



# Evaluation of fuelwood consumption and implications on the environment: case study of Makurdi area in Benue state, Nigeria

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## ABSTRACT

*Objectives:* To address the problem of increasing disappearance of vegetal cover in and around Makurdi area, Nigeria.

*Methodology and results:* The fuelwood consumption patterns and various user groups in the area, different wood species utilized for fuelwood, and implication of these uses on the environment were identified. Applying random sampling technique, 180 respondents were selected and interviewed between September, 2007 and June, 2008. Data were analyzed using descriptive statistics on SPSS 14.0 software version. The result revealed eight user groups and/or patterns of utilization, i.e. household cooking, brewing of liquor, charcoal production, cooking in hotels/restaurants, burnt-bricks production, oven baking, rice milling, and smoking. Also, 37 wood species were useful for fuelwood in the area, and out of these, five were under threat of extinction. Furthermore, there was on-going massive exploitation with little planting operations going on in the area. This portends grave environmental degradation with severe consequences.

*Conclusions and application of findings:* Fuelwood remains the major source of energy for all energy-demanding groups in and around Makurdi. However, its supply is limited and the preferred fuelwood species are under threat of extinction. The excessive pressure on the forest for fuelwood, poor harvesting and exploitation with the negative attitude of the people towards establishing fuelwood plantations has resulted in environmental degradation. From the foregoing, governments and other development agents are encouraged to make use of this information to support availability of alternative energy sources to supplement fuelwood. In this regard, converting wood wastages (wood shavings and saw-dust) to briquettes and motivating the public to plant trees would improve energy supply and therefore reduce pressure on the natural forests. This will also minimize environmental degradation and its negative consequences. Policy-makers and other stakeholders should also use the information to develop policies and strategies to preserve and sustain the species identified as threatened in the area.

**Key words:** Fuel-wood, consumption pattern, user groups, environment.

## INTRODUCTION

Fuelwood is a source of energy derived by burning wood materials like logs and twigs and is common among the rural dwellers. It is a traditional source of energy, which has remained the major source of



fuel for over half of the world's population (FAO, 1981; Fuwape, 1995; Ogunsanwo & Ajala, 2002). According to the International Energy Agency (1999) and Aide (2002), the share of various energy sources in the total primary energy supply in Nigeria is made up of oil, 10.4%; gas, 6%; hydro, 0.6%; and commercial renewable energy, 83%. The greater portion of the commercial renewable energy is wood, while other agricultural wastes constitute the remaining smaller portion (Aide Memo-ire, 2002).

The over-dependence on fuel-wood for energy is chiefly because of its relatively low prices and easy accessibility (Fuwape, 1985; Adedayo *et al.*, 2008). Other reasons are constraints in the supply of the conventional fuels and the growing population with a larger segment still falling below incomes that can afford the cost of conventional fuels (Aide Memo-ire, 2002). In South Asia where there is a large poor population, poverty is the most significant parameter that drives extensive traditional use of fuel-wood and residues (Human Development Report UNDP, 1997; Aide Memo-ire, 2002).

Fuelwood is consumed in diverse ways and at different levels and the life of the majority of rural dwellers depends either directly or indirectly on fuelwood. However, meeting rural household fuelwood energy needs in the country has become a herculean task due to the enormous quantity of wood required. Daily consumption of firewood by the rural communities in Nigeria is estimated at 27.5 million kilogram per day (Aide Memo-ire, 2002). In the drive to satisfy fuelwood requirements, most lands have been stripped bare of vegetation cover. This has resulted in soil exposure and erosion thereby placing a heavy burden on the environment and on the resources base. The scramble for fuelwood has resulted in massive destruction of many wood resources leading to deforestation and increasing desertification in parts of Nigeria and other parts of sub-Saharan Africa (Barrott, 1972; Adedayo, 2005).

