

## Household Energy Consumption Pattern in Osogbo Local Government Area of Osun State

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**Abstract:** The study was carried out to assess the energy consumption pattern in households in Osogbo Local Government Area of Osun State. Systematic random sampling was used to sample 120 households in the study area. The data used for the study were obtained with the use of well-structured questionnaires. Data analysis on personal characteristics, income level, availability of different energy source in the area and consumption pattern of energy by household were based on descriptive statistics. Regression model and Pearson correlation coefficient were used to test the relationship between personal characteristics of the respondents and consumption pattern of energy, the relationship between the total income of the household and amount spent on energy, respectively. The finding revealed that 50% of the respondents were 55 years old on the average and about 40% had family size of 4 members. Most of the household heads (45%) had primary education. About 57% of the household earned ₦2,000 as their monthly income 35% of the household heads earned ₦4,000. Energy source available for use in the study area are firewood (75%), charcoal (13%) and saw dust (12%). Household size (Xh) and household total income (Xi) were significant variables to the consumption pattern of the respondents at  $p = 0.05$ . The amount spent on energy was quite significant to the total income of the households. Improvement of household purchasing power through the implementation of schemes that can increase the household's income level would encourage them to use easily accessible and durable energy source.

**Key word:** Energy source, firewood, charcoal, saw dust, consumption, household

### INTRODUCTION

Energy in the layman's language is often synonymous with strength or force or better still fuels. In technical terms energy is that thing that can be used to produce work. Fuels are materials that ignite at moderate temperature burn with comparative rapidity and are obtainable in quantities of reasonable prices<sup>[1]</sup>. Energy sources can also be classified as renewable and non-renewable forms. Renewable forms include fuel wood, solar energy, biogas and crop residues while the non-renewal forms are mainly petroleum products. Such as kerosene, petrol, Liquefied Natural Gas (LNG) and coal<sup>[2]</sup>.

Energy consumption is of great importance to the society because of the strong dependent of socio-economic variables and even to some extent cultural activities on it. An energy source in its raw state before conversion into mechanical work is said to be primary energy while secondary energy refers to the transformed state of all primary energy forms. Primary or secondary

forms of energy that must be subjected to combustion or fission to release their stored energy are referred to as fuels<sup>[2]</sup>.

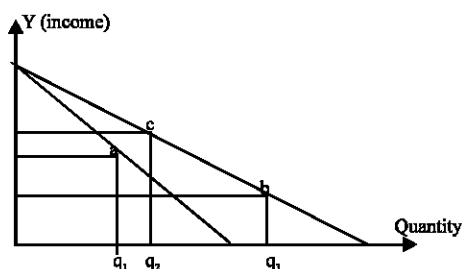
The income level of individual influences fuel preferences and options that to some extent depend on the economic situation of the country considered. Technological advances and energy infrastructures also influence the cost, accessibility and affordability of different fuel options. Population growth and the rate of urbanization limited access to any fuel other than fuelwood and these also exert pressure on both fuel wood supply and demand. Globally, over 2 billions people depend on firewood for cooking but 1.5 billion of these have daily difficulty in finding sufficient supply. Increasing population have put pressures on the use of firewood to the point where its collection is destructive and unsustainable<sup>[3]</sup>. Fuel wood will continue to be a key energy source for cooking and heating in poor homes where fuel wood could be considered the "fuel of the poorest of the poor"<sup>[4]</sup>.

## THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The study is premised on the Engel's Law, which state that income is positively related to consumption. That is as income increases the proportion of income spent on luxury goods tends to increase while the proportion spent on basic commodities tend to decrease or remain static.

This implies that utility maximization will be at different points for various consumers at different income levels and various prices. The following are the resultant effects of changes in prices of consumption goods;

- The income effect (a to b), which may be positive or negative in term of the price and quantity of goods with respects to the nature of goods.
- The substitution effect (b to c), the fall in price of a substitute will necessitate the reduction in quantity consumed of the other commodity and vice versa and
- Price effect, the real income of the consumer increases, if there is a fall in commodity prices. The direction of the movement on the indifference plane will then be determined by the nature of the commodities (normal and inferior). Thus the price effects are the combination of income and substitution effects



### Household energy consumption pattern in nigeria:

Household energy consumption can be defined as the energy consumed in homes to meet the needs of the household members. Thus, for example, cooking food at home for the household is included, while cooking food for sale and food processing and preparation undertaken before the household purchases the food is not. The final energy consumption of households is often called residential energy consumption and its covers the energy consumed in household dwellings.

