions of Fireplace for Use of Fuelwood
Figure 5 shows the analysis of the conditions of fireplace where users of fuelwood in Jos metropolis prepare meals and carry out other domestic chores using fuelwood. Results indicated that 53% of the respondents cooked in open air spaces, 42% cooked with fuelwood in poorly ventilated kitchens and living rooms while only 5% of the respondents have good fireplaces such as detached kitchens with chimneys and sufficient windows for cross ventilation. This means that the 95% of wood users are predisposed to smoke-related diseases in the study area thus, confirming World Health Organization's (WHO) report that 98,000 people die annually due to smoke emanating from poorly ventilated kitchens in Nigeria. Because of the health costs, there are substantial benefits from switching to cleaner, environmental-friendly and more efficient energy sources like electricity, cooking gas and kerosene (Sa'ad and Bugaje, 2016).
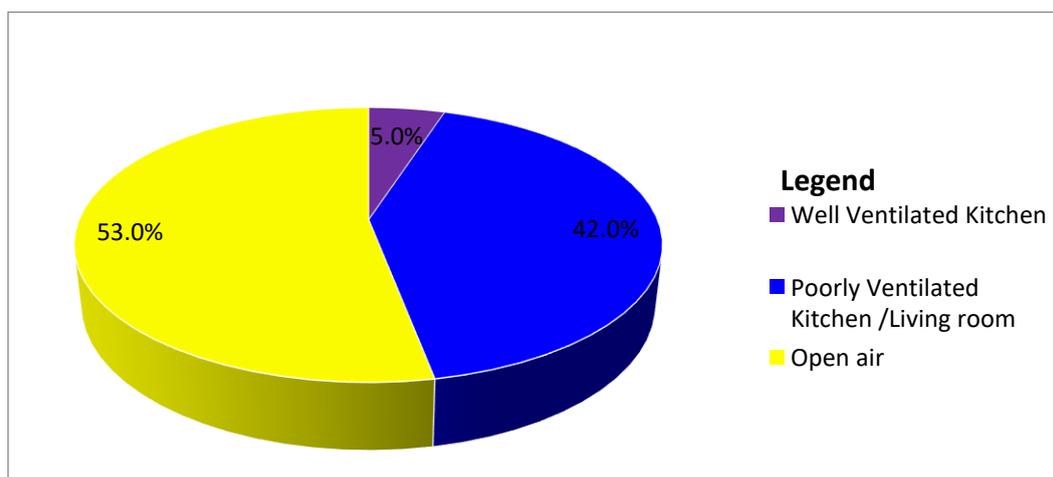

Figure 5 Fireplace for Fuelwood
Source: Researchers' Field Survey.

Reasons for Continued Dependence on Fuelwood
The need to identify the main reasons for relying on fuelwood in Jos metropolis led to generation of data from the field for this study. The results presented in table 2 indicate that about 91.5% of the respondents attributed the continued reliance on wood as an energy source to its: availability, affordability and reliability while 89.0% argued that modern alternative energy sources are sometimes inaccessibly costly, scarce and unreliable in supply. This

finding confirms the claim by Momodu (2013), that the prevailing poor road networks in the country inhibits constant flow of energy goods and when these products eventually reach consumers, they are sold at prices more than 50% above the financial capabilities of the

people. There is need for Government to subsidize the prices of cleaner sources of fuels to enable households switch over to these sources in order to meet their domestic energy needs.

Table 2 Reasons for depending on fuelwood

S/N	Reasons	Agreed	Not Agreed	Not Sure
1	Fuelwood are **accessible** (available, affordable and reliable)	**183** (91.5%)	**1** (0.5%)	**16** (8.0%)
2	Modern alternative sources are **sometimes inaccessible** (costly, scarce and unreliable)	**178** (89%)	**3** (1.5%)	**19** (9.5%)

Source: Researchers' Field Survey.

Environmental and Health Effects Associated With Fuelwood Consumption

Table 3 shows that between 73%-97% of the respondents have a good knowledge of the consequences of relying on fuelwood consumption (mean=85.9%), such as deforestation, soil erosion, flooding, siltation of dams, reduction in rainfall, desertification, global warming and ill-health arising from indoor and outdoor air pollution. Findings in Jos are at variance with Jande's (2005) discovery among residents of Makurdi suburbs where over 86% of the respondents were not aware of the consequences. The differences could be attributed to the fact that about 54% of the respondents in this study attained a minimum of secondary school education and possess some sort of environmental education than their counterparts in Makurdi Suburbs. This implies that there is high tendency for people in Jos metropolis to switch over to environmental-friendly and clean energy sources of these any intervention that guarantees regular supply of such modern energy types at the cost they can afford. Further, table 3 also shows the Chi-Square statistics applied to test the hypothesis that: "Fuelwood consumption does not cause significant environmental problem". However, the result obtained indicated that fuelwood consumption causes significant environmental problems, because the computed value obtained was higher than the table value at 0.05 confidence level.

