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## An Appraisal of Household Domestic Energy Consumption in Minna, Nigeria.

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**Abstract:** One of the characteristics of African cities is uncoordinated urbanization with a trend of 4% annually, but the rate differs according to regions. Several factors are associated with urbanization such as lifestyle, consumption habit and pattern. The environment today is facing challenges from urbanization as consumption of resources such as land; water; energy, and air have changed to artificial environment. Energy consumption has been the driving force in global warming. Overtime, urbanization has been a great threat to sustainability of urban environment. However, kerosene and LPG that are supposed to be the major source of energy for cooking becomes unaffordable to low income households. This research was conducted in two residential areas of the identified neighbourhood and the choice of this neighbourhood is influenced by the fact that the phenomenon under study is more prevalent in the high and medium density localities. The effect of increase in electricity tariff, kerosene and LPG has shifted the focus of household source of cooking energy to biomass and this has been the cause of the environmental problems in the area which includes Indoor Air Pollution, Deforestation and Desertification. The analysis however shows a significant relationship between choice of energy and income.

**Keywords:** Deforestation; Energy Consumption, Households; Environment; Urbanization.

### I. Introduction

The major characteristics of African cities have been urbanization from the early 1950s. There are only about 11% of Africans in urban area in 1950s and this has risen to about 37.9% in year 2000 (UN-Habitat, 2008). This urbanization trend implies that by 2015, 46.15% of African will be in cities. Though the recent publication by UN-Habitat estimated that the world break in term of population globally (50% rural and urban) in 2007 (UN-Habitat, 2008). There has been high percentage of urbanization in Africa than any part of the world. The trend is about 4% averages, but the rate of population increase differs according to regions and urban and rural area. The National Population Commission (NPC) indicated that the national average is about 3.2%, though the urban areas have higher percentage than rural areas in Nigeria (NPC, 2010). Also there are differences in urbanization in different parts of Nigeria; while it is higher in the north it is lower in the south.

There are several factors that are associated with urbanization such as lifestyle, consumption habit and pattern etc. which all have consequential effect on the environment. This process has made resources to be collected, distributed and used. Though the process according to Ecological Footprint shows that Africa is consuming lower resources but that does not mean that Africans should be complacent as poverty and population growth have tendency of consuming the resources (Clancy, 2008). GFN (2010) has proven that some cities have Ecological Footprint higher than the world average and has been compensated by other areas where consumption is lower. One of the major problems of the environment today is urbanization as consumption of resources such as land, water; energy, air etc. have changed the environment and brought about artificial environment. Energy consumption has been the driving force in global warming as Carbon emission has gone beyond the world ecological limit. Urbanization has been a threat to sustainability of urban environment because it depends on productivity of the neighbourhood, households and individuals. Nigeria with her population of over 150 million is the most populous Black Country in the world has urbanization process that is higher. By the year 2050, her population will be 250 million (UN-Habitat, 2010). The process of urbanization in Nigeria has its own antecedents, the national growth rate ranges between 2.9% and 3.2% between 1991 and 2006 but the urban growth rate within this period ranges between 4.8% and 5.7% (NPC, 2010). The population figure indicated that urban population was about 23.4% in 1970 and by year 2000 rose to about 43.3% and with the current trend, it will be about 61.6% by the year 2025 (UN-Habitat, 1996).

There have been many problems associated with this rapid urbanization such as manageability, livability, security threat, serviceability and stiff competition for land, long distance to work, congestion and inadequate urban infrastructure including housing, water and energy. Environmental degradation has also

become a factor of urbanization as proper planning is lacking in the use of land and resources which occurs due to human activities on the environment: consumption of fossil fuel, deforestation, industrialization, excessive consumption of natural resources etc. due to population explosion.

Households have been affected greatly by the economic *cul-de-sac* and global economic meltdown and that contribute to the rapid urban growth in Nigeria was the oil boom of the 1970s. The fall in the oil price at the world market has had untold hardship on households and government have introduced several austerity measures such as Structural Adjustment Programme (SAP), control on importation and removal of subsidy. 80% of the oil subsidy was removed in 1986 (Ojo, 1989) the trend has continued with the present dispensation that price of petrol by about 50%. All these increases instead of controlling the system help in perpetuating the sufferings of the poor households in urban areas. For example, there was negative growth in consumption of resources at both governmental and individual level. The inflation rate rose to 26% between 1987 and 1992. The Human Development Index of the country declined from 0.31 to 0.20 in the same period (FOS, 1992). This has put households at risk of using energy for their daily need. Kerosene and LPG that are supposed to be the major source of energy for cooking becomes unaffordable to low income households and rural populace. The consequence of this has led to change in pattern of domestic energy consumed by households in Nigeria; this has a greater consequence on the socio-economic characteristics of the poor (about 70% of Nigerians are classified as poor, earning less than a dollar per day, World Bank, 1996). It also has effect on the environment as consumption of biomass has been on the increase for households energy used for cooking on daily basis.