The pattern of household energy consumption represents the stage of welfare as well as the stage of economic development. As the economy develops, more and cleaner energy is consumed. It is natural for people to pursue a better life which often means increased mobility, proper heating and cooling and more equipment<sup>[5]</sup>. However most poor households have their entire

existence threatened as the proportion of time and income spent on domestic energy sources keeps escalating. The problems faced by the Nigerian society include, inadequacy energy generation and distribution; improper pricing of household fuels. There is also a great difficulty in procurement of household energy needs; constant increase in the price of available household energy fuels without a corresponding increase in average household income, inefficient use of energy supplies to mention a few<sup>[1]</sup>.

Firewood is not burned directly often but it is processed into a more suitable form, such as chips and pellets, in which the general physic-chemical characteristics of wood remain basically unchanged. In other cases wood is transformed into secondary solid, gaseous and liquid fuels, of which charcoal is perhaps the most common. These secondary fuels are prepared to meet the special needs of industrial users (as in the use of charcoal in the iron and steel industry), or to improve their transportability and storage (for example charcoal for urban households). Wood fuels meet the special energy needs of the industrial, household and transport sectors<sup>[4]</sup>.

Some of the traditional fuels in Nigeria, because of the concentration of their use in the rural areas, receive scant attention in planning and policy-making. This is unfortunate since their relation scarcity affects the lives of the majority of the people living in the developing countries. Alabe,<sup>[6]</sup> explains that, In Northern Nigeria for instance, firewood as a fuel is mostly used in their rural area than their urban area. In the rural area of the Northern part of Nigeria 45% of the rural people buy wood while 55% collect it but in the urban area of the same part of Nigeria 97% buy their wood and only about 3% collect it. About 60% of the firewood is bought by household heads, 10% is bought by servants and 5% is bought by housewives.

Moreso, in the Northern part of Nigeria, urban area has a higher rate of charcoal consumption for example Borno region because apart from its use in space heating and ironing clothes charcoal is widely used in homes to heat prices of local scant sticks used as room air freshener. Between the year 1993 and 1994 which coincided with the period of acute fuel scarcity in Nigeria, rural household use less wood (as much less as 25%) because the urban household which were hitherto using fossil fuels now had to rely more on wood because of availability and avoidability<sup>[6]</sup>.

Charcoal usage is extensive during the harmattan season in Nigeria when it is used for domestic space-heating purpose in addition to use as cooking fuel. Wood as firewood is used both in modern and traditional households and especially since the supply of other fuels is inadequate, irregular and or expensive. Consumption of firewood is however not constant as it also varies from

time to time and from season to season. For instances, more firewood is consumed during holidays when school children can participate in its collection and during the Harmattan season when domestic hot water requirement is highest<sup>[6]</sup>.

Firewood seems the major source of fuel is the Northern part of Nigeria, which loses an estimated 4km<sup>2</sup> of useful land every year in addition to the treat of drought. This is because of its affordability and availability the other sources of energy; kerosene and gas are not readily available due to inadequate supply<sup>[3]</sup>.

In general, production and consumption of almost any type of energy have environmental impacts. Daniel and Edward<sup>[5]</sup>, revealed that harvesting of fuel wood, in particular contributes to deforestation, soil erosion and desertification. In Nigeria, harvesting of fuel wood contributes to deforestation at a rate of about 400,000 hectares per year. If this trend continues, the country forest resources could be completely depleted by 2020. Use of firewood as an energy source can also contribute to accumulation of CO<sub>2</sub>, deforestation also destroys an important CO<sub>2</sub>. In addition use of coal pot exposes the users mainly women and children to high levels of indoor air pollution

The general objective of this study is to

- describe the personal characteristics of the respondents
- identify the various energy sources available for domestic use.
- determine the proportion of income used on energy by different households in the study area.

The research hypotheses are

Ho 1 ; There is no significant relationship between the personal characteristics of the respondents and their energy consumption pattern

Ho 2; There is no significant relationship between amount of money spent on energy and the respondent income level.

## **MATERIALS AND METHODS**

The area of study is Osogbo Local Government Area of Osun State. It is located in the forest zone and grassland of South Western Nigeria and it is the administrative seat of Osun State. It is located at latitude 7.7<sup>0</sup>N and longitude 1.05<sup>0</sup>E at the equator. It is about 237 kilometres away from Lagos by direct route.

The data used in this study were obtained from primary source. The data were obtained from 120 households in the study area with the aid of well-structured interview schedules. Data on household energy consumption pattern were collected, such householdconsumption data covers some socio-economic

factors that affect the energy consumption pattern of the household such as household size, age, income, education status and other factors responsible for energy consumption pattern. The study area is allocated into 16 wards consisting of both the rural and urban communities but only one ward is urban i.e., Osogbo Township and the rest 15wards are rural. 5 ward which are wards 3, 6, 9, 12, 15 were selected from the rural areas while the only urban area was also selected making 6 wards. two village was selected randomly from each ward and 10 household heads were sampled making a total of 120 households heads. Descriptive statistics such as frequency distributions, percentages, were used to analyze the level of availability of energy source (s), problems associated with the energy usage by the household. Also Pearson correlation coefficient was used to test for relationship between household income level and amount of money spent on energy used. Regression model was used to test hypotheses one, while Pearson correlation analysis was used to test hypotheses two.

