



Socio-Economic Determinants of Household Dirty Energy Use in Nigeria

Maina, Y. B.¹, *Kyari, B. G.² & Maina, M. B.³

¹*Department of Economics, Faculty of Social Sciences, University of Maiduguri, Borno State, Nigeria,*

²*Department of Agricultural Economics, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria.*

³*Department of Geography, Faculty of Social Sciences, Yobe State University, Damaturu, Nigeria.*

ABSTRACT

The issue of climate change has gone beyond the boundaries of science and environmentalism to involve both economists and political scientists as the policymakers. Moreover, as environmental economists, one of our roles is to examine our contribution to this negative externality through our unsustainable energy use in order to proffer ways to curb it. This study analyzed the major energy used by households in Nigeria and their implication on the environment based on two objectives. It identified the patterns of energy sources used by households and analysed their determinants. The study utilized descriptive statistics (bar chart) and multiple regression analysis using General Household Survey data by NBS. The results showed that most of the energy sources used by households in Nigeria for cooking and lighting homes are dirty with the most common energy used as kerosene 31%, Petrol 21%, Fuelwood 30% and Charcoal. The results further revealed that increase in income, educational level and having a female as a household head were associated with less dirty energy use, where increase in family size and age are associated with high dirty fuel use. Finally, policies to improve awareness on the impact of the use of dirty energy sources on the environment and the health implications are recommended. Also, there is the need to improve income level of the consumers and the supply of clean energy sources by making them more available and affordable.

Keywords: Household, Dirty, Energy, Use, Nigeria.

INTRODUCTION

Nigeria is well endowed with natural resources such as abundant solar radiation, wind, water (hydro) and crude oil in the various geo-political zones of the country. These resources are however underutilised towards generating environmental sustainable fuel sources such as electricity and Liquefied Petroleum Gas (LPG), thus, influencing the pattern of household energy used in the country negatively (Maina, Kyari and Jimme, 2019).

Moreover, the various energy sources used by households are categorised into two, clean and dirty. Clean energy sources are identified as Liquefied Petroleum Gas (LPG) and electricity generated through hydro, solar and wind and other renewable energy sources that are constantly replenished. These energy sources have very low composition of the negative externality of Carbon-dioxide (CO₂) which has much negative impact on the environment (Maina, 2018).

Dirty energy sources on the other hand, include all forms of fossil fuels such as coal, oil, natural gas that cause a serious damage to the environment and to the planet in general (Greenpeace, 2016). Moreover, these fuels when burn release harmful greenhouse gases, mostly in form of CO₂ which accelerates the Climate Change (CC) impact (James & Alhaji, 2017). Unlike renewable energy sources which can in certain situations cause some environmental damage, fossil fuel burning always causes environmental damage (Ciolkosz & Wallace, 2011).

In addition to fossils, solid fuels such as fuel wood and charcoal also contribute to global warming. Although it is relatively less discussed aspect because they are considered as “carbon neutral” i.e., the carbon released into the atmosphere through burning of these fuels is considered to be recaptured during the growth of the biomass (Kavi & Brinda, 2007). However, in Nigeria trees are been indiscriminately cut down without replacement which has resulted to high rate of deforestation and desertification. Moreover, the country is now losing about 350,000 to 400,000 hectares of land per year, which consequently results to high concentration of CO₂ in the atmosphere (Food and Agricultural Organization [FAO], 2016). In addition, charcoal has the highest composition of CO₂, it is about 70% pure carbon (United States, Environmental and Protection Agency [EPA], 2013). Thus, it is regarded as the dirtiest fuel if used in large quantities because it would emit the most CO₂ per kg than other fuel types (Maina, Dantama & Kyari, 2017).

Due to the acute electricity supply and a low demand for LPG because of high installation cost in Nigeria, the household sector has been forced to rely heavily on alternative energy sources for lighting homes, cooking and for other household uses (Maina, 2018). Consequently, causing a considerable burden on the environment especially because the country’s population is very high which is currently projected to increase to 213, 312,387 by the end of 2019 (National Population commission, 2006). Towards this end, it has become of paramount importance for the pattern of energy sources used by households in Nigeria to be examined for efficient resource utilisation to curb CC.

