EMPIRICAL INVESTIGATION OF THE POVERTY- FUELWOOD CONSUMPTION NEXUS IN MAKURDI METROPOLIS

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Abstract
The paper empirically investigated the poverty-firewood consumption nexus in Makurdi Metropolis. Simple random sampling technique was used to select 200 respondents in the Metropolis. Data were collected using questionnaire, while descriptive tools such as tables, percentages and charts as well as binary choice probit model were used to analyse the data. From the probit models, it was confirmed that the behaviour of the respondents is consistent with the Energy Ladder model's postulations; and as such, firewood was considered an inferior good whose demand is likely to fall given a rise in income. it was also confirmed that there exist substitution effect between the demand for firewood and other cooking energy types. Again, a negative own-price effect in the demand for firewood was found in the study area. Finally, the study has revealed the existence of poverty- environment hypothesis in the study area ; on this basis, it was concluded that poverty leads to high firewood consumption in the study area. Thus, it was recommended that the government should make concerted efforts to reduce the scourge of poverty so as to reduce the of high level of firewood consumption, hence reduction in its attendant consequences of environmental degradation in terms of pollution and deforestation.

KEYWORDS: Energy Ladder, Fuel-wood, Own-price effect, Probit Model, Poverty-environment Hypothesis, Substitution-effect.

Introduction

Fuel wood as a source of energy for cooking and heating is highly utilized by households in both the urban and rural areas particularly among the poor (Sokona, 1996). This is more pronounced in developing countries where the use of other energy alternatives is difficult because of low income levels. According to World Energy Council (1999), the use of traditional fuels is derivable from bio-mass and is common in the rural areas and in the poor outlying urban areas of the developing countries. Amongst poor families, the use of fuel wood as energy for cooking and heating makes up 90% to 100% of residential energy consumption.

In several underdeveloped countries, the use of bio-mass accounts for as much as 95% of home energy consumption both in the remote villages and towns (Bruce, 2002). The contribution of bio-mass to the consumption of primary energy varies between 80% to 90% (poor countries), to 55% to 65% (middle-income countries) and 30% to 40% (high-income countries) (UNDP, 2002).

In Nigeria, empirical studies such as Ojinnaka (1998), Luwapal and Onyekwelu (1995), Adegbehin (1999), Bilyamin (2006), Bello (2010), have revealed high level of fuel wood consumption both in the rural and urban areas in Nigeria. According to the Nigeria's Energy Study Report (2002), despite the abundance of oil and gas and high potential for hydro-electricity, Nigeria still depends to a large extent on traditional energy sources such as fuel wood, bagasse and crop residue for its domestic energy needs. Nigeria's fuel wood consumption is estimated at about 80million cubic meters (about 25million tones). Fuel wood is widely used for heating and cooking, cottage industrial application and food processing. Currently, these traditional energy sources account for about 55 percent of Nigeria's primary energy requirements.

From the foregoing, it can be deduced that the high percent use of traditional energy sources such as fuel wood is precipitated by the high poverty incidence in the country vis-à-vis the shortage of modern energy sources. Relationships have been established between energy and major socio-economic global issues such as poverty, gender disparity, population, food security, health, environment, economy, and security. Thus the energy-poverty nexus is obvious, people living in poverty primarily use wood, and other biomasses for their energy services, and tend to use less electricity and liquefied petroleum gas than those

that are better off. Energy, poverty and social equity are intricately linked and intertwined. (Nigeria Energy Report 2002).

In Benue State, given the high level of poverty, fuel wood is widely used as a major source of cooking energy, both in the rural and urban areas. According to the National Population Commission (2010) the distribution of households by the type of cooking energy revealed 627,030 regular households for firewood, 48,260 for electricity, 6067 for gas, 78,401 for kerosene, 37,749 for coal, 2,558 for animal dung/saw dust/coconut husk, 775 for solar and 93 for others in Benue State. This suggests that firewood consumption is very high in the state more than any other cooking energy source. Also, at the local government levels, Makurdi Local government is third highest with 37,571 regular households in the consumption of firewood after Gboko with 44,573, followed by Kwande with 39,330. Given this high level of firewood consumption in Makurdi local government, the fundamental question that arises is; is it truly that poverty precipitates this high level of firewood consumption in the area? Thus, the paper aims at investigating empirically the nexus between poverty and firewood consumption in Makurdi metropolis. The rest of the paper is divided into seven sections after the introduction. Section two deals with the conceptual and theoretical issues, section three discusses the empirical review, section four is on firewood consumption in Benue state, section five considers the methodology, section six treats data presentation and analysis, while section seven centers on discussion and conclusion of the paper.

