E3 Journal of Environmental Research and Management Vol. 3(7). pp. 0180-0188, March, 2013
Available online http://www.e3journals.org
ISSN 2141-7466 © E3 Journals 2012

Full Length Research Paper

Assessment of Socio-economic Factors Affecting Household Charcoal use in Makurdi Urban Area of Benue State, Nigeria.

Ogwuche Jonathan Ali And Mr Asobo Victor

Department of Geography Benue State University, Makurdi, and Viktuwa Environmental Managers, Makurdi

Accepted 7 February, 2013

The pronounced shift to charcoal as a major household fuel in Makurdi urban area has raised concerns among people. Investigating the factors that drive this led to the use of 1000 purposively selected charcoal users in Makurdi urban area. Using Multiple Regressions, 6 main household socio-economic factors were identified that promote the popularity and use of charcoal in the households. These are (in order of contribution) gender, age, literacy, size, income, and access. The study, using ANOVA, has shown that increase in income does not translate to increase in quantity of charcoal used in the household. However, it identified, using T-Test, significant difference in the quantity of charcoal used in male- and female-headed households. The study recommends sustainable production and use of charcoal through proper management, supervision and planning of supply sources, to conserve wood resources, reduce migration, and improve people's livelihoods.

Key Words*: Charcoal, fuel switching, fuel stacking, household characteristics, and socio-economic factors*

.

INTRODUCTION

Household fuels constitute energy sources used for domestic cooking, space heating and lighting, but, according to ESMAP (2003), excludes fuels for transportation. Many of the different types of households' fuels in use in developing countries come under the category of "traditional", which include animal dung and agricultural residues, as well as woodfuel. Woodfuel, in the view of World Resources (2001), comprises of charcoal, firewood and other wood-derived fuels; and also constitutes the most important form of non-fossil energy used in households.

In the urban areas, a wide selection of household fuels and equipments is available for use. Of all sectors, the household sector experiences the most pronounced changes in its pattern of fuel use over time. Typically, a household may shift from biomass to kerosene, gas, and finally to electricity for specialized cooking. This shift phenomenon is often referred to as 'fuel transition' from traditional (biomass-based) to modern household fuels (Sathaye and Taylor, 1991). Also, even within the biomass-based fuel, there is a shift from one to another.

For a number of developing countries, including Nigeria, issues relating to household energy choice and transitions are important from a policy standpoint. Efforts at encouraging households to make substitutions that will result in more efficient energy use and less adverse environmental, social and health impacts are advocated in many of these countries. To achieve this requires research and analysis of the factors affecting household energy choices and use.

Despite a major shift in the use of household energy, many households rely solely on charcoal as their primary source of cooking energy, especially in urban areas. The popularity of the transition to charcoal was brought to the fore following the acute scarcity of firewood and kerosene as well as their exorbitant prices. Uzoma (2006) reports that the kerosene scarcity led to the invention of *Abacha Coal Pot* - a locally made stove that use charcoal. Over the years, the cooking technology of the coal pot became widely accepted and used. Also, the high initial investment cost of kerosene stove, gas and electric cookers, coupled with low generation, and cost of

*Corresponding authors: E-mail: ogwuche.jonathan@yahoo.com

electricity discouraged the use of alternative fuels in favour of charcoal. Because of these, African ministers on African preparatory conference for the World Summit on Sustainable Development in 2001, submitted that at least 80% of African population continues to depend on traditional biomass fuels (charcoal and firewood) for their energy needs. Also, Harsch (2001) reports that the continents' urban population, growingat an average rate of 4% per annum, is putting more demand for charcoal, and by extension the forests and other biomass services. It is therefore reasonable to infer that biomass (mainly charcoal) will remain the key source of energy for most of the population in sub African continent for several decades to come. This observation is shared by various institutions including the World Energy Council (World Energy Council in its WEC statement in 2000), the Food and Agricultural Organization (FAO)(Gustatson, 2001), and the UNDP (2000).

