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Article

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Energy Utilization in Residential Kitchens in Bauchi, Nigeria

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Abstract: Energy has remained essential for cooking services by households through their kitchen. The source of this energy has remained multiple in nature, with a concise order of it being Modern or Traditional. This study through a survey, using four points scale and chi-square test of association of energy utilization by households in the University staff quarters explored the cooking energy so as to acknowledge the energy type used by households. The incentive for use and its impact on users and established that with a high level of education, only 9% of the households use LPG as a modern form of energy while the choice for Electricity and Kerosene has remained foremost in use by the household. The household size was noted to encourage the quantum of energy consumed as well as the persistent use of inferior energy like firewood which was penultimate looked as a rural energy. The study concludes that household in the study area use multiple energy sources to support their cooking activities due to affordability and it being dependable and easily obtainable even though not very durable and effective. It is noted that the study area has not obeyed the theory of utilizing the energy ladder concept.

Keywords: Energy, Household, Kitchen, Choice, Utilization

JEL codes: at, least, two, JEL, codes

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1. Introduction

Energy has been in great demand for human development in years and has remained a source of primary and secondary requirement for advanced development. Developing nations have been relying on multidimensional sources of energy (from fossil to renewable sources) for health, educational entertainment food preparation. Cooking across the globe has remained the mainstay

for human sustenance, as most edible products may have to be prepared through cooking, thus food has remained one of the most basic needs of man. Hence cooking is very essential in human existence. Different activities of man consume different forms of energy. It then goes without saying that meal preparation also consumes some amount of energy. The kitchen is a room or part of a room used for cooking and food preparation within the building unit having in it numerous appliances or equipment aimed at easing and enhancing the design. Kitchen types and complexity differ depending on the kind of users it accommodates. It is therefore safe to say that energy consumption in a kitchen may differ for different kitchen types.

Improving access to affordable and reliable sources of energy is essential, especially in developing countries like Nigeria. It will not only aid in improving living standard but reducing poverty and promoting economic development of the Nation. This study evaluated energy types utilized in residential kitchen as some energy sources are detrimental through a survey of household energy utilization by aggregating random samples.

In the bid to evaluate domestic kitchen energy, this study explored the energy utilized by households and the driving forces behind the choice of energy sources along their effects. Hence providing useful information that can aid in predicting the choice and kitchen use of energy by the households.

2. Background of the Study

2.0 Energy consumption in domestic households

Energy and fuel use are important for the welfare of households in developing countries. Using an energy source for lighting and cooking is essential to human life and part of what first defined the human race as separate from animals in pre-historic times.

To this day, many people remained dependent on biomass (fuels) for cooking and other inefficient and costly sources of light such as candles and kerosene. Improving access to modern energy sources – electricity for light, appliances use and clean cooking technologies – is an important development goal; it is complementary with other goals of development such as improving health and education. 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. Consequently, fuel type utilization patterns are said to be closely linked to socio-economic factors (Ramachandra et al, 2000) as well as cultural practices.

Purchase of energy claims a substantial portion of poor people's budgets, and collection of cooking fuels often absorbs a significant amount of time for women and children.

Efficient lighting is crucial for educational performance. Clean cooking fuels are important for combating the high levels of indoor air pollution encountered whenever traditional solid fuels are used for cooking or heating.

The use of clean cooking fuels can also have positive effects on the external environment by reducing outdoor air pollution from venting of kitchen smoke as well as by combating forest degradation; collection of wood for firewood or charcoal production is thought to contribute to forest degradation in certain locations, especially near cities and major roads (ESMAP, 2001; Heltberg, 2001).

2.1 Cost of energy

The cost of purchasing energy is one of the most important interactions between energy and welfare. Pricing of modern energy is often politicized. There are many examples from a variety of countries of energy pricing reforms meeting stiff resistance, sometimes causing those reforms to be cancelled, reversed, or altered. The reason is basically the non-negligible share of energy in household budgets combined with its role as a basic household good; fuels for lighting and cooking are nearly impossible to live without. A high budget share for energy services translates into vulnerability to energy price fluctuations (Heltberg 2003)

In countries and areas where households have shifted out of wood their vulnerability to fuel price fluctuations is increased. To assess these topics, it is important to know the total share of energy costs in household budgets, and the burden imposed on specific groups of households of purchasing individual fuels.