A lot of research works have been conducted on household energy demand/ to mention but a few is a study by Olaleye and Akinbode (2012) which was on demand for alternative energy sources in Lagos. Onyekuru and Eboh (2011) looked at the determinants of rural household energy demand in Enugu, while Maina *et al.* (2017) looked at determinants of household energy demand in the north-eastern region of Nigeria. Each of these studies dwelt on energy use without categorising them as dirty or clean fuels. Also, the studies were on a particular region, state or local government. Therefore, this paper is limited to dirty energy sources only and will therefore, bridge a gap by assessing two objectives: The pattern of fuel use and their determinants in Nigeria’s household sector.

METHODOLOGY

Study Area

The study area is Nigeria, it lies between latitudes 4° 12' 40.37" N to 13°51' 36.50 " N of the equator and longitudes 2° 45' 47.735" E to 14°42' 55.123" E of the Greenwich meridian. Located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa, Nigeria occupies an area of 923,768 sq. km (356,669 sq mi), extending 1,127 km (700 mi) East to West and 1,046 km (650 mi) North to South. The country is made up of 36 states and had a combined projected population of 214, 312, 387 as at the end of 2018 (NPC, 2006). The study area is characterized by widespread use of dirty energy sources with majority (86%) of the

rural households relying on fuelwood and dungs as their major sources of energy while the urban households use biomass, kerosene and petrol (Ogunniyi *et al.*, 2012 & Olaleye & Akinbode, 2012).

Data Type and Variables

Secondary data obtained from the database of the National Bureau of Statistics (NBS) on the General Household Survey, Panel 2015-2016 was used for the study. Secondary data set was used for the study, obtained from the database of the National Bureau of Statistics (NBS) on General Household Survey, Panel 2015-2016. A total of 5000 households were interviewed across the country. The relevant information collected in the survey include household socio-economic characteristics, information on farm, non-farm enterprise, income generating activities, food consumption expenditure, and other non-food expenditure. Table 1, presents how each of the variables is measured based on each household.

Table 1: Data Type and Variables Measurements

Variables	Measurement
Dependent Variable	Household monthly expenditure on dirty fuel types (₦)
Household monthly income	Household Monthly income is proxied by total household monthly expenditure (₦).
Household size	The variable is measured as the total number of individuals dwelling in the same house and sharing meals together.
Age	This variable is measured in years as the total number of years since the person was born.
Sex	Sex of respondent is a binary variable representing a value of 1 for male and 0 for female.
Educational level	The variable is measured by the total number of years spent in formal education

Model Specification and Method of Estimation

Multiple regression analysis

For this study (objective 2), only the four dirty energy sources used by households i.e. (Charcoal, Fuelwood, Kerosene and Petrol) were considered to capture the determinants of dirty energy sources, while diesel was dropped due to inadequate data. Also, LPG and electricity being clean energy sources were also excluded from the analysis. Hence, multiple regression analysis was used for households that record 100% expenditure share to the use of any of the fuels. The model is specified as:

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + U_i \dots\dots\dots (i)$$

Where:

- Y = Household monthly expenditure on any of the dirty energy sources in (₦)
- X₁ = Household income(₦)
- X₂ = Age of household head (years)
- X₃ = Sex of respondent (Male (1), Female (0))

- X_4 = Educational level (years)
 X_5 = Household size (Numbers)
 U = Error term.