The use to which charcoal is subjected to is as old as man. Charcoal, very often constitutes the most frequent type of archaeobotanical remains on archaeological sites. The information it provides, according to Zapata, Pena, Ibanez and Gonzalez (2003) is two-fold. First, environmental, showing at least the presence of different taxa in the vicinity of a site; and secondly, ethnobotanical, showing patterns of wood provision and preferences of human groups when collecting trees and shrubs for fuel. However, Asouti and Austin (2005) suggest that greater integration of charcoal and archaeological data is needed when evaluating charcoal preservation and sample composition, and that a more coherent theory of the complex ecological and cultural processes affecting species availability and firewood management needs to be developed.

It has been proposed in a number of recent publications that ethnoarcheology constitutes an appropriate way to expand the range of hypotheses currently applied to the analysis of fuel remains from prehistoric sites, in order to move beyond the classic paleoecological and paleoeconomic interpretations (Zapata et al 2003, According to Asouti and Austin (2005) ethnoarcheological studies can provide useful insights into how different ways of perceiving the landscape may be translated into habitual woodland exploitation practices. However, the objective of undertaking ethnoarcheological research is to gain a better understanding of the complex ways in which cultural, ecological and economic variables may interact in shaping an activity as important and as routine as charcoal collection in modern societies.

Charcoal was used during the world war to power commercial road vehicles usually buses; where oil was scarce or completely unavailable. In North Korea, such vehicles are still in use till today. Besides its household use, charcoal has industrial applications, as well as in metallurgical operations, as a reducing agent (FAO, 1983). Even in developed countries, there is an increasing demand for charcoal as barbecue fuel. This heavy reliance on charcoal that characterize energy consumption in much of the urban households in developing countries, like Nigeria, seems to be tied to socio-economic characteristics of the households and as well as some factors that propel its choice. This is the sole aim of this paper.

Statement Of The Problem

In Makurdi urban area, urbanization and economic development are bringing about changes in consumption patterns, which in turn are leading to major changes in the household energy sector. A pronounced shift from petroleum products to charcoal in the area has raised some concerns, as witnessed in the increases in the number of traders on charcoal, charcoal shops, as well as charcoal users. The real effect of this problem is that the government's understating of household fuel sector in the area is minimal, and the ability to predict and plan household fuel agenda is woefully inadequate. Attempts at such studies at the national level have been based on estimates, which are usually generalized. This implies that the factors that drive this household energy shift to charcoal are complex and location-specific. These factors should therefore be identified to serve as a basis for formulating a sustainable household fuel agenda, as well as to allow for the design of site-specific strategies and programmes to address wood development issues in the state.

The Study Area

Makurdi, the state capital, is the largest urban area in Benue State. It is located between latitudes 7^0 35^1 – 7^0 53^1 N and longitudes 8^0 24^1 -8^0 42^1 E, and covers a land area of about 800km^2. The urban area is traversed by the River Benue, which divides it into two - Makurdi North and South, as shown in figure 1.

Makurdi is located in the Guinea Savannah vegetation zone. This is a transitional zone separating the forested belt of the South and true savannah of the North. The vegetation consists mainly of grass and variety of scattered small trees and shrubs. Much of the natural vegetation is being depleted due to persistent and uncontrolled deforestation, bush burning, and intensive cultivation of the arable agricultural land. However, the use to which these wood logs are subjected in Makurdi is accentuated now by the increasing socio-economic variables in the area. Also, the demand for charcoal seem to be heightened in the area now due to increase in population, civilization and modernization, and poverty.

