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AN ASSESSMENT OF HOUSEHOLD ENERGY CONSUMPTION IN BIDA AND ITS ENVIRONS, NIGER STATE, NIGERIA

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Abstract

The study examined the relationship between household size and energy consumption in Bida and its environs. Based on the population of the study area, the total sample size was 398 with 80 households each from three wards and 79 household each from two wards. The structured questionnaires were administered to the 398 households, however only 388 questionnaires were retrieved back, the rest were misplaced or the respondents were absents as at the time of retrieval. The data was analyzed using descriptive statistic and chi-square was use to test the relationships. The result shows that fuel wood and charcoal are the main types of energy for cooking, while for room lighting electricity dominates kerosene, household size correlate positively with energy consumption. It is therefore, recommended that since the use of fuel wood and charcoal dominates and this may lead to serious deforestation, alternatives such as gas, solar and wind energy should be made available at affordable prices and peoples should be encouraged to use them.

Keywords: Assessed, household, misplaced, expenditure, alternatives, encouraged**.**

Introduction

Energy is the basic necessity of life for meeting domestic, social and industrial needs. Adequate energy supply for industrial and domestic purposes are prerequisites for keeping socio-economic life moving (Momodu, 2013). In developing country like Nigeria, the level of domestic energy consumption is highest in all the sectors of the economy. The domestic sector consumed more than half of the total energy consumed in Nigeria (Ikuponisi, 2006). Nigeria,s domestic energy consumption figure in 1999 was 79.5 percent of the total national energy consumption. The energy commission of Nigeria (ECN, 2003) stated that domestic sector accounts for over 50 per cent of the grid electricity consumed and more than 50 percent of the total energy produced in the country.

Energy plays a central role in the overall framework of development planning of any nation as it affects all human activities either directly or indirectly. Energy is important for the sustenance of life, and it is a vital input in economic growth and development of any economy in order to keep it moving towards the desired

direction and achieve the desired goal; hence it is an indispensable commodity. Energy sources are generally classified under two broad generic names – renewable and nonrenewable sources. The principal renewable energy sources include solar, wind, hydropower, geothermal and biomass energy (ECN, 2003).

Energy for domestic purposes is determined by two major factors availability and affordability. This implies that energy must be readily available and the price must be within the reach of the people especially the poor. Making energy available to all and sundry in a particular society is a measure of the level of economic development of that particular society. For example, in advanced countries like UK, USA, and France, majority of their population have access to cheap and affordable energy supply because they are technologically advanced. The necessary energy infrastructures are available while the costs of energy are affordable by the majority of the people.

The reverse is however the case with people living in the low income countries like Nigeria, where the purchasing power of large proportion of the populace is low while necessary energy infrastructure are not in place. Thus, majority of the people do not have access to energy sources of their choice. In addition, there is lack of adequate energy infrastructure and adequate energy supply. This further compounds the problems of energy availability. Over all, most of the developing nations do not have access to cheap, reliable and environmentally friendly energy sources (Momodu, 2013).

Aim and Objectives of the Study

The study aimed at assessing the housed hold size and income with a view to ascertaining the relationship between household size, income and energy consumed. The specific objectives are:

1. To identify major types of energy used by the household in Bida
2. To examine the relationship between household size, income and energy consumed.
3. To examine percentage of household income expended on energy.

