Factors influencing consumption of charcoal as household energy in Benue State, Nigeria

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ABSTRACT

Charcoal has been an important domestic cooking energy for many years and has wide market acceptance in developing countries. A study was therefore conducted to assess the socio-economic factors affecting consumption of charcoal by household in Benue State, Nigeria. Structured questionnaire was administered to selected households within the State. It was discovered that the use of charcoal is on the increase with about 76.7% of the sampled households use charcoal as cooking fuel almost every day of the week. The most competitive alternative cooking fuels to charcoal used by the sampled household were kerosene and firewood. Affordability as a result of cheaper cost (62.8%) and consistent availability constituted the main reasons for using charcoal when compared with other domestic energy sources. The sustainable production and use of charcoal through proper management and planning of supply sources, together with rational trade and marketing infrastructures and efficient use, can also have a significant positive impact by helping to conserve resources and improving people's incomes.

Keywords: Biomass energy, charcoal, household, cooking fuel, consumption,

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INTRODUCTION

According to Kammen and Lew (2005), half of the world's population uses biomass fuels for cooking. At least 80% of the African population continues to depend on traditional biomass fuels, mainly charcoal and firewood for their energy needs. Though precise quantity of charcoal produced and consumed is not easy to determine due to the informal nature of the products, yet about 24 million tonnes of charcoal have been estimated to be consumed worldwide in 1992 with developing countries accounted for nearly all of this consumption; Africa alone consumes about half of the world's production (FAO, 1993). There has been increase in the production of charcoal and this is expected to increase with the rapidly growing population in the developing world. This situation is expected to remain unchanged for many decades to come. In particular, the demand for charcoal in most developing countries will continue to grow at high rates owing to the ever-increasing rural-urban migration. These trends coupled with inefficient charcoal production and consumption practices, and inaccessibility by most households to other reliable and affordable commercial energy forms indicates the continued and probably growing dependence on the already dwindling biomass resource for energy. Production of traditional fuels (mostly charcoal) is often insufficient to satisfy rising demand. The availability to the poorest communities is expected to decline, which will intensify environmental degradation in those communities. Charcoal production from natural forests is on the raise and it is the biggest forest resource use by African communities.

Charcoal, an age old refined from of wood fuel, still remains an important energy source for domestic cooking and a wide range of industrial and processing applications (USDA, 1961; FAO, 1993). It is made from ligno-cellulosics materials such as wood and other woody biomass wastes through a process called "carbonization". Wood is heated in a closed entity with very limited air (oxygen) to decompose it into a variety of substances, the important one being charcoal. Charcoal is a black porous solid substance consisting mainly of elemental carbon (FAO, 1985). Foley (1986) reports that charcoal can be made from organic materials such as wood, straw, coconut shells, rice husks, and bones. Wood, however, is the most common and best yielding raw material. Charcoal made out of hardwoods yield a dense charcoal which burns cleanly and slowly while those made from softwoods tends to be light and porous, burns too quickly and is thus prone to breakage during transport. Properties such as fixed carbon, volatile

matter, moisture and ash contents decide the suitability of charcoal for different purposes (Foley, 1986).

Charcoal is one of the more important commodities produced from natural forests or trees outside the forest by the rural poor across Africa and is largely used in urbanized areas to meet domestic energy needs. It is an important and simple means of earning cash income; in the production areas this income is more important than income from alternatives such as agriculture. As timber is readily available within and outside forests which only needs to be converted using simplest means and tools. It is mostly men who are involved in charcoal production. Income from charcoal is a guaranteed as there is very demanding market and in many parts it has become a form of insurance against crop failures, emergency cash needs etc. Charcoal suits the living conditions of the urban poor, by providing a reliable, convenient and accessible source of energy for cooking at all times and at a stable cost in any required proportions. In addition, the charcoal trade provides income opportunities for many people in the urban areas, through small scale retail businesses which are mostly run by women.

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 inconsistence 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 coking 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

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METHODOLOGY

The study was conducted in Benue State located in latitude 6^0 30′ N and 8^0 10′ N, and longitude 8^0 29′ E and 10^0 0′ E. It is a State in the Middle-Belt region of Nigeria with a population of about 2.8 million in 1991 (Wikipedia, 2011). It derives its name from River Benue, the second largest in the country and the most prominent geographical feature. The 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, Afzelia 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. Multistage sampling technique was used to administer fifteen structured questionnaires to randomly selected households in six Local Government Areas (LGAs). The selected LGAs

include Gboko, Guma, Kwande, Makurdi, Ohimini and Otukpo. This gives a total of ninety respondents. Out of the total administered questionnaires, eighty six were eventually retrieved, giving a 95.6% recovery. 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.

