

CHARCOAL VERSUS OTHER DOMESTIC COOKING FUELS: SURVEY OF FACTORS INFLUENCING CONSUMPTION IN SELECTED HOUSEHOLDS OF BENUE STATE, NIGERIA

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ABSTRACT

Production of charcoal constantly generates debates during discussion on sustainable forest management due to its contribution to forest loss. However, it was reported that consumption of charcoal is on the increase. The need for assessment of socio-economic factors influencing consumption of charcoal as domestic cooking fuel necessitated this study. Structured questionnaire was administered to ninety respondents sampled from households in six Local Government Areas (LGAs) in Benue State, Nigeria. About 76.7% of the sampled households used charcoal as energy for cooking food. Rank on top of the main reasons for using charcoal by majority of the households was due to its cheaper cost (62.8%) when compared with other domestic cooking fuels. More than half of all the respondents (54.7%) informed that their households purchased charcoal in retail quantity and from roadside retailers. On monthly basis, total average amount spent by the sampled households on charcoal was ₦3,310.37 while the average amount of ₦2,394.78 was spent on alternative cooking fuels. About 55.0% of the respondents affirmed that they would change to other convenient types of energy if their standards of living improve. Increase in the use of charcoal poses a major concern to sustainability of forest management. There is need for appropriate intervention to facilitate availability and affordability of alternative domestic cooking energy to charcoal. To facilitate efficient use of charcoal, there is need for introduction of efficient equipment such as improved charcoal stoves. Establishment of plantation of fast growing tree species should also be explored for production of charcoal and reduce impacts on natural forests.

Keywords: Affordability, frequency of use, charcoal, cooking energy, standard of living

INTRODUCTION

It has been estimated that over two billion people in developing countries rely on biomass energy in the form of firewood, charcoal, crop residues, and animal wastes to meet their cooking and heating requirements (MEA, 2005). The links between fuelwood (firewood and charcoal) use and deforestation, as well as expected fuelwood shortages, have been established (Schulte-Bisping *et al.*, 1999; Kauppi *et al.*, 2006). The number of people relying on fuelwood is expected to keep increasing with an estimate of about three quarters of total residential energy in Africa by 2030 (IEA, 2002). Moreover, it has been estimated that charcoal consumption is often growing faster than firewood consumption and also becoming a much larger part of the fuelwood total in Africa and South America (Barnes *et al.*, 2002; Wurster, 2010).

Charcoal has been an important domestic product for many years and has wide market acceptance (USDA, 1961). Its greatest use is for home and outdoor recreational cooking (Domac and Trossero, 2008). Charcoal is produced by heating wood in airtight ovens or retorts, in chambers with various gases, or in kilns supplied with limited and controlled amounts of air. High-temperature heating by all methods breaks down the wood into gases, a watery tar mixture, and the familiar solid carbon material commonly known as charcoal. About 24 million tonnes of charcoal were consumed worldwide in 1992 alone. Developing countries accounted for nearly all of this consumption, and Africa alone consumes about half of the world's production. Charcoal production has increased by about a third from 1981 to 1992, and is expected to increase with the rapidly growing population in the developing world (Dzioubinski and Chipman, 1999).

Globally, the use of woodfuels has been growing in line with population growth (Amous, 2000; IEA, 2002). During the past two decades, a better understanding of wood energy systems has led to the recognition that supply sources are more diversified than was once assumed, including not only forest areas but also trees outside forests (Girard, 2002). Furthermore, the shift from fuelwood to charcoal could have major ecological consequences if it is not kept under control. However, the introduction of improved and efficient charcoal stoves, which are more efficient than wood stoves, the ratio of primary energy to usable energy is almost the same as with fuelwood (Girard, 2002).

Good-quality charcoal burns cleanly and produces high heat. This important property, along with its low average ash content, makes charcoal desirable for metallurgy or as a domestic fuel. In weight, charcoal may be rather heavy to quite light depending on the weight of the dry wood of the various species used in its production. Charcoal is comparatively easy to ignite, and when of good quality burns evenly and without smoking (USDA, 1961).