Conceptual and Theoretical Issues

According to the Wikipedia (2013), firewood consumption refers to the use of wood as fuel energy. Wood fuel may be available as firewood, charcoal, chips, sheets, pellets, and sawdust. The particular form used depends upon factors such as source, quantity, quality and applications. Fuel wood can be used for cooking, heating, and occasionally for fuelling steam engines and steam turbines that generate electricity. Also, fuel wood can be used in many bakery industries as a source of energy.

Fuel wood belongs to Biomass group of energy. Biomass refers to energy derivable from sources of plant origin such as trees, grasses, agricultural crops and their derivatives, as well as animal wastes. As an energy resource, biomass may be used as solid fuel, or converted via a variety of technologies to liquid or gaseous forms for generation of electricity power, heat or fuel for motive power. Biomass resources are considered renewable as they are naturally occurring and when properly managed, may be harvested without significant depletion (Bello, 2010). In this study, the terms fuel-wood and firewood are used interchangeably to mean the same thing.

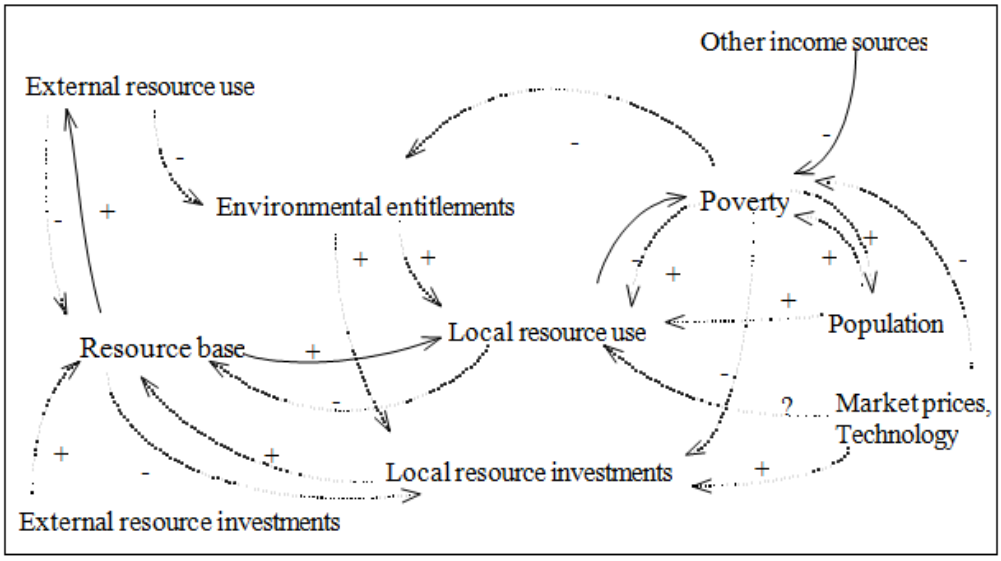
Poverty on the other hand, has been variously conceptualized. Ravallaion and Bidani (1994), defined poverty as lack of command over basic consumption needs, that is, a situation of inadequate level of consumption; giving rise to insufficient food, clothing and shelter. World Development Report (1990), defined poverty as the inability to attain a minimum standard of living. Schubert (1994), classified poverty into absolute and relative poverty. Absolute poverty being that which could be applied at all time in all societies, such as, the level of income necessary for bare subsistence; while relative poverty relates to the living standards of the poor to the standards that prevails elsewhere in the society in which they live.

Two theories, namely; the poverty-environmental hypothesis and the energy ladder model were employed in this study to explain the casual link between poverty and firewood consumption. The poverty-environment hypothesis was first developed by Leach and Mearns in 1992; and was developed by Reardon and Vosti in 1994 and later modified by Angelsen in 1995 and 1997 respectively; while the Energy Ladder model was popularized by the World Health Organization in 2002. The poverty-environment hypothesis upholds that poor people tend to extensively exploit the natural resources leading to the depletion of environmental resources. According to the proponents of this hypothesis, a key variable in this framework is local environmental entitlements, which is also central in the framework of Leach and Mearns (1992). This represents an application of Sen's (1981) entitlement approach to the environment-poverty complex. Of particular importance are institutional arrangements in the form of the property rights regime governing the resource use: who has access to natural resources? what are the rules for their use? how effectively are the rules enforced? etc. The local resource rights are functions of, inter alia, the use and claims made by external users, and the level of poverty. This means that poor people see

natural resources such as firewood, and animals dung as cheap energy sources for cooking and heating, considering the huge financial implications in the use of other energy sources around them. According to Yahaya(2002) there exist a strong relationship between household income, the most common parameter for measuring poverty, on the one hand, and the type of energy consumed, on the other hand; and he concluded that the poorer a country (or a community) is, the greater its dependence on fuel wood (or inefficient energy sources), and *vice versa.*

The poverty-energy connection could also be approached from the demographic angle within the framework of the poverty-environment hypothesis. According to Osei-Hwedie (1995) the faster population grows among the poor, this tend to translate to pressure on the local resources base. He posits that, as population expands and the number of the poor increases, the demand for resources will also increase. For example, the demand for food, cooking fuel and wood would put greater pressure on agricultural land as well as the stock of a number of environmental resources, especially biomass, the traditional sources of energy.

