SURVEY OF FUELTYPE/ENERGY UTILIZATION PATTERN IN URBAN AREA OF JOS, PLATEAU STATE NIGERIA

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ABSTRACT

Several fuel have been used for domestic cooking through history ranging from solid to liquid and gaseous forms, Renewable and non-renewable, each coming with an associated problem, ranging from environmental pollution to depletion of material reserve. Today the rising prices of energy (cooking fuel) and fear of sustainability of renewable sources has been a major concern over the years. This study enumerated and documented the existing domestic cooking fuel-type and utilization pattern in Anguwan Rogo/Anguwan Rimi in Jos. A quantitative research method was adopted; through a field and randomized selection of 385 respondents using face-to-face interview format through structured questionnaire, . The data collected was analyzed using descriptive statistics. The results of the field survey revealed substantial difference in the fuel-type utilization patterns of the household and household dwellers qualities. Accordingly, the result indicated the fuel-type energy utilization pattern as; fire wood 33%, charcoal 12%, Kerosene 46%, electricity 5% and Gas (LPG) show 4%.

Keywords: Energy, Utilization, Urban Area, Sustainable, Access

INTRODUCTION

Fuel type choice is linked with socio-economic status of a country (Winrock International Nepal 2004), some attributed it to complex socio-economic and environmental function (Pundo, et al, 2006:24). Others suggested that, choice rely on household demography and infrastructure variables such as; gender, age, education, and occupation of the household head and spouse, including household size, types of food commonly cooked, type of cooking pots commonly used, the ownership of the main dwelling unit, and the materials with which the main dwelling unit is constructed.

ISSN: 2277-0097

Consequently, fuel type utilization patterns are said to be closely linked to socio- economic factors (Ramachandra et al, 2000) as well as cultural practices.

Bajet (2012), assert that the choice of Liquid Petroleum Gas (LPG) or propane is becoming more popular, especially in countries with large urban areas and rising income levels. It is popular with middle and upper income families because it is clean burning and quick cooking compressed gas with an adjustable heat output. Therefore, it can be said that, there exist a direct correlation between financial power and fuel type choice (Amigun, et al, 2008). About 3 billion people still rely on solid fuels (Bruce, et al, n.d) and around half the population of the world rely mainly on biomass, (wood, animal dung, and crop wastes) and coal for cooking, which are inefficient and highly polluting as primary fuel source (Sarmah, *et al*, 2002; Bruce, et al, n.d in IEA 2002; Smith, Mehta, and Feuz 2004) their usage present adverse consequences on health and the environment (Daurella, *et al*, 2009).

Traditional sources of energy supply accounts for more than 90% of total energy used by households (Jebaraj, *et al* 2006), Pundo *et al*, (2006) confirms this with a total usage at 92.78 %, broken down as Firewood 58.28%, Charcoal 34.50% and Kerosene 7.22% confirming Jebaraj, *et al* (2006). However, Ogbonna (2006) indicated that, fuel utilization pattern stands at Firewood represent 19.40%, Charcoal 28.20 %, Kerosene 37.90% while gas and electricity stands at 19.40% & 4.0% respectively totaling the use of traditional fuel at 47.60%. The per capital consumption of modern energy is low in Africa due to poverty and lack of access (Amigun et al, n.d), this accounts for the low usage of electricity and can be attributed to the fact that, in 21 sub-Saharan African countries, less than 10% of the people have access to electricity (Mshandete *et al*, 2009) and LPG thereby, dependent on traditional biomass such as wood, crop, and dung for cooking (Kanagawa *et al*, 2006). Sesan (2008), assert that the major (fuel) energy-consuming activities in Nigerian households are cooking, lighting and use of electrical appliances respectively. Cooking accounts for a staggering 91% of household energy consumption, lighting uses 6 % and the remaining 3% can be attributed to the use of basic electrical appliances such as televisions and pressing irons. Furthermore, the major household energy carriers are fuel wood, kerosene, electricity and liquefied petroleum gas (LPG). Fuel wood is the most widely used, supplying over 80 percent of household energy, while less than 20 percent is supplied by the other sources and complemented by small

quantities of coal and charcoal. A survey of both urban and rural communities of five local Government Areas (LGA) of Oyo State in Nigeria showed that 76% household depend on fuel wood for cooking, Ogunkunle et el (2004).