Methodology

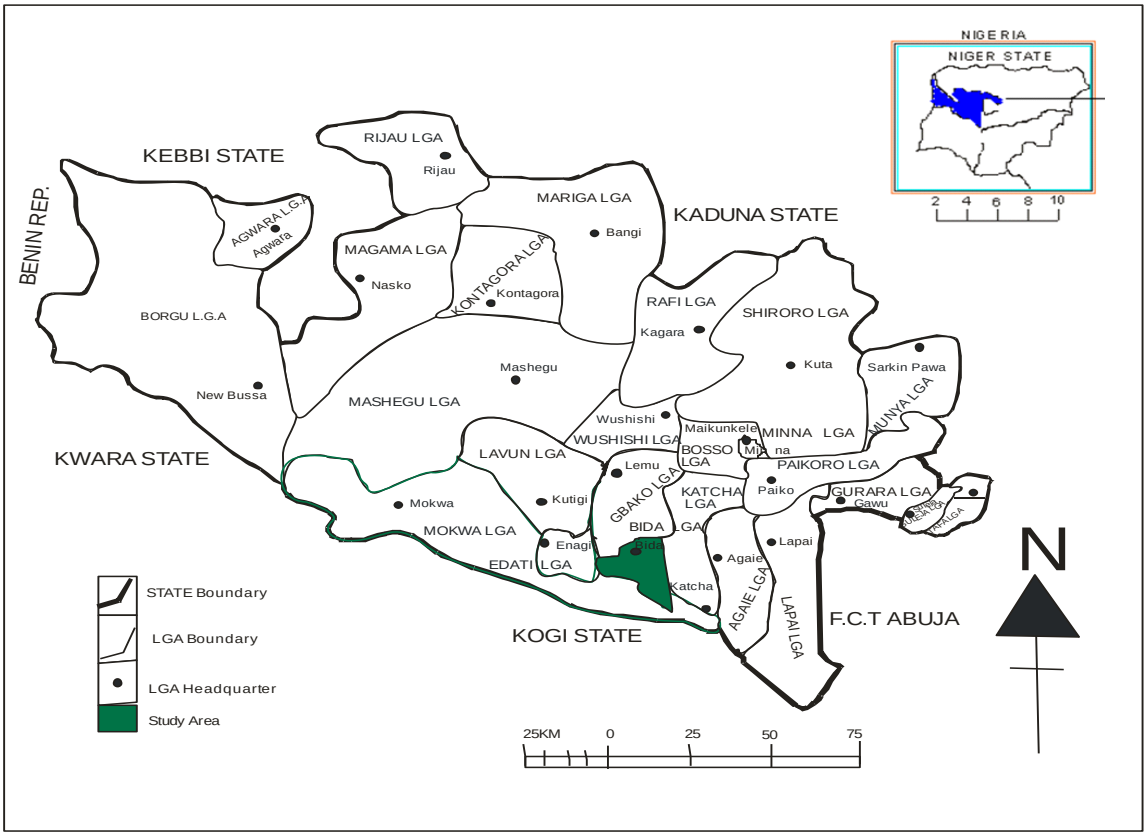
This methodology consists of study area, sources of data, sampling techniques, sample size determination, procedure for questionnaire administration and method of data analysis.

The Study Area

Figure 1 below is Niger State showing Bida Local Government Area, (Study Area) located between latitude 8^0 and 11^0 North and between longitude $4^0.30'$ and $7^{0\cdot}00$ East and a population of 188,181 persons at the 2006 census (2006 census Gazets). It is also located on the Nupe sandstone formation, which consist of plains with ironstone capped hills or mesas. The senery is fairly uniform since lithology and dock structure are not greatly variable. An important feature of the scenery is the existence of large areas of fadama. The northern edge of the town

consists of a broken – off Plateau. The town is drained by Chiken and Musa rivers, with Landzun which flows right across the heart of the town. The importance of these rivers is that they provide good irrigation opportunities for the inhabitants. Thus they are of both economic and social importance (Abubakar 2003).

Figure 2 is the map of Bida town showing the sample collection wards .This ancient city was walled to measure more than 19 kilometers in circumference. Before it was demolished this wall had ten gates.Bida a traditional once walled city, is situated on a gentle slope of the river landzun which runs through its heart in a given swath of fadama.(Abubakar 2003). Bida has a mean annual rainfall of 1227mm with the highest mean monthly rainfall in September with 248mm. The rainy season starts on average between the 5th and 15th April and last just over 200 days. The mean monthly temperature is highest in March at 31 and lowest in August (Abubakar 2003).