RESULTS AND DISCUSSION

Demographic information of the selected household members

The 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. More than half of all the respondents (54.7%) informed that their households purchased the charcoal from roadside retailers, 25.6% of them purchased in bulk from wholesaler, while only 18.6% purchased from producers (Fig. 1). This retail quantity of charcoal purchased by majority of the household could be connected with the fact that it is a bulky commodity and could need more space to store. Also, the respondents believed that charcoal will always be available whenever they want to purchase, therefore needed not to store in bulk.

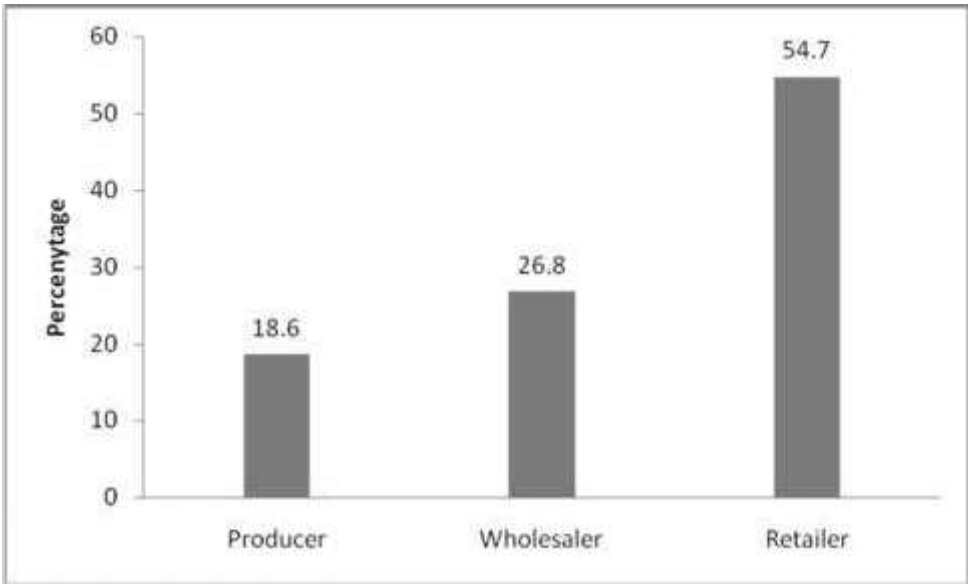

Fig. 1: Sources and quantity of the charcoal purchased by the households

Alternative cooking fuel to Charcoal used by households

It was discovered by Kammen and Lew (2005) that biomass users prefer charcoal over other biomass fuels such as wood, residues and dung. The alternative cooking fuels to charcoal used by the sampled household were kerosene and firewood. About 46.7% and 40.0% 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 1). 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.

Table 1: Alternative cooking fuel to Charcoal used by households in Benue State, Nigeria

S/N	Alternative cooking fuel to Charcoal	Always (%)	Sometimes (%)	Do not use (%)	No response (%)
1	Firewood	40.0	46.7	11	2.3
2	Kerosene	20.9	69.8	4.7	4.7
3	Gas (LNG)	4.7	5.8	82.6	7.0
4	Electricity	3.5	38.4	51.2	7.0
5	Agricultural products	8.1	9.3	82.6	0

Source: Field Survey, 2011

Preference for charcoal

The respondents were asked if they would change from using charcoal to other advanced domestic energy when their standard of living improves. About 55.0% affirmed that they would change to other convenient types of energy if their standards of living improve. It has been discovered that as users become more affluent, they typically switch from wood fuels to charcoal and then to petroleum fuels such as kerosene or LPG (Dzioubinski, and Chipman, 1999; 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). In a study conducted by Okunade (undated), about 93.3% of the respondents preferred charcoal as domestic cooking energy because it is cheap relative to other energy sources of cooking energy, 46.7% because it makes the pot neat and not blackened, 43.3% for its relative availability, 32.2% because it is easy to ignite when compare to firewood while 20% use it because the food cooked on charcoal is more tender or well cooked.