According to Helberg (2003) the tendency for the energy budget share to decrease with income is more pronounced in urban areas. In rural areas people often have better possibilities for

substituting collected or homegrown biomass for purchased fuels, and poor rural households are therefore better able to limit their energy expenses and their exposure to energy price fluctuations. The lack of electricity may also contribute to lower energy spending among the rural poor; although lighting with kerosene and candles is vastly more expensive per unit of light, the absence of appliances can mean that unconnected households spend less overall on energy than connected households.

2.2 Household Cooking fuels

In developing countries Nigeria inclusive, majority of the rural population depend on biomass as their major source of energy. This is due to their economic status and the availability of the biomass in their environment. Policy interventions targeting cooking fuels and cooking practices were earlier mostly motivated from a desire to control deforestation; increasingly, such interventions are now being motivated due to concerns regarding indoor air pollution. Indoor air pollution has been estimated by the WHO (2002) to be the world's 4th largest killer, causing perhaps 2.5 million premature deaths a year. Policies to reduce indoor air pollution focus on either inducing a healthier fuel choice or on making biomass use cleaner and safer, for example through improved stoves or better ventilation in the cooking area. Household energy is therefore as important as ever. It is however unfortunate that there exist a relative lack of solid data on household energy. For example, the World Bank's *World Development Indicators* – a broad-spanning and fairly comprehensive source of statistics on many development-related issues – does not contain a single indicator on household fuel use. Neither does it contain indicators on household access to electricity (nor to the affordability or quality of electricity services. Nonetheless a study conducted in Lagos by Omole et al. (2016) revealed that electricity is the most dominant source of energy while LP gas followed by kerosene and other sources of energy were used.

Policy analysis and thinking concerning fuel choice is usually rooted in the concept of the energy ladder. The energy ladder theory posits that in response to higher income and other factors households will shift from traditional biomass and other solid fuels to more modern and efficient cooking fuels such as LPG, kerosene, natural gas, or even electricity. This process is usually termed 'fuel switching' or 'interfuel substitution' (Barnes and Qian, 1992; Hosier and Kipondya, 1993; Leach, 1992).

2.3 Types of energy sources

Households generally use a combination of energy sources for cooking that can be categorized as traditional (such as dung, agricultural residues and fuel wood), intermediate (such as charcoal and kerosene) or modern (such as LPG, biogas, ethanol gel, plant oils, dimethyl ether (DME) and electricity).

According to World Energy Outlook (2002) over 2.5 billion people, or 52% of the population in developing countries, depend on biomass as their primary fuel for cooking.

Heavy dependence on biomass is concentrated in, but not confined to, rural areas. Almost half a billion people in urban areas also rely on these resources. Although urbanization is associated with lower dependence, the use of fuels such as LPG in towns and cities is not always widespread. In sub-Saharan Africa, well over half of all urban households rely on fuelwood, charcoal or wood waste to meet their cooking needs. Over a third of urban households in some Asian countries also rely on these fuels.

As incomes increase fuel options broadens and the fuel mix may change, but wood is rarely entirely excluded. Over the long term and on a regional scale, however, households in countries that become richer will shift away from cooking exclusively with biomass using inefficient technologies (Smith *et al.*, 2004). Studies in south west Nigeria indicates that households use multiple energy sources in urban areas with major use of kerosene, gas, and coal while kerosene, wood, and coal dominant in the rural areas as well as higher education contributing to electricity use in kitchen as fuel.(Olufem, 2011).

2.4 Effects of traditional energy sources.

The World Health Organization (WHO) estimates that 1.5 million premature deaths per year are directly attributable to indoor air pollution from the use of solid fuels, more than 4 000 deaths per day, more than half of them children under five years of age. More than 85% of these deaths (about 1.3 million people) are due to biomass use, the rest due to coal. Meanwhile in Nigeria the types of energy accepted for cooking include Kerosene, firewood, Electric and Charcoal sources as common in urban areas most particularly low/middle income urban dwellers to augment their domestic energy needs (Chikwendu, 2011, Nwofe, 2013) despite associated harmful and health consequences (Babanyara and Saleh, 2010) with lean support from LP Gas.

Inefficient and unsustainable cooking practices can have serious implications for the environment, such as land degradation, local and regional air pollution. There is some localized deforestation, but depletion of forest cover on a large scale has not been found to be attributable to demand for fuelwood (Arnold *et al.*, 2003). Fuelwood is more often gathered from the roadside and trees outside forests, rather than from natural forests.