The current un-sustainable use of existing fuel type, from traditional sources account to more than 90% of total energy used causing rapid deforestation, decreasing soil fertility, (Jebaraj, 2006). In Nigeria, the household sector is the largest energy- consuming sector consuming energy for cooking (Bailis , n.d) and water heating while firewood is the major cooking and heating fuel (Adeoti, et al, 2001). Firewood is the mostly utilized in Nigeria (Ezema, 2001 in Ebe, 2006), accordingly, 70% of the total population of Nigeria relies on firewood or charcoal (traditional fuel type) as their major source of energy for cooking and heating purposes (Chukwu, 2001). Renewable energy accounts for over 15% of world primary energy supply in 2004, including traditional biomass (7–8%), large hydro-electricity (5.3%, being 16% of electricity generated), and other 'new' renewable (2.5%); Renewable- energy systems can contribute to the security of energy supply and protection of the environment (Sims, *et al*, 2007).
There are three levels of cooking fuel energy stacks or models. They are categorize as; Primitive, Transition/Modern and Advance, while, domestic cooking fuels are divided into four major categories (AICD, 2008; Schlang *et al* 2008)

1. Liquefied Petroleum Gas (LPG),

2. Kerosene,

3. Wood and Charcoal

4. Others.

However, for the purpose of this study, domestic cooking fuel to be considered are; Firewood, Charcoal, Kerosene, LPG and Electricity.

Table 1: Fuel type Source and Nature.

S/No	Fuel Type	Stack/model	Sources	Nature
1.	Firewood	Traditional	Renewable	Non-commercial
2.	Charcoal	Traditional	Renewable	Non-commercial
3.	Kerosene	Transition	Non-Renewable	Commercial
4.	Gas (LPG)	Modern	Non-Renewable	Commercial
5.	Electricity	Modern	Non-Renewable	Commercial

From Table 1 both LPG and electricity are seen to belong to the modern fuel stack/model which are from a non-renewable source and by nature are commercial. Kerosene stands as transition fuel, has a non-renewable source, and is commercial in nature. Charcoal and Firewood exist as traditional fuel types from a renewable sources and are by nature are non-commercial. According to Daurella et al, (2009), only between 3-4% households Sub Saharan Africa uses electricity to cook. At an aggregate level of the 25 Sub Saharan Africa countries, 83% of the population uses firewood as its cooking fuel. This figure goes up to 93% for rural areas, and down to 58% for urban areas. Within the firewood (wood-fuel) category, fire wood is predominantly used in rural areas, while in urban areas charcoal has a higher presence due to a better supply chain. LPG and kerosene are almost inexistent in rural areas – 1% and 3% respectively - while in urban areas, LPG by 8% of the population, and kerosene by almost 22%. All these figures indicate that the transition modern fuels is at a much advanced stage in urban than in rural areas, although the urban a' population is still far from having completed this transition. They also indicate that kerosene have a higher penetration rate than LPG. Medium-income countries (MIC) have LPG use of 8% and low-income countries (LIC) of 3%. For kerosene these figures amount to 15 and 7% respectively. If countries are put in net hydrocarbon importers and exporters, it appears that in exporter countries 4% of the population use LPG and 15% use kerosene, whereas in importer countries 3% use LPG and 2% use kerosene, while the considered utilization around the globe is revealed in table 2. According to Makame (2007), most rural and urban people in Africa, Asia and Latin America still rely on trees and woody vegetation to meet their basic energy needs. Indeed, the use of fuel wood as a source of energy is a rural habit. However, this has found acceptance in urban areas, and in a manner to which its demand is leading to the harvest of both dry and wet

wood, as against the mostly harvested dead woods, dry branches and twigs. He further argues that in Africa the pressure on forest resources has increased since the oil shocks of the 1970s. This is mainly because many poor urban dwellers previously using kerosene for cooking have reverted to fuel wood.

Table 2: Fuel type utilization in some countries around the world

			Fuel-type					
S/No	Author/Year	Country	Firewood	Charcoal	Kerosene	LPG (gas)	Electricity	Others
1.	ASTRA (1999)	India	58.28	34.50	7.22	nc	Nc	-
2.	ACID (2008)	Nigeria (country wide)	57.90	Nc	21.70	8.12	Nc	2.0
3.	Daurella (2009)	Nigeria (Urban area)	76.56	Nc	21.34	1.04	Nc	0.9
4.	Njong (2011)	Cameroon (country wide)	69.5	4.1	9.7	16.3	0.4	-
		(Urban area)	44.7	7.2	16.6	31.1	0.5	-
5.	Ogbonna (2011)	Nigeria (Urban area)	19.4	28.2	37.9	19.4	4.0	-
6.	Author (2011)	Nigeria (Urban area)	34	13	46	4	4	

