FUEL WOOD CONSUMPTION: A MATTER OF CHOICE OR ECONOMICALLY CONSTRAINT ALTERNATIVE; AN ASSESSMENT OF ALTERNATIVE ENERGY PREFERENCES IN GOMBE METROPOLIS

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Abstract

The continuous dependence of human on fuel wood has resulted in serious degradation of the fragile forest ecosystem. We evaluated the scale of fuel wood usage as well as preference for other alternative sources of fuel and energy within the study area. We investigated the ecological implications of over-dependence on some preferred tree species that are harvested daily for use as fuel. Our results were drawn from Two hundred (200) structured questionnaires administered to willing respondents in the study area of Gombe metropolis and environs. Energy preference differed among household users, with (54.44 %) of 180 respondents favoring fuel wood, (17.22 %) gas, (10.56 %) kerosene, (10.56 %) electricity, (6.11 %) charcoal, and (1.11 %) preferred saw dust. Twenty (20) respondents drawn from bulk users were found to depend exclusively (100 %) on fuel wood. *Anogeissus leiocarpus, Parkia biglobosa*, and *Detarium microcarpum* were among the three most preferred and harvested of the nine known economic tree species recorded in this study, and may be the most vulnerable to local extinction in the near future. Affordability, availability and efficiency are the key drivers of fuel wood preference. Our results suggest that respondents prefer to use fuel wood exclusively rather than as an option. We found that conversion of woody tree species to fuel wood in the study area is unsustainable and unregulated, and pose severe consequences for biodiversity in Gombe and by extension the North – East region.

Key Words: Fuel wood, Preference, Biodiversity, Conservation

Introduction

Fuel wood is wood burnt directly as source of energy (Alan, 1996). It is obtained from trunks, branches and other part of trees and shrubs (Chukwu, 2001). It is bulky and heavy materials of low unit value and low price compared to conventional fuels such as kerosene and gas powered stove. Fuel wood is socially and environmentally acceptable, especially by low income earners (Agagu, 2009), and remains an important source of energy, and a globally utilized alternative to fossil fuel in their large scale use (Ezema, 2001). Among the various items derived from forest trees such as timber, stakes for yam tendrils and wood extracts for craft and medicinal purposes, fuel wood is the most important wood item or product in terms of volume consumed in Nigeria and other West African countries (FAO 2010). It

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accounts for about 95 % of total wood consumed in Nigeria (FAO, 2011). In Nigeria the role fuel wood plays can only be replaced by expensive alternative sources of energy/power, such as gas, kerosene, and electric powered cookers. Incidentally, more than 70 % of the total population who rely on fuel wood as their major source of energy for cooking purposes cannot afford these fossil energy alternatives (Irene and Joan 1997). In the light of the above, poverty is unarguably one of the major drivers of continuous or overdependence on forest wood as domestic source of fuel (Pandey, 2002; Sambo, 2008, Maconachie *et al.,* 2009).

While poverty and availability of fuel wood may work synergistically to determine fuel wood preference, it does not preclude other factors such as the conservative attitude and cultural values of most rural dwellers (Sambo, 2008). For instance wood becomes the most preferred choice of fuel for the rural and urban poor, because the dishes of the poor often require lengthy cooking probably because of the nature of the food, size of the household and the need to destroy germs and parasites (Iwu, 1998). In addition there are misconceptions that food processed with fuel wood taste better than when prepared using other modern alternative energy sources. In the light of the above, woody tree species have become the preferred source of energy in rural areas both for domestic uses, for use in small scale traditional industries and for commercial enterprises (Specht, 2015). In the urban areas, low income household (urban poor) use it as their main source of energy for cooking and heating. The

middle income earners use it as substitutes or supplementary fuel for domestic cooking and heating (Ki-zerbo 1981).