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 2). Other uses of charcoal include roasting of meat (barbeque), maize, yam, plantain, cocoyam, meat and fish. Rank on top of the main reasons for using charcoal by majority of the households was due to its cheaper cost (62.8%) when compare with other domestic energy sources. Other reasons for using charcoal were: ready availability (10.5%), prolong heat (15.1), and not turning pot black unlike firewood (9.3%). Affordability is therefore considered as the main reason why majority of the households use charcoal.

Poverty is inextricably linked to the use of biomass (World Bank, 2003). In sub-Saharan Africa, an average 52% of people live on less than US$1 per day and urban poverty is increasingly severe, with about 43% of urban dwellers living below the poverty line of US$47 per month per capita (ECA, 2001). According to Dzioubinski and Chipman (1999), 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).

When asked on the number of times that the household uses charcoal per week (Table 2), 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. This confirms that the use of charcoal by households is on the increase. Moreover, the respondents inform that the quantity of the charcoal purcahsed by 44.2% of the households has been on the increase, while those of 24.4% remained the same (Table 2).

Consumption of charcoal: A cause for concern?

For many households, switching away from traditional wood energy to cleaner domestic energy is not feasible in the short term. In the present study, more than half of the respondents affirmed that they would abandon charcoal and shift to next improved cooking energy if their standards of living are improved; it is therefore possible that considerable percentage of the household would shift to alternative cooking energy like kerosene, electricity or cooking gas if their standard of living is improved. This could have positive impacts on the environment as well as remaining forests. However, these assertions may not be as easy as highlighted unless necessary alternative sources of energy are provided at affordable price and easy accessibility.

The shift from fuelwood to charcoal, even if it lasts only a few decades, could have major ecological consequences if it is not kept under control. However, since charcoal stoves are more efficient than wood stoves, the ratio of primary energy to usable energy is almost the same as with fuelwood. Thus with adequate supervision, management and support, the shift does not need to disrupt present levels of resource use. One great concern, however, is that charcoal, unlike fuelwood, is most often produced from forest resources. Thus the use of forest biomass for charcoal making could still represent a threat to the future of the resources in local terms, especially in certain situations with high demand (for instance the periphery of large urban zones with low resources) and lack of proper forest management practices and regulations.

Table 2: Factors influencing the use of charcoal by households in Benue State, Nigeria

	Reason and frequency of use of charcoal by household	Total	
		Freq	%
1.	Number of times household use charcoal per week		
	1 to 5	**33**	**38.4**
	6 to 10	21	24.4
	11 to 15	17	19.8
	16 to 20	1	1.2
	>21	11	12.8
	No response	3	3.5
2.	Household trend in the quantity of charcoal in use		
	- Increasing	38	**44.2**
	- Decreasing	14	16.3
	- Remain the same	21	24.4
	- Do not know	13	15.1
3.	Major use of charcoal		
	- Food cooking	66	**76.7**
	- Ironing of cloth	16	18.6
	- Others	4	4.7
4.	Main reason for using charcoal		
	- Cheaper	54	**62.8**
	- Readily available	9	10.5
	- Prolong heat	13	15.1
	- Not turn pot black	8	9.3
	- Others	2	2.3
5.	Where charcoal is purchased		
	- Roadside retailers	47	**54.7**
	- Wholesaler in bulk	22	25.6
	- Producer in the wild	16	18.6
	- Others	1	1.2

(Source: Field Survey, 2011)

With adequate forest management, supervision and control practices, however, the growth of charcoal use does not have to have a serious impact on forested areas that supply consumption centres. Work carried out in the Niger and Mali, for example, indicated that control of the resource by the people living in the charcoal production areas can lead to proper management of the resource while improving local people's incomes (CIRAD, 2001). Despite some successful examples like these, many African governments, concerned about the potential threat of charcoal

to forest resources, have launched programmes in the past two decades to encourage substitution of charcoal with other fuels (particularly LPG and kerosene) through subsidies and provision of equipment to households. Despite the effective distribution of equipment (in Dakar, Senegal, over 60 percent of families were equipped to use LPG), these programmes have not succeeded, in part because African cities do not always readily take on urban habits. However, substitution programmes have also had the negative effect of creating unemployment in forest areas when charcoal production was discouraged. The lack of employment led to increased migration towards urban and peri-urban areas and accentuated the demand for fuelwood and even more charcoal, as these are the main source of affordable energy for poor people. Banning the production and/or marketing of charcoal, as has sometimes been done (for example in Mauritania and Kenya), has proved counterproductive: bans do not in fact reduce production, but simply drive producers underground, thereby precluding proper control of production procedures (FAO, 1993).