In many developing countries, particularly in rural areas, traditional fuels, such as fuelwood, charcoal and agricultural wastes constitute a major portion of total household energy consumption. As indicated by Dzioubinski and Chipman (1999), average per capita household energy use in developed countries is about nine times higher than in developing countries, even though in developing countries a large share of household energy is provided by non-commercial fuels that are often not reflected in official statistics. FAO (1993) estimate that fuelwood and charcoal consumption in tropical countries is projected to increase from 1.34 billion m³ in 1991 to 1.81 billion m³ in 2010.

Many households in Nigeria are facing challenges of inaccessible to and unaffordable of clean, less dangerous and convenient cooking fuel. Studies have shown the sources of cooking energy in Nigeria to include electricity, liquefied natural gas (popularly known as cooking gas), kerosene, charcoal, firewood, wood waste, and agricultural waste

(Adelekan and Jerome, 2006; Babalola, 2011; Okunade, undated). The use of any of these sources of cooking fuel by a household has been faced with some challenges and also depends on the affordability, preference and availability. There has been long years of inconsistency in the supply of electricity while kerosene is faced with persistence scarcity and increase in price (Adelekan and Jerome, 2006; Babalola, 2011). The cooking gas is also very expensive and out of reach for the poor and low-income class. Tomori *et al.* (2005) in an assessment of the effect of some selected macro-economic shocks on poverty showed that the increase in prices of petroleum products impacted badly on majority (72.9%) of poor households in Nigeria. The economic impact on households therefore led to either a switch in the choice of energy preferred for domestic use or a situation of energy combination by different income groups. Many of the people in the rural areas, as well as low-income class in the urban areas therefore preferred to switch to charcoal or firewood which they considered less expensive and available. Out of the lasting solutions to household energy problems might therefore be a better understanding of the household sector i.e. accessibility of the various cooking fuels, and other socio-economic factors guiding fuel choice (Babalola, 2011). Most importantly, some of the opportunities to mitigate climate change and resolve issue of household pollution resulting from cooking fuel in Nigeria is to improve the way charcoal is being consumed through introduction of improved efficiencies of stoves (Makundi, 1998). The study therefore assessed major socio-economic variables influencing utilizations of charcoal as household cooking fuel with the view to making appropriate recommendations in Benue State, Nigeria.

METHODOLOGY

The study was conducted in Benue State, Nigeria (Figure 1), located between latitude $6^{\circ} 30' N$ and $8^{\circ} 10' N$, and longitude $8^{\circ} 29' E$ and $10^{\circ} 0' E$. It occupies 34,059 square kilometres. Benue is a state in the Middle-Belt region of Nigeria with a population of about 2.8 million in 1991 (Wikipedia, 2011). The State was created on February 3, 1976 out of the old Benue-Plateau State. The capital is Makurdi. It derives its name from River Benue, the second largest in the country and the most prominent geographical feature in the state. It shares boundaries with six states namely; Nassarawa to the north, Taraba to the east, Cross River, Ebonyi and Enugu to the south, and Kogi on the west; and the Republic of Cameroon in the southeast. The present day new Benue State (after a portion was carved out to create Kogi State in August 1991) has twenty three local governments (Benue State, 2011; Wikipedia, 2011).



Figure1: Map of Benue State, Nigeria

Benue state is acclaimed the nation's "food basket" because of its rich and diverse agricultural produce which include yams, rice, beans, cassava, potatoes, maize, Soya beans, sorghum, millet and coco-yam. The state also accounts for over 70 percent of Nigeria's Soya beans production. It also boasts of one of the longest stretches of river systems in the country with great potential for a viable fishing industry, dry season farming through irrigation and for an inland water way through irrigation and for an inland water way (Benue State, 2011). The vegetation of the State is located within a transitional zone; between the tropical high rain forest of the Southern part of Nigeria and the Sahel savannah dry lands in the North (Tee *et al.*, 2009). It therefore composes of rich tree diversities like *Vitex doniana*, *Vitellaria paradoxa*, *Irvingia gabonensis*, *Dacryode, edulis*, *Annona senegalensis*, *Azelia Africana*, *Ficus species*, *Parkia biglobosa*, *Prosopis africana*, *Acacia Species*, *Borassus aethiopum*, *Adansonia, digitata* and *Tamirandus indica* to mention but few (Nwoboshi, 1982; Keay, 1989; Verinumbe, 1991). In addition to provision of various fruits and seeds consumed as food and for income generation, the tree resources of the State are also used as firewood and in production of mortar and pestle (Babalola and Opii, 2009), and charcoal.