While most developed countries are deemphasizing dependence on fossil fuels and advocating for green energy, developing countries are struggling to make the best of the huge deposits of fossil fuels and are experiencing a different kind of crisis – that of prudent management of her natural resources. In Nigeria the problem is more complicated, as it stems from a deep-seated culture of corruption, especially among regulatory institutions and ministries charged with the management of these natural resources (Ogbonnikan, 2012, Tsan and Odemwingie, 2013).

However, the vast majority of poor people in Nigeria and other developing countries face a different kind of energy crisis - fuel wood shortages. This is because most of them have continued to depend on fuel wood in an unsustainable manner, with a resultant progressive gap in demand and supply over the years. In Africa, the fuel wood consumption rose by 23.08 % from 154 million to 190.2 million metric tonnes in 1975 (Nwamani, 2005). The imbalance constitutes a great danger to the environment because the existing forests are diminishing as a result of over-exploitation, leading to deforestation and subsequently erosion (Hajara, 2015). A major consequence of these is massive drop in ecosystem productivity (Omar, and Priya, 1996).

The scarcity of fuel wood is evident in the price increase and seasonal shortages in supply over the years. Also in Nigeria the scarcity of conventional energy sources

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and incessant hike in the prices of these fuels had encouraged sustained dependence on fuel wood by many households relative to other commercial fuels even among urban households (Akpan and Akosin 2007). The high demand of wood products has also been adduced to the increases in the rate of poverty in the country. Almost 87 % or 93 million Nigerians live below poverty line (Pandey, 2002).

Poverty has been adduced as the major factor responsible for over-dependence on natural resources, and fuel wood is among the most dependable natural resource available to more than 80 % of Nigerians (Sambo, 2008, Maconachie *et al.,* 2009). As a result, forest and green vegetation have become Nigeria's most endangered natural resources.

According to the World Food and Agriculture Organization (FAO 2010), Nigeria lost almost half of its forest cover in just 20 years between 1990 and 2010 (47.5 %). In 2012, Verisk Maple croft a global risk analysis market leader ranked Nigeria as number one among countries hardest hit by deforestation. Today, deforestation in Nigeria continues at an alarming rate accounting for the loss of forest cover equivalent to four times the size of Lagos State (4,000 sq km) annually. In Northern Nigeria, the rapid encroachment of the Sahara Desert is perhaps the most devastating impact of Nigeria's deforestation crisis. Experts say that the Sahara now encroaches southward at a rate of 6 kilometers every year, converting 2,168sq km of previously arable land to hot, dry desert (Hajara, 2015). This progressive encroachment and conversion of arable lands into desert has been closely linked with food shortages, insecurity, poverty, climate related migration, cattle routes displacement and communal clashes. Ironically, the most desert prone region in Nigeria (Northern Nigeria) seems oblivious of the environmental effect orchestrated by continuous dependence on fuel wood. It is worrisome, considering that most villages and settlements in the Northern region do not only depend on fuel wood as a domestic source of energy, but depend solely on fuel wood as a major trade commodity and livelihood option (Akpan and Akosim, 2007). The felling of trees in such quantities for use as firewood destroys our natural defenses against desertification and erosion. It is therefore not surprising that the Federal Ministry of Environment has attributed the acceleration of desert encroachment in the 11 Frontline States in Northern Nigeria to uncontrolled logging and tree felling. Given the fact that registered bakeries in Jigawa state alone (one of the 11 Frontline States), consume over 100,000 trees annually; it is hard to argue against this assertion (Sambo 2009).

The loss of biodiversity is one of the major drawbacks of excessive logging and over-harvesting of fuel-wood (Obuah, 2000). In this study, we attempt to identify the proximate factors responsible for preference and level of dependence on fuel wood by residents of Gombe Metropolis and environs. Gombe is one of the 1 1 frontline states hardest hit by environmental and ecological constraints such as desertification, drought, dry-spells, dust storms, soil erosion, deforestation and

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overgrazing. The study focuses on generating adequate information and data, to steer policy formulation towards specific and empirically identified ecological problems or issues within the study area.