The figure below shows the poverty-local resources use interaction in an environment.



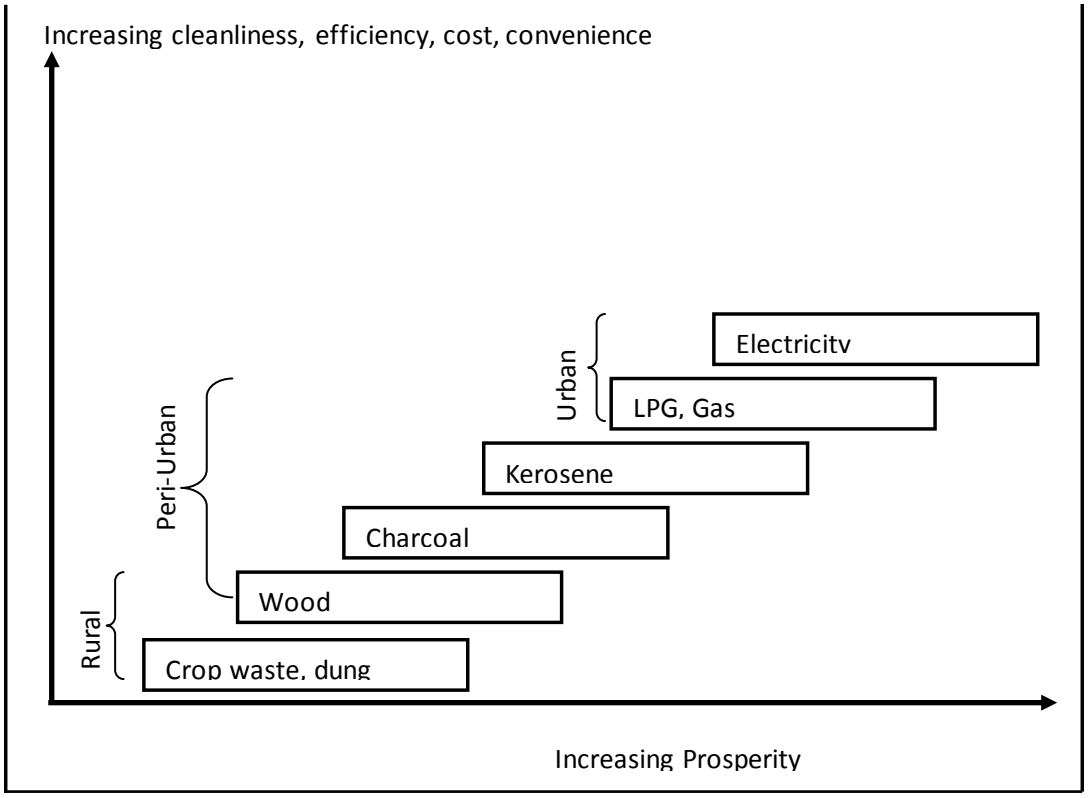
Source : Angelsen,1995

Figure 1 Some causal linkages between the natural resource base and poverty.

Dotted arrows indicate that a variable affects another; Solid arrows represent physical or income flows.

From the above diagram, it can be seen how poverty leads to pressure on local resources. This implies that increasing poverty and market prices exert pressure on firewood consumption in an environment. Also population increases the use of local resources including firewood. Environmental entitlements in turn affect both the local resource use and investments (with opposite effects on the resource base).

The Energy Ladder model of energy consumption posits that people tend to switch to modern energy sources if their income levels increase. In this connection, studies by Gundimeda and Kohlin (2003) have shown that while wood fuel is accepted as a normal good for the poor, it is considered an inferior good for the high income households. Scott (2006) observed that whenever the government increases the prices of oil, people decide to economize, by sliding down the energy ladder and reverting to the use of traditional fuels such as fire wood. A typical Energy Ladder model is depicted in the diagram as shown below.



Source: WHO,2002.

Figure 2: The Energy Ladder Model

From the above diagram, it can be seen that the linkage in energy ladder shows that growing access to better cleaner, more efficient and convenient energy services comes with an increasing level of income. This establishes an inverse relationship between poverty and better energy consumption on one hand, and a positive relationship between income and better cleaner, more efficient and convenient energy. This means therefore that, in the rural areas where people are poor with low income, they use crop waste, animal dung and firewood as their major source of energy; while in peri-urban areas where people are moderately poor, tend to use wood, charcoal, kerosene and Gas as their cooking energy. On the other hand, in the urban areas where the majority are non-poor, they use Gas and electricity as their cooking and heating energy as shown in the energy ladder model.