* nc = not considered

The table above shows result of studies conducted in different countries both in the urban and rural areas. The use of traditional fuel type stands high at urban centers (ASTRA 1999, ACID 2008, Daurella 2009, Njong 2011, Ogbonna 2011). ASTRA (1999) studied three fuels, Firewood, Charcoal and Kerosene. Firewood was seen to be the most used fuel with 58.28% usage. In another study by ACID (2009) in Nigeria, Firewood was also seen to be the most used fuel with 57.9% usage. Similarly, firewood was also seen to be the most used fuel in a study by Durella (2009) with 76.56% usage. Njong (2011) in Cameroon also indicated that firewood is the most used fuel with country wide result as 69.5% and 44.7% in urban area. A study

conducted by Ogbonna (2011) in jos, indicated that the use of kerosene is highest. The use of firewood as a household fuel is overwhelmingly concentrated in less developed countries (Daurella *et al*, 2009) and in Nigeria; firewood was the mostly utilized (Onoja *et al*, 2011 as in Ezema,2001 & in Ebe, 2006) and has continued to be the most popular energy sources for many poor countries (Aina *et al*, 1998; Audu, 2013). However, the differences in percentage utilization of any fuel type irrespective of its nature and the area can be attributed to;

i. Socio-Economic (Age, Occupation, Level of education, Income etc: Pundo *et al*, 2006; Adeoti *et al*, 2001; Njong *et al*, 2011) and Environmental (Locality and Climate) factors (Bailis, 2004; Ramachandra *et al,* 2000; Horgan, 2002)
ii. Household Income (Jebaraj *et al*, 2006) and Expenditure (Daurella *et al*, 2009; Girard, 2002)
iii. Access to fuel-type supply mix (Sims *et al*, 2007) and Pricing (Kanagawa *et al*, 2006, Pundo *et al*, 2006; Daurella *et al*, 2009; IARC, n.d; SCHLAG *et al*, 2008)
iv. Availability of Utensil, Apparatus and Appliances (Pohekar, *et al*, 2006; Reddy 2003)

Table 3: Percentage (%) Distribution of Households by type of fuel for cooking, 2007

	Fuel type				
	Modern		Transition	Traditional	
Area	Electricit	Gas	Kerosen	Woo	Coal
Urban	1.5	2.0	54.1	39.0	3.4
Rural	0.3	0.1	7.0	92.0	0.6
National	0.7	0.7	22.9	74.1	1.6

Source: Audu, 2012. (Modified and adopted)

In a study conducted by Audu, (2012), it revealed the use of traditional cooking fuel to be higher in the rural areas, equally, fuel type choice was seen to be guided by availability, accessibility and affordability (Audu, 2012). Others attributed it to age, socio-economic and educational levels, level of country's development (Girard, 2002). Nigeria is currently using 80 million cubic metres (43.4 x 109 kg) of fuel wood annually for cooking and domestic uses

according to a study by Sambo (2005). With the continuous growth of the country's population and indeed that of urban areas, this trend is becoming a threat to the environment, particularly the rural areas from where these fuel woods were harvested, with the rate of harvest and utilization higher than its natural regeneration or replenishment. The demand of fuel wood in Nigeria's urban areas has been increasing, due to the fact that other sources of energy are experiencing hike in prices.

At present, fuel wood constitutes the main source of fuel for cooking by over 76% of the Nigerian population, according to Babanyara (2010) and UNDP (1993) figures in Olusegun (2009) Nigeria is consuming 262,783 metric tonnes of fuel wood compared with 7,210 tonnes for South Africa and 35,313 tonnes for Thailand. While our dependence on fuel wood is rising in Nigeria, it has virtually ceased in the other two countries. At the present rate of fuel wood consumption, cutting may soon convert our forests to savannahs and grasslands. Furthermore, Yahaya (2002) stated that the poorer a country is, the greater its dependence on fuel wood. This is further buttressed by the United Nations Centre for human settlements that despite the availability of modern energy sources to some city dwellers, the majority of the immigrants cannot afford them, wood still remains their fuel; but instead of collecting it from dead trees, branches and twigs, they now buy it from vendors (Habitat-UNCHS 1990).

In Nigeria, fuel wood is being exported from rural areas into urban areas, a scenario Cline-Cole et al. (1988) described as the urban-rural conflict. However profit oriented business of cutting down trees for export to the urban areas as fuel wood may be to the rural dwellers, culminates into a vicious circle of problems to the environment, the rural dweller and eventually the urban areas in general. According to Anderson (2006), urban centres depend on the hinterlands (rural areas) for its resources, if depleted it will spell doom for the nations concerned. It should be noted that, between 1990 and 2000, Nigeria lost an average of 409,700 hectares of forest equal to an average annual deforestation rate of 2.38%. Additionally, between 2000 and 2005, Nigeria lost 35.7% of its forest cover, or around 6,145,000 hectares (Wikipedia 2008). As such, it is of paramount importance if other energy sources available in Nigeria are harnessed and made available and affordable, so as to curb the awaiting disaster of deforestation, desertification and erosion.