Multi-stage random sampling technique was used to assess the socio-economic uses of charcoal in randomly selected households in the study area. Out of the twenty three Local Government Areas (LGAs) in the State, six were randomly selected LGAs for the survey. The selected LGAs include Gboko, Guma, Kwande, Makurdi, Ohimini and Otukpo. The tool used for the data collection was structured questionnaire, and was designed to collect socio-economic information at household level. The information collected include the demographic characteristics of the charcoal household users, competitive alternative domestic energy to charcoal, main reasons for domestic use and preference for charcoal, sources and trend of charcoal in use, quantity of the charcoal purchased by the households, and weekly and monthly amount spent on charcoal and alternative energy by selected households in Benue State, Nigeria.

Fifteen copies of structured questionnaire were randomly administered to households in each of the LGAs; this gives a total of ninety respondents. Out of the total administered questionnaires, eighty six were eventually retrieved, giving a 95.6% recovery. The data obtained through the questionnaire was subjected to both descriptive statistics and analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Demographic information of the selected household members

Table 1 presents the demographic information of the sampled household members for the study. Female gender dominated the respondents with 66.3.0%. The age of majority of the respondents was between 20 and 40 years, although 50.0% were mainly between 20-30 years. About 67.4% of the respondents were married while 65.1% of the number of individuals living in the households was between one and five. The highest level of education recorded for the respondents was secondary (37.2%), this was followed by degree holders from the university (22.1%) and diploma from the polytechnic (17.4%). About 83.7% of the respondents were native to the study sites. The main occupations of the respondents were civil servant (36.0%), trading (27.9%), farming (20.9%), and artisans/self employed (12.8%). The remaining 2.3% of the sampled respondents were students and those stills searching for employment.

Alternative cooking fuel to Charcoal used by households

Households do not normally stick to only one type of energy; rather shift in consumption or combine them depending on affordability and availability. The competitive alternative cooking fuels to charcoal used by the sampled household were kerosene and firewood. About 34.9% and 30.0% indicated that they sometimes and always respectively use firewood while 69.8% sometimes and 20.9% always use kerosene. On the contrary, 82.6% each and 51.2% of the respondents indicated that they do not use cooking gas, agricultural products and electricity respectively (Table 2). This same trend was discovered by Babalola (2011) in a study on the domestic energy carriers and consumption pattern in rural and urban households of Southwest States of Nigeria where kerosene ranked highest for both the rural (44.9%) and urban (45.1%) areas, and closely followed by firewood in rural (38.4%), urban (22.5%) areas. Adelekan and Jerome (2006) also discovered that the proportion of consumers of firewood has continued to be on the increase. This is because consumers of kerosene especially those belonging to the low-income class, are constrained to switch over to firewood or other cooking fuels as an alternative energy source.

It was discovered by Kammen and Lew (2005) that biomass users prefer charcoal over other biomass fuels such as wood, residues and dung. Charcoal has a higher energy density than other biomass fuels and can be stored without fear of insect problems. It has excellent cooking properties: it burns evenly, for a long time, and can be easily extinguished and reheated. Even in developed countries, such as the US, charcoal is desired for the flavors which it imparts to grilled food. In a study conducted in Tanzania (Kilahama, undated), some households in the City of Dar-es-Salaam are using Charcoal but in combination with other sources of energy. Many of the respondents indicated that they use charcoal and kerosene (26%) while another 25% reported using charcoal, firewood and electricity. On the other hand, for some respondents that use single energy source, charcoal is the critical and most used source of domestic energy by majority of users (81%) of sample followed by firewood and kerosene (9.2%) and (7.3%) of the sample respectively.