The major determinant of the amount and type of energy used by households in urban area is a function of population and urbanization. Research indicated that household consumption of domestic energy corroborated with "energy ladder" that implies that households consumes less costly energy and less conventional (biomass) energy, of immediate price and quality (kerosene) to more expensive highly convenient types of energy (LPG, electricity) as their income increases and or habits changes over time (Sathaye and Meyer 1990; UNCHRS, 1991; Smith, 1994) but the inflation rate has changed the whole situation as households depend on biomass to beat the effect of inflation. There has been increase in the use of kerosene among the middle and low income group in recent past (Sathaye and Meyer 1990) but the trend has changed for high consumption of charcoal due to recent increase in pump price of petroleum product in early 2012. The key factors that affect the consumption of any kind of energy in urban area by households include: the price of the energy, the availability of the energy, income and cultural preference. All these contributed to pattern of energy consumption by households. It has become an established fact that there are disparities in the energy consumed by urban households and rural households, between high and low income group; within a region, country and among countries (Fakama et al. 2011). Level of urbanization, economic development and lifestyle has also been a contributing factor in the use and differences (Dzioubinski and Chipman, 1999). Urbanization influences demand for cheaper energy in Nigeria because of high level of poverty (NBS, 2011).

One of the cheapest forms of domestic energy consumption in Minna is wood fuel, because of its accessibility and availability. Many migrants from the rural areas to Minna also retain their rural habit in relation to energy use. The use of alternative energy such as kerosene, LPG and electricity are discouraged because of its low availability, cost and inadequate infrastructure. The research by Warwick and Doig (2004) indicated that wood fuel consumption in India's urban household was 33% of the total domestic energy use and this has no correlation with level of income, but correlates positively with LPG. But the recent removal of subsidy in Nigeria that has increase the tariffs of the alternative energy sources have return the medium income earners to traditional wood fuel consumption in Minna. Basically wood fuel is the poor man's energy source in both urban and rural setting and the demand is very high (Parisot, 1986).

Leach and Gover (1987) indicated that there is relationship between income and domestic energy consumption in India, Pakistan and Brazil; the use of biomass has decline, it was also investigated that there is positive link among income, inflation and wood fuel consumption in Ghana. The relationship shows that there is a negative correlation between income and quantity of wood fuel consumed and a positive correlation between inflation and quantity of wood fuel consumed (Abakah, 1990). Mascarenhas (1999) showed that 79% of domestic energy use in Dar-es-salaam is with wood fuel; World Bank (1989) also proved that several cities in Senegal uses charcoal for their domestic energy. The pattern of wood fuel energy use in urban area is due to availability of the product.

## II. Study area

The research was conducted in Minna being the capital of Niger state. The city is located in the central region of Nigeria. It is about 200km from Abuja, the Federal Capital of the Country. It has an estimated land area of about 1,000 square kilometres (Maxlock, 1980). The population of Minna over time has shown tremendous increase from 192,437 in 1991 to about 300,000 in 2006 (NPC, 2010).

Minna is emerging as one of the growing cities in Nigeria with population density of 50 persons per km<sup>2</sup>. The growth of the city recently has been due to increase in the developmental projects embarked upon by the government and individuals in the city especially after it became the state capital. The residential layout in Minna shows three characteristics; that is high, medium and low densities with mixture of these densities except for the low density that is clearly demarcated. Many neighbourhoods of the high density found in the inner-city of Limawa, Ungwan Daji, Ungwan Kaje, Kpakungu, Bosso etc. have buildings of low quality and improper planning in the process of their development. Many of the buildings in these neighbourhoods lack accessibility due to lack of planning, the mode of accessibility has been through footpath that are narrow and not motorable. There is no adequate setback and are poorly ventilated. This area belongs to the low income earners and the few medium density for those planned by the government as residential layout such as Tunga Estate, M.I Wushishi Estate, Bosso Estate, Bosso Low cost and recently Talba Estate. The only low density area is the GRA that is characterized with high quality housing and proper layout; though there is distinction in the types of residential area but there is uniformity with each other in terms of population density, housing density, housing quality and the general neighbourhood conditions.

### III. Research Methodology

This research was conducted in two residential areas of the identified neighbourhoods (the high and medium density) the choice of these neighbourhoods was based on the fact that the area most affected by change in economic conditions as applied by government. It has been proven that macro-economic shocks affect the poor more than the rich because of their better economic capabilities to live conveniently (Pereira et al. 2004, Adelekan and Jerome, 2006). This is also a fact in the developing countries; there is a gulf between the rich and the poor, though both are sensitive to change in pump price of petroleum products (Leach, 1994). The pattern of domestic energy consumption was conducted to ascertain the level of households energy use for cooking between 2000 and 2012. There is administration of questionnaire and this questionnaire consists of two sections: section A consider the socio-economic characteristics of respondents and the second section B examines the pattern and changes in energy use for cooking by households during the period and other activities that affects the energy consumption in each households. Secondary data was also used to obtain the national energy use in the country.