Empirical Review

The effects of poverty on firewood consumption hence environmental degradation have long been variously established in literature. To some authors, poverty is the major cause of high level of firewood consumption and hence environmental degradation in rural areas most especially the rural areas of the Less Developed Countries. For example, Demurger and Fourner (2010) took a study to examine the relationship between economic wealth and firewood consumption in rural areas of China and they found out that, there exists a significant and negative relationship between economic wealth and firewood consumption. As ones poverty level increases, his level of demand for firewood also increases. Studies by Audu (2013); Bello, (2011); Onuche, (2010) and Chikwendu, (2011) all collaborated Demurger and Fourner (2010) submission. According to Audu, (2013), firewood is almost only the means of domestic fuel in many rural areas leading to desertification as other sources of domestic fuel are almost not in use. Onuche (2010) asserted that, the rapid rate of deforestation has been linked with increases in prices of petroleum products, especially dual purpose kerosene. These increases in prices have equally been linked with the incidence of poverty. He concluded that poverty reduction is the key to the sustainability of our

forest resources in Nigeria. Chikwendu (2011), whose study confirmed the energy ladder theory, concluded that, the relationship between economic wealth and improved energy consumption is positive. As ones income increases, the individual energy consumption moves from firewood to kerosene and from kerosene to LPG(Liquefied Petroleum Gas). Buttressing their submission, Abdusalam, (2005), argued that, women consumption of firewood is higher than men and the major reason is that they have a higher incidence of poverty than their male counterpart.

Many studies on the relationship between poverty and environmental degradation have also shown that, the relation between poverty and environmental degradation is transmitted through firewood harvesting. One of such studies was taken by Niringiye, Wambugu, Karugia and Wanga (2012), to investigate the poverty/environmental nexus in Katonga basin. The study revealed that deforestation and wetland degradation were positively linked with poverty in a spiral web through inadequate access to clean water, access to toilets, and access to electricity and use of charcoal and firewood. To Ding (2013), poor people tend to have a lot of children. An increase in the poor population may cause the environment to deteriorate, while deterioration in the environment causes population to increase. For example, as forests recede up the mountainside, and poor households find it harder to have firewood, they need to have an additional child to gather firewood. As children grow, so does the need in the house for firewood and poor people are compelled to collect more firewood at the risk of aggravating the deforestation in progress. So, poor people aggravate automatically, the process of environmental degradation. To Sola and Zinbabwe (2001), a large and growing population of rural people struggling to survive in a limited land resource base has led to the overexploitation of the environment. Firewood is a major source of energy for people in the rural areas. Firewood extraction from indigenous forests is causing widespread deforestation in rural areas. Firewood is a cheap energy source for rural households especially the poor. Anijah-Obi (2001), also submitted that, poverty, a deplorable state of human welfare, is closely linked to environmental degradation. Those who are poor and hungry often destroy their immediate environments in order to survive. Other Studies by Kahyarara, Mbowe, and Kimrere (1998); Nwagbara, Abia, Uyang and Ejeje (2012); Jean-Marie, Pranab, Sanghamitra, Dilip and Rinki (2007), Forsyth and Leach (1998), all have concluded that, there is a relationship between poverty and environment. Poor people are compelled to consume firewood as their major source of energy and high firewood consumption lead to environmental degradation. This phenomenon has serious economic implication.

Fire wood Consumption in Benue State

In Benue state, firewood is widely consumed both in the rural and urban areas. The following table shows the distribution of Regular Households by cooking fuel in Benue state during the 2006 population and housing census of the Federal Republic of Nigeria.