The rate of deforestation in Nigeria is estimated at 400,000 hectares per annum. Popoola (2000) observed that the country's forest

reserve which was estimated to be at 10% of the total land area in 1970 has been reduced to just 5% as of 1999, which is alarming. In Katsina state, which is located in Northern Nigeria, it was reported that the major source of firewood is farm trees, whose density is diminishing (Aide Memo-ire, 2002). In Benue state, the total land area covered by forest reserve is put at 2%. This falls far short of the 20% standard of the total land area set by the federal government for each state as minimum target for self-sufficiency in forest goods and services. With its small percentage (2%) of reserved forests, the projected wood deficit in Benue state is placed at about three million cubic metres by the year 2010. By implication, all the stakeholders in fuelwood consumption will have to find alternative sources of fuel for energy supply, if the environmental quality and energy supply are to be sustained.

Again, increasing industrial activities have led to increased environmental pollution through the release of green house gases (carbon dioxide and nitrous oxides) into the atmosphere by automobiles and other engines. The continuous burning of fossil fuels, fuelwood and bush burning have also contributed to environmental pollution (NEST, 2003). The increasing current demand on the natural purifiers (trees) for fuel wood without concomitant replenishment is an indication that the forest area will disappear fast, which makes the environmental situation more precarious. If no measures are put in place to check these threats, the environment might not be able to support life after a few years, particularly in the savanna ecological zone that is more fragile relative to the rainforest. It follows from the above that, the utilization of wood resources in the savanna lands should be done with caution.

This study evaluated fuelwood consumption patterns in Makurdi Metropolis and its implications on the environment. The specific objectives were to identify fuelwood consumption patterns and levels in Makurdi Area, identify the different wood species utilized for fuelwood in the area and to examine the implication of these uses on the environment.



## METHODOLOGY

This study was carried out in Makurdi Local Government Area (LGA) of Benue State. Apart from its status as the Headquarter of Makurdi LGA, Makurdi town also doubles as the state capital. The local government area is situated between latitude 6°22' and 7°56' to the North and longitude 7°37' and 9°5' East and has a total area of 325km<sup>2</sup>. In 2006, the population of the inhabitants was estimated to be 297,398 people comprising of 157,295 males and 140,103 females (NPC, 2007). The LGA is made up of 11 council wards; six of which were selected for data collection. The selected wards were noted for having large quantities of fuelwood and consumers of wood almost all year round. The primary occupations of the traditional inhabitants of Makurdi LGA were fishing and farming, and the settlers' civil service and trading. The wards

selected were Agan, Fiidi, Wailomayo, Modern market, Central South Mission and North Bank II. From each of these council wards, 30 respondents were drawn applying a random sampling technique.

A total of 180 respondents were selected and interviewed using a pre-tested checklist (questionnaire) to collect primary data between September, 2007 and June, 2008. Secondary data was generated from scientific articles and other reports published in journals, books, bulletins and newsletters.

Simple descriptive statistics were used in analyses of the variables studied using SPSS version 14. Frequencies and percentages were used to rank the fuelwood consumers, and the tree species that consumers preferred.

## RESULTS AND DISCUSSION

**Patterns of fuelwood utilization:** The results (Table 1) show that fuelwood was mostly consumed for household cooking (150.2 cords); representing 49.4% of the fuelwood consumed by the different user groups. This was followed by hotels/restaurants, 13.8%; rice milling, 11.2%; and burnt-bricks production, 11.1%. The least user-group of fuelwood was charcoal production (1.1%). This finding partially corroborates that of Fuwape (1985) and Adedayo *et al* (2008), who reported that over 95% of the Nigerian population in the savanna region, depend on fuelwood as the main source of domestic energy supply. The greater proportion of fuelwood utilized for household consumption could be explained by the fact that most homes depended on fuelwood for cooking since the cost of other fuels was higher (Sodimu *et al*, 2003). Similarly, other user

groups also preferred fuelwood to other energy sources because of easy availability, cheaper costs and its high heat production capacity. However, the mean distribution of fuelwood consumption level by the user groups revealed that consumption was essentially uniform, with every user group consuming an approximate mean of 6.0m<sup>3</sup> of fuelwood. This corroborates the findings of Jande (2005) that the household, which was considered the greatest consumer of fuelwood for its energy need is no longer the major consumer of fuelwood. The industrial consumption such as brewing of liquor, cooking in hotels/restaurants, brick production, oven baking, rice milling, and smoking of fish are now closing up the gap to equal households in fuelwood consumption.