The Chi-square test has been computed (see table 3). The computed value X^2 obtained is 1.429 while the critical p-value at alpha 0.05 (df=18) is 0.001. Since the computed value X^2 is larger than the critical p-value (alpha 0.05) of 0.001, we fail to accept the null hypothesis and conclude that fuelwood consumption does cause significant environmental problems.

Attitudes toward Planting Trees for Mitigating the Danger of Fuelwood Consumption

Households' efforts at mitigating the environmental and health problems associated with fuelwood consumption was analyzed and presented in table 4. Results indicate that only 3.5% of the respondents of this study in Jos have planted trees to mitigate the consequences associated with fuelwood utilization while, 96.5% of them never planted trees to reduce the environmental problems associated with wood harvesting for fuelwood. This finding is in congruous with Jande's (2005) discovery, where he reported that 74% of the fuelwood users in Makurdi never planted trees. It is worrisome that only 3.5% of the respondents care to plant trees in Jos because the number is grossly inadequate to guarantee continued supply. There is need for Government at all levels to resuscitate tree planting campaign programmes in order to salvage Nigeria's environment from deforestation and degradation.

Table 3 Perceived environmental problems associated with dependence on fuelwood consumption

S/N	Hazard	Agree	Not Agree	Not Sure	Df	Chi-Square	P-value	Decision Rule
1	Deforestation	190 (95.0%)	3 (1.5%)	7 (3.5%)				
2	Wind Erosion	154 (77%)	7 (3.5%)	39 (19.5%)				
3	Soil Erosion	175 (87.5%)	11 (5.5%)	14 (7.0%)				
4	Flooding	167 (83.5%)	20 (10.0%)	13 (6.5%)				
5	Silting of Dams	146 (73%)	8 (4.0%)	46 (23.0%)	18	1.429	0.001	Reject H_0
6	Reduced Rainfall	166 (83.0%)	13 (6.5%)	21 (10.5%)				
7	Desertification	178 (89.0%)	3 (1.5%)	19 (9.5%)				
8	Ill-Health	187 (93.5%)	4 (2.0%)	9 (4.5%)				
9	Air Pollution	194 (97.0%)	2 (1.0%)	4 (2.0%)				
10	G/warming	161 (80.5%)	15(7.5%)	24 (12.0%)				
	Mean	85.9	4.2	9.9				

Source: Researchers' Field Survey.

Table 4 Attitude towards mitigating the danger

S/N	Rate per year	Response (%)
1	Always plant trees	1 (0.5)
2	Often plant trees	6 (3.0)
3	Never planted any tree	193 (96.5)
4	Total	200 (100)

Source: Researchers' Field Survey.

Policy Implications of the Findings

The paper showed that a considerable number (40%) of household heads earned income less than two hundred and one thousand Naira. This amount is grossly inadequate for a household of 7-10 members. This in part accounts for the heavy dependence on forest-derived biomass for domestic chores. Continuous consumption of fuelwood has been found to have both direct and indirect impacts on people's health, fauna, flora and the physical environment that sustains life on planet Earth (Tripathy and Panda, 1999; Asthana and Asthana, 2012). It is therefore, necessary to take proactive steps in order to arrest some of the deleterious consequences, which include deforestation, culminating into desert encroachment, flood, soil erosion and climate variability. Sambo (2006) estimated an annual loss of about 350,000 hectares of Nigeria's natural vegetation due to exploitation for various uses including fuelwood; of which afforestation rate is only 50,000 hectares. This implies that the rate of deforestation far exceeds

afforestation by seven times annually. The situation is even worse in the study area where only 3.5% of fuelwood users plant trees to replace those felled for fuel (See Table 4). This portents great danger with ecological consequences. Ecological imbalance will make primary economic activities upon which millions of Nigerians depend even more precarious. It will exacerbate carbon build-up which contributes to global warming, increase soil loss, aridity and flooding as well as famine and diseases.

When trees are cut down, the land becomes bare or exposed, vulnerable to soil erosion. Hence, degradation in the form of desertification will occur. Nigeria is currently losing over 350,000 hectares of its land to desert and is increasing southwards; a situation which left unchecked, will put agricultural production in crises. Forests act as carbon sinks for carbon dioxide that causes climate variability and global warming. It is estimated that carbon is accumulating at an annual rate of

3.5 billion metric tons; and favorably enough one hectare of trees well preserved can offset up to 200 tons of carbon a year (British Broadcasting Corporation, 2009). The impact of climate variability and global warming are numerous and the consequences are beyond what a developing country like Nigeria can cope. This means the adaptation option for us as a nation is to keep the forests standing so that they provide essential environmental services such as carbon sinks, check desert encroachment, soil loss, flood and air pollution. Forests that are usually exploited for fuelwood are also habitats for wild animals and valuable plant species. Once such forests are destroyed for fuel and other uses, the animals become helpless and homeless to the detriment of mankind. Further, most of the trees and shrubs used as fuelwood are part of the biological diversity that provides food, medicine and aesthetic value to the nation. The Federal Department of Forestry (cited in Itanyi and Ugwuanyi, 2014) lamented that in 1997, about 205 plant species out of 4,600 identified were endemic and 496 species were threatened due to over-exploitation. Therefore, uncontrolled exploitation for domestic energy and other uses can lead to their disappearance as it is being witnessed presently in the country (Momodu, 2013).