Preference for charcoal by the household

According to Dzioubinski, and Chipman, (1999), one of the important determinants of household energy demand and fuel mix is the price of various fuels. With increasing disposable income and changes in lifestyles, households tend to move from the cheapest and least convenient fuels (biomass) to more convenient and normally more expensive ones (charcoal, kerosene) and eventually to the most convenient and usually most expensive types of energy (LPG, natural gas, electricity).

It was envisaged that with increasing disposable income and changes in lifestyles, households tend to move from the cheapest and least convenient fuels (biomass) to more convenient and normally more expensive ones (Dzioubinski, and Chipman, 1999). The respondents were therefore asked if they would change from using charcoal to other advanced domestic energy when their standard of living improves. About 55.0% of the respondents affirmed that they would change to other convenient types of energy if their standards of living improve (Figure 2). It has been discovered that as users become more affluent, they typically switch from woodfuels to charcoal and then to petroleum fuels such as kerosene or LPG (Kammen and Lew, 2005). Charcoal's position in the middle of the cooking ladder implies that with economic growth, charcoal users will switch to more modern fuels, but other biomass users, on the order of two billion people, may switch from other biomass fuels to charcoal (Kammen and Lew, 2005).

Variables	Ohimini		Otukpo		Gboko		Kwande		Makurdi		Guma		Total	
	Freq n=13	%	Freq n=14	%	Freq N=14	%	Freq n=15	%	Freq n=15	%	Freq n=15	%	Freq n=86	%
Gender														
• Male	3	23.1	4	28.6	8	57.1	6	40.0	5	33.3	3	20.0	29	33.7
• Female	10	76.9	10	71.4	6	42.9	9	60.0	10	66.7	12	80.0	57	66.3
Age (Years)														
• 20-30	4	30.8	9	64.3	6	42.9	8	53.3	4	26.7	12	80.0	43	50.0
• 31-40	9	69.9	2	14.3	7	50.0	6	40	10	66.7	3	20.0	37	43.0
• 41-50	0	0	3	21.4	1	7.1	1	6.9	1	6.7	0	0	6	7
• 51-60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
• >61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marital Status														
• Single	6	46.2	7	50.0	4	28.6	4	26.7	1	6.7	6	40.0	28	32.6
• Married	7	53.8	7	50.0	10	71.4	11	73.3	14	93.3	9	60.0	58	67.4
Number of individuals in household														
• 1 to 5	4	30.8	5	35.7	10	71.4	12	85.7	10	66.7	15	100	56	65.1
• 6 to 10	9	69.2	7	50.0	4	28.6	2	14.3	5	33.3	0	0	27	31.4
• >11	0	0	2	14.3	0	0	0	0	0	0	0	0	2	2.4
• No response	0	0	0	0	0	0	1	6.9	0	0	0	0	1	1.2
Main Occupation														
• Farming	5	38.5	3	21.4	3	21.4	1	6.7	3	20	3	20.0	18	20.9
• Trading	1	7.7	4	28.6	2	14.3	7	46.7	5	33.3	5	33.3	24	27.9
• Civil servant	6	46.2	5	35.7	5	35.7	5	33.3	7	46.7	3	20.0	31	36.0
• Artisan/self	1	7.7	2	14.3	3	21.4	1	6.7	0	0	4	26.7	11	12.8
• Others	0	0	0	0	1	7.1	1	6.7	0	0	0	0	2	2.3
Highest Education														
• No formal	3	23.7	0	0	1	7.1	0	0	2	13.3	1	6.7	7	8.1
• Primary	1	7.7	0	0	1	7.1	0	0	5	33.3	1	6.7	8	9.3
• Secondary	2	15.4	4	28.6	6	42.9	8	53.3	3	20.0	9	60.0	32	37.2
• Adult Edu	0	0	1	7.1	0	0	0	0	0	0	1	6.7	2	2.3
• Diploma	2	15.4	4	28.6	5	35.7	2	13.3	1	6.7	1	6.7	15	17.4
• Degree	5	38.5	3	21.4	1	7.1	4	26.7	4	26.7	2	13.2	19	22.1
• Others	0	0	0	0	0	0	1	6.7	0	0	0	0	1	1.2
• No response	0	0	2	14.3	0	0	0	0	0	0	0	0	2	2.3
Origin														
• Native	12	92.3	11	78.6	10	71.4	11	73.3	13	86.7	15	100	72	83.7
• Migrant	1	7.7	3	21.4	4	28.6	4	26.7	2	13.3	0	0	14	16.3

