



## DETERMINANTS OF CHARCOAL CONSUMPTION AMONG HOUSEHOLDS IN MAIDUGURI METROPOLITAN AREA OF BORNO STATE, NIGERIA

UMAR ASS <sup>a\*</sup> ● BABA AS <sup>b</sup> ● IBRAHIM A <sup>a</sup> ● UNEGBU AY <sup>a</sup>

<sup>a</sup> Department of Agricultural Economics, University of Maiduguri, P.M.B.1069, Maiduguri, Borno State, Nigeria

<sup>b</sup> Department of Agricultural Economics and Extension, Usman Dan Fodio University, Sokoto State, Nigeria

\*Corresponding Author's email: [sidiumar@yahoo.com](mailto:sidiumar@yahoo.com)

**ABSTRACT:** This study examines the main determinants of charcoal consumption among households in Maiduguri Metropolis, Borno State, Nigeria. Simple random sampling technique was used to select 120 households. Primary data were used for the study which collected from the 120 randomly selected households using the questionnaire method. Multiple regression was the analytical tool used to analyse the data. The result revealed R<sup>2</sup> value of 0.865, implying that about 87% of the variation in charcoal consumption in the study area was explained by the variables used in the model. The result showed that while educational qualification, family size, price of charcoal and monthly income was negatively related to charcoal consumption sex, marital status, age of household head, price of substitute and proximity to source of supply were positively related to charcoal consumption. It was concluded that charcoal is a major source of fuel in the study area and its consumption is greatly influenced by the socio-economic variable of the people in the study area. In order to reduce over-exploitation of forest resource, study recommends that the cost of substitute fuel like gas and kerosene should be subsidized, level of income should be improved through increase in the minimum wage rate, and higher levies should be placed on the exploitation of forest resource by the government in order to discourage their over-exploitation.

**Keywords:** Charcoal, Consumption, Determinants, Households, Maiduguri Metropolis

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### 1. INTRODUCTION

Energy is a basic necessity of daily life among households in the world. Energy from renewable natural resource (charcoal) is one of the main sources of wood fuel for man. It plays a significant role in meeting the fuel requirement of many developing countries especially Nigeria where there is an increasing dependence due to increasing urban population coupled with limited accessibility to the modern alternative fuels like gas and electricity. It is a prime source of energy in most African countries as well as a driving force of their economies (Tomaselli 2007). Extraction of tree for wood fuel accounts for 61% of total wood removed globally and hundreds and millions of the people remain completely dependent upon wood and its by-products for fuel (FAO 2006).

Wood fuel contributes about 83% of total energy consumption in developing countries. Africa consumes over 50% of the world's total production of fuel wood and charcoal. Nigeria alone consumes about 16%, majority of which is consumed in urban areas by households for cooking and heating. Several energy policy documents in Nigeria, stress the need for households to experience a transition from forest products to the modern fuel sources such as kerosene and gas. The transition has not occurred as charcoal is becoming an increasingly dominant source of fuel especially for cooking among urban households in Nigeria (Maconachie *et al.* 2009).

Many households in the urban areas including Maiduguri Metropolis mainly rely on traditional fuels such as charcoal and fuel wood as their primary source of energy for cooking (Onoja, 2012). This could be as a result of rapid urbanization, high population growth,

inadequate supply and high cost of modern alternative fuels (electricity, kerosene and gas) which make the products beyond the reach of the common man. Similarly, responsible for this trend are the decreasing real income of urban dwellers due to extreme economic conditions and the relatively cheaper price of charcoal (Onoja 2012). This results in thousands of bags of charcoal entering into the urban cities in most part of the country on a daily basis.