Table HCH: Distribution of Regular Households by Type of Cooking Fuel

STATE	Total	Electricity	Gas	Kerosene	Firewood	Coal	Animal dung/ awdust/ coconut husk	Solar	Other
BENUE	**801833**	**48260**	**6067**	**78401**	**627030**	**37749**	**2558**	**775**	**993**
Ado	34382	1923	338	2413	27692	1668	277	37	34
Agatu	21998	617	197	2930	17889	280	42	19	24
Apa	18454	653	140	1921	15480	190	41	18	11
Buruku	38405	2216	200	2401	29697	3593	209	51	38
Gboko	66817	8460	644	6669	44573	6077	152	99	143
Guma	36163	617	104	2534	29754	3012	105	21	16
Gwer East	32628	1348	155	2016	27252	1674	107	39	37
Gwer West	23485	322	82	1781	20999	197	72	11	21
Katsina-Ala	39920	630	100	3235	35030	727	151	32	15
Konshisha	42759	2801	312	2385	35082	1982	116	58	23
Kwande	46638	2100	202	3141	39330	1648	115	37	65
Logo	32194	3387	242	2115	22284	4000	116	32	18
Makurdi	58708	1843	1461	16684	37571	810	100	23	216
Obi	18814	253	39	1140	16864	454	46	13	5
Ogbadibo	25185	305	83	3282	21293	132	37	14	39
Ohimini	13798	262	118	1663	11664	49	18	8	16
Oju	34885	1796	131	2339	27646	2627	271	49	26
Okpokwu	34252	1044	292	4310	28052	314	134	51	55
Otukpo	48939	3602	537	7461	36152	832	248	36	71
Tarka	15387	163	37	983	14091	69	7	10	27
Ukum	40732	5884	245	2792	29198	2494	59	32	28
Ushongo	34632	2076	217	2025	27790	2356	76	49	43
Vandeikya	42658	5958	191	2181	31647	2564	59	36	22

Source: National Population Commission, March, 2010.

A cursory look at the above table reveals eight different cooking fuel types used by households in Benue .A total of 801833 households were surveyed about the energy types they used in Benue state during the 2006 census; out of which 627030 representing 78.20% were reported as regular consumers of firewood as cooking fuel. This implies that only 21.80% of the people that used the other energy sources. In order to show clearly the proportions of the people that use the various energy sources in the state, the information in the table above was used to construct a pie chart as shown below;

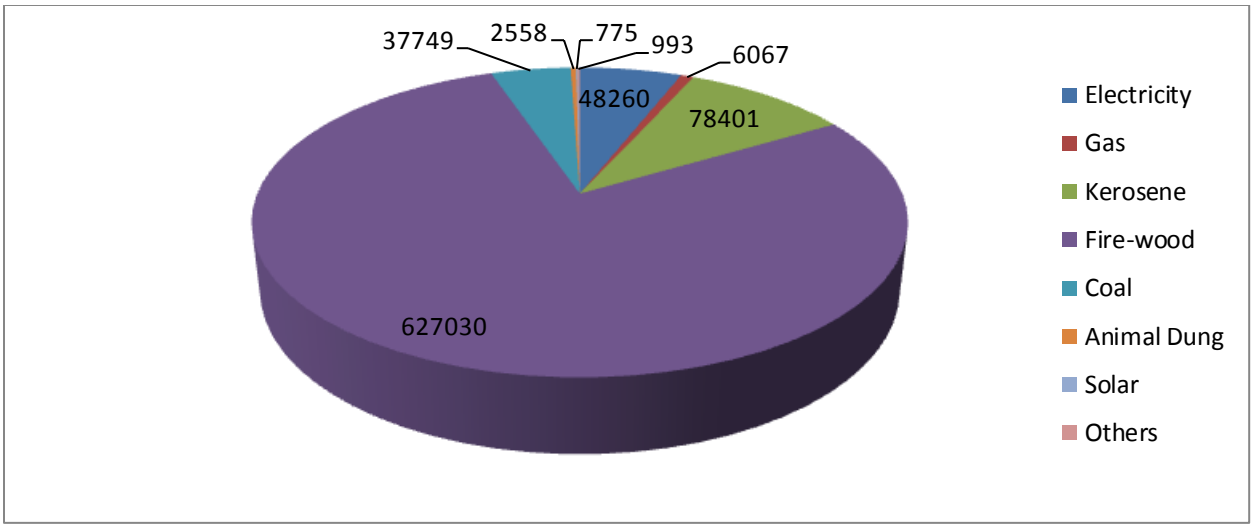


Figure 3: Household Energy Consumption in Benue State

Furthermore, the table depicts the consumption of the various energy sources in the state by local governments. From the table, it can be seen that Gboko local government has the highest proportion of people that use firewood, that is, 44,573 on regular basis representing 66.71% of the total people surveyed in Gboko LGA; this is followed by Kwande local government with 39330 persons representing 84.33% of the total people surveyed in Kwande LGA. The third highest according to the census figure is Makurdi local government with 37571 people representing 64% of the total population surveyed in Makurdi LGA. For clarity purposes, the information in the above table about the various energy consumption in the local government areas in the state are presented in a pie chart as shown below;