Table 1: Demographic characteristics of respondents sampled from the charcoal household users in Benue State, Nigeria

Table 2: Competitive alternative cooking fuel to Charcoal used by households

Alternative cooking fuel to Charcoal	Always (%)	Sometimes (%)	Do not use (%)	No response (%)
Firewood	30.0	34.9	11	2.3
Kerosene	20.9	69.8	4.7	4.7
Gas (LNG)	4.7	5.8	82.6	7.0
Electricity	3.5	38.4	51.2	7.0
Agricultural products	8.1	9.3	82.6	0

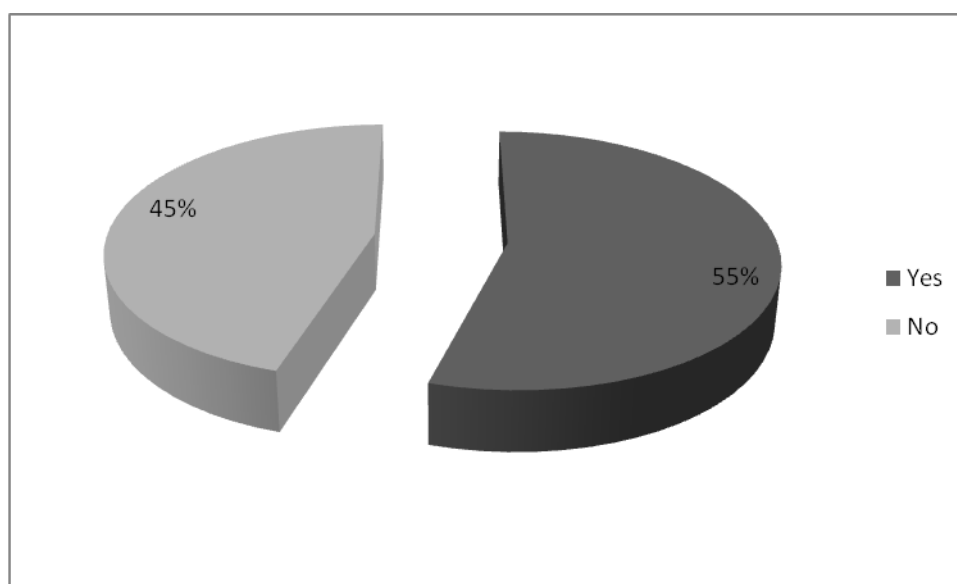


Figure 2: Preference of the household respondents on choice of using charcoal if standard of living improves

Factors influencing the use of charcoal by the households

Studies have shown that charcoal is used for many domestic purposes (Kalu and Izekor, 2007; Kambewa, 2007; Babalola, 2011). About 76.7% of the sampled households used charcoal as energy for cooking food and 18.6% used it in ironing of cloth (Table 3). Other uses of charcoal were making barbeque; roasting of maize, yam, plantain, cocoyam, meat, fish, among others. In a similar study by Okunade (undated), about 93.3% of the respondents used charcoal because it is cheap relative to other energy sources, 46.7% because it makes the pot neat and not blackened, 43.3% for its relative availability, 32.2% because it is easy to make while 20% use it because the food cooked on charcoal is more tender or well cooked.

Rank on top of the main reasons for using charcoal by majority of the households was due to its cheaper cost (62.8%) when compared with other domestic energy sources. Other reasons for using charcoal were: ready availability, prolonged heat, and not turning pot black unlike firewood. When asked on the number of times that the household uses charcoal per week, the overall response showed that 38.4% of the households used charcoal between one and five times a week, followed by between 6 and 10 times (24.4%). This means that majority of the respondents used charcoal almost once a day within a week.