Source:Niger State Ministry of Land and Survey

Figure 1: Niger State map showing Bida Local Government (The Study Area)

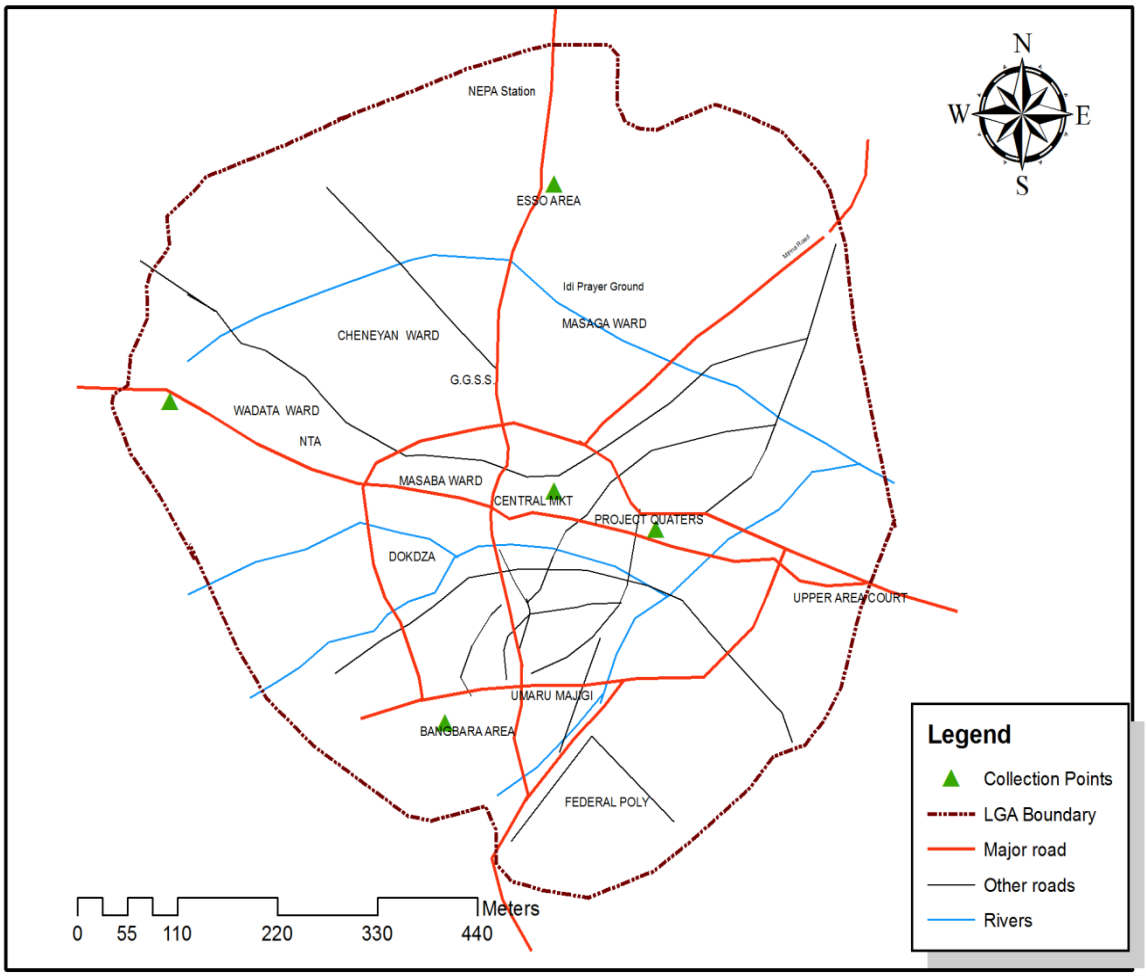


Figure 2: Bida Local Government Area of Niger State, Nigeria. (Sample Collection wards)

Sources of Data

In carrying out the study, both primary and secondary data were used. The primary data were questionnaire administration and Interview with the heads of household; while secondary data were obtain from journal articles, related literatures from text book and the internet.

Sampling Techniques

Five wards in Bida Local Government were systematically selected, these wards are: Esso, Central Market Area, Agricultural Development Project Quarters, Bangbara ward, and Wadata. At the second instance simple random sampling technique was used in administering 398 well structured questionnaire to residents of the selected wards for the purpose of questionnaire administration and interview, the size of

the population of the selected wards was used to determine sample size from the selected wards. 79 households from Esso ward, 80 from Bangbara ward, 80 from Central Market Area, 79 for Agricultural development Project quarters, and 80 from wadata ward. These figures represent 0.5% of the estimated population of the Area.