From the biological and ecological point of view, the study will identify specific woody plant species that are most preferred and perhaps most depleted and the impact this might have on the species in question and the ecological community at large. Since lack of information limits our ability to draw firm conclusions about the scope of these problems, remedial actions becomes unattainable. Obviously more research is required. Therefore, an assessment of the current situation regarding fuel wood production and consumption in the study area is not just timely but highly imperative.

The aim of this study is to determine the level of fuel wood consumption and forces behind preference for alternative energy sources in Gombe metropolis and environs. Several objectives were explored to actualize the core goal of the research, these are;

1. Determine empirically the factors driving preference for fuel-wood as an alternative to other available energy sources in Gombe metropolis and environs.
2. Generate baseline data and information on the level of dependence on fuel wood and other energy sources in Gombe Metropolis and environs.
3. Identify tree species that are most vulnerable based on preference by fuel wood users.
4. Determine the level of awareness of the ecological implication of over-dependence on fuel wood by users in Gombe.

Study Area

The study was conducted in Gombe metropolis and environs, north eastern part of Nigeria. Gombe lies between latitude $10°.29'$ North, longitude $11°.17'$ East and 449 meters elevation above sea level. Gombe State shares boundaries with Yobe to the North, Adamawa and Taraba states to the South, Borno to the East and Bauchi to the West. Gombe state covers a total area of 20,265 km^2. The vegetation and flora of Gombe state is Guinea savannah grassland with concentration of woodland in the South East and South West divisions of the state. Gombe state has two distinct seasons, the dry season (November-March) and the rainy season (April-October) with an average rainfall of 850mm.

Method of Data Collection

The target population for the study was individuals and households from rural and urban settlements in and around Gombe metropolis, as well as bulk users (bakeries, restaurant, boarding schools and barbecues). Data was obtained primarily to estimate the determinants of fuel choice and energy consumption patterns in Gombe metropolis and environs.

We used 200 structured questionnaires (180 domestic/ household users and 20

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bulk users) to collect the necessary data from primary sources. Additional information was obtained through oral interviews. The questionnaires addressed the following; preferred energy type (kerosene, fuel wood, gas, charcoal and saw dust), reasons for preference, preferred alternative source of energy, income of respondent, occupation, awareness of ecological/environmental impact of fuel wood usage and frequency of fuel wood usage.

Identification of Tree Species used for Fuel

We used field guides offering taxonomic keys for plant identification. These include; Hausa plant names; Hausa Latin names the circulation version (Burkill, 2004), and secondary information from the wood sellers at the wood depot/market.

Data analysis

The data collected was analyzed; using computer-based statistical packages for social sciences (SPSS version 15.0).The software was used for frequency analysis and descriptive statistics, since data was mainly categorical in nature not count.

Results

Our results were quite revealing and in tandem with previous studies and expectations. Our results indicated that fuel wood was the most preferred energy source in the study area. Based on evaluation of 180 respondents drawn from household users, we found that dependence on fuel wood accounted for (54.44 %), gas cooker (17.22 %), kerosene (10.56 %), electricity (10.56 %), charcoal (6.11 %), and Saw dust (1.11 %),. However, Bulk users (restaurants, suya sellers, school cafeteria and bakeries) relied exclusively on fuel wood accounting for (100 %) fuel wood consumption out of 20 respondents (Table 1).