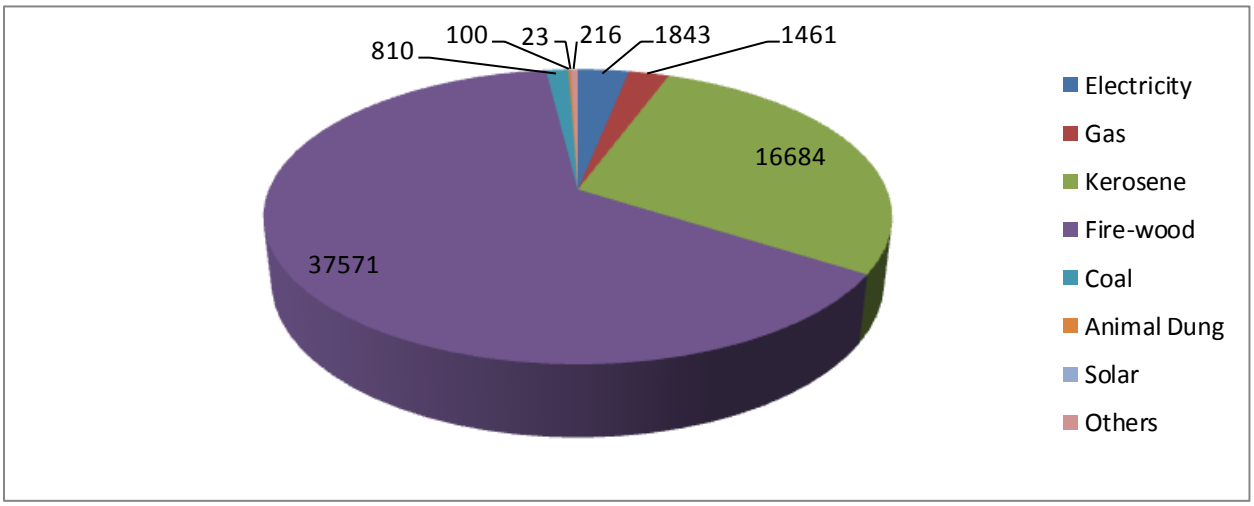


Figure 4: Household Energy consumption in Makurdi Local Government

Methodology

The study was carried out in Makurdi metropolis. The choice of Makurdi is predicated on the premise that the 2006 census revealed Makurdi Local Government as the third highest firewood consuming local government in the state after Gboko and Kwande local government areas. In this study, Makurdi metropolis was assumed to comprise Gyado villa zone, Wurukum, North Bank, Wadata, High level, Owner occupiers' zone, Modern Market side, Nyiman Layout, Terwase Abadu and Judges Quarters. This

assumption is premised on the fact that, these are the major settlements that constitute Makurdi metropolis.

The population of the study was made up of all the households that use fuelwood, charcoal, kerosene, gas, electricity and other energy sources as cooking and heating energy within these zones specified above. Given that this population cannot be easily ascertained; we randomly selected 20 households from each of these zones and this gave us a sample of 200 respondents. Data concerning the sex, age, occupation, income, household size, marital status, level of education, energy sources used, reasons for using the source(s), daily/weekly or monthly expenditure on cooking fuels.

Data were analyzed using simple descriptive tools such as tables, percentages and charts as well as a probit model. We used the 1.5 dollars per day measure to group the respondents into poor and non-poor with a view to ascertaining the relationship between poverty and the consumption of firewood in the metropolis.

Model Specification

Using the framework of Demurger and Fourner (2010) which expressed the utility function of firewood consumption as:

$U= u(C_E, C_X, C_L, Z^C)$……1

Where U is the utility derived, C_E stands for consumption of goods requiring energy (basically cooking or heating), C_X is the consumption of other goods and C_L is leisure, Z^C is the vector of the household's characteristics likely to influence its preferences (wealth, household size, education level, etc,). Household utility maximization is subject to budget constraint determined by household consumption expenditures and income;

$P_X C_X + P_{FW} C_{FW} = R$……..2

Where P_X and P_{FW} are market prices respectively for goods X and firewood, C_{FW} is the amount of firewood consumed and R is the total income.

The consumption of goods requiring energy (CE) depends primarily on the energy consumption, either firewood or other energy sources. The maximization process leads to reduced-form equation for the quantity demanded of firewood, hence, we specified the demand for firewood as: binary choice models. Therefore, the binary model is of the form; following Bello (2010).

$Y = \beta_o + \sum \beta_j X_j + \mu_i$……..3

Where Y is an unobserved latent variable. What is actually observed is a binary variable say HDF= (1, if a household demand fuel wood, 0, if other wise). The assumption made is that households are faced with a choice between two alternatives to demand for firewood or to demand for substitutes (Kerosene, Gas, electricity, solar and others). The demand decisions are essentially influenced by their socio-economic characteristics in addition to the prices of the available energy source; hence we postulate the stochastic equation as follows;

$HDF= \beta_o + \beta_1 AGE + \beta_2 HSZE + \beta_3 INC + \beta_4 LEDU + \beta_5 PG + \beta_6 PK + \beta_7 PW + \mu$…….4