Sample Size Determination

For the purpose of sampling, 2006 population was updated to 2017 using 3.4% growth rate for the state and the updated figured was used to calculate sample size using Yaro Yamane formulae.

$$n = \frac{N}{1+N(e)2}$$

Where

n= the Sample size

N= the finite population

e= level of significance (or limit of tolerable error) (0.05)

1= unity (a constant)

Source: Practical Guide to Writing Research Project by A.E Uzoagulu Pg 6.

Data Analysis

Descriptive statistics such as charts, tables, frequency counts, percentage, were used to analyze the socio-economic characteristic of the respondents and also to examine household energy consumption of the area and factors influencing particular energy source

Selected Wards samples according to their Population

S/N	Bida LGA Data Collection Centres	Estimated Pop	Sample Size
1	Wadata	600	80
2	Central Market Area	550	80
3	Bangbara Area	550	80
4	Esso Area	600	79
5	Project Quarters	300	79
Total		2600	398

Source: Authors field survey, 2017

Theoretical Framework

Neoclassical economic theory examined the wider socio-economic context of energy demand in developing country. The need for such approach was driven by the lack of reliable and continuous data which is instrumental in convectional modeling

techniques. Obtaining such data may not be easy as identified in the case of the study area. More so, there is no doubt that econometric is subject to important limitations, which stem largely from the incompleteness of the economic theory and non-experimental nature of the data. Among approaches to energy consumption, the energy ladder:' and mix models are found to be relevant. This enable us to study electricity as one part of the household energy mix which in turn is influenced by different factors such as the size of household, the household income levels, the price of different fuels, and their availability to name a few.

Literature Review

Nigeria is a developing economy with human population of about 144 million and total land area of 923.8 square kilometers (World Development Indicators, 2006)). The population of urban dwellers is about 67million (48 per cent) while that of rural dwellers is 73 million (52 per cent). The implication of this demographic structure is that large amount of energy will be required for meeting obligations at both the urban and rural areas in the country (Momodu,2013).

The rural dwellers, whose needs are often basic, depend to a large extent on the traditional sources of energy for their domestic energy requirements while the majority of the urban dwellers depend on traditional energy sources and fossil fuels. However, the high level of poverty and other socio-economic problems inhibit both the rural and urban dwellers from having access to adequate and reliable sources of energy for domestic purposes (Momodu, 2013.

According to Momodu (2013)In terms of energy availability, there are various ample energy sources in Nigeria such as wind, solar,hydro, coal, oil and gas etc, which if properly managed will alleviate energy problems of the people most especially for domestic consumption. Obviously, Nigeria is naturally endowed with oil and gas and depends on it for her economic development. For example, oil accounts for 80.5 per cent of national revenue (CBN, 2007). These two energy sources are the major export commodities that provide foreign exchange for the country. Oil and gas also play major role in meeting energy needs of the various sectors of the nation's economy. For example, gas, petrol, diesel and kerosene provide energy for wide industrial and domestic application. Apart from oil and gas, other energy sources such as electricity, wood and coal also play significant roles in meeting energy demands in the country. However, among all these energy sources, only fuel wood is mostly available and utilized almost everywhere in the country for meeting domestic energy needs.

Fuelwood has assumed a major role as domestic energy source in Nigeria as a result of several factors such as poor state of the economy, inadequate infrastructure and lack of good political will. Among all these problems, the poor state of Nigerian economy is the most significant problem confronting majority of the people (Sambo, 2005).

Household energy demand is known to be mostly guided by prices of fuels and

appliances, disposable income of households, availability of fuels and appliances, and cultural preferences (Dzioubinsky and Chipman 1999; Zhang and Guo 2013).

Kerosene is the sole fuel for lighting in non-electrified households; it is also the fuel of choice in electrified households during the periods of power outages. Future consumption of kerosene for lighting in both electrified and non-electrified households in urban and rural dwellings is tied to the number of households in these demand categories, electrification rates, and electricity availability factors (Francis, 2017).