Table 1: Preference for fuel wood and alternative energy sources in study area

Energy Sources	% main reference	% As Alternative	Reason(s) for preference	Category of Users
Fuel wood	54.4	3.3	Affordability,	Rural/urban poor, bulk-users
Gas cooker	17.22	10	Availability	High and middle income earners
Electric	10.56	5	Efficiency	High/middle income earners
stove	10.56	8.89	Affordability, Efficiency	Middle income earners
Kerosene	6.11	0	Affordability	Low/middle income earners
Charcoal	1.11	0	Affordability, availability	Low income
Sawdust			Affordability	

Table 2: Percentage distribution of woody species preferred for use as fuel in study area

Species	Hausa names	Percentage preference	IUCN Status
Anogeisus leiocarpus	Marke	32.22	LC
Parkia biglobosa	Dorowa	13.33	LC
Detarium microcarpum	Taura	8.33	LC
Vitellaria paradoxa	Kadanya	5.56	VU
Prosopis africana	Kiriya	5.00	LC
Tamarindus indica	Tsamia	4.44	LC
Isoberlinia doka	Doka	2.78	L.C
Ficus platyphyla	Gamji	0.56	LC
Diospyros mespilliformis	Kaiwa	0.56	LC
Unknown species	N/A	27.22	N/A

LC= Least concern, VU= Vulnerable, N/A = Not applicable

Table 3: Reasons attributed by respondents for preference of Fuel wood

Reasons	Percentage
Affordability	45.56
Availability	27.78
Efficiency	14.44
Safety	7.22

Table 4: Public perception of the implication for fuel wood consumption in study area

Implications	Percentage public awareness
Personal health	50.56
Climate	24.44
Forest Cover	10.56
Farmland	5.56
Soil status	5.56
Not sure	3.33

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Table 5: Sourcing of Fuel wood in study area

S/n	Source of fuel wood	Percentage users
1	Purchase (through vendors)	88.89
2.	Direct harvest from forest (live trees)	7.22
3.	Direct harvest (fallen logs)	1.67
4.	Undisclosed	2.22

Discussion

The goal of this study was to investigate the pattern and level of dependence on fuel wood and other alternative sources of energy in Gombe metropolis and environs. Other goals were to identify the forces driving preference and usage of the various energy (fuel) sources and whether or not the respondents were aware of the implications of over dependence on forest resources such as fuel wood.

Interestingly, while we found that 54.44 % of the 180 respondents depended on fuel wood as their main source of energy, 34.44 % of this (54.44%) depended exclusively on fuel wood, while only16.66 % depended on fuel wood and fossil fuels as complementary alternatives. Incidentally only a negligible 3.33 % of the 180 respondents did not use wood as fuel.

Our results are in tandem with the work of Akpan and Akosin (2007) who found a similar pattern in fuel wood usage in Bauchi State. Their results indicated 98% dependence on fuel wood. Of this, 42 % exclusively depended on fuel wood, while 54 % depended on both fuel wood and fossil fuels. Similarly, 2 % did not depend on wood as fuel. Interestingly, past studies carried out in other regions of Nigeria had similar outcomes (e.g. Ogunkunle, 2004; Oluwagbenga et al., 2015; Machonochie et al., 2009; Asifat, 2012). These widespread pattern of preference for fuel wood across different parts of Nigeria, implies that similar forces could be responsible for the seeming interest in fuel wood, despite the virtual availability of other relatively cheaper and more efficient sources of energy. On the bright side, it means that a particular solution may be a national fix for what appears to be a common national energy crisis.

Majority (54.44 %) of respondents and by extension Gombe state metropolis residents depend on fuel wood, while only 17.22 % and 10.56 % depend on fossil fuels, (gas and kerosene respectively) (Table 1). Electricity which is a major and most dependable source of energy in developed countries, only accounted for 10.56 % preference in this study. Understandably, this could be as a result of intermittent and prolonged power outage in Nigeria, making electricity an unreliable and less attractive option. A total of 6.11 % of the respondents use charcoal as their main source of energy while only 1.11 % relies on saw dust. This implies that 61.66 % (i.e. a combination of fuel wood,

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charcoal and saw dust) of preferred energy among respondents is sourced from the forest. This revelation implies that too much pressure is placed on the forest. It is rather disturbing to note that nothing is being done to replace what is taken from the forest and the threshold of self-recovery and resilience of the forest may have been exceeded several decades ago (Specht, 2015). It is quite obvious that we are facing an eminent ecological crises and something needs to be done to reverse this ugly trend (Hajara, 2015).