Table1: Fuelwood utilization patterns in Makurdi Local Government Area, Nigeria.

Utilization Patterns	Quantity Used (m <sup>3</sup> )	Mean Quantity Utilized (m <sup>3</sup> )	Frequency	Percentage
Household Cooking	543.7	6.2	89	49.4
Hotels/Restaurant	152.0	6.1	25	13.8
Rice Milling	123.1	6.2	20	11.2
Brick Production	122	6.1	20	11.1
Brewing of Liquor	67	6.1	11	6.1
Oven Baking	61.5	6.2	10	5.6
Smoking Fish	18.8	6.3	3	1.7
Charcoal Production	12.0	6.0	2	1.1
TOTAL	1100.1	49.2	180	100

The lesson from this result is that there is a widening demand for fuelwood with limited supply sources. Thus

there is a massive exploitation of trees to meet the demand. The massive exploitation of the trees without



replacement is causing rapid disappearance of tree (vegetal) cover within Makurdi LGA and the environs. Consequently, there is environmental degradation leading to increased flood occurrences, soil erosion, drought, desertification and excessive heat and rising temperatures. Although there are no statistics to support this claim, observable signs like rampant floods, erosion and wind related disasters are being witnessed in Benue State for the past four years (2005 to 2009). Tee *et al* (2008) also reported that Benue State in the past three years is beset by harsh hammatan winds; dry air and very hot days, which hitherto were not experienced.

**Sources of fuelwood:** Data (table 2) showed that 62.2, 20.6 and 17.2% of the respondents obtained their fuelwood from free access areas, farmlands and the reserved natural forest areas, respectively. This means

the greater proportion (62.2%) of fuelwood consumption in the area comes from the free access areas, for most fuelwood dealers submitted that they got it from the neighbouring states in free access areas. The metropolis has very limited vegetal cover in the form of amenity trees and gardens. Consequently, there was extended pressure on the surrounding villages (which also have little tree density) for fuelwood supply, which has further aggravated the disappearance of forest cover in Makurdi area. This finding agrees with that of Adedayo *et al* (2008) showing that intense deforestation occurs more in forests closer to human settlement. This rapid disappearance of the natural purifiers (trees) and the corresponding increase in the release of greenhouse gasses to the environment by burnt brick producers, bakeries, breweries, automobiles, and industrialists has rendered the Metropolis environmentally unfriendly.

Table 2: Respondents' sources of fuelwood supply in Makurdi metropolis, Nigeria.

Sources	Frequency	Percentage
Farmlands	37	20.6
Free access areas	112	62.2
Reserved Natural Forest Areas	31	17.2
Total	180	100.0

**Tree species utilized as fuel by respondents in the area:** Results (Table 3) showed that the most utilized tree species were *Prosopis africana*, (65%), *Terminalia macroptera* (38.9%), *Burkea africana* (29.4%), *Daniella olivera* (27.8%), and *Vitellaria paradoxa* (25.6%). The reasons adduced for this were that these tree species have high heat capacities with hot amber, high combustibility, and production of quality fuel and

charcoal. The least used tree species were *Annona senegalensis* (1.1%), *Azalia africana* (1.1%) and *Ficus thonniigii* (0.6%) in that order. The reasons advanced for this low utility were that some of the species were scarce and others possess poor burning characteristics. Plate 1 shows photograph of different tree species displayed for sale by fuelwood dealers at North Bank Makurdi Market in Nigeria.



Plate 1: Species of fuelwood displayed for sale at North Bank Market in Markudi, Nigeria.