Energy ladder model

The energy ladder is a concept used to describe the way in which households will move to more sophisticated fuels as their economic status improves. According to Leach (1992), the energy ladder model (ELM) process is strongly dependent on urban size and within cities, on household income, since the main constraints on the transition are poor access to modern fuels and high cost of appliances for them to us. Understanding household energy consumption, fuel choice and fuel switching behavior is vital in searching for policies to support a transition process. This study uses energy ladder hypothesis as a starting point (Kayode, et'al, 2013). With this hypothesis the study focuses on the variables such as household size, income, educational status, gender, household composition, and social status as the major parameters of the research.

Socio- Economic Characteristics of the Respondents

Socio-economic characteristics are used to reveal social status of the respondents. It gives the socio-economic information of the respondent. This information can reveal to some extent the living condition of the respondent. The researcher therefore considers it necessary to obtain this information that inference can be made from it.

The distribution of respondents by sex

The sex is very important in assessing energy consumption, because various sexes have its role in the household. In most Nigerian family women takes charge of cooking for the entire family, therefore they are directly involved in using most energy sources than man.

Table 1: Distribution of the Respondents by Sex

Sex	Frequency	Percentage
Male	161	41.49%
Female	227	58.51%
Total	388	100%

Source: Author Field work, 2017

Above table shows the distribution of respondents by sex, 41.49% of the respondents were male, while 58.51% of the respondents were female. The female group are directly involved in using most sources of energy in achieving their social responsibility of woman hood. The sources such as fuel wood, charcoal and gas are used more by women for cooking, heating than men. However, men also use energy for their domestic utilities such clothes ironing, and other electronics such as television, radio, e.tc.

Distribution of the Respondents by Education level

Education determines social status of individuals and this also determines the kind of energy source the household will use. Education also determines sometimes the income of an individual, so education influences the change in energy ladder. For this reason educational attainment also determines the kind of energy sources used by the by the household.

Above table reveals educational distribution of the respondents, 40.72% of the respondents has attained secondary level of education, 34.53% has attained tertiary level of education and while 8.76% has non-formal level of education. Educational attainment is very important in assessing household energy consumption, because educational attainment determines social status and income of individuals. Highly educated people would prefer using modern sources of energy and this is also a function of their income.

Distribution of the Respondents by Income

Income is very important in determining the household energy source to be used. The income of the household help in determining the kind of energy the household will use, when income increase the household status also change and the energy requirement also change. For example the household that uses fuel wood for cooking would now change to gas or any other sources of energy more advance than fuel wood.

Table 2: Distribution of the Respondents by Educational Level

Educational Status	Frequency	Percentage
Primary	62	15.97%
Secondary	158	40.72%
Tertiary	134	34.53%
Non-formal	34	8.76%
Total	388	100%

Source: Author Field work, 2017

Table 3: Distribution of the Respondents by Income

Expected Income per month	Frequency	Percentage
0-20,000	36	9%
21,000-30,000	106	27.31%
31,000-40,000	73	18.81%
41,000-50,000	57	14.69%
51000-60000	75	19.32
61,000 and above	41	10.56%
Total	388	100%

Source: Author Field work, 201

Household Size of the Respondent

Household size is important in determining energy consumed by the household, where household is large energy consumption will be high, because of their utilities and also the expenditure on energy sources will also increase compared to a small household size.

Table 4: Household size of the respondents

Household Size	Frequency	Percentage (%)
0-10	31	7.78
11-15	82	21
16-20	138	35
20- 25	83	21
26- above	54	13.53
Total	388	100

Source: Author Field work, 2017

Above table shows household size of the respondents,.34% of the respondents have between 16-20 family members that uses energy for one thing or the other, 22% has

between 11-15 family members that require energy, while only 9% has between 1-10 family members. However, it is clear that the more the family members the more energy consumed for cooking for heating and other household utilities such as lighting, ironing of clothes et.c.