The use of poorly ventilated fireplace to cook with fuelwood by about 95% of the households in Jos predisposes women and children to smoke-related diseases. Poor combustion fuelwood causes epidemiological problems; the smoke is the third largest killer of women and children in Nigeria, which according to WHO (cited in Premium Times, 2013) claims the lives of 98, 000 Nigerians every year. Besides, heavy dependence on fuelwood has negative effects on the social life of the people. Women and children involved in the collection and transportation of fuelwood from the bush to home may have to travel far to obtain the product. Some women are often seen head-loading fuelwood as heavy as 35kg over long distances of up to 10 km in difficult terrains, which can damage their spines and cause difficulties during pregnancies and childbirth (Momodu, 2013). There is the need for Government to discourage households from continued dependence on this traditional biomass by making modern alternative forms of energy accessible, affordable and available to

Nigerians. Further, in order to avert the trend of over reliance on fuelwood, comprehensive microfinance and cooking technology packages should be provided to households in need. However, this may require administrative initial funding from local and national public actors but such an activity would generate income and local jobs for installation and maintenance (Lucas, 2012).

Heavy dependence on fuelwood may lead to scarcity of wood thereby, creating the need to resort to cooking fewer meals. Such meals like soybeans, cowpeas, and lima beans that require large amount of heat and longer time to cook may either be cooked poorly or shunned, in preference to starchy food. Continuous intake of starchy food alone can expose the people to protein-deficiency diseases which can cause socio-economic disaster.

CONCLUSION

This study has established that inhabitants of Jos metropolis depend on the use of fuelwood to meet domestic energy needs. The use of fuelwood is indeed, an issue that cannot be done away with so easily because of the poverty status of many Nigerians. Empirical results have indicated that the situation is posing serious threat to human health, quality of life and environmental sustainability. Consequently, the following measures are recommended in order to mitigate the impacts so as to promote sustainable environment and healthy well-being of households.

First, rural communities from where fuelwood is imported into the city should be enlightened through campaigns on the hazards of indiscriminate felling of trees and how they can actively get involved in managing local woodlands sustainably. Various media for the creation of awareness such as hand bill, newspaper, magazine as well as radio and television jingles should be employed to sensitize the general public on the environmental and health hazards of relying on fuelwood as energy source. Other agencies of Government, such as the National Orientation Agency and National Environmental Standards and Regulations Enforcement Agency should live up to their responsibility of sensitizing, enlightening and educating the public on the dangers of over-relying on fuelwood as an energy source.

Secondly, there is urgent need for relevant authorities to promote and facilitate the development of diversified energy supply system by improving its supply infrastructure to ensure that the country becomes less dependent on fuelwood in both residential and industrial sectors. Diversification of energy sources would considerably reduce the city's pressure on its surrounding biomass stocks.

Thirdly, there is need to develop and produce biomass electricity, ethanol or gas for use by households. The Energy Commission of Nigeria, alongside other research institutions should intensify research towards producing improved version of biomass stoves that can reduce fuelwood consumption by 50% and then make them accessible to households. There is need to engage experts and the private sector in piloting these new energy technologies to help communities meet basic fuel needs and generate livelihood opportunities.

Fourthly, there is need to promote the establishment of woodlots at household, community and school levels. Since poverty contributes to heavy dependence on fuelwood, the introduction and implementation of pro-poor policies that ensure the poor have access to electricity will be very helpful. Non-Governmental Organizations and other agencies that have been collaborating with the Government should distribute fuel-efficient stoves at the household level. Targeted beneficiaries should be sensitized on energy-saving practices, including cooking practices and techniques, as well as correct use of cooking utensils for food preparation.

There is the need for Government to give entrepreneurship training to help equip the young citizens boost their businesses. This would go a long way to reduce the economic hardship which they face and encourage rapid shift to the higher energy ladder. Besides, the pay structure of workers should be reviewed upward by the Govenment to accommodate the cost of embracing modern energy sources for domestic chores.

Finally, there is need to strengthen and enforce environmental laws against indiscriminate exploitation and felling down of natural trees without permission. There should be legal provision mandating fuelwood users to plant two or more trees for every tree felled for personal use.

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