Four neighborhoods were sampled in high density area: Kpakungu, Limawa, Bosso Town and Barkin Sale and three neighbourhoods in medium density area: Tunga Low Cost Estate, Bosso Estate and M.I Wushishi Estate. 50 questionnaires were administered in each neighbourhood totaling 350. Most of the questionnaires were administered on women because it is their responsibility to cook for the households. Men as household heads were not used because of the antecedent of Nigerians that cooking is the sole responsibility of women.

Systematic random sampling was employed in the administration of the questionnaire to choose the respondents because of large number of housing units in the neighbourhoods; therefore, it was one household per housing unit. Quantitative data that were collected was analyzed using descriptive and inferential statistics; this was done through the use of Statistical Package for Social Scientists. The analysis was presented using frequency table, percentages, charts and graphs. The inferential statistics was used to show relationship between income and cost of domestic energy use.

### IV. Results

#### 4.1 Trend in Price of Petroleum Product in Nigeria

All the macro-economic policies of the government of Nigeria have been having effect on the price of petroleum products in the country, since the period of oil boom of late 1970s and early 1980s. Since then the price adjustment embarked upon by the government due to advise of the World Bank and IMF have had untold hardship on households in terms of the energy use by the households especially the poor. There has been increase in the price of petrol, for example from N0.60 in 1991 to about N97.00 in 2012. The trend indicated that the price was N11.00 in 1994 and was changed to N20.00 in 1998. This implies that between 1991 and 1998 there has been an increase of over 3000%. There has been increase in price of kerosene and Liquefied Natural Gas (LPG), for example the cost of kerosene which is the major source of energy for household cooking rose from N0.40 per litre in 1991 to N6.00 in 1994 and N17.00 in 1998, it has since the advent of the democratic dispensation rose to N50.00. A 12.5kg cylinder of LPG rose from N200 in 1991 to about N3,900.00 in 2012. Table 1 shows the rate of increase in the price of petroleum product used for domestic cooking by households.

Table 1: Price of Petroleum Product Used for Domestic Cooking in Minna.

Year	Kerosene		LPG	
	N/litre	% change	N/litre	% change
1991	0.40	-	80	-
1993	2.75	587.5	200	150.0
1994	6.00	118.2	200	-
1998	17.00	183.3	450	125.0
2000	17.00	-	1,000	122.2
2002	24.00	58.3	1,200	20.0
2004	50.00	34.2	1,500	25.0
2008	50.00	-	2,500	66.7
2012	50.00	-	3,900	56.0

Source: Adapted from NNPC Annual Report, 2012.

The effect of increase in petroleum price adjustment on household poverty indicated that over 73.0% of the households in Nigeria are badly affected by the increase in the price (Tomori, 2005). This has led to households shifting from this conventional energy to non-conventional ones. The proportion of consumers using firewood for cooking purposes has increased tremendously especially in Minna where there is availability of shrubs to be cut down for charcoal and wood fuel as source of cooking in Minna due to the economic-cul-de sac. The change in the proportion of people using the charcoal and firewood in Minna is tabulated thus in table:

Table 2: Number of Households using Different Energy Source for cooking in Minna.

Energy type	2000-2003		2004-2008		2009-2012	
	Low %	Medium %	Low %	Medium %	Low %	Medium %
Firewood	10.0	4.0	45.0	25.0	65.0	54.0
Charcoal	2.0	5.0	15.0	11.5	21.0	17.0
Kerosene	84	60.0	35.0	30.0	6.5	15.0
LPG	1.2	25.0	0.0	1.5	0.0	2.0
Electricity	1.0	5.0	1.0	3.0	0.5	1.0
Others	0.0	0.0	0.0	20.0	0.0	0.0
No response	1.8	2.0	4.0	5.0	7.0	10.0

Source: Author's Field Survey, 2012.

The analysis shows that the consumers of kerosene have shifted to the use of firewood due to the fact that they are low income earners and the increase in the price of kerosene have not allowed them to use the product often. Furthermore, it was revealed that the price of the product is not what the government place on it due to scarcity and non-availability of the product in the filling station.

The effect of the scarcity and increase in price of this conventional energy is the use of charcoal, firewood which has also increased the users and sellers of the product. There has been increase in the number of participants (both men and women) who are now involved in the marketing of firewood. There has been increase in the price of firewood overtime not minding the consequential effect on the environment and users health. A bundle of firewood that cost ₦10 in 1992 was sold for ₦50 in 1999 and now cost about ₦100 in 2012. This quantity of firewood is about enough for the cooking need of an average household in a day.