Discussion with key informants supported by personal observations revealed that *Vitellaria paradoxa*,

*Prosopis africana*, *Terminalia macroptera*, *Azalia africana* and *Pilliosigma thonniigii* were under threat of

extinction; the reasons being that much pressure is being mounted on them for fuelwood and charcoal production. More awareness is needed to sensitize the

people about the imminent adverse social and environmental consequences that will arise if this situation is not reversed.

**Table 3:** List of tree species utilized for fuelwood in Makurdi Metropolis, Nigeria \*(N=180).

S/No	Species' Name	Frequency	%	S/No	Species' Name	Frequency	%
1.	<i>Prosopis Africana</i>	117	65	15	<i>Sygygium gunieensis</i>	18	10.0
2.	<i>Terminalia macroptera</i>	70	38.9	17	<i>Pericopsis loxiflora</i>	16	8.9
3.	<i>Burkra Africana</i>	53	29.4	18	<i>Lophira lanceolata</i>	16	8.9
4.	<i>Daniella oliveri</i>	50	27.8	19	<i>Sacrocephata latiphalaws</i>	13	7.2
5.	<i>Vitellaria paradoxa</i>	46	25.6	20	<i>Ficus sur</i>	13	7.2
6.	<i>Parkia biglobosa</i>	42	23.3	21	<i>Azadiracta indica</i>	10	5.6
7.	<i>Khaya sengalensis</i>	38	21.1	22	<i>Bridelia ferruginea</i>	9	5.0
8.	<i>Gmelina aborea</i>	32	17.8	23	<i>Tectona grandis</i>	8	4.4
9.	<i>Mitryana inermis</i>	28	15.6	24	<i>Parinari curatellifolia</i>	7	3.9
10.	<i>Acacia spp.</i>	28	15.6	25	<i>Stereospermum kunthianum</i>	5	2.8
11.	<i>Terminalia superb</i>	27	15.0	26	<i>Steculia setigera</i>	4	2.2
12.	<i>Combretum spp.</i>	23	12.8	27	<i>Pillio stigma thonnigii</i>	3	1.7
13.	<i>Vitex doniana</i>	23	12.8	28	<i>Annona senegalensis</i>	2	1.1
14.	<i>Pterocarpus eminascerus</i>	20	11.1	29	<i>Azelia Africana</i>	2	1.1
				30	<i>Ficus thonnigii</i>	1	0.6

Note: \* Shows number of respondent

**Environmental effects of fuelwood utilization:** Focus group discussions and personal observations during ecological surveys in the area revealed that there has been considerable decrease in the vegetal (tree) cover in terms of number and species diversity (Plate 2). Over 90% of the respondents accede to the fact that this decrease was due to removal of trees for fuelwood, construction and agricultural purposes. Consequently, deforestation and its attendant effects; desertification, soil erosion, flooding, drought, and temperature rises were being experienced in the area for the past four years and at a threatening rate. At least 78.3% of the respondents attested that there has been serious disappearance of many tree species within their surroundings in the last 10 years. This finding agrees with that of Jande (2005) that over 50% of the forest cover in Markurdi environs and suburbs have been deforested for fuelwood and timber production in the in the last five years (2000-2004). Other activities that affected the environment negatively were the release of smoke or green-house gases (Carbon monoxide and Carbon dioxide) into the atmosphere from burnt brick production and brewing activities.

**Respondents' involvement in plantation establishment:** The data for the study shows that 27.8% of the respondents carry out tree planting

activities while 72.2% do not. This is considerably low compared to the level of tree felling activities going on in the area; as a result of which many locations are degenerated giving rise to marginal sites and spots (Plate 2). Marginal sites as used here were lands that could no longer support agricultural production, fuelwood supply or other socio-economic and environmental services effectively. The reclamation of these marginal lands is an imperative, thus; government, non-governmental organizations, local people and other stakeholders should jointly intervene towards saving the forest from continuous degeneration.