The inhabitants are predominantly civil servants, and

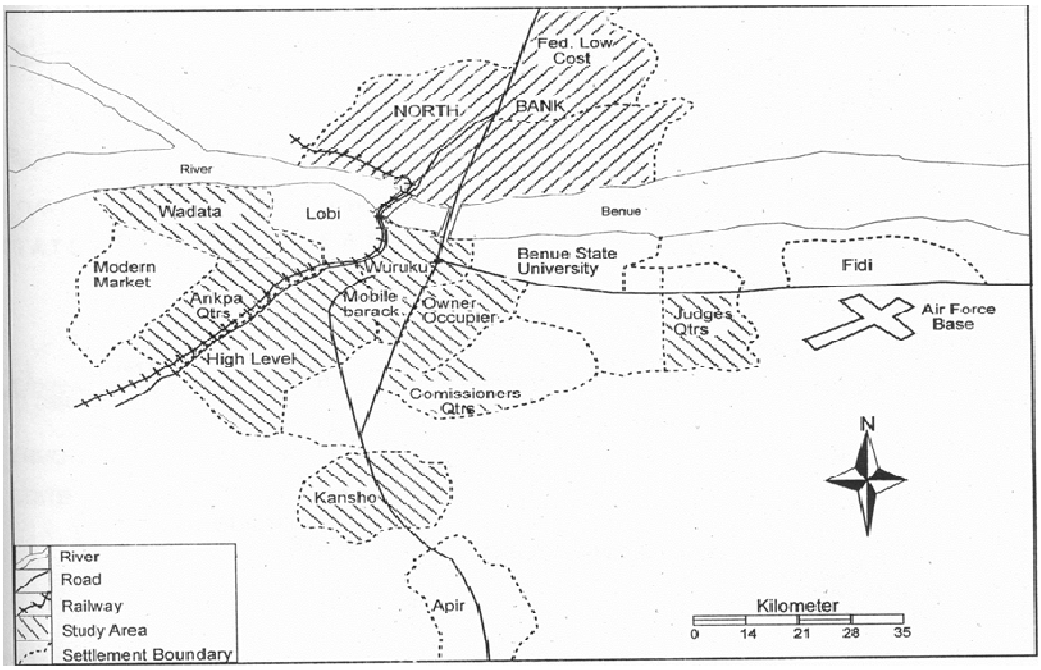

Figure 1: map of makurdi urban area showing residential are
Source: ministry of land and survey makurdi

farmers of tropical crops. The presence of alluvial soil and abundant surface water makes urban agriculture and market gardening to gain prominence throughout the year in the area. This serves as a major source of livelihoods to many producers and traders, thus stimulating commercial activities in the area.

Types And Uses Of Charcoal

Charcoal is the dark grey residue consisting of impure carbon obtained from vegetation substance, and is produced by slow pyrolisis, the heating of wood or other substances in the absence of oxygen. FAO (1983) sees charcoal as a soft, brittle, lightweight, black, and porous material that resembles coal. Charcoal burning is probably the oldest chemical process known to man.
Commercial charcoal is found in either lump, briquette or extruded forms (Resende, 1983). The lump charcoal which is the commonest is made directly from hardwood material and usually produces far less ash than briquette. Briquettes are made by compressing charcoal, typically made from sawdust and other wood by-products. Extruded charcoal is made by extruding either raw ground wood or carbonized wood into logs without the use of a binder.

A number of literatures have dwelt on the various uses of charcoal for various purposes, beside its household use in cooking and boiling (FAO 1983, Kaale 1985, World Bank 2000). In addition to these, Foley (1986) enumerates three distinct uses of charcoal that makes it unique as household fuel. They are:

i. excellent domestic fuel: charcoal is cleaner, easier, and less smoky and smelling than other biomass fuels,
ii. **light weight:** conversion of wood into charcoal reduces its weight, and makes it easier and cheaper for transportation. It can also be used in smaller quantities, with cheap burning devices for domestic applications, and
iii. high energy content: the calorific value of charcoal primarily depends on its quality, depending on the amount of water, volatility and ash content. Charcoal commonly used for domestic purposes have a net calorific value of 28Mj/kg. This net energy value is roughly twice as much as air dried fuelwood. This big difference makes charcoal cheaper to transport over a longer distance compared to fuelwood.