Sources of Energy for Cooking, Room Lightning, and water heating

The choice of the sources of energy to be used by household is indeed determined by factors such as income, household size and invariably the educational level of individuals. The source of energy to be used for various functions such as cooking, water heating and room lightening is determined by above mentioned factors

Table 5: Sources of Energy for Cooking, Room Lightning and Water heating

	Cooking		Water heating		Room Lightning	
Energy Types	Respondents	Percentage	Respondents	Percentage	Respondents	Percentage
Kerosene	78	20%	68	17.52%	51	13.14%
Gas	48	12%	53	13%	08	2%
Fuel wood	101	26%	115	29.63%	41	10.56%
Electricity	45	11.59%	61	15.72%	251	64.69%
Charcoal	98	25%	91	23.45%	09	2%
Others	18	4.63%	0	00%	28	7%

Source: Author Field work, 2017

Table 6: Income and Commonly used Energy Sources

Income Group	Energy Source							
	Fuel wood		Charcoal		Kerosine		Gas	
Low class (142)	97	68%	21	14.78%	15	10%	9	6%
Midle class (130)	70	53%	35	26.92%	16	12%	9	6.92%
High Class (75)	19	25%	13	17%	31	41%	12	16%
Higher Class (41)	08	19%	09	21%	11	26%	13	31%

Source: Author Field work, 2017

Above table revealed sources of energy used by the respondents for cooking, water heating and lightening. 26% use fuel wood for cooking, 20% use kerosene for coking, 25% use charcoal for cooking, while only 12% use gas for cooking. For water

heating 29% use fuel wood for water heating 23.45% use charcoal for water heating and 13% use gas for water heating. For lightening 64.69% use electricity for lightening, 13% use kerosene for lightening and only 2% use charcoal for lightening. This difference in the choice of sources of energy for cooking, water heating and lightening is a function of household size, income and level of education of the individuals.

Income Group and Commonly used Energy Sources.

Here based on monthly income on table 3, the income group is classified in to Low class, middle class, high class and higher class. The low class are those that earn between N20,000 -N30,000 per month, 21% use charcoal, 26% use kerosene and 31% use gas. The energy consumption and sources to be used are determined by the income and household size. For example where income is low but the household size is small such household can afford to use costly source of energy. Also income could be high, but if the household is higher than the income, such household would have to resolve to use affordable energy source.

Household size and commonly used Energy source of Cooking..

Energy used by the household is a function of the household size and the income of the head of the household. Household size is very important is determining the choice source of energy the household will use, where the household size is large the household goes for cheaper and convenient middle class is between 31,000 – N50,000 per months, high class is between 51,000 – 60, 000 per month and higher class are those that earn N61 and above per months. This classification of income group is used based on the nature of the society. In other societies within Nigeria this classification may not be applicable.

Table 6 above shows income group and energy sources of the household, 68% of low income earners use fuel wood as their sources of energy, 14% use charcoal, 10% use kerosene and 6% use gas,. Middle income earners, 53% use fuel wood, 26% use charcoal, 12% use kerosene, and 6.92% use gas. High class income earners, 25% use fuel wood, 17% use charcoal, 41% use kerosene and 16% use gas. Higher income earners 19% use fuel wood energy for the purpose. Income has been identified as important determinant of the kind of energy source use by the household. However, both income and household size goes hand in hand in determining the choice of energy sources especially for cooking.

Table 7 above reveal commonly used energy sources in the area by the household. Most large household used fuel wood as common source of energy for cooking. This is because of the size of the household. 53% the household having between 20-25 members used fuel wood as their main cooking energy. Other source of energy used is charcoal which is used by household as supplement of the fuel wood. It is followed by kerosene for most of the household. Gas has mean of energy is used by most household with few

members and it is determined by the financial capacity of the household.

The relationship between Income and Energy Expenses

Household size, income and expenditure have serious influer Dangana *et al*., 2018 consumption of energy in the study area. The expenses on energy and other necessary household needs are determined by the household income.

Table 7: Household size and commonly Used Energy source for Cooking

Household size and No. of Respondents	Commonly used Energy source for Cooking.							
	Fuel wood (137)		Charcoal (107)		Kerosine (84)		Gass (60)	
0-10 (31)	04	12%	08	25%	12	38%	08	25%
11-15 (82)	21	25%	16	19%	38	46%	16	19%
16-20 (138)	47	34%	45	32%	38	27%	08	5%
20- 25 (83)	44	53%	22	26%	08	9%	09	10%
26- above (54)	27	50%	16	29%	05	9%	06	11%