**Respondents' attitudes toward forestry regulations:** Results (Table 4) revealed that 76.7% of the people are aware of forestry laws concerning afforestation and deforestation. However, adherence to these laws is very minimal hence the continued intrusions into the existing forests. The non-adherence to forestry regulations by the respondents was attributed to some defects in the existing enforcement structures in Benue State. The respondents decried that many forest officers commit flaws in the course of enforcing the regulations. They alleged that some forest officers, even Directors of Forestry, own power saws and are themselves involved in indiscriminate flitching activities



with impunity. There were also reported cases of connivance between forest officers and timber contractors to carry out logging activities for a token to the detriment of the forest. Apart from the above reasons, the forest guards that were expected to keep watch over the protected areas were hardly available at their duty posts, and so, trespassers are always at liberty to encroach the protected forest areas unnoticed. All these add up to bring the forest area to its present degraded situation. This situation has to be reversed if sustainable forest management is to be attained in Benue State.

Furthermore, as shown in Table 5, 31.7% of the respondents cannot avoid cutting down trees from the existing reserves. This is because they have been using firewood since childhood, and again it is relatively cheaper and an additional source of income. Thirty

percent of the respondents revealed that trees should be cut but with permit, while 18.3% were of the opinion that only the endangered species should not be cut. Twenty percent, mostly traditional inhabitant, were not concerned about forestry laws on afforestation and deforestation. Of this group, some were aware of the forestry laws and regulations; however, they felt they are the legitimate and bona-fide owners of the forest, and so government has no control on them. Very few claimed ignorant of any forestry law. If these people are mobilized and trained based on their respective limitations and strengths specified above, they may be used in jointly managing forest resources in Makurdi metropolis. This approach will significantly save the forest from further degradation and the attendant negative consequences.



Plate 2: A degenerated forest area in North Bank, Markudi, Nigeria.

This research study reveals that a large amount of fuelwood is being utilized at both the domestic and commercial levels. However, little effort is being made in afforestation, which implies that in a short time, there will be acute scarcity of fuelwood also. In addition, the

adverse effects of deforestation on the environment will be experienced greatly if measures are not put in place in time. Deliberate efforts are required to curtail the present level of deforestation and disappearance of plants.

Table 4: Awareness of forestry laws among the population in Makurdi Metropolis, Nigeria.

Response	Frequency	Percentage
Yes	138	76.7
No	42	23.3
Total	180	100



Table 5: Attitude of respondents towards forestry laws (N =180).

Response	Frequency	Percentage
Cut Down Trees But With Permit	54	30
Endangered Species Should Not Be Cut	33	18.3
Cannot Avoid Cutting Of Trees	57	31.7
Not Concerned About It	36	20
Total	180	100.0

## CONCLUSIONS AND RECOMMENDATIONS

Fuelwood is the major source of energy for the inhabitants of Makurdi metropolis. It is utilized for a variety of purposes both domestic and industrial. There is a widening demand for fuelwood, with increasing pressure on the remaining forest trees.

The supply of fuelwood within the metropolis is mainly from fuelwood dealers, who obtain it mainly from the free access forest areas and on farmlands. For the continued supply of wood and protection of the forest, the traders and other user groups should be made to pay for research and establishment of the trees in plantations. Increased awareness and education on the environmental consequences of over-exploitation and poor management practices should be intensified, while joint management efforts are explored between forest managers, traders and other stake-holders. Several species including *Vitellaria paradoxa*, *Prosopis africana*, *Terminalia macroptera*, *Terminalia superba*, *Azalia africana*, and *Pilliosigma thonningii* are under threat of extinction. Adoption of improved harvesting techniques, reduced exploitation pressures, extensive silvicultural research and planting of these species in plantations as well as proper enforcement of forest regulations will protect these trees from extinction. In spite of these threats the involvement of people in tree planting and forest protection in the metropolis is abysmal and adherence to forest regulation generally negative.

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