Emergence Of Charcoal As A Household Fuel

In Africa, over 90% of the wood taken from forest is woodfuel (Amous, 2000). This majority is consumed directly as fuel. This substantial amount is transformed

into charcoal. Substantiating this, Pereira *et al* (2001) claims that more than 80% of it is used in urban areas, making charcoal the most important source of household energy in many African cities. To buttress this, Kalu and Izekor (2007) discovered that charcoal enterprise has been adopted to meet some socio-economic benefits and energy needs of the people. Also, Alemu *et al* (2009) report that annual charcoal production in Kenya is estimated to be around 1.6 million tons, and households are consuming between 350 to 600 kg annually; and estimate that about 2 million people are economically dependent on charcoal production, transportation and trade.

The importance of charcoal is also reflected by the fact that 4 African countries rank among the 8 countries with the highest charcoal production worldwide (Williams, 2000). In the ranking, Nigeria is the 2nd in Africa, after Kenya, and 4th in the world with 1.8 million tons per year. The pattern of household energy consumption represents the stage of welfare as well as the stage of economic development. As the economy develops, more and cleaner energy is consumed. Rapid urbanization increases the total urban demand for household energy, as well as facilitates the process of fundamental transformation in the organization of human behaviour.

Socio-Economic Factors Affecting Household Fuel Use

A synthesis of socio-economic studies on household energy supply and demand in developing countries has been carried out. Amous (2000) identify income and price as the most predominant and significant factors. Guptilla and Kohlin (2003) observe that increase in population, family size, economic activities in household, often lead to increase in the use of fuel. In their view, increasing economic activities lead to increasing incomes and a better quality of life for the members of the households. Growth in population and income of the household stimulates the socio-economic transformation that moves households to more diverse and intensive use of household fuel. This shows that as people move up the income ladder, they adopt energy-intensive lifestyles. For instance, Olubusola (2007) claims that the choice between firewood and charcoal among urban families seems to be dictated, to a large extent, by poverty, with charcoal having the highest figure.

A number of economic literatures contain a number of multivariate economic analyses of household fuel demand that include income as an explanatory variable. In a demand analysis of gas consumption in Nigeria, Adegbulugbe and Dayo (1986) observe that several energy studies have been carried out to model the demand for energy, and that these are econometric in nature and usually relate energy consumption to such independent variables as disposed income, price, transportation and energy substitutes.

How responsive charcoal demand is to its own price is at the heart of the charcoal scarcity issue. In urban areas, a study such as Leach (1993) indicates that charcoal demand is responsive to increased scarcity. Cross-price elasticities between charcoal and other fuel indicates how close they are as substitutes. Study carried out by Gundimeda and Kohlin (2003) shows charcoal to be a significant substitute for firewood. The study also shows that the use of firewood declines by 3% for every 10% increase in its price relative to kerosene, while the use of charcoal increases by about 6% for every 10% increase in the price of firewood relative to kerosine. Gundimeda and Kohlin (2003) further explained that this is consistent with the hypothesis that firewood scarcity near urban areas, accompanied by rising prices causes switching from firewood to charcoal.

Besides income, Guptilla and Kohlin (2003) identify convenience, price and reliability of supplies as the main attribute influencing transition to charcoal use. In general, they observe that charcoal consumption decisions depend on how household characteristics interact with external factors such as prices, forest cover, population and urbanization.

METHODOLOGY

This study used the household survey research method as the study design, as it deals with the relationship between variables as well as the development of generalizations that have universal validity (Nworgu 2005, Best and Kahn 2006). Also a questionnaire was designed as the research tool to elicit information from the respondents on household socio-economic characteristics as they relate to charcoal fuel use in the household.

Sampling Techniques

Two classes of sampling techniques were employed in this study. First, stratified sampling technique was used to stratify the study area into eleven (11) residential areas. Secondly, purposive sampling technique was used to choose the target respondents, i.e. those households that use charcoal as their primary or secondary or occasional household fuel.