Where HDF is demand for firewood, AGE is age of the household head measured in years, HSZE is household size(number of people in the house), INC is the income level (in Naira), LEDU is the level of Education of the household head (Education qualification), PG is the price of Gas, PK is the price of Kerosene, and PW is price of firewood all in Naira. β_o is the constant, β_1 - β_7 are the parameters to be

estimated and μ is the error term. Secondly, income variable was replaced with the poverty status and the model is expressed as follows:

$HDF = \beta_{o+} \beta_1 AGE_+ \beta_2 HSZE_+ \beta_3 POV_+ \beta_4 LEDU_+ \beta_5 PG_+ \beta_6 PK_+ \beta_7 PW_+ \mu$…….5

Where POV is the poverty Status measured using 1.5 Dollars per day, any respondent whose income is less than 1.5 Dollars a day was considered poor and a value of 1 was assigned and otherwise was considered non-poor and a value of 0 was assigned. All other variables are as defined in equation 4. The maximum likelihood technique was used to estimate models 4 and 5.

Data Presentation and Analysis

This section presents the results of the data collected. First, energy sources used for cooking by the respondents in the study area are presented. The result is presented in the table below.

Table 2: Distribution of Respondents According to Energy used for Cooking and Heating

Sources	Frequency	Percentages (%)
Fuelwood	*118*	*59.0*
Charcoal	*43*	*21.5*
Kerosene	*29*	*14.5*
Gas	*6*	*3.0*
Electricity	*4*	*2.0*
Total	***200***	***100***

Source: Field Survey, January, 2013

From the above table, it is obvious that more than half of the respondents use fuel wood more than any other energy source. This suggests that there is high level of fuel wood consumption in the study area. Further, the respondents were asked to indicate reasons for using a particular energy source. Their responses are presented in the following table.

Table 3: Reasons for Utilization of Energy Sources

Energy Source	***Reasons***					***Total***
	Availability	*Cheapness*	*Low Level Of Income*	*Convenience*	*Efficiency*	
Fuelwood	*20*	*32*	*63*	*2*	*2*	*118*
Charcoal	*9*	*12*	*19*	*1*	*2*	*43*
Kerosene	*3*	*8*	*15*	*0*	*3*	*29*
Gas	*0*	*0*	*0*	*4*	*2*	*6*
Electricity	*2*	*0*	*0*	*2*	*0*	*4*
Total	***34***	***52***	***97***	***9***	***8***	***200***

Source: Field Survey, January, 2013

From the above table, it can be seen that for fuel wood, charcoal and kerosene, the principle reason for their high usage by the sampled respondents is the low income level; since 48.5% of the total respondents have indicated so. The second reason advanced by the respondents for using fuel wood, charcoal and kerosene is cheapness; 26% of the total respondents have also indicated so. The third reason is availability which make up 17% of the total respondents while (9)4.5% and (8)4% of the respondents indicated convenience and efficiency as the reasons for using gas and electricity. These results are in consonance with the theoretical postulations of the energy ladder hypothesis. The hypothesis postulates that the poor tend use more fuel wood, charcoal, and they are likely to switch over to more convenient and efficient energy source given an increase in their income level.

To further ascertain whether their income levels are truly low as indicated above, they were asked to state their annual income and their responses are presented in the table below.

Table 4: Distribution of Annual Income of the Respondents

Income level(₦)	Frequency	Percentage
<100, 000	87	43.6
101, 000-200,000	52	26.0
201, 000-300, 000	41	20.5
301, 000-400, 000	15	7.5
Above 400, 000	5	2.5
Total	**200**	**100**

Source: Field Survey, January, 2013

A close examination of the income levels of the respondents revealed that on the average, 43.6% of the respondents' income is less than 1.5 dollars per day (N240) assuming that exchange rate of $1: N160. This suggests that, 87 respondents representing 43.6% are living below the poverty line; hence, we may say that 43.6% of the sampled respondents are core poor and the rest are considered moderately poor. Thus, we may further deduce that the 59.0% of the respondents in table 2 who indicated that, they use firewood as their major source of cooking energy may be attributed to their income levels as also shown in table 3.

To further confirmed poverty – fuel wood consumption nexus, binary- choice- firewood demand function was estimated. First, we included the income level of the respondents as an explanatory variable and second, the model included poverty status as any explanatory variable. Here, the value of 1 was assigned to the non-poor respondents on the basis of 1.5 dollars (₦240) per day, and the value of 0 was assigned to the poor respondents.