The regression equation for hypothesis one is stated in the linear form:-

$$Y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \beta_6x_6 + \beta_7x_7$$

Where:

- Y = energy consumption pattern
- Xa = Age of the respondents
- Xe = Educational status of the respondents
- Xo = Occupation of the respondents
- Xh = Household size of the respondent
- Xi = Total income of the respondents

$\beta_0, \beta_1, \dots, \beta_7$  represent explanatory variables

Pearson correlation coefficient (r) formula hypothesis two

$$r = \frac{n \sum XY - \sum X \sum Y}{\sqrt{_{n} \sum X^2 - (X^2)} \sqrt{_{n} \sum Y^2 - (Y^2)}}$$

Where

- X = total income of the respondent (#)
- Y = Amount spent on energy
- n = number of respondents
- Σ = Summation sign

T-test was also used to test the significance of r With the formular

$$t_c = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}}$$

Where:

- r = correlation between the variables
- n = number of respondents
- t<sub>c</sub> = t-calculated

**RESULTS AND DISCUSSION**

**Personal characteristics of the respondents:** The finding revealed that 50% of the respondents were 55 years old on the average, 27.5% were averagely 35 years old and 7.5% were above 60 years Table 1. Also it was discovered that about 40.0% of the respondents had family size of 4, about 53.0% had family size of 7, while 4.0 % had many

Table 1: Personal characteristics of the respondents

| Variables          | Frequency | Percentage |
|--------------------|-----------|------------|
| Age                |           |            |
| Less than 30       | -         | -          |
| 31-40              | 33        | 27.5       |
| 41-50              | 18        | 15.0       |
| 51-60              | 60        | 50.0       |
| more than 60       | 9         | 7.5        |
| Total              | 120       | 100.00     |
| Household size     |           |            |
| None               | -         | -          |
| ≤2                 | -         | -          |
| 3-5                | 48        | 40.0       |
| 6-8                | 63        | 52.5       |
| > 8                | 4         | 3.3        |
| Many               | 5         | 4.2        |
| Total              | 120       | 100.00     |
| Level of education |           |            |
| 0                  | 34        | 28.3       |
| 1-6                | 54        | 45.0       |
| 7-10               | 30        | 25.0       |
| >10                | 2         | 1.7        |
| Total              | 120       | 100.00     |

Source: Field Survey, 2005

Table 2: Description of energy sources in the study area

| Variables                      | Frequency | Percentage |
|--------------------------------|-----------|------------|
| Type of energy sources used    |           |            |
| Firewood                       | 90        | 75.0       |
| Charcoal                       | 16        | 13.3       |
| Sawdust                        | 14        | 11.7       |
| Total                          | 120       | 100.00     |
| Reasons                        |           |            |
| Availability                   | 67        | 55.8       |
| Cheap                          | 32        | 26.7       |
| Renewability                   | 21        | 17.5       |
| Total                          | 120       | 100.00     |
| How to get it                  |           |            |
| Purchase                       | 92        | 76.7       |
| Searching                      | 28        | 23.3       |
| Total                          | 120       | 100.00     |
| Numbers of energy sources used |           |            |
| One                            | 98        | 81.7       |
| Two                            | 22        | 18.3       |
| Three                          | -         | -          |
| Total                          | 120       | 100.00     |
| Causes of problems             |           |            |
| Smoke                          | 54        | 45.0       |
| Dust                           | 21        | 17.5       |
| No problem                     | 45        | 37.5       |
| Total                          | 120       | 100.00     |

Source: Field Survey, 2005

household members. About 28% heads of the house had no formal education, 45% finished their education level of the primary school and about 25% had secondary education while only 1.7% had tertiary education.

**Energy sources available for domestic use in the study area:**

In the study area, there were three major type of energy sources available for domestic use, firewood was commonly used, 75% of the respondent used firewood, 13.3% used charcoal while 11.7% used saw dust, 81.7% of the respondents used anyone of the energy sources while 18.3% used two different types of energy sources that was available at that particular point in time Table 2. Most of the respondents (56%) used firewood, charcoal and/or sawdust because of their availability, 27% of the respondents revealed that it was cheap while the remaining 17.5% noted that it was renewable. About 76.7% of the respondents purchase the energy sources they used. Concerning the problems associated with firewood, charcoal or saw dust usage, 62.5% of the respondents explained that they had health problems due to smoke and dust from the energy sources

**Proportion of income spent on energy:**

It is revealed that 56.7% of the respondents earned average income of ₦2000 per month while 35% of the respondents earned income of ₦4000 per month Table 3. Most of the respondent (41.0%) spent ₦400 on either firewood, charcoal and sawdust, while 15.0% spent an average of ₦200 on the energy used. it was also discovered that the lowest amount spent on energy source(s) in a month was ₦100 while the highest was above ₦1500. It was also noted that 68.3% of the respondents preferred the energy they used based on their level of income.