Data Collection

A sample size of 1000 respondents, purposively chosen from the eleven (11) residential areas in Makurdi urban area was used for this study, based on the criterion of

Table 1: Gender of the Head of Household

Variable	Frequency	Percentage (%)
Male	690	69
Female	310	31
Total	1000	100

Table 2: Age Distribution of the Household Heads

Variable	Frequency	Percentage (%)
Less than 40	264	26
40-59	460	46
60-79	240	24
80 and above	40	4
Total	1000	100

common interest that is anchored on the socio-economic characteristics of the households. Respondents were served the questionnaire to respond to, and at the end all of them distributed were retrieved. In this study, the dependent variable is the use (quantity) of charcoal in the household, whereas, nine (9) of household socio-economic characteristics were used as independent or predictor variables. They are gender, size, income, literacy, age, livelihood activities, access, fuel switching, and status of fuel use. A brief analysis and discussion of these variables is given below:

Gender Of The Head Of The Household

Gender of the head of the household is a very significant factor in the household. Female headed households are distinct from male-headed households, especially in terms of decision-taking the household. Charcoal issues are kitchen items that are in the domain of women. Here, women can take better decision about the quality needed for the household for the various types of food to be cooked than the men. Table 1 shows the gender distribution of the head of households

Table 1 shows that 69 percent of the households are male-headed whereas 31 percent are female-headed. This means that there are more male headed households than female head households since charcoal is a kitchen item which is within the domain of women, the women (in the 31 percent female headed households) can take better decision about the quality needed for the household for the types of foods to be cooked as against men in the 69 percent male head households).

Age Of The Head Of The Household

Age is a vital factor in this study because it relates to the types of food to be cooked, frequency of cooking and household size. Younger heads of households seem to eat different meals and frequently than the older ones, hence more charcoal is needed. However, they are not likely to have larger household sizes than the older ones. Charcoal is more modern than firewood, so younger heads of households could adopt it easier than the older household heads. The result of the age distribution of the heads of households is shown in table 2.

Table 2 shows that 72 percent of the household heads are of age less than 40 and between 40-59 and are hereby classified as young. This means that there are younger household heads than the older once (28 percent). The implication of this is the ease within which the younger household heads would adopt the use of charcoal in the households.

Economic Activities In The Households

The economic activities undertaken in the household is a very strong factor that affects household charcoal use. In urban areas especially, economic activities such as frying of beancakes, roasting of yams, maize, meat, fish, plantain, etc, are carried out in the residential houses as part of their livelihood activities that require charcoal. The essence is to supplement the family income, and is usually undertaken by the women and children. Table 3 shows the household economic activities and the energy the households use for them.

From table 3, it can be seen that all the 12 household economic activities undertaken in Makurdi urban area are carried out with charcoal as the main energy. It is noticed that only in the making of *suya* that firewood is used more than charcoal.

Literacy Level Of The Head Of Households

The literacy level determines the level at which the head of the household is informed. This variable is closely related to social status, income, household size, eating habit, and type of food consumed. All these can trigger fuel switching to charcoal, as well as the quality of charcoal that is needed in the household. The literacy level categorization is shown in table 4.

Table 4 shows that 53 percent attained tertiary education (polytechnic, college of education, and university) whereas only 12 percent have no education. This implies that a greater number of the head of households are well learned and enlightened.

Number Of Persons In The Household

The number of persons in the household i.e the

Table 3: Household Economic Activities and Energy in use

S/No	Household Economic Activities	Energy in use (Frequency)
1	Frying Beancakes	Charcoal (27)
2	Roasting Yams	Charcoal (21), Firewood (11)
3	Roasting maize	Charcoal (86), Firewood (2)
4	Roasting meat	Charcoal (43), Firewood (18)
5	Roasting fish	Charcoal (29), Firewood (9)
6	Roasting plantain	Charcoal (13), Firewood (3)
7	Frying groundnut	Charcoal (53), Firewood (6)
8	Cooking food	Charcoal (128), Firewood (12), Kerosene (41), Gas (3)
9	Metal works	Charcoal (13)
10	Baking of bread and cake	Charcoal (27)
11	Making *suya*	Charcoal (16), Firewood (25)
12	Laundry	Charcoal (16)

Table 4: Literacy Level of Heads of Households

Variable	Frequency	Percentage (%)
No education	120	12
Primary education	180	18
Secondary education	170	17
Tertiary	530	53
Total	1000	100

household size is also an important variable in the study. Moving from a predominantly rural area to an urban area involves many changes for households. Large families are an economic asset in the countryside, since child labour can help in household economy. While immigrants to urban areas initially retain rural traditions, including large families, the implication here is that more household fuel is needed. The number of persons in the household can also influence the types and quality of food to be cooked, as well as the quantity of charcoal to be used. It is therefore obvious that the household with large number of persons will use more charcoal than those with few numbers of persons.