2.5 The Burden of Fuel Collection and Cooking Time

In developing regions the reliance and collection of biomass is on women and children, it is a time-consuming and exhausting task. The average fuelwood load in sub-Saharan Africa is around 20 kg but loads of 38 kg (Rwelamira, 1999) have also been recorded. Women can suffer serious long term physical damage from strenuous work without sufficient recuperation.

Meanwhile, many factors are involved in the amount of time that women spend cooking each day. The vast majority of time can be attributed to collecting fuel, but additional time is spent storing wood; splitting it into manageable pieces; starting the fire; cleaning and clearing the cooking area, with higher frequency and length of cooking events (Jiang and Bell 2008). These differences can be explained by more efficient and faster cooking methods using natural gas and/or electricity in urban areas. In addition to productivity losses from cooking with wood, the particulate matter (PM) levels in the air were far higher in rural areas in comparison to urban areas, resulting in a greater incidence of negative health issues. In Tamil Nadu, India, women cooks spent over six hours per day in the kitchen area, whereas those not involved in cooking spent less than an hour (Balakrishnan et al. 2002). Nevertheless a common theme in rural settings is that women spend significantly more time in the kitchen area than do men, thereby increasing their exposure to indoor pollution (Jiang and Bell 2008).

3. Research Methodology

The research design for this study is the descriptive approach, to investigate the perception of a population on a prevailing phenomenon. It establishes facts from existing conditions and proposes solutions to the observed phenomenon. It is purely based on aggregation of facts observed from expressed opinions since the possibility of experimentation would not be feasible. Random sampling procedure was used in the selection of the sample size. The main instrument of the study

is questionnaire due to its enormity in population coverage. It is compatible with most sampling techniques and is an efficient means of gathering large information to improve on existing phenomenon (Oyejola and Adebayo, 2004).

The study is on Abubakar Tafawa Balewa University Staff quarters (Yelwa and Kari) with a total of 104 residential units in Bauchi state Nigeria and its findings is limited to the area but could be extended to other areas where similar conditions are applicable and their involvement concerned energy sourced for cooking. The questionnaire was administered randomly to members of the quarters for enhancing fair representation of the population and it allows for equal chances of representation by the individuals within the population since with the approach every member of the campus community has equal chance of being involved (Oyejola and Adebayo, 2004).

The questionnaire was structured into four components. The first part solicited for the respondents demographic characteristics while the other part was essentially on energy utilization.

- i Section B: Types/sources of energy adopted by the respondents
- ii Section C: Incentive for choosing energy type
- iii Section D: Awareness of the impact of the fuel type on the users

The responses to item in B, C and D were measured on a four point scale format which ranges from Strongly Agreed (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The scale is assigned numerical value of 4, 3, 2, and 1 respectively from positive expression to negative opinion. The respondents were handy on the questionnaire. Where a respondent could not fill such questionnaire immediately sometime was allowed and was picked afterwards.

The data collected was analyzed using summary statistics such as frequencies and percentages for the demographic characteristics utilizing Statistical Package for Social Sciences (SPSS), to construct frequency distribution tables and cross tabulations, that reveals the various characteristics of the sampled demography.