Changes in socioeconomic circumstances no doubt can improve household fuel choice by moving up the energy ladder carrying out more activities with fuels and appliances that are increasingly efficient, clean, convenient and more expensive (Bruce, et al, n.d). Accordingly, there exist today, global and national energy crisis and is leading to lingering demand and supply gaps for cooking fuels in Nigeria (Anozie *et el* 2007; Onoja *et al*, 2012), therefore, this study was designed to enumerate cooking fuel type utilization pattern in terms of their nature and sources. According to Ramachandra *et al*, (2000), Cooking, water heating and space heating are the major end use activities. In the context of this research work, the use to which various fuel type were put ranges from cooking, water and space heating as well as space lighting.

METHODOLOGY

In this study, a survey design, was carried out in Anguwan Rogo/Anguwan Rimi in Jos, Plateau State of Nigeria. For the purpose of calculating sample size, the equation $s=(z/e)^2$ was used

Where; s = the sample size.

z = a number relating to the degree of confidence desired in the result.

(Note: 95% confidence is usually most frequently and is accepted, the value of 'z' = 2.58 is for 99% confidence, **1.96** for 95% confidence, 1.64 for 90% confidence and 1.28 for 80% confidence) (Ball and Gall 1971, Uji, 2010).

e = acceptable error measured as a portion of the standard deviation. Therefore,

$s = (1.96/0.1)^2 = 384.16$ approx. = 385

Therefore, the sample size of 385 was sufficient and adequate from the total population; consequently a total of 385 questionnaires were administered to the targeted population representing 23.80% of the total number of household in the study area.

The Study Area

The study area is predominantly the residential district; an area of Anguwan Rogo/Rimi in Jos Plateau State Nigeria. It is shown in the

figure below and is bounded from the east by Anguwan Rogo/Rimi road to the north by Zaria road; west by Katako road and to the south by forestry stream.

Figure I : Satellite Image of Study Area

Source: The Greater Jos II (http://www.viewphotos.org/nigeria/flat-map-of-Jos-203.html)

RESULTS AND DISCUSSIONS

Schlang et al (2008) suggested that there exist three levels of cooking fuel energy stacks or models. They are Primitive, Transition/Modern and Advance; however transition from one to another indicates socio-economic status change. Accordingly from the survey, 47% of the fuel energy used is made up of traditional biomass, mainly fire wood and charcoal with 34% been fire wood while charcoal represents 13% of the fuel supply mix. This is seen to belong to the primitive fuel. The transition fuel utilization is seen to account for 46% of the fuel supply mix. Advance fuel comprising of electricity and LPG show 4% each of utilization in the fuel supply mix.

It is worth noting here however, that the high percentage of Kerosene usage seen as transition fuel is mainly attributed to the fact in the use of both firewood and charcoal, kerosene is used as well.

There are enormous variations in the level of consumption and the types of fuels used; the main use of energy in households in developing countries is for cooking, followed by heating and lighting. Households generally use a combination of energy sources for cooking that can be categorised as;

1. Traditional, (animal dung, agricultural residues and firewood).

2. Intermediate, (charcoal and kerosene) and

3. Modern, (LPG, biogas, ethanol gel, plant oils, dimethylether (DME) and electricity).

However, electricity is mainly used for lighting and small appliances, rather than cooking, and represents a small share of total household consumption in energy terms (World Energy Outlook, 2006). The result indicated the fuel-type utilization pattern as; fire wood 33%, charcoal 12%, Kerosene 46%, electricity 5% and Gas (LPG) show 4%.