From table 5 above, 76 percent of the households have 5-10 persons in their households with only 15 percent with less than 5 persons. This explains the increase in the population of urban areas. In most households, besides the household head and the wife or wives there are children as well as dependents. Since all these household members should be fed at home, there should be a corresponding increase in the quality of charcoal needed for cooking.

Monthly Incomes Of The Head Of The Households

The monthly of the head of the household determines the economic status of the household. The higher the income of the head of the household, the greater the flexibility of shift to the desired household fuel. For instance, high relative prices of other household fuels induce fuel switching usually, towards charcoal. Specifically high income households continue to use charcoal after they have otherwise switched to modern fuels. Heltberg (2005) gives two reasons for this. First, it competes with wood as a cooking fuel in urban areas where wood has become distant from urban centres; and as such it acts as a transition fuel. Second, it competes with modern fuels in some end uses, i.e specialized cooking. Table 6 shows the monthly income of the heads of households.

Makurdi urban area is a civil service town, where the majority of the people are civil servants with a few business men and women. This is clearly reflected in table 6. The majority of the households heads (32 percent) earn between N51,000 – N100,000 monthly. The 26 percent that are traders fall among those whose monthly income are less than N20,000, moreso as they cannot quantify their monthly earning. However, their monthly earning/income are relatively sufficient to purchase the quality of charcoal needed in the household.

Distance Covered to Access Charcoal

The distance here refers to the distance from the household to the point where charcoal is sold. This distance is a measure of access to the household fuel. The respondents expressed the distance they cover to access charcoal in table 7.

Table 7 reveals that 53 percent of the households cover

Table 5: Number of Persons in the Households

Variable	Frequency	Percentage (%)
Less than 5 persons	150	15
5-10 persons	760	76
11 persons and above	96	9
Total	1000	100

Table 6: Monthly Income of the Heads of Households

Variable	Frequency	Percentage (%)
Less than N20,000	260	26
N20,000-N50,000	300	30
N51,000-N100,000	320	32
N101,000-N150,000	60	6
N151,00 and above	60	6
Total	1000	100

Table 7: Distance Covered to Access Charcoal

Variable	Frequency	Percentage (%)
Less than 50m	530	53
50m-1km	360	36
1km-3km	100	10
Above 3km	10	1
Total	1000	100

less than 50m to access charcoal. This indicates that charcoal is available within the neigbourhood. Also, 36 percent of the households who access charcoal within 50m-1km are those who live in the urban fringes, hence trek that distance to the core centre of the town. The implication is that the less distance to be covered to access charcoal, the bigger the quantity to be purchased, moreso since transportation cost is not involved.

Data Analysis

Two types of statistical analytical tools were used - the Multiple Linear Regression and Analysis of Variance (ANOVA). The results of these are shown in the tables below.

From table 8, the study identified that the use (ie quantity) of charcoal (dependent variable) a household uses is explained by 6 main predictor variables, called factors. These factors are the household socio-economic characteristics that affect charcoal use in the households in Makurdi urban area. The effects of each of the socio-economic factors on the use of charcoal in households can be obtained from inspection of each of their percentage contributions (R^2). In decreasing order, they are listed below;

i. Gender (Gender of the household head)
ii. Size (Number of persons in the household)
iii. Age (Age of the household head)
iv. Income (Monthly income of household head)
v. Access (Distance covered to collect charcoal), and
vi. Literacy (Literacy level of household head)

Also, from computation, as shown in table 8, the correlation (R) between the dependent variable and the linear combination of the 6 predictor variables is 0.962. This indicates a very significant and positive relationship. The coefficient of multiple determination, (R^2), is 0.925. This means that 93 percent of the variation in the quantity of charcoal can be attributed to the variations in the six (6) predictor variables

Further, analysis using ANOVA, shows the following result in table 9.