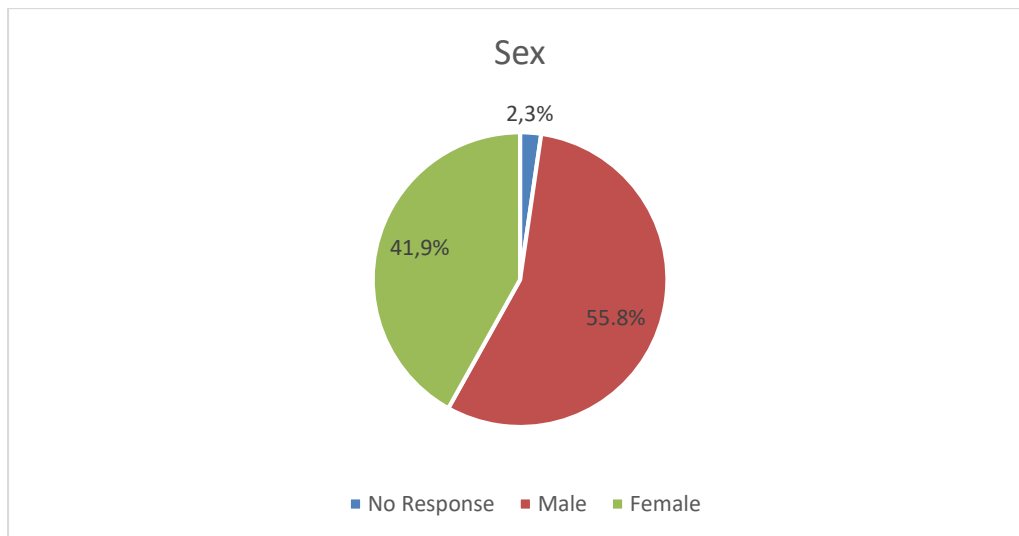
Equally mean and standard deviations was used in the analysis of the variables for the assessment of the energy utilization while hypothesis was tested with inferential statistics that included the Chi-square procedure to establish the significance of association between investigated variables in relation to energy utilization in domestic kitchen at a probability level of 0.05.

4. Results and Discussions

The empirical analysis of this study was conducted using primary data obtained from respondents across the selected area of study. A total of 60 questionnaires were issued randomly, out of which only 71.6% were analyzed. The questionnaire categorized the sampled respondents into various socio-political demographics, Sex, Educational Qualification, Occupation, Age, type of house and number of persons in the household.

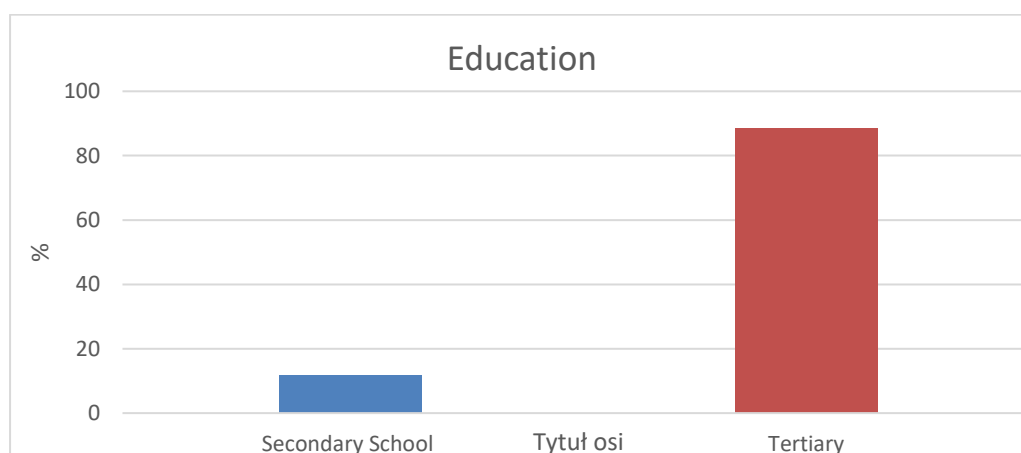
It was recorded that 55.8% were male while 41.9% were females as 2.3% had not responded as presented in the distribution Figure 1.

Figure 1: Sex of respondents



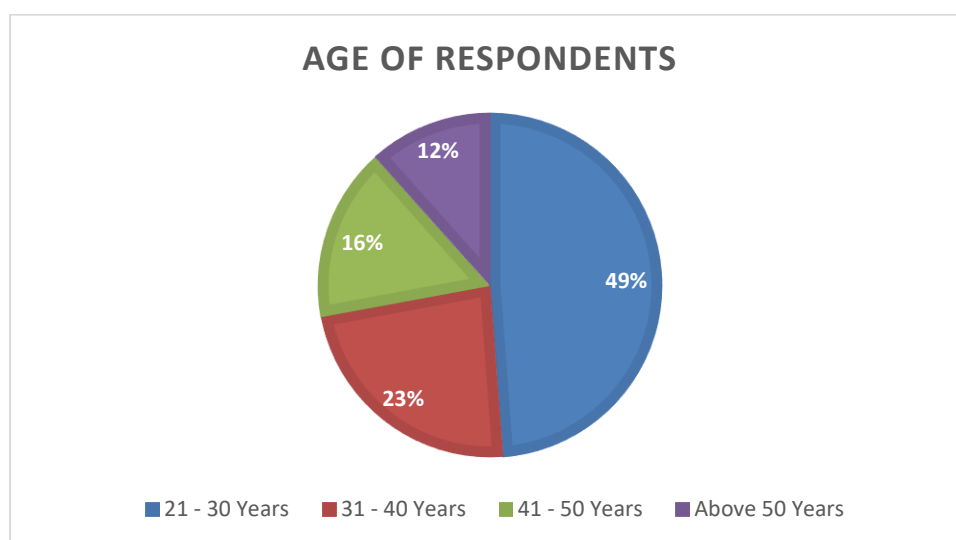
Source: Authors Elaboration 2016.