The results are shown below,

Table 5: Probit Results from Models 4 and 5

MODEL 4				MODEL 5			
Variables	Coefficient	Std Error	Prob	Variables	Coefficient	Std Error	Prob
AGE	0.2339	0.0116	0.0034	AGE	0.0062	0.0129	0.625
HSZE	0.0331	0.0537	0.5370	HSZE	0.0424	0.0562	0.4507
INC	-1.0112	0.512	0.0231	LEDU	0.1216	0.152	0.423
LEDU	-0.0481	0.1359	0.7238	POV	0.2976	0.0441	0.000
PG	0.1421	0.0440	0.0121	PG	3.04E-05	0.0005	0.9496
PK	-1.721	5.182	0.7398	PK	4.54E-05	5.48E-05	0.4074
PW	-2.8311	2.3612	0.0411	PW	-3.26E-05	-2.7400	0.2354
C	-0.1252	0.6684	0.8514	C	0.59116	0.7495	0.4303
Dependent Variable: HDF				Dependent Variable: HDF			
Mac Fadden R-Squared	0.542			Mac Fadden R-Squared	0.492		
Akaike ifo Criterion	1.3820			Akaike ifo Criterion	1.129		
Schwarz Criterion	1.51396			Schwarz Criterion	1.2607		
LR Statistic	8.175			LR Statistic	53.83		
Prob(LR Statistic)	0.0872			Prob(LR Statistic)	0.000		

Source: Authors' output from E-Views 7

From the results of model 4, AGE is positively related to household demand for fire wood, and it is statistical significant at 1% level of significance. This could be explained as traditional effect as old people tend to use firewood more than young people. The finding is consistent with Demurger and Fournier (2010). The household size (HSZE) is positively associated with the demand for fire wood. This

suggests that as the house size increases, there is tendencies for increase demand for fire wood hence, lower demand for its substitutes (kerosene and cooking gas). This finding is in line with Bello (2010). An inverse relationship was found between the income and the demand for fire wood in the sample contrary to the findings of Bello (2010). Given this significant negative relationship, we interpreted that, as income increases, the demand for firewood decreases. This implies that income increase make people switch over to better energy sources such as kerosene, gas, etc. This explanation is consistent with the Energy Ladder hypothesis. Thus, we considered firewood as an inferior good. This is in line with Demurger and Fournier (2010). The results also revealed a negative relationship between the level of education and the demand for firewood. This suggests that as ones level of education increases, there is the tendency for such a person to demand for more convenient energy sources, other things being equal. The result again showed a positive relationship between the price of gas and the demand for fire wood. The positive sign suggests the *substitution effect* ; while the price of kerosene appeared with a negative sign contrary to our expectations. Lastly, the price of firewood has a negative relationship with its own demand. This suggests the classical *own-price effect* ; implying that if the price of firewood increases much, there is tendency for households to switch over to other energy substitutes such as kerosene, if their prices remain fairly stable.

The Mac Fadden R^2 is 0.542 meaning that explanatory variables included in the model explain changes in the demand for firewood in the area by 54.2%. The Akaike and Schwarz statistics are relatively low; suggesting that the model performs well. The LR statistics is significant which suggests element of joint effect by the explanatory variables of the model.

In model 5, income was dropped and was replaced by poverty status. From this model, even with the introduction of the POV variable, AGE, HSZE have appeared with positive signs as in the case of model 4; however, the coefficients are not significant. Conversely, the level of education (LEDU) has appeared with a positive sign as well as the price of kerosene.

The poverty variable is positive and significantly related to the demand for firewood in the study area. This implies that if poverty increases by 1%, the demand for firewood will increase by 29.8%, other things being equal. The price of firewood still demonstrates a negative *own-price effect* character as in model 4. The Mc Fadden R^2 of 0.492 suggests that the changes in the demand for firewood are explained by the predictor variables of the model by 49.2%. The Akaike and Schwarz statistics show goodness of fit of the model, while the significant LR statistic suggests elements of joint effect by the explanatory variables of the model.

Discussion and Conclusion

Emergent from the foregoing analysis, it was found out that 59% of the sampled respondents use firewood as their major cooking energy. Principal reasons advanced for the overwhelming utilization of firewood were; low level of income and cheapness of firewood. It was further found that 43.6% of the sampled respondents' incomes were less than 1.5 Dollars per day. This suggested high poverty incidence.

From the probit models, we confirmed that the behaviour of the respondents is consistent with the Energy Ladder model's postulations; and as such, firewood was considered an inferior good whose demand is likely to fall given a rise in income.

Furthermore, it was confirmed that there exist substitution effect between the demand for firewood and other cooking energy types. Again, there is a negative own-price effect in the demand for firewood in the study area. Finally, the study has revealed poverty- environment hypothesis; on this basis, it was concluded that poverty leads to high firewood consumption in the study area. Thus, it was recommended that the government should make concerted efforts to reduce poverty so as to reduce high level of firewood consumption, hence reduction in its attendant consequences of environmental degradation in terms of pollution and deforestation.

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