The increasing level of charcoal consumption significantly contributes to deforestation with consequent land degradation and soil erosion (FAO 2006). The harvesting of forest for fuel wood contributes to deforestation at the rate of about 400,000 ha per annum. If this trend is not controlled, the nation's forest resource could be completely exhausted (Oladosu and Adegbulugbe 1997). Hence, to address the situation, there is the need to study the main factors contributing the over-increasing dependent on charcoal as source of fuel for cooking. The complex issues regarding the increasing reliance on charcoal in Nigeria are yet to be fully uncovered. It was against this background that this study was conducted to identify the major determinants of charcoal consumption among households in Maiduguri Metropolis, Borno State with a view of recommending appropriate policy measures to control deforestation of the nation's forest resources.

## 2. METHODOLOGY

### 2.1 The Study Area

The study was conducted in Maiduguri Metropolis, Borno State. It is located within the semi-arid zone of Northern Nigeria at an elevation of about 35 meters above sea level. It lies between Latitudes 11° 45' and 11° 54' N and longitudes 13° 08' and 13° 14' E of the Equator. It has a land mass of about 69,436 square kilometers, with a population of about 521,592 people (NPC 2006).

The city is characterized by rainy and dry seasons. The rainy season last for three to four months in a year and which normally starts in June and ends in September. Annual rainfall ranges between 300 – 700 mm. The dry season is usually long and very hot. The driest months are March and April while the coolest are December and January. The average temperature ranges between 35 ° to 43° C with a mean relative humidity 45% (BOSAP 2010). The weather condition in the state is not conducive for growth for wood production.

### 2.2 Sampling Procedure and Data Collection

Maiduguri Metropolis comprises wards from Maiduguri Metropolitan Council, Jere, parts of Konduga and Mafa Local Government Areas of Borno

State. Multi-stage sampling technique was used to select the sample respondents for the. In the first stage, eight wards were purposively selected based on their prominence in charcoal consumption. These wards were Bolori 1, Bolori 2, Mairi, Maisandri, Mai, Musari, Gwange 1, Gwange 2 and Mashari. In the second stage, simple random sampling was used to select 15 household from each of the wards to 120 households as respondents from Metropolis.

Primary data was used for the study which was collected through structured questionnaire. Data were collected on socio-economic variables of the respondents such as age, sex, marital status, family size, educational qualification, level of income price of charcoal and price of other substitute products as well as the quantity consumed per month.

### 2.3 Analytical Techniques

Multiple regression analysis was used to examine the main determinants of households' charcoal consumption in the study area. The regression model used was explicitly represented as:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + e_i$$

Where:

Y = Charcoal Consumption (Kg/ month)

X<sub>1</sub> = Sex of household head (male or female)

X<sub>2</sub> = Marital Status of household head (married or single)

X<sub>3</sub> = Age of household head (years)

X<sub>4</sub> = Educational Qualification (years spent in school)

X<sub>5</sub> = Family size (number of persons)

X<sub>6</sub> = Level of Income ((₦/ month)

X<sub>7</sub> = Price of Charcoal ((₦/ kg)

X<sub>8</sub> = Price of Substitute ((₦/ kg)

X<sub>9</sub> = Proximity (Distance to charcoal supply in km)

β<sub>0</sub>, β<sub>1</sub> – β<sub>9</sub> = Estimated Parameters

e<sub>i</sub> = Error term

Different functional forms such as semi-log, double-log and exponential forms were tried. Linear Regression was selected as the best based on statistical and economic criteria of selection of the functional forms.

## 3. RESULTS AND DISCUSSION

### 3.1 Determinants of Charcoal Consumption among Households in Maiduguri Metropolis

The determinants of charcoal consumption among households in Maiduguri Metropolis, Borno State were analyzed using the linear regression model. The result is presented in Table 1. A positive sign of a coefficient implies that the variable is positively related to charcoal consumption and the reverse is the case for

negative sign. The result shows that the coefficient of determination ( $R^2$ ) was 0.865, implying that about 87% of the variation in charcoal consumption in the study area was explained by the variables used in the model. The result revealed that the coefficient of age and sex of household head were positive, but not significant, implying that they have little or no influence on the consumption of charcoal in the study area. Regardless of the age and sex of the respondents, charcoal consumption will continue to increase or decrease depending on the prevailing conditions.