The respondents have different responses on the trend of the quantity of charcoal used by households. Majority informed that the quantity of charcoal consumed is increasing, while the remaining indicated that the quantity is either decreasing or remain the same. Some of the reasons why the respondents think the quantity of charcoal utilised by household has been increasing include cheaper price of charcoal; scarcity of alternative cooking energy like kerosene and cooking gas; increase in the number of individual living in household which eventually lead to increase in quantity of charcoal needed in household cooking; and low density charcoal quickly burns faster into ashes and cook less food than charcoal of high wood density. On the other hand, the respondents that indicated decrease in quantity of charcoal was because they believe improvement in the standard of living will facilitate shift to clean alternative fuels like kerosene, cooking gas and electricity. Households tend to shift to alternative cooking fuel with increase in the household income and therefore reduce the quantity of charcoal.

Among the arguments given by the respondents in support that quantity of charcoal consumed by the household is the same include: quantity of charcoal bought in the family remain the same and has not changed; quantity of food cooked and the number of times the household engaged in cooking per day still remain the same; charcoal is combined with other alternative cooking fuels therefore quantity does not change; number of cloth iron with charcoal remain the same; and regular supply of charcoal makes the quantity consumed remain constant.

More than half of all the respondents (54.7%) informed that their households purchased charcoal from roadside retailers, 25.6% of them purchased in bulk from wholesaler, while only 18.6% purchased from producers. In addition, the quantity of the charcoal purchased by 44.2% of the households has been on the increase, while those of 24.4% remained the same, 16.3% decreasing, and 15.1% households do not have particular reason (Table 3).

Monthly amount spent by household on charcoal

About 62.8% of the sampled households purchased charcoal they used in retail quantity. One of the major reasons why charcoal was bought in small quantity by majority of the household was that it is a bulky commodity and also need more space to store. Amount spent on monthly basis to purchase charcoal and alternative cooking fuel by the households were obtained and presented in Table 4. The total monthly average amount spent on charcoal was ₦3,310.37 (minimum average of ₦410.00 and maximum average of ₦18,926.67) while the the monthly average amount of ₦2,394.78 (minimum of ₦308.33 and maximum of ₦12,093) was spent by households on alternative cooking fuels. These figures show that many of the households allocated and spent more money on purchasing charcoal than alternative cooking fuels.

One of the major observations made on amount spent by households on cooking fuels was that majority did not normally keep record of the monthly amount. The reason is that they did not consider cooking fuel as a burning issue within their families' spending. Overall assessment therefore suggests that, for the majority of households, priority is to purchase food, payment of house rents, among others.

Table 3: Factors influencing the use of charcoal by households

Reason and frequency of use of charcoal by household	Ohimini		Otukpo		Gboko		Kwande		Makurdi		Guma		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Major use of charcoal														
• Food cooking	11	84.6	13	92.9	7	50.0	7	46.7	15	100	13	86.7	66	76.7
• Ironing of cloth	1	7.7	0	0	7	50.0	6	40.0	0	0	2	13.3	16	18.6
• Others	1	7.7	1	7.1	0	0	2	13.3	0	0	0	0	4	4.7
Main reason for using charcoal														
• Cheaper	10	76.9	8	57.1	6	42.0	5	33.3	13	86.7	12	80.0	54	62.8
• Readily available	2	15.4	0	0	3	21.4	3	20	0	0	1	6.7	9	10.5
• Prolong heat	0	0	2	14.3	3	21.4	4	26.7	2	13.3	2	13.3	13	15.1
• Not turn pot black	1	7.7	2	14.3	2	14.3	3	20	0	0	0	0	8	9.3
• Others	0	0	2	14.3	0	0	0	0	0	0	0	0	2	2.3
Number of times household use charcoal per week														
• 1 to 5	7	53.8	5	35.7	7	53.8	7	46.7	3	20	4	26.7	33	38.4
• 6 to 10	4	30.8	1	7.1	4	30.8	6	40	3	20	3	20	21	24.4
• 11 to 15	2	15.4	6	42.8	2	15.4	2	13.3	2	13.3	3	20	17	19.8
• 16 to 20	0	0	0	0	0	0	0	0	1	6.7	0	0	1	1.2
• >21	0	0	2	14.3	0	0	0	0	6	40	3	20	11	12.8
• No response	0	0	0	0	1	7.1	0	0	0	0	2	13.3	3	3.5
Where do you purchase the charcoal?														
• Roadside retailers	8	61.5	8	57.1	4	28.6	9	60.0	9	60.0	9	60.0	47	54.7
• Wholesaler in bulk	3	23.1	4	28.6	2	14.3	1	6.7	6	40.0	6	40.0	22	25.6
• Producer in the wild	1	7.7	2	14.3	8	57.1	5	33.3	0	0	0	0	16	18.6
• Others	1	7.7	0	0	0	0	0	0	0	0	0	0	1	1.2
Household trend in the quantity of charcoal in use														
• Increasing	9	69.2	5	35.7	3	21.4	2	13.3	7	46.7	12	80.0	38	44.2
• Decreasing	0	0	2	14.3	4	28.6	5	33.3	2	13.3	1	6.7	14	16.3
• Remain the same	4	30.8	4	28.6	6	42.9	5	33.3	2	13.3	0	0	21	24.4
• Do not know	0	0	3	21.4	1	7.1	3	20	4	26.7	2	13.3	13	15.1