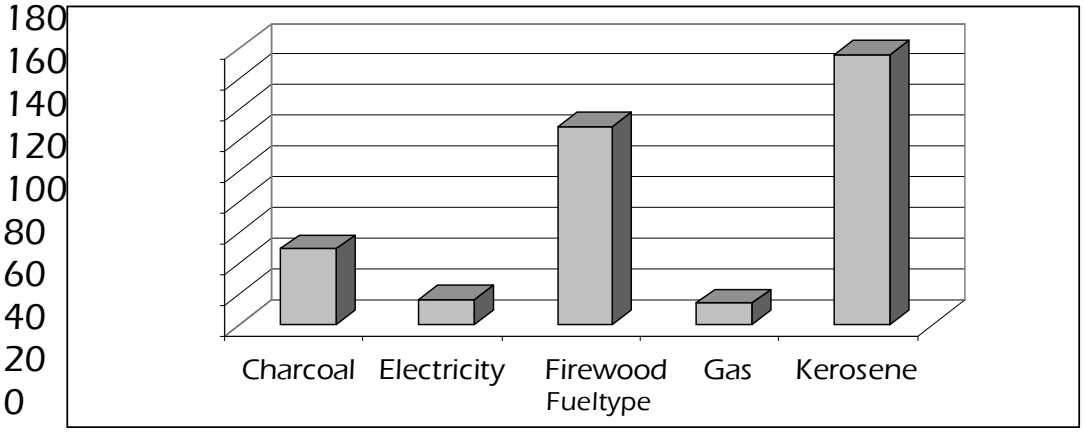

Figure 1: Fuel types Utilization Chart

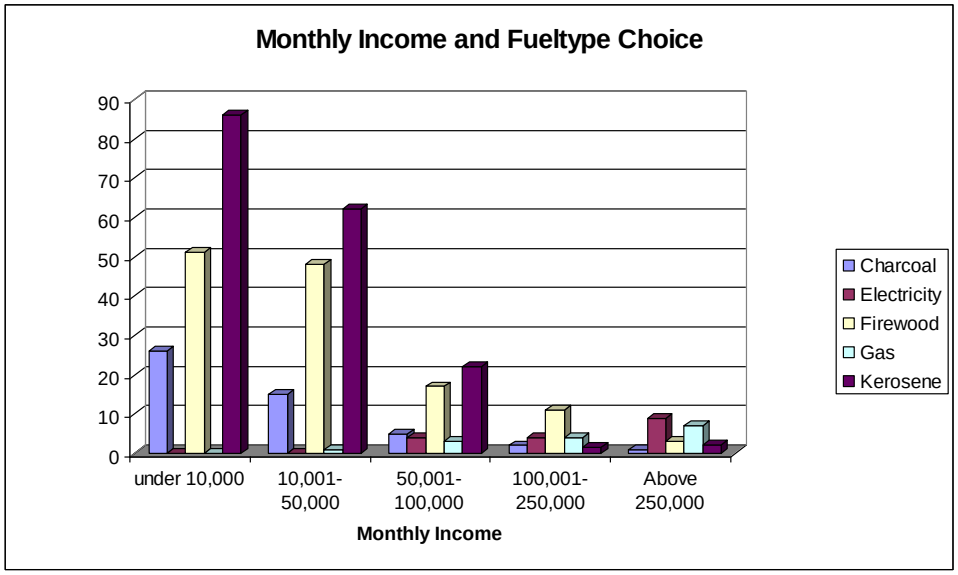

Figure 2: Monthly Income and Fuel type Choice

Following the results of the field survey, figure 1 clearly showed the current fuel type used by respondents. It also showed the sources of the fuel type and the nature of the various fuel types. Only firewood source is renewable and is a non-commercial fuel type. Charcoal is sourced from a non-renewable source and is a non-commercial fuel type. However, Kerosene, Gas (LPG) and Electricity are sourced from non-renewable source and are commercial fuel types.

Figure 2 showed the various fuel type, application and degree of Usage. Large quantity of firewood and charcoal, kerosene is been used for cooking (food), Heating (Water and Space) with a small quantity been used lighting. Note however, the use of kerosene cut across other fuel type, it is been used with firewood as well as charcoal especially in the initial starting of fire. In the case of gas (LPG), a small quantity is used for cooking, none used for heating (Water and Space) and lighting. While for electricity, very low quantity used for cooking. Large quantity of the supply is been used for heating (Water and Space) and lighting.. Hence this can be deduced that the choice of fuel type is linked to income, educational level, age and country's development level.

CONCLUSION

From the analysis of the obtained results of the survey conducted, it was discovered that five major cooking fuels were in use in varying degrees by dwellers for different domestic cooking activities. They are both from the renewable to the non- renewable sources. These fuel types are either commercial or non-commercial in nature. The areas of application of these cooking fuels in irrespective of their supply sources or nature range from Cooking, to heating of water/spaces, and to lighting, with varying percentage of use ranging from low to high .

In conclusion, the study observes that fuel types for the non-renewable sources were used the most; however, non-sustainable usage has impact on the environment.

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Reference to this paper should be made as follows: Umaru Auwalu N. et. al., (2016), Survey of Fueltype/Energy Utilization Pattern in Urban Area of Jos, Plateau State Nigeria. *J. of Environmental Sciences and Resource Management,* Vol. 8, No. 2, Pp. 56-73.