Figure 2: Highest educational level



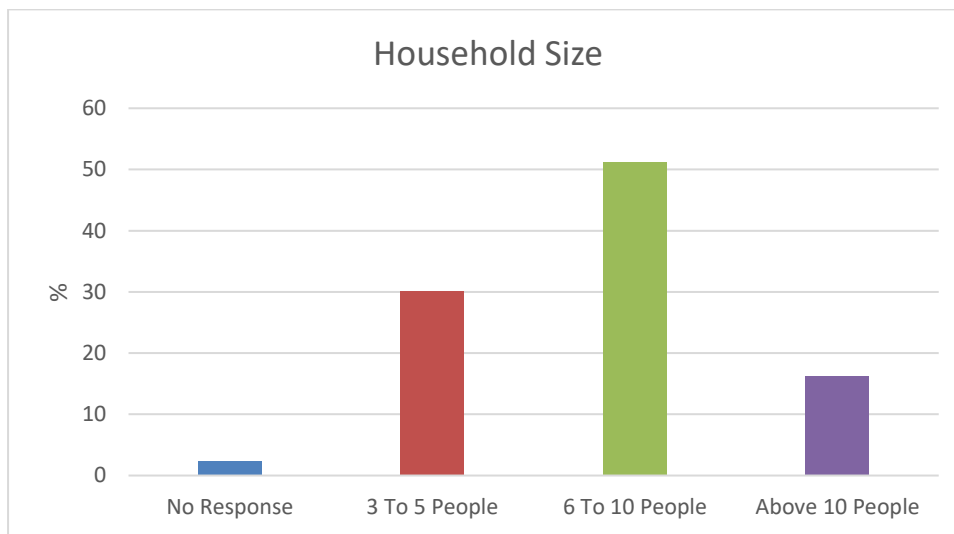
Source: Authors Elaboration 2016.

Figure 3: Age of respondents



Source: Authors Elaboration 2016

Figure 4: Household size



Source: Authors Elaboration 2016

As presented Figure 1, sampled gender composition and approximately 56% are male and 42% female, while majority (88%) of the respondents in Figure 2 have acquired tertiary education. The data also showed that about half of the respondents in Figure 4 lived in houses with 6 to 10 people, 30% of the respondents lived in houses with 3 to 5 people, and 16% lived in houses with more than 10 people. These mostly remain unchallenged as household size can increase energy utilization.

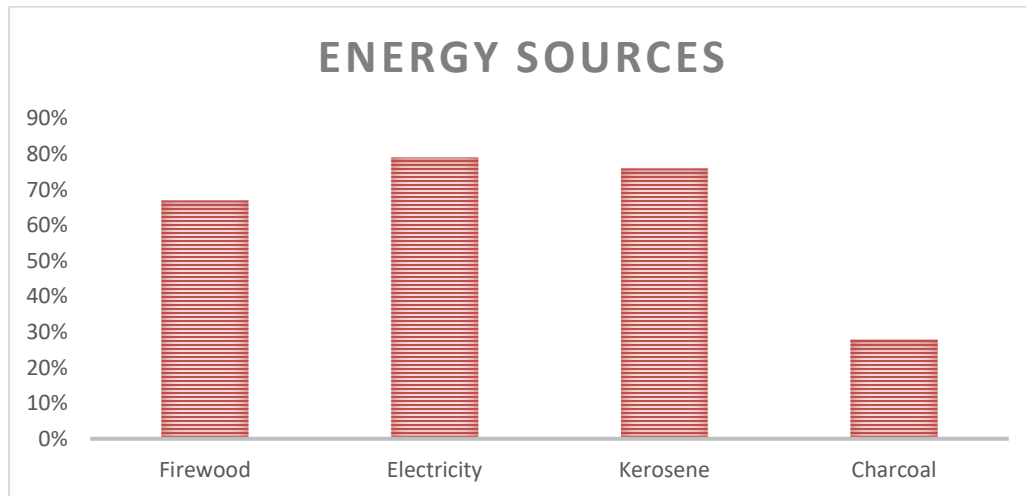
4.1 Evaluation of adopted Sources of Energy

