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Household Energy for Cooking in Benue State and its Implication for Sustainable Development

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Abstract

Households in Nigeria use different cooking fuels including wood, charcoal, kerosene and liquefied petroleum gas (LPG) for cooking. The use of electricity has not been widely reported in the energy literature and the limited studies that examined household fuel use in Benue State could not provided context to studies investigating household's energy fuel choices. Drawing on qualitative data elicited from three different locations in Benue State, Nigeria, this paper sets out the information on households' cooking system choices; fuels, and cookstoves. The Nigeria Demographic and Health Survey (NDHS) data were analysed and the results on Benue State was used to contextualized the study. The limitations identified in the energy and cookstove questions asked in the NDHS household questionnaire were used to inform the household questionnaire, interview questions and direct observation approaches for this study. Thematic analysis was used to identify ideas and patterns in respondent responses and that provide detailed account that is independent of analytical bias. The findings indicated that cooking system choices were impacted by energy infrastructure and access considerations linked to fuel cost. Respondents indicted preferences for wood and traditional stoves although shifts in fuel use were observed. There was limited awareness about household air pollution and health risks and smoke. The study concludes by emphasizing the importance of monitoring households cooking system choices and suggests that finding from this research could engage the interest of stakeholders in government, private and public organizations and stove promoters seeking to promote clean fuels and cookstove programs.

Keywords: Energy choice, household, demographic and health survey, Benue State

1.0 Introduction

The Demographic and Health Survey (DHS) is a global health program established by the United State Agency for International Development (USAID) in 1984 that collects data to monitor and evaluate population, health and nutrition. The key indicators that are measured during the survey include: type of cooking fuel and stove used, kitchen location, fertility rates, under-five mortality rates, contraceptive use, skilled assistance with births, childhood immunization coverage, nutritional status of children, women and men, and knowledge and behavior associate with them [1]. Type of fuel, stove used and kitchen location are important indicators the study aim to investigate using a qualitative approach. A key gap that studies in Nigeria have identified is the type of cooking fuel used by households [2,3], but have neglected to examine type of cooking devices, personal and financial circumstances that influence fuel and stove choices and this study aim to address this knowledge gap.. There are

many barriers to sustainable use and up-take of clean fuels and cookstoves such as economic influences, access and availability/infrastructural factors and cost considerations. In Nigeria, a range of efficient, clean burning woodstoves and rocket stoves, liquefied petroleum gas (LPG) and ethanol stoves and solar cookers interventions has been promoted, In practice, the benefits of these interventions are not widely understood and this might help to account for the failure of some the programs [4]. This could also influence end users' opinions about alternative fuels, such as LPG, kerosene, electricity including ethanol. The failure of clean fuels and efficient stoves promoters to understand preferences of users relating to cooking practices, stove size and suitability for cooking needs have also been linked to low adoption [5]. In order to understand household fuel and stove preferences, it is important to examine the social, economic and technical contexts within which they are used. that for sustainable use of clean fuels and efficient cookstoves, relevant agencies should create awareness to encourage household to use LPG and electricity for cooking. For sustainable use of clean fuels and efficient cookstoves, relevant agencies should create awareness to encourage household to use LPG and electricity for cooking. Findings from this study could engage the interest of stakeholders in government, private and public organizations and stove promoters seeking to promote clean fuels and cookstove programs.

2.0   Theoretical framework underpinning cooking system choices

In a qualitative study, [6] propose that researchers and energy actors have failed to examine and consider the needs and priorities of end users. Further, previous qualitative studies [7,8,9] claim that technology interactions, socioeconomic factors and personal behavior influence technology adoption. However, these factors have not been widely considered in non-health programs, and this study aims to explore this knowledge gap. Similar finding were echoed in a more recent study which explored participants perceptions about and ways of dealing with air pollution [10], in addition to another study performed in Nigeria that focused on understanding the social shaping of fuel and cooking practices [5]. For instance, [5] ascertained that these households possessed limited knowledge regarding HAP. Drawing on 'human-centered' research methods [11], qualitative approaches comprising of biomass fuel users can provide useful insights into how preference and priorities are influence by culture as well as how household fuel and cookstove choices changes with circumstance. [12] concluded that an assessment of a local group selected for intervention should employed a qualitative data collection approach to obtain relevant information that reflect the daily reality faced by people, which this study adopts effectively. The study concludes that information on the pattern of cooking energy use would help policymakers align intervention with the needs of the population they served for sustainable development.