A priori expectation

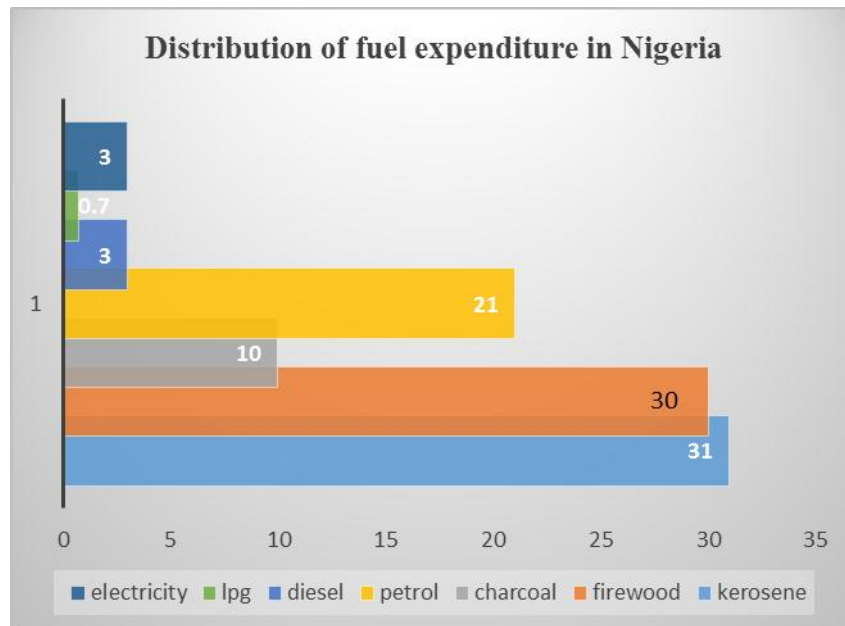
The coefficients of household income and area residence (rural/urban dichotomy) and sex would have negative effects. While the sex of household head, age and family size would have a positive effect.

RESULTS AND DISCUSSION

Pattern of Energy sources used Based on Expenditure

The pattern of energy sources used based on expenditure studied included all the common household's available fuels namely, charcoal, diesel, electricity, fuelwood, kerosene, LPG and petrol for lighting homes cooking and for other household uses. The results are presented in Figure 1

Figure 1: Distribution of Household Energy Expenditure in Nigeria (%)



Source: Generated by Stata 13 from the GHS BY NBS 2016 data

Figure 1 presents the percentage of expenditure on all the available energy used by the household sector. It can be virtually seen that kerosene has the highest percentage of expenditure with 31% budget share, making it the highest in terms of energy sources used for cooking. This is justified by the fact that it has been a traditional fuel especially in the urban areas. It is considered safer than LPG by most households with children and more convenient than fuel wood because it is less smokey and more convenient than fuelwood. This corresponds with the findings of Olaleye and Akinbode (2012). Petrol was the third most used energy source. With regard to energy for lighting homes however, it was found to be the most used because of the wide spread use of power generating plants as alternative source of electricity due to the acute shortage of power supply in the country. The reason for the high budget share could be due to the fact that petrol used for fuelling power generating plant is more expensive than either kerosene or fuelwood. This is in line with the findings of Maina et al. (2017).

The fuel with the expenditure share of 30% was fuel wood. Its use for food preservations and processing appeared as the third. However, in most household's energy consumption studies such as (Bello, 2011; Busola & Olaniyi, 2012; James & Alhaji, 2017) showed wood as the most used fuel. The reason could be because most of its quantities used are fetched from nearby bushes which usually end up not being captured in an effective demand study. This agrees with findings of Maina (2018). The next energy type with only 10% expenditure share is charcoal. The reason for such low demand could be because it was demanded by few geopolitical zones in the country such as north east where it is used for burning scent wood as room fresher as reported by Maina, *et al.* (2019).

However, electricity and diesel use were found to be as low as 3% in terms of budget share. The reason for this could be because electricity supply has been acute in the country. This has forced most of the household to resort to the use of power generating plants which uses petrol, hence the justification for its' high budget share, while the use of diesel is low because it is used by bigger power plants mostly found in urban areas and among higher income households. Hence its low use as a household fuel for lighting. Similarly, the expenditure share for LPG appears to be the lowest in Nigeria. This is not surprising as most energy studies have reported the same results. This corresponds with the findings of Bello (2011), Maina *et al.* (2017) and Maina & Kyari (2019). LPG use is low, this could be due to high installation cost, it is often scarce and its level of awareness by households as an environmental sustainable fuel is low.

In general, the demand for dirty energy sources is found to be the highest in Nigeria. The implications of these on the environment is that the use of more fossil fuels such as kerosene, petrol and diesel for lighting or cooking at home as shown by Maina (2018) emit high rate of carbon-dioxide thereby causing high concentration of greenhouse gases in the atmosphere. This does not only pose health risk on members of households as opined by Ogunniyi *et al.* (2012) but also affects the ozone layer and consequently results in climate change in the long term as found by (Kavi & Brinda, 2005). In addition, the demand for solid fuels like fuelwood is also found to be high. This could result in indiscriminate cutting down of trees to meet the increasing demand for fuelwood. All these deplete the ozone layer thereby exposing the atmosphere to dangerous gases this is in line with the findings of (James & Alhajji, 2017).