The analysis revealed the various sources of energy adopted by the respondents which was cross-tabulated socio-political demography. From the data, 67% of the residence use fire-wood as a source of energy, as noted in Figure 5. Charcoal as a source of energy is used by 28% of the respondents; Cow-dung is used by only 7% of the respondents, 9% use Agricultural residue. Kerosene is used by majority (77%) of the respondents. Cross-tabulations of kerosene and the demography revealed that kerosene is used almost uniformly across the entire population. As for electricity, 79% of the respondents use it as an energy source for cooking just like kerosene; it is used across the demography. The study also revealed that LPG and Bio-gas are used by 9% and 7% respectively, while ethanol gel, plant oils and dimethyl are not in use.

Based on the analyzed data, it is established that the major sources of energy used in the residential kitchen include electricity, kerosene, firewood and charcoal, which complement the

multiple nature of energy used by households the study also noted cow dung distinctly used as energy form as well as Agricultural residue usually from farm raised by the household when transported home for sorting served as a cheap source of energy as residents do not require to invest any income on this energy source.

Figure 5: Source of Energy used by Households



Source: Authors elaboration 2016

It was also discovered that households with 6 to 10 people recorded the highest percentage of 51% in terms of quantity of energy used in cooking. While those with above 10 people recorded 16% as earlier anticipated.

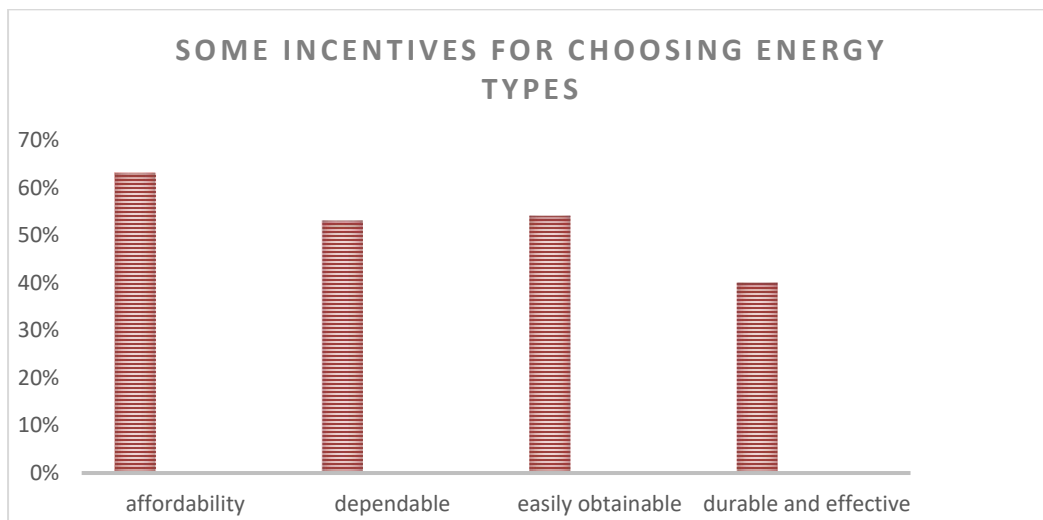
The use of firewood which was looked as inferior energy and declining in urban areas and widely populated in rural areas is not the same in the study area. The general opinion of energy use in the study area can not completely exonerate the use of firewood in urban areas of Nigeria. Equally, Electricity, Kerosene, and Charcoal are heavily used by households as energy in kitchen service delivery which also is dependent on purchasing power or income importantly; these are energy forms used in residential kitchens.

4.2 Incentive for Choosing Different Energy Sources

This was geared towards uncovering the incentives behind the energy sources used by the respondents. The data shows that 72% of the respondents cook 3 times daily, 70% use a moderate amount of energy in cooking, and 47% of the respondents often use energy consuming appliances

in cooking. As for the incentives behind the choice of energy source, 63% use a particular energy source due to its affordability, 53% choose their energy as it is dependable, equally 54% choose to use their energy as it is easily obtainable and 40% choose to use an energy source because it is durable and effective. This indicates that the choice which has remained inherent does not seem to have harmful effect on users rather a dependable source which did not give cognizance to the energy ladder concept as indicated in Figure 6.