The coefficient of marital status (0.010) was positive and significant ( $p < 0.05$ ), implying that 1% increase in the number of married people in the study area would result in about 0.01% increase in the quantity of charcoal consumption. A plausible explanation is that unmarried ones will tend to opt for kerosene and gas cooker because they are faster and cleaner source of cooking fuel. The coefficient of family size (-0.062) was negative and significant ( $p < 0.01$ ). This implies that 1% increase in the family size leads to about 0.06% decrease in the quantity of charcoal consumption in the study area. This might be due to the fact that charcoal is not for cooking large quantity of food. It will take too long to cook a large quantity of food for household with large number of people. Hence, larger households prefer other faster means of cooking like fire wood.

Table 1: Determinants of Charcoal Consumption in Maiduguri Metropolis

Variable	Parameter	Coefficient	t-value
Constant	$\beta_0$	3.784	4.215***
Sex of household head	$\beta_1$	0.025	1.203
Marital Status	$\beta_2$	0.011	2.327**
Age	$\beta_3$	0.031	-1.538
Educational Qualification	$\beta_4$	-0.042	3.453***
Family size	$\beta_5$	-0.062	2.973***
Level of Income	$\beta_6$	-0.121	5.261***
Price of Charcoal	$\beta_7$	-0.062	3.261***
Price of Substitute	$\beta_8$	0.125	2.784***
Proximity	$\beta_9$	0.031	2.447**
$R^2$		0.865	
Adjusted $R^2$		0.832	
F-Statistics		78.64	

Sources: Field Survey, 2016

The coefficient of education (-0.042) was negative and significant ( $P < 0.01$ ), implying that 1% increase in the level of education leads to about 0.04% reduction in the level of charcoal consumption in the study area. This is plausible as higher level of education implies higher income. Highly educated people in the society are expected to earn higher level of income. Hence, they prefer the better, healthier faster and cleaner source of fuel like gas cooker and kerosene for their cooking. The coefficient of monthly income (-0.121) was negative and significant ( $P < 0.01$ ), indicating that 1% increase in

the household head's monthly income results in about 0.12% decrease in the consumption of charcoal. This is plausible as law of demand states that better-off people in the society always prepare superior goods like gas cooker and kerosene to inferior sources of fuel like charcoal which is dirty to use and slower in cooking. This finding also agrees with Onoja (2012), Jonathan and Victor (2013) and Maurice *et al.* (2015), all of which reported inverse relationship between the level of income and consumption for charcoal and fuel wood in their respective studies.

The coefficient of price of charcoal (-0.062) was also negative and significant ( $p < 0.01$ ), implying that 1% increase in the price of charcoal leads to about 0.06% decrease in the consumption of charcoal. This is attributed to the law of demand which state an inverse relationship between quantity and price of commodity. This suggests that as the price of charcoal increase, consumers will switch to cheaper alternative sources of fuels such as gas, kerosene and firewood. Similar finding was reported by Maurice *et al.* (2015) in their study on factors influencing fuel wood consumption in some selected Local Government Areas of Taraba State.

The coefficient of proximity to source of supply (0.125) was positive and significant ( $P < 0.05$ ), indicating households that are closer to source of the product tend to consume higher quantity of the product than those living far. That suggesting that household those are closer to source of charcoal are tempted to consume more of the product.

#### 4. CONCLUSION AND RECOMMENDATIONS

1. Charcoal consumption in the study area is greatly influenced by the socio-economic characteristics of the people such as level of education, monthly income, family size, price of charcoal as well as the price of substitute product.
2. There is the need for the government to subsidize the cost of substitute source of fuel like gas and kerosene to encourage their usage particularly by the low-income earners in the study area.
3. The general level of income should be improved through increase in the minimum wage rate of all workers enabling them to afford the superior source of energy like gas and kerosene and equally reduce the pressure on charcoal consumption.
4. High levies should be place on the exploitation of forest resource in order to discourage its abuse.

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