Determinants of Energy Expenditure in Nigeria

OLS regression technique was employed to determine the socio-economic factors influencing fuel use in Nigeria. The data set used contains all the information of the various households' interviewed based on their socio-economic factors and food and non-food expenditure (energy shares).The coefficients and the significant levels are presented in Table 2.

Table 2: Socio-economic Factors Determining Nigeria's Energy Expenditure

Variable	Coefficient	Standard error	T value	p>[t]	R ²
Constant	3.425445	.208205	16.45	0.000***	0.623
Educational level	-.1881203	.01219	-15.43	0.000***	
Monthly Income	-.5865661	-.010649	-55.08	0.001***	
Household size	.1182682	.0246805	4.79	0.000***	
Sex	-.0529781	-.0773088	-0.69	0.493	
Age	.1850243	.0288777	6.41	0.000***	

*Source: Generated by Stata 13: GHS by NBS's 2016 data. ***(1%) NS (Not significant)*

Household monthly income was found to be a significant determinant of dirty energy sources used at 1% level but negatively related. This agrees with findings of Maina (2018). Also, the finding agrees with the *a priori* expectation which assumes that the higher the income the lesser the expenditure on dirty fuels. *Ceteris paribus*, income is one of the major determinants of expenditure allocation. However, the negativity implies that the higher the income level, the lower the use of dirty fuels. This indicates that when household incomes increase, household heads would use more clean energy sources such as LPG and less dirty energy sources such as kerosene, charcoal and fuelwood. This is in line with environmental Kuznets hypothesis; which states that when income levels keep increasing, environment status also changes from a worsen situation to an improved stage (Kuznets, 1955).

Household size showed positive and significant relationship with the expenditure on dirty energy. This implies that *ceteris paribus* the larger the unit, the more dirty energy use. This is in line with the *a priori* expectation and contrary to the findings of Olufemi *et al* (2012). It was assumed that the coefficient of family size would have positive effect on dirty fuel use. This is because increase in household size without a corresponding increase in income would increase household expenses. Thus, households would be forced to resort copping strategies which includes resorting to the use of dirty fuels which are cheaper sources of domestic energy than clean energy sources.

Household size showed positive and significant relationship with the expenditure on dirty energy. This implies that *ceteris paribus* the larger a household, the dirtier energy the household will use. This is in line with the *a priori* expectation, and contradicts the findings of Olufemi *et al.* (2012). It was assumed that the coefficient of family size would have positive effect on dirty fuel use. This is because increase in household size without a corresponding increase in income would increase household expenses. Thus, households would be forced to resort copping strategies which includes resorting to the use of dirty fuels which are cheaper sources of domestic energy than clean energy sources.

Educational level of the household head was found to be significant and negatively related to the expenditure on dirty fuels. This could imply that higher level of education is synonymous with higher level of income and awareness. This agrees with the *a priori* expectation which assumed that higher educational level would result to less use of dirty fuels. Thus, the more educated a household head is, the more the person is well informed about the implications of the use of dirty energy sources on his/her health and the environment. It could also be linked with having the opportunity to be employed. So the higher the level of education the better the opportunity to be employed and consequently better income level, and the more he demands for clean energy sources and the less the use of dirty fuels.

CONCLUSION

This study examined the pattern of fuel use in Nigeria. The results revealed that most of the energy used by households whether for cooking or lighting homes were dirty. The most common energy sources used were Kerosene, Petrol, Fuelwood and Charcoal. These fuels have direct negative impact on the environment and are thus considered dirty energy source. The use of dirty energy is determined by socioeconomic characteristics of households including low levels of education and income of household heads as well as large family sizes and older family heads.

RECOMMENDATIONS

The following policies are recommended to government/policymakers based on the findings of the study;

- Making the environmentally sustainable energy sources more affordable to the Nigerian households by subsidizing the price of such fuels especially for low income households that cannot afford them.
- There is there is the need to reinforce the policy of planting trees that is already in existence in order to conserve the environment. Since Nigeria is one of the countries that acceded to emission reduction, it can achieve this target by adopting the United Nations policy of Reducing Emissions from Deforestation and Forest Degradation (REDD) which rewards people to plant more trees.

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