3.0   Materials and Methods

The primary qualitative data for this study is the field information obtained through ad hoc conversations, household survey and participant's interviews. Fieldwork in Benue State took place May 2022 and March 2023. Access to the study community was negotiated through the community elders who acted as gatekeepers and assisted in the purposive selection of male and female participants from different socio-economic groups and with access to a range of stove/fuel combinations [13]. The targets of the community-based research were adult men and women from different ethnic groups (see Table 1) in the three study sites that used a range of different fuel and cookstove types. In response to calls for improved understandings of the dynamics that drive household fuel and stove choices, qualitative techniques were used [14] to elicit information on local cooking practices and stove/fuel preferences. Participatory exercises were carried out with 29 (10 male, 19 female)

participants to identify fuel/stove use and preferences in the different sites with ranking exercises chosen as a means to identify where fuel and stove choice sat within broader household priorities and aspirations. Semi-structured interviews were undertaken with 3 community elders in each site to elicit information on existing cooking practices and the extent to which these have changed over time. Information on household's demographics and perceptions of existing fuels/stoves used and their features were obtained from 46 households in three different sites within Benue. The fieldwork also involved direct and participant observation of cooking activities in the three sites. Qualitative data derived from these methods was transcribed and exported into NVivo Pro 11, coded and analysed qualitatively. NVivo Pro 11 is qualitative software that has capability to assist researcher to explore different themes and can link them according to the characteristics of each study participant and area (urban, semi-urban, and rural) wherein they live and also draw out models.

Table 1: The study population

Participant	Location	Female	Male	No.	Role
Community Elders	Urban	2	1	3	Opinion Leader
	Semi-Urban	1	2	3	
	Rural	2	1	3	
Ordinary Residents	Urban	3	2	5	Local people living in the study sites
	Semi-Urban	1	1	2	
	Rural	2	1	3	
Participatory	Urban	8	5	13	Opinion Leaders/Local people
	Semi-Urban	7	3	10	
	Rural	4	2	6	
Household Survey	Urban	6	6	12	Opinion Leaders/Local people/ Custodian of culture of the people
	Semi-Urban	8	4	12	
	Rural	7	5	12	
Total				84	

The extracts from the analysis of the qualitative data were used to support explanations. The quantitative data from the household surveys were coded in Microsoft Excel 2013 and analysed using simple descriptive statistics. The secondary quantitative datasets was the results from the analysis of NDHS 2008, 2010, 2013 and 2015. The datasets are available online from the ICF international, Rockville, MD, USA, and access is restricted [1]. The datasets were analyzed using SPSS 22 with emphasis on descriptive statistics of cooking fuel use, and imported into Microsoft Excel 2013 and analyzed graphically. The results from the quantitative data (NDHS) were used to draw comparisons while the qualitative data (extracts from interviews and observations) were used to support explanations. It is important to understand that the DHS report are useful in the analysis of cooking system choices they may be an underestimation of the levels of fuel use and may not give a true representation of the pattern of use. For this reason, it was necessary to use qualitative as well as quantitative methods for data collection for

the study. This approach to the authors understanding is novel given that such investigation is undertaken in Benue State for the first time.

3.1   Sample design

The DHS program surveys aim to provide representative national, regional and state level information and usually employ a stratified two-stage design for sampling. The first stage requires an up-to-date sampling frame so a list of small administrative units with defined boundaries and known population sizes, census Enumeration Areas (EAs), are selected as the sampling frame. For most of the DHS programs, 300-500 of these EAs are selected from the sampling frame with the probability proportional to population size, and selection is by stratification. However, if the EAs (cluster) are too large, the area is further divided into smaller units of about 150-200 households during the initial stage of field enumeration. The sample can then be selected from smaller units using the procedure adopted from the first stage of sampling. It is important to note that all DHS datasets are estimated figures, representing a proportion of the entire population.