The preference observed amongst bulk users (100 %) of fuel wood followed a similar pattern with that of domestic and house-hold users. However, 95 % respondents preferred fuel wood and considered other alternatives as inappropriate options (As alternative 10 % use gas cooker, 8.80 % kerosene, 5 % use electric stove, 3.3 % use fuel wood. However, 80 % of bulk users think it is more realistic and cost –effective to use fuel wood because of the amount of energy required for their daily needs and obviously the unreliability and high cost associated with electricity, kerosene and gas.

Disturbing trends, fact and figures

The results of this study revealed that most of the users of fuel wood (88. 89 %) do not source for wood directly from the forest, but purchase from vendors and major marketers. Only 7.22 % of fuel wood users harvest their wood directly from the forest, 1.67 % get their wood from fallen logs within their settlements or other alternative means, while 2.22 % of the respondents

did not offer any respond to the question of where are how they source for their fuel wood (Table 5).

The major wood vendors source for fuel wood outside Gombe metropolis and buy from local fuel wood harvesters in rural settlements around and within Gombe State. These wood comes in daily from various routes (Bauchi road, Nafada-Bajoga road, Dadin Kowa –Maiduguri road, and Kaltungo-Numan road) at least 30 trucks were observed conveying wood into Gombe between the hours of 7 am – 6 pm per day from Bauchi road alone and about 59 trucks from a combine road of Bajoga-Nafada and and Kaltungo-Numan road (Personal Observation) . Fuel wood usage is not just a preferred alternative source of energy driven by choice and affordability but a dynamic and deeply rooted business venture managed by a cartel. This is disturbing because it is much easier to regulate and control domestic fuel wood consumption but very difficult to put people out of business, especially if and when it has become the major source of income or livelihood. From local intelligence and informed sources, we learned that the marketers have an association comprising of dues paying members and have organized their activities and business to the extent where they meet periodically to negotiate with regulatory authorities of the state government. There are indications that laws and forest regulatory authorities have been compromised and the fuel wood marketers have bargained their way through and now enjoy a field day scouring the forest of what is left of the

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rapidly disappearing vegetation all year round.

We found that some respondents use each of the available sources of energy exclusively irrespective of the availability of alternative sources. Fuel wood accounts for 34.44 % exclusive dependence while other sources combined account for 31.12 % exclusive usage making a total of 65.56 % of respondents who use fuel wood, gas, kerosene, electricity charcoal and saw dust exclusively. In combination with other sources of energy, fuel wood was the least preferred alternative (3.3 %), while kerosene and gas cooker were the most preferred alternative source of energy (8.89 and 10 % respectively) (Table 1). These figures allude to the fact that respondents will prefer to use fuel wood exclusively rather than as an option.

In a bid to understand the forces driving preference for the various fuel alternatives, we found that availability, affordability and efficiency (in this order of decreasing strength) have the highest influence on fuel choice or preference. They accounted for 56, 27.78, and 14.44 % respectively (Table 3). This is in agreement with the findings of (Maconachie *et al.,* 2009).

It is pertinent to note that the forces of demand and supply are largely at play here; for instance, it takes availability first of all for a user to consider whether he / she can afford a commodity, before considerations are made regarding the efficiency of the product or commodity. The efficiency of the commodity follows only when the two factors (availability and affordability) are in place. For instance, between the rural and urban poor, the rural poor will be less concern about the

efficiency of a gas or electric cooker, since it is not available, hence not an option; while the urban poor who probably lives next door to the urban rich and middle class, will only avoid gas and electricity because of affordability rather than availability and efficiency.

With the worsening and ominous economic crisis in Nigeria, there is every indication that more and more fuel users will migrate from dependence on fossil fuels to fuel wood.