Table 9 shows that since the probability value (P = .038) is less than the alpha level (R = .05) for 2-tailed test, there is significant difference in the quantity of charcoal used in male- and female-headed households. The reason for this is that women are better managers of kitchen items (including charcoal) than men, where they are the main actors. However, this is in disagreement with a study by Mekonnen and Kohlin (2008) in Ethiopia, where charcoal consumption was higher in male-headed households than female-headed households.

On the status of charcoal use in Makurdi urban area, 50 percent of the households use charcoal as their primary household fuel, while 39 percent use charcoal as

Table 8: Regression Analysis of the Main Predictor Variables

Predictors	R^2	% of Coefficient of Det.
Gender	.200	20.0
Age of the Household Head	.151	15.1
Literacy of Household Head	.101	10.1
Number of Person in the Household	.230	23
Monthly Income of Household Head	.131	13.1
Distance Covered to Collect Charcoal	.112	1.2
Total		92.5

Table 8: Model Summary of Regression Analysis.

R	R^2
0.962	0.925

Table 9: Result of T.Test on Gender and Quantity of Charcoal

Variables	N	Mean	SD	F	Df	P	R	Rmk
Male	69	2.536	9.788	-1.767	98	.038	.05	Sig
Female	31	2.935	1.181					

their secondary and only 11 percent use charcoal occasionally. This shows that besides the use of charcoal as a primary household fuel, charcoal is also used in conjunction with other household fuels such as kerosene, firewood, or gas. This is a typical case of fuel stacking in which modern fuels are used alongside traditional ones (Masera, Saatkamp and Kamonen 2000). In the study area, charcoal is used for cooking (72%), boiling (11%), roasting (10%), and ironing of clothes (7%). Household uses constitute 67 percent of charcoal utilization and commercial activities account for 33 percent of charcoal utilization.

Besides socio-economic factors, other reasons that promote the popularity and use of charcoal in the area were revealed from this study. They include availability, affordability, increase in household-based livelihood activities, feeling of being modern, urbanization, as well as the intrinsic characteristics that charcoal possesses.

CONCLUSION

This study has identified the main socio-economic factors that affect charcoal fuel use in households in Makurdi urban area. These factors explain 93 percent of the variation in the use of charcoal in the household in the area. Urbanization in the area is on the increase, with attendant consequences – increase in population and economic activities. In the area, these factors are sustained; hence imply that charcoal will continue to be widely used in the household for livelihood activities. Besides this, charcoal has inherent characteristics that are advantageous to the users. All these justify the popularity of charcoal as a major household fuel in Makurdi urban area. However, if these factors improve positively, the quest for fuel transition from charcoal to improved cleaner household fuels in the area.

RECOMMENDATIONS

This study recommends adequate forest management, supervision and control practices so that the growth of charcoal use does not have serious negative impact on forested areas. To this end, it is recommended that the government should:

initiate efficient management of existing forests and plantations so as to have sustainable supply of wood for charcoal production,

increase its investment and encouragement in community participation in wood-related development through community/social forestry,

subsidize the current cost of kerosene and gas to ensure availability for a smooth shift from charcoal to improved cleaner household fuels, and

promote improved and more efficient charcoal stoves that emit significantly less smoke, for health and environmental purposes, and

political will to improve the socio-economic conditions of the residents to facilitate fuel transition from charcoal to cleaner fuels.

REFERENCES.

Adegbulugbe AO, Dayo FB (1986). Demand analysis of gasoline competition in Nigeria. Centre for Energy Research and Development, University of Ife, Ile-Ife.

Alemu M *et al* (2009). Income alone doesn't determine adoption as choice of fuel types: Evidence from households in Tigrai and major cities in Ethiopia. EFD Policy Brief.

Amous S (2000). Review of wood energy reports from ACP African countries. EC-FAO Partnership Programme Working Document, Rome.