3.2   Domain use for data collection

The domain that is selected for study determines the type of survey instrument that is used. The DHS program surveys usually design model questionnaires that include all the performance indicators that are to be measured. The DHS has four types of questionnaire: household questionnaire, women's questionnaire, man's questionnaire and biomarker questionnaire. There are standardized modules for countries with special interest in other indicators such as malaria, domestic violence, or maternal mortality. The DHS household questionnaire is used to collect information on background characteristics such as household ownership, dwelling place and household eligibility for individual interview. An individual woman's and man's interview is conducted along gender lines based on the information that precedes the household questionnaire. The DHS programs collect data and are reported at regional and state level in files of different software packages such as SPSS, STAT, SAS and Flat files.

3.3   The structure of the DHS questionnaire

The DHS questionnaires emphasize basic indicators and flexibility, including eligibility for interview. Women between the ages of 15-40 are interviewed while men aged 15-59 are eligible. It is important to note that in the DHS programs, model questionnaire have changed with each phase of the DHS survey beginning in the 1990s. The household questionnaire contains two basic sets of information: the schedule and household characteristics. The former collects data on number of household and visitors, and the information is sorted by age, sex, relationship to head of household, education, parental survivorship and residence, and birth registration. The latter collects information on sources of drinking water, toilet facilities, cooking fuel, household assets, and exposure to second-hand smoke and, cooking salt tested for iodine content. The women's questionnaire contains domains such as background characteristics, age, sex, marital status, education, employment and place of residence. The questionnaire is design to elicit the demographic characteristics of respondents, and seeks information on secondary smoke like tobacco use, and health insurance and other related environmental health behavior. The men's questionnaire contains questions that are similar to the women's questionnaire but dwell entirely on men's characteristics and is shorter in context. The men's questionnaire seeks variables like background characteristics, knowledge and use of employment and gender roles.

The paper benefitted from the context of the DHS questionnaire and the omissions that were identified. The study used results from the analysis of the NDHS to compliment qualitative field based data on cooking preferences, perception of household and stove choice. The use of solid biomass such as wood and charcoal is wide spread in Nigeria. Evidence from the NDHS indicated that in the

past decade (from 2003-2013), the proportion of household in Nigeria using solid fuels as their primary source of domestic energy for cooking remains at 69 percent [15]. In the analysis of the NDHS data, emphasis was placed on variables such as household fuel, stove and kitchen type.

4.0   Results and Discussion

As indicated from the qualitative results presented in Table 2 and Figure 1, wood is the most common fuel choice, use by more than 80 percent of the households samples and may correspond to the households that reported the use of open fires for cooking; however, on average about 5 percent of these households used kerosene and charcoal. Although there is a steady decline in wood use, the difference is not significant. This finding supports studies by [3,16] that report the prevalence of wood fuel use in Nigeria. These results indicate that households in Benue State use multiple fuels on different cookstoves (Table 3) and this complicates the energy transition [17].

Table 2: Main fuel used by sample households in the study sites.

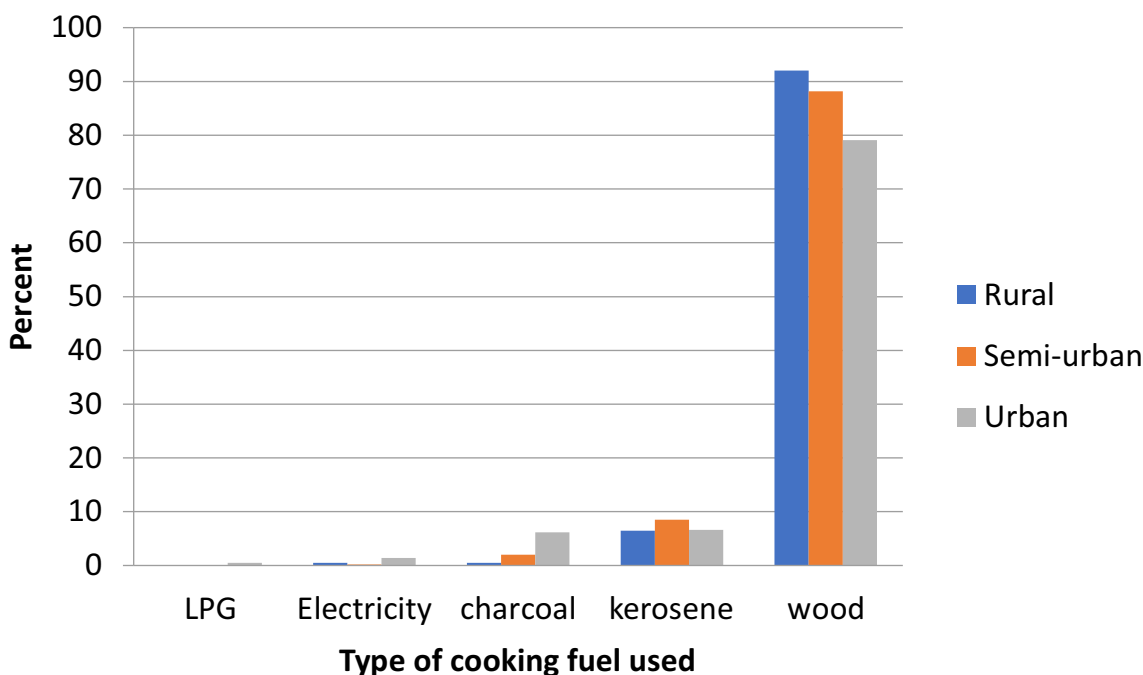| Site	LPG	Electricity	Charcoal	Kerosene	Wood
Rural (%)	0	0.5	0.5	6.5	92
Semi-urban (%)	0	0.2	2.0	8.5	88.2
Urban (%)	0.5	1.4	6.2	6.6	79.1