The sustainable production and use of charcoal through proper management and planning of supply sources, together with rational trade and marketing infrastructures and efficient use, can also have a significant positive impact by helping to conserve resources, reducing migration from rural or forested areas and improving people's incomes. However, the necessary interventions for long-term solutions are not easy to implement, especially for poor tropical countries that lack the necessary financial resources, institutional capacity and skilled personnel.

Issues on consumption of charcoal

Despite its versatility, charcoal production is often not encouraged due to a wide belief that charcoal making would contribute to deforestation or would be a less efficient source of energy than fuelwood. On a local scale, the effects of charcoal use are mostly related to the inefficiency of production, forestry and land degradation, and the transportation distances. Because most of the energy of the fuelwood is lost in the production process, charcoal users ultimately use much more fuelwood than direct fuelwood users. Because charcoal is typically produced in sizable batches, it is rarely linked with sustainable forestry practices, and is more often linked with clear-cutting. At best, charcoal may be produced from plantations, but it is more likely to be produced from land cleared for agricultural purposes or from smaller areas cleared specifically for charcoal production.

The main issues confronting the production and trade of charcoal in selected Africa countries as identified by ICRAF (2005) include the following:

Inappropriate policies and legislation have created confusion: Besides issuing and policing incidental bans on charcoal production and trade, authorities in a number of African countries have little to say, in a positive manner, on how production and marketing ought to be organized. On their part, inappropriate policies have driven the industry underground. To go around such insensitive policies, charcoal producers and traders have resorted to illegal payments to relevant government officials in order to produce charcoal and get their product to the market.

Lack of a planned, sustainable production system: Many African countries neither plant trees nor give land owners incentives to engage in wood production, and are merely pre-occupied in policing the exploitation of existing stocks of wood.

Inefficient production leads to massive wastes: Weak policies have hampered R&D that is key to the improvement of traditional kilns and to engendering efficient production. Producers are rarely able to manage the firing process well, which exacerbates a situation that is responsible for massive and rising environmental damage.

With no standards, buyers and sellers continue to be swindled: Most African countries lack standards to regulate quality, weight and the sizes of the charcoal entering the market. As a result, sellers and buyers along the distribution chain are swindled, as they are required to pay the same price for bags of different weights. In addition, mixing of the packed charcoal in bags with sand, stones, leaves, among others dirt is prevalent making investing in the product susceptible to low return or loss.

Lack of financial support for an 'illegal' industry: Like officialdom, financial institutions have also neglected the industry. This is linked to its semi-illegal status in many Africa countries, which makes potential supporters shy away from being identified with it.

Poor marketing hampers regulation of the industry: In addition to the absence of designated selling points, lack of guidelines on its marketing makes the charcoal business difficulty to regulate. Although millions of dollars could be changing hands on a daily basis, the taxman is permanently locked out of these transactions as most are done on an 'underground' basis.

CONCLUSION

Although charcoal is such a significant fuel to millions of households in developing countries, it hardly attracts the attention of policy makers. Probably discouraged by this near-policy vacuum, big businesses have taken cue. To them, the charcoal business has remained a 'no-go zone'. The production and trade in charcoal is currently faced with unsupportive government laws and policies. Over the last two decades, successive official decrees have issued bans on production and transportation of the fuel. However, the thousands of producers have always beaten these directives by either providing illegal payments to government agents charged with their policing or by using the night as cover for production and transportation. As a result, thousands, if not millions, of small-scale producers, transporters and distributors, most of who cling to it out of a sheer need for survival, currently dominate it. Consequently, the business has failed to attract solid investments that are so necessary for research and development. Thus, the main production technique remains the traditional, which results in massive wastage of standing wood stocks and has a direct link to the worsening state of the region's environment.

Strategies for sustainable charcoal production and consumption have been developed. In line with the recommendation of ICRAF (2005), the following could assist the developing countries in sustainable production and consumption of charcoal:

i) Create the right climate for profitable and sustainable charcoal production and use through enacting sound policies and legislation.
ii) Assign the roles of charcoal production, distribution and marketing to a single department or ministry and hold it accountable for all the issues affecting the industry.
iii) Sensitize the public, through mass media and other fora to the contents of the charcoal policy and legislation.
iv) Provide adequate finances and enough personnel for implementation of the policy and legislation and extend credit for those willing to engage in commercial tree farming.
v) Develop and implement short and long term plans for massive tree plantings.
vi) Facilitate research that would lead to the development of efficient and affordable kilns for the millions of smallscale charcoal producers.

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