#### 4.2 Household Energy Consumption Pattern

The macro-economic policies of government which, was the idea of IMF that the government implemented shows that price increase of domestic energy use is felt by low and medium income group more. This is examined by considering the dynamic of household energy consumption pattern between 2000 and 2012. Table 3 above indicated the adjustment mechanism of households to the increase in the price of the petroleum product to the non-conventional energy consumption by the households. This consumption centered on firewood, charcoal, kerosene, gas, electricity etc.

##### 4.2.1 Consumption Pattern between 2000 and 2003

Before and during this period, kerosene has been the major source of energy for households used in both low and medium income households because of its availability and affordability. The cost of kerosene then was between ₦17.00 and ₦24.00. 84% of the household surveyed in the low income group uses kerosene while 60% of the middle income also uses kerosene. This is because kerosene does not need much tending. Also the number of household in this category makes the use of kerosene a widespread. There was preference for kerosene because houses built nowadays have no kitchens. "All the landlord's concerns is that the rooms are



completed, and those that will live in such houses have envisaged problems with the use of firewood to be less much smoke" (Adelekan and Jerome 2006).

Middle income group in this period also prefers the use of LPG (25%) of the households surveyed. very few household consumes firewood, charcoal, electricity for cooking; though firewood is the 1<sup>st</sup> most important in low income area (10.0%), the use of other sources of energy are not important during this period.

#### 4.2.2 Consumption Pattern between 2004 and 2008

With the increase in the price of kerosene and LPG, household in this income group moved drastically to other sources of energy consumption apart from the kerosene and LPG. This period also shows high involvement of middlemen in the trade of kerosene which makes the product scarce and not available at the pump price. The price of kerosene jumped from ₦24 to ₦50 per litre and middlemen that normally have the product now sell it at the rate of ₦150 per litre which is triple the pump price by the government. The analysis shows that the proportion of household using kerosene and LPG dropped drastically to 35.0% in low income group and 30.0% in medium income group. The implication is that there are more households that use firewood and charcoal as source of domestic energy use. There has being falling down of trees in large quantities and no replacement. The percentage of the households using firewood as source of domestic energy rose from 10% in 2000 to 45% in 2008 in low income groups and from 4% in 2000 to 25% in 2008 in medium income group. The use of LPG has also changed negatively as more households are not considering it as a means of energy use.

The analysis in the table 3 indicated that the pattern of energy use by the low and medium income group change during this period as more households' resolved to the use of firewood for their domestic energy use. The use of other sources such as Electricity is on the decline. The use of hot plate for cooking by large number of household is not visible because of the amount of energy it consumes and also there has been increase in the tariff of electricity over time in Nigeria. Table 3 indicates the rate charged by the electricity company in Nigeria.

Table3: Changes in Electricity Tariff between 2000 and 2012

Year	N/KW/hr	% change
2000	2.30	-
2004	4.50	95.65
2007	6.50	44.45
2010	7.80	20.00
2012	11.75	51.00

Source: Adapted from PHCN Record, 2012.

Furthermore, there has being the problem of fluctuation in the voltage supply to the households and also irregularity in the supply, while some areas of the low income neighbourhoods like Kpagunka, Tokin-Safe hardly boast of 6hours electricity supply per day, and inconsistent in the time of supply has also posed a serious to be problem to the use of the electricity. It is only in few middle income neighbourhoods that the use of electricity is still practiced, though electricity will provide cheaper forms for cooking but the attendant electric shock, epileptic in supply has not encouraged its uses.

#### 4.2.3 Consumption Pattern between 2009 and 2012

By 2012 when the survey was conducted the price of kerosene, LPG has risen astronomically which thereby endangered its uses. The number of households that use these sources as their main energy consumption for cooking diminishes with the price adjustment. The analysis shows that the use of firewood and charcoal has been on the increase and there is no sign of it been reduced because of the cost of these conventional energy. The percentage of households using firewood rose from 10% in 2000 to 45% in 2008 and about 65% in 2012. This implies that more households find it difficult to use other sources and the poverty level of the country has been such that households living below poverty line are on the increase. (The report of the National bureau of statistics indicated that the national poverty index is presently at 62.5% though there is the dichotomy between the northern and southern Nigeria.)

This implies that households in Minna that fall below the poverty line are on the increase and therefore the financial resources available for use by household for domestic energy is dwindling which however encourages the use of firewood. The use of conventional energy has not been convenient and the price have skyrocketed to the extent that a litre of kerosene now costs between ₦150 and ₦200, which is not enough for household energy use per day.