Figure 1: Fuel usage pattern in Benue State

As the discussion on types of cooking fuel continued, respondents made it clear that the cooking needs of households require a stack of fuel and stove combinations. This finding implies that restacking sometimes results in cleaner stove/fuel combinations but both short and longer-term 'backsliding' often lead to more polluting systems [13]. The result from the analysis of NDHS is presented in Tables 3 - 10 and shown in Figures 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 and 4.9. Figure 2 shows the fuel used by households in the North Central region. The result indicates that wood is the most popular fuel used by households, the large majority of which use open-fire stoves. It is noticed that kerosene was also used, followed by charcoal and LPG. This pattern of fuel use implies that households do not rely exclusively on wood, and highlights the use of different fuels and stoves instead of sustained use of clean fuels and efficient stoves.

Table 3: The main fuel used by households in the North Central region (NDHS)

DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	0.9	-	1.7	0.5	15.3	73.8
2010	1.1	1.4	0.1	3	18.1	75.6
2013	1.5	1.2	2.2	6.3	17.8	67.7
2015	1.2	3	1.7	9	16.9	69.7
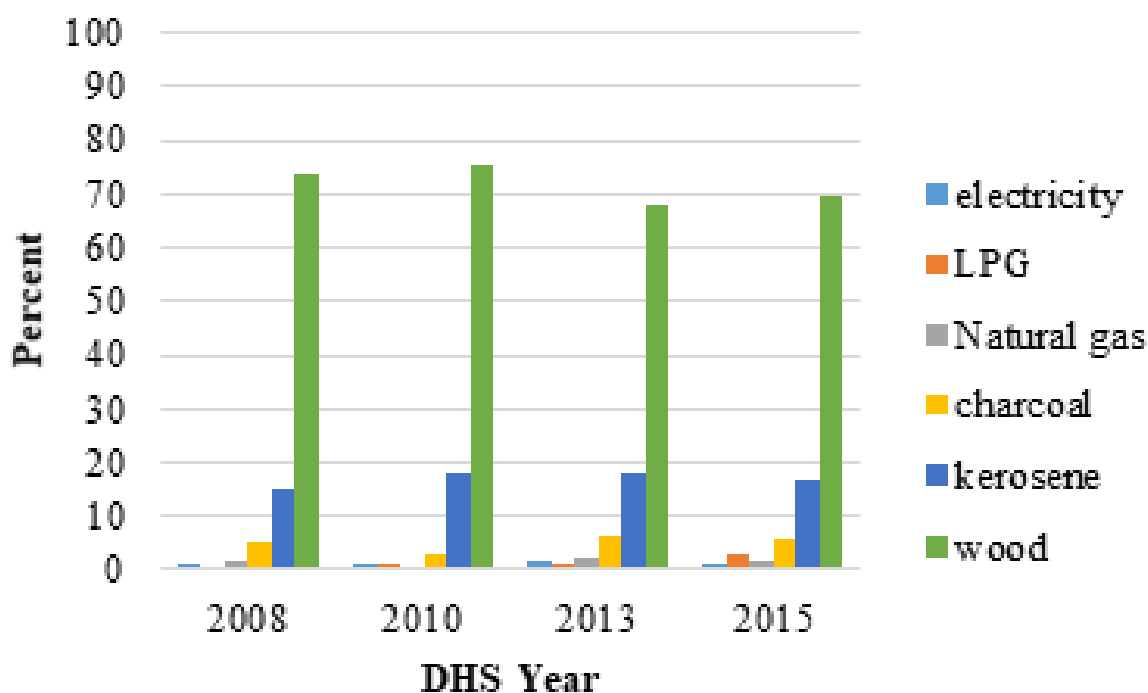
Figure 2: Fuel usage pattern in the North Central region