Source: Author Field work, 2017

Table 8: Relationship between Income and Energy Expenses

Monthly Income	Amount Spent Monthly on Energy source.	Frequency	Percentage
20,000-30,000	1,000- 2,000	142	36.
31000-50000	3,000-5,000	130	34
51000- 60,000	6000- 8,000	75	16
Above 61,000	9,000-10,000	41	8

Source: Author Field work, 2017

Table 9: Household size and Average energy consumption per month

Household size	Average Energy consumption per months
0-10	100- 150 Watts
11-15	150- 200 watts
16-20	200- 300watts
20- 25	300- 500watts
26- above (54)	500-700watts

Source: Author Field work, 2017

Some families resolve to use traditional sources of energy because of its affordability and accessibility. Fuel wood is used in the study area by most families because it is affordable and accessible in the study area.

Above table revealed the relationship income and energy expenses, from the table those that have their monthly income between N20,000- N30,000 spent between 1,000- 2,000 mnonthly on energy sources, about 36% of the respondents belong to this group. Those that have their income between N31, 000- N50,000 spent N3,000-5,000 on energy sources, this group formed about 34% of the respondents. The expenses on energy by a household determine by income and sometimes household size, despite the income of the household size is small, less will be spent on energy sources. However, some household resolve to use traditional sources of energy to reduce expense on energy.

Household size and Average Energy consumption per month in the area.

The amount of energy consume by household is depended on factors such as household size, income and level of socialization. A family may small but energy consumption be high, However, if the household size is the same and the level of socialization and income are the same, there is likelihood that the energy consumption will be the same.

Above table shows average energy consumption in the area, from the table energy consumption increase according to the increase in household size. An average household of 10 consumes between 100-150 watts per months, while household size of 20-25 consumes between 300-500 watts per months. This is because the more the household the more the utilities and the more energy used.

Relationship between Household size and energy consumption

Chi-square= (X^2), chi-square is non-parametric statistical test that is used when the research data are in the form of frequency count. The frequency count can be placed into two or more categories. For this reason, since the data of this research is in frequency count Chi-square was chosen for testing the relationship between

Household size and energy consumption. This was calculated in the appendix 1.

$X^2 = \sum \frac{(0f-Ef)2}{Ef}$ Where $\sum$ = Addition sign

O_f = Observed frequency

E_f = expected frequency

The relationship was tested under 0.05 significant levels. The calculation was done to determine whether there is relationship between household size and energy consumption.

The relationship between household size and energy consumption, Average Household size and Domestic energy consumption on Table 9 was used to test the relationship using Chi-square method. The calculated value between household size and energy consumption was (154.038). The table value at 0.05 and 0.001 is 15.086. The calculated values are greater than the table value, therefore the relationship is positive. This shows that the quantity of energy use by the household in the study area is highly related to household size. That is the energy consume for utilities such as cooking, heating, lighting and other uses that relates to individuals; accordingly the size of the household plays a significant factor in household energy usage.

Summary of findings

The result revealed that most household in Bida use conventional or traditional sources of energy especially fuel wood and charcoal, only few have adopted modern sources of energy. However, there is no complete abandonment of one form of energy in preference to another due to income. It was also revealed that people with large families resolved to use conventional sources of energy (fuel wood) due its affordability and accessibility. This evident as revealed on table 6 where 68% of the respondents used fuel wood for cooking. The research result also show that income is not the sole determining factor of house hold energy choice, but the choice of energy source is dependent on household size, income, level of education, affordability and accessibility of the source of energy.

Conclusion

The research investigates the energy consumption in the area. As income is a constraints to households in developing countries, many are inclined to determine how much income of theirs will be spent on energy and in addition then determined the amount to be spent on the different types of the fuels and the quantity of such fuels. The study has examined all sources of energy in the area and it was revealed that there is no complete abandonment of any form of energy in the area as all form of energy is used in the area.

Recommendations

1. Since the use of fuel wood and charcoal result into serious deforestation, which could lead to environmental degradation, it is recommended that gas, kerosene should be made available at affordable prices so as to reduce the use of fuel wood and charcoal.
2. The Government should enforce the legislation on the deforestation.

3. The Government should encourage people to use gas by subsidizing gas.
4. The area is located in the tropical savanna zone, therefore the use of solar energy can be possible. The Government should encourage people to use solar energy.

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