Table 4: Monthly amount spent on charcoal as compared with alternative cooking fuels by selected households in Benue State, Nigeria

		Ohimini	Otukpo	Gboko	Kwande	Makurdi	Guma	Total	Mean total
Charcoal	Min	360	400	600	200	300	600	2,460	410.00
	Max	60,000	20,000	4560	12000	9000	8000	113,560	18,926.67
	Mean	5725.8	3198	1950.8	2354.3	3100	3533.3	19,862.2	3,310.367
	SD	17075.6	5962	1285.2	3115.7	2890.9	2934	33,263.4	5,543.9
Alternative cooking fuel	Minimum	100	200	300	150	300	800	1,850	308.3333
	Maximum	20,000	20,000	4560	12,000	9000	7000	72,560	12,093.33
	Mean	2984.6	2700	1565	2725.7	1646.7	2746.7	14,368.7	2,394.783
	SD	6342	5494.3	1414.7	3432.6	2144	1930.5	20,758.1	3,459.683

₦ 1 = USD 160

CONCLUSION

The study has shown that charcoal is widely used as domestic energy and consumed by various categories of people in Benue State. At the household level, preference for charcoal as domestic energy was mainly due to its cheaper cost, prolong heat when in usage, availability all year round, and not turning pot black. Many of the sampled household used charcoal almost every day of the week; this is gaining more acceptance due to increase in price and unavailability of more convenient and clean alternative cooking energy like kerosene, cooking gas and electricity. Despite its usage by the household, more than half of the respondents affirmed that they would abandon charcoal and change to next available and convenient cooking energy if their standards of living improve.

Increase in the use of charcoal poses a major concern for sustainable forest management as well as its sustainable production in the face of increasing demand. There is need for appropriate intervention by the government and concerned authorities to facilitate availability and affordability of alternative domestic cooking energy to charcoal. From the results of the study, kerosene was ranked topmost among the identified alternative cooking energy to charcoal. This means that for the consumption of kerosene to compete favourably with charcoal, it must be made available and affordable to the people. In addition to this, government should formulate policy that will enhance proper distribution and availability of other alternative domestic cooking energy with special focus on the environmental impact.

It has been envisaged that switching away from traditional firewood and charcoal is not feasible in the short term for most household. To reduce exploitation of remaining natural forest in unsustainable production of charcoal, establishment of plantation of fast growing tree species should be explored and same should be properly managed. Improving the way charcoal is supplied and used for cooking is also an important way of reducing its harmful effects in homes. Furthermore, there is need for appropriate inspection and grading of charcoal in circulation to improve the quality and efficiency. Efficient use of charcoal should also be facilitated through transformation of charcoal into less polluting forms and introduction of efficient equipment such as improved charcoal stoves. This stove has the potential of energy saving as well as reducing emission of compounds that are detrimental to both health and the environment. The use of the improved firewood and charcoal stoves is getting more awareness and gaining acceptability in a number of developing

countries. It is unfortunate that the stoves are almost non-existence in Benue State; there should therefore be a deliberate move by the government and concerned nongovernmental bodies to promote them among households.

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