Nigeria has just come out of economic recession, and economic pundits seem optimistic about the seeming recovery, although the masses seem oblivious of this emerging light in a dark tunnel. The presidency was also very clear on the position of Nigeria's economic fortunes during this time; as alluded in a statement credited to the President, "suddenly, we are a poor country" (Vanguard, August 2016). This declarations are still dominating public economic discuss two years after.

Nigeria's economic fortune is dwindling despite the optimistic posture of the government. There is really no hope in sight for Nigerians especially the lower class and rural poor that forms the bulk of the population. The first quarter of 2018 was typified by scarcity of petrol and other fossil fuels (Kerosene, diesel and gas) across the nation. This crisis has been recurrent, persistent and very disheartening and has forced most low income earners and in fact most Nigerians to resort to the dwindling forest resources for energy and livelihood options.

It is quite obvious that more pressure will be placed on our forest with more people

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migrating from fossil fuels (gas and kerosene) to fuel wood due to scarcity and high cost of living. This is in line with studies that have reported earlier that poverty is one of the major factor responsible for over-dependence on forest and forest products (Sambo 2008, Yahaya 2002).

One of the highlights and novelty of this study is that we were able to identify the most commonly used tree species for fuel wood. Perhaps more research needs to be conducted to probe this further. We found that despite the abundance of several trees and plant species, only a few are targeted because of the knowledge over the years of their efficiency and durability. This is disturbing considering the danger associated with single species persecution, where a particular species is intensely harvested to the point of local extinction because of its efficiency or preference. The following trees may require urgent conservation attention locally or most specifically within the northern region. This include nine common tree species namely; Marke (*Anogeissus leiocarpus*), Tsamia (*Tamarindus indica*), Kadanya (*Vitellaria paradoxa*), Gamji (Ficus platyphylla), Kiriya (Prosopis africana), Dorowa (*Parkia biglobosa*), Doka (*Isoberlinia doka*), Taura (*Detarium microcarpum*), and Kaiwaa (*Diospyros mespiliformis*) (Table 2). These tree species were also evaluated in terms of the percentage demand or preference placed on them. The three most preferred tree species in the study were; *Anogeissus leiocarpus* (32.22%), *Parkia biglobosa* (13.33%) and *Detarium microcarpum* (8.33%) which is in partial agreement

with the work of Akosin and Akpan (2007), where they recorded the following *Anogeissus leiocarpus* (42.9%), *Vitellaria paradoxa* (15.3%) and *Prosopis africana* (10.2%). It is also important to note that *Parkia biglobosa* and *Tamarindus indica* are amongst some of the tree species that are under protection by CITES (Convention on international Trade on Endangered Species).

The level of ecological and conservation awareness was also considered in this study and results indicated that majority of fuel wood users and respondents generally are aware of the implication of continuous reliance on fuel wood. Seventy five (75 %) are in agreement and answered affirmatively while 11.11 % were not in agreement with the general effects of dependence on fuel wood. The remaining 13.89 % are either ignorant or rather not concerned by the issue (Table 4). However, we found that respondents placed more emphasis or concern on their health and safety rather than the health of the environment (Table 4). Ironically and regrettably, the latter (environment) has a huge influence on the former (human health and safety).

Conclusion

The results of this study suggest that the health and safety of our environment depends largely on the government waking up to their responsibilities of tackling corruption by purging or ridding regulatory and la Nsor and Abiram, 2018 of officers that are aiding and abetting offenders. Government can also focus on ensuring that alternative sources of energy

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are made available and affordable by all. we believe that with constant electricity, availability of cheap and affordable kitchen appliances (cookers and ovens) and fossil fuels, the problem of over dependence on fuel wood will be tackled decisively. Conservatism and conservative practices needs to be address by sensitizing people on the benefits of conserving nature and the implication of acting otherwise.

Now that we know the tree species that are at risk of extinction steps and actions can be geared towards managing and using them more sustainably in Gombe and environs. Overall this study has shown that fuel wood usage is very high and is highly affected by choice related variables such as affordability and availability in the study area.

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