Figure 6: Incentive for Energy Choice



Source: Authors elaboration 2016.

4.3 Impact of Energy Sources on Users

The impact of the energy sources chosen by the users was also analyzed, 81% of the respondents believe that the fuel type they use in cooking is safe, and the respondents were divided almost equally on whether the cooking fuel they used affected their cooking time. Meanwhile 60% of the respondents believed that the fuel type they used does not affect their health, while 49% believed their fuel type doesn't affect their kitchen, 67% believe that their fuel type doesn't affect the environment, 67% of the respondents indicated that their cooking fuel is not a burden to their finances and 51% of them indicated that the type of cooking fuel they use affects their kitchen hygiene.

The choice/use of energy has not restricted the educational attainment of individuals rather is tied to convenience and other factors as the study expect that the use of LPG was to score a high rating as modern energy, however it is clear from the conducted survey that the use of LPG and Biogas remained very low despite the educational background of the householders.

5. Conclusion

This study investigated energy utilization in domestic kitchen. It was observed that even though various energy sources were used, the majority of the respondents used firewood, kerosene and electricity as a multiple option. This was ascertained by a cross tabulation of fuel types against housing. Electricity used was the highest with a 79% rate closely followed by Kerosene at 77%. Ethanol gel, plant oils and dimethyl were not used by any of the respondents.

In the assessment, it was observed that most respondents (63%) use a particular energy source because of its affordability, 53% use an energy source because it is dependable, 54% choose to use an energy source because it is easily obtainable and 40% choose to use an energy source because it is durable and effective.

The Impact of Energy sources on users and found a total of 81% of the respondents believing that the type of energy they use is safe while 61% agreed that their choice of fuel did not have an impact on their resources.

From the findings of this investigation, the choice of energy sources was influenced by factors other than their demographic characteristics. It can be deduced from the study that even though some households had above 10 people living there, they recorded a low percentage on energy consumption. Also that the cooking fuels used by the respondents were generally believed not to have negative impact on them. Hence the desire on energy consumption can actually be on the number of cooking done by residence as they cook three times daily increasing the hours invested in the period for cooking as well as mixture of energy choice with its attendant consequences in the study area. This multi choice and use of energy sources particularly traditional energy does not fit into modern designed kitchens as a result forcing households to carve some external kitchens to suit this purpose arising from smoky indoor arae or kitchen normally filled with sooth defacing the walling unit and all other modern schedule in such kitchens.

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Wykorzystanie energii w kuchni w Bauchi w Nigerii***Streszczenie***

Energia pozostaje kluczową kwestią z punktu widzenia przygotowywania posiłków przez gospodarstwa domowe w ich kuchniach. W naturze istnieje wiele źródeł tej energii, z typowym podziałem na nowoczesne i tradycyjne. W niniejszym artykule zbadano rodzaje źródeł energii wykorzystywanych do gotowania przez gospodarstwa domowe pracowników uniwersyteckich w Bauchi w Nigerii, wykorzystując w tym celu badania ankietowe oraz czteropunktową skalę testu chi-kwadrat. Koncentrując się na bodźcach do wyboru oraz efektach wykorzystywania źródeł energii wśród osób z wysokim poziomem wykształcenia, ustalono, że jedynie 9% badanych gospodarstw domowych korzysta z LPG jako nowoczesnego źródła energii, natomiast głównym źródłem pozostaje elektryczność oraz nafta. Wielkość gospodarstw domowych wpływała na ilość zużywanej energii, a także na wykorzystywanie źródeł gorszej jakości, jak np. drewno. We wnioskach stwierdzono, że analizowane gospodarstwa domowe wykorzystują do gotowania różne źródła energii, zależnie od możliwości finansowych oraz dostępności, a mniejszą uwagę poświęcają ich trwałości oraz efektywności. Należy zauważyć, że w obszarze badawczym nie stosowano teorii wykorzystującej koncepcję drabiny energetycznej (ang.: energy ladder concept).

Słowa kluczowe: energia, gospodarstwa domowe, kuchnia, wybór, wykorzystanie