**Test of hypotheses:**

In order to test whether the energy consumption pattern of the respondents is significant to their personal characteristics, some measured variables (age, educational status, occupational status, household size and total income of the respondents) were subjected to regression analysis Table 4. The linear function gives the good fit based on the co-efficient and the magnitude of R<sup>2</sup> economic criteria.

$$R^2 = 0.6512$$

$$\text{Adjusted } R^2 = 0.607$$

$$F \text{ value} = 9.140$$

Significant at 0.05% Level

$$Y = 3561.25 + 489.2X_a + 36821X_e + 8.569X_o + 9254 X_h^{**} + 3.129X_i^{**}$$

(0.008) (0.0252) (0.145) (2.742) (2.556)

The co-efficient of multiple determinations (R<sup>2</sup>) is 60.7%, which indicates that 60.7% variation in gross margin is caused by the independent variables while the

**Table 3: Proportion of income spent on energy**

| Variables                          | Frequency | Percentage |
|------------------------------------|-----------|------------|
| Total income of the household      |           |            |
| ≤ ₦1000                            | -         | -          |
| ₦1001-₦3000                        | 68        | 56.6       |
| ₦3001-₦5000                        | 42        | 35.0       |
| > ₦5000                            | 10        | 8.4        |
| Total                              | 120       | 100.00     |
| Amount spent on energy consumption |           |            |
| ≤ ₦100                             | 6         | 5.0        |
| ₦101-₦300                          | 18        | 15.0       |
| ₦301-₦500                          | 49        | 40.8       |
| ₦501-₦700                          | 28        | 23.4       |
| ₦701-₦1000                         | 12        | 10.0       |
| > ₦1000                            | 7         | 5.8        |
| Total                              | 120       | 100.00     |

Source: Field Survey, 2005

**Table 4: Presentation and analysis of correlation results**

|                                | Income | Energy |
|--------------------------------|--------|--------|
| Income pearson correlation (r) | 1.000  | 0.388  |
| Energy pearson correlation (r) | 0.388  | 1.000  |

Source: Data Analysis, 2005

remaining 39.3% is due to error term. The value of F-Test obtained shows that overall equation is statistically significant at 5% probability level. With this result the null Hypothesis ( $H_0$ ) is rejected.

The co-efficient of Xh (household size) and Xi (income of the respondent) variables are positive and statistically significant, this means that energy consumption pattern of the respondents increase as their household size become large, also increase in income of the respondents raise the energy consumption level of the respondents.

The correlation analysis revealed the result between the household income level and amount spent on energy consumption and this interpret the second hypothesis. The Pearson correlation coefficient (r) is 0.388 and the t-test is 2.73, significant at 0.05 level. This result shows that there is significant relationship between the income level of the household and the amount spent on energy consumption.

This means that if income level increases, the amount spent on energy used by household will increase or invariably if there is decrease in the income level of the households, the amount spent on energy decrease respectively. T- test is used to confirm the significance of Pearson correlation coefficient.

### CONCLUSION

In this study, an attempt was made to evaluate the consumption pattern of energy by household in Osogbo local Government area of Oyo state.

Most respondents (household heads) were old, with large family size and no formal education. About 75% of the respondents used firewood for energy consumption, 13.3% used charcoal while 16.7% used saw dust. Respondents used these energy sources because of their

availability. Most respondents explained that they had health problems due to smoke and dust from the energy sources.

Larger percentage of the respondents collected income of ₦2,000 Most of the respondents 41.0% spent an average of ₦400 per month on firewood, charcoal and sawdust. Regression analysis revealed that personal characteristics of the respondents affected their energy consumption pattern The result of Pearson correlation coefficient showed that income earned by the household affect the amount spent energy consumption.

In order to improve the energy consumption pattern of the household in Osogbo local government area, the following recommendation should be taken into consideration

- Improvement of household purchasing power through the implementation of schemes that can increase the household's income level would encourage them to use easily accessible and durable energy source.
- Medical facilities should be provided in the study area, in order to treat the health problems caused by the type of energy used such as cough, headache and tuberculosis.
- There should be increase in employment, so that there will be improvement in the standard of living of the household in the study area due to increase in income.
- All members of the household should be encouraged to increase their educational knowledge so that improved ways of using the firewood, charcoal and sawdust would be discovered.

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