Asouti E and Austin P (2005). Reconstructing Woodland Vegetation and its Exploitation by Past Societies, Based on the Analysis and Interpretation of Archaeological Wood Charcoal Macroremains, Environmental Archaeology, 10: 1-18

Best JW and Kahn JV (2006). Research in Education. India, Person Education Inc.

ESMAP (2003). Household fuel use and fuel switching in Guatemala. Joint UNDP/world Bank Energy Sector Management Assistance Project.

Food and Agricultural Organization (FAO) (1983). Wood fuel surveys. GCP/INT/365/SWE, Food and Agriculture Organization of the United States, Rome.

Foley G (1986). Charcoal making in developing countries. Technical Report No 5. IIED. Earthscan. London.

Gundimeda H, Kohlin G (2003). Fuel demand elasticity for energy and environment studies, Indian sample survey evidence. Env. Econs. Unit. Dept. of Econs. Goteborg Univ. Sweden.

Guptilla G, Kohlin G (2003). Preference in urban domestic fuel demand: The case of kolkata, India. Env. Econs. Unit. Dept. of Econs. Goteborg Univ. Sweden.

Gustafson D (2001). The Role of Woodfuels in Africa, Food and Agricultural Organization, in Wamukonya (ed) Proceedings of the African High-Level Regional Meeting on Energy and Sustainable Development, 10-13 January, 2001 Nairobi, Kenya.

Harsch E (2001). African Cities under Strain. Africa Recovery, Vol 15, No 1-2, United Nations.

Heltberg R (2005). Factors determining households' fuel choice in Guatemala. Env. and Dev. Econs. 10: 337 – 361.

kaale BK (1985). Utilization of fuel wood and charcoal in East Africa. Energy Resources Group Review Paper 38. Ministry of Land, Natural Resources and Tourism.

Kalu C, Izekor DN (2007). Charcoal enterprise in Benin City, Edo State. J. Ap. Sc. Env. Mgt. 11(30): 63-67.

Leach G (1993). The Energy transition. Energy Policy. 116-123.

Masera O, Saatkamp B, Kamonen D (2000). From bio-energy fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. World Development. 28 (12): 2083 -2103.

Mekonnen A, Kohlin G (2008). Determination of Household Fuel Choice in Major Cities in Ethiopia. Env. for Dev. Disc. Paper Series No. 18.

Nworgu BO (2005). Introduction to Educational Research. Ibadan, Longman Publishers

Olubusola O (2007). Energy poverty in urban Africa: A case study of the energy needs of urban poor in Lagos and Ibadan, Nigeria. Being M.Sc Dissertation, Imperial College, London.

Pereira C, Brouwer R, Monjane M, Falcao M (2001). Charcoal potential in Southern Africa. University of Ecuador Mondale, Mozambique.

Rezende ME (1993). Commercial Charcoal Manufacture in Brazil. First Biomas Energy Congress of the Americas, Burlington, Vermont, USA.

Sathaye J and Tayler S (1991). Transition in household energy use in urban China, India, the Philippines, Thailand, and Hong Kong. Annual Review of Energy and the Environment.

Uzoma CD (2006). Indigenous People Right Crusader. WRM's Bulletin No 106.

United Nations Development Programme (2000) World Energy Assessment, UNDP/UN DESA/ WEC

Williams E (2000). Global Production Chains and Sustainability: the Case of High Purity Silicon and its Application in IT and Renewable Energy. United Nations University.

World Bank (2000). A Review of World Bank's 1991 Forest Strategy and its Implementation Volume 1: Main Report. Op. Eval. Dept. World Bank. Washington D.C

World Resources (2001). People and Ecosystem: The Fraying Web of Life. WRI. Washington D. C.

Zapata L, Pena L, Ibanez JJ and Gonzalez JE (2003). Ethnoarchaeology in the Morocan Jebala (Western Riff): Wood and Dung as fuel, Food, and Fields. Process in African Archaeobotany (K. Neumann, A. Butlery, S. Kahlheber, eds.), Koln: Barth-Institut-Hendrik: 163-175.