Figure 3 shows that wood is the most used fuel in the Northeast region, used by more than 80 percent of the households sampled. Charcoal and kerosene are also used, but not as much as wood. This finding reflects the views of many participants who responded that:

"I like firewood for …[…]…the quantity of food that I prepare in my household is done with firewood, everyone in this community knows this" Female: interview. Community Elder, Semi-Urban).

Table 4: The main fuel used by households in the North East region (NDHS)

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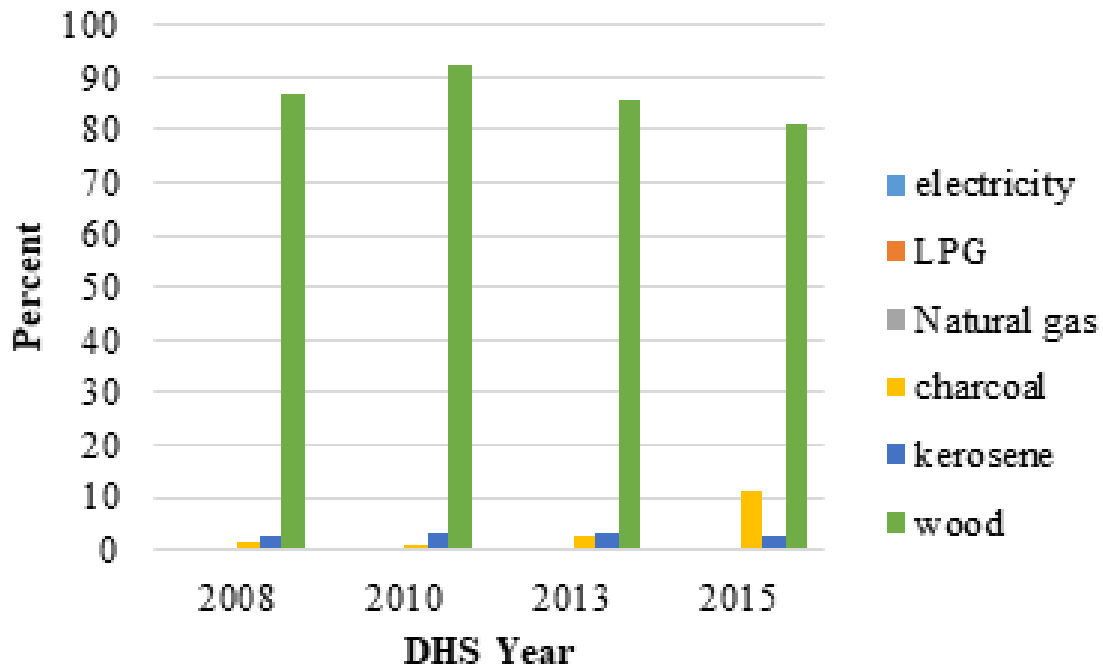| DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	-	-	-	1.5	2.5	86.7
2010	-	-	-	1.1	3.5	92.4
2013	-	-	-	3.2	2.9	85.6
2015	-	0.5	0.1	11.5	-	81.9

Figure 3: Fuel usage pattern in the North East region

Figure 4 shows the fuel used by households in North West region. The statistics are about the same as those in the North East regions. This could mean that availability and socioeconomic factors impacted the pattern of use in the two regions.

Table 5: The main fuel used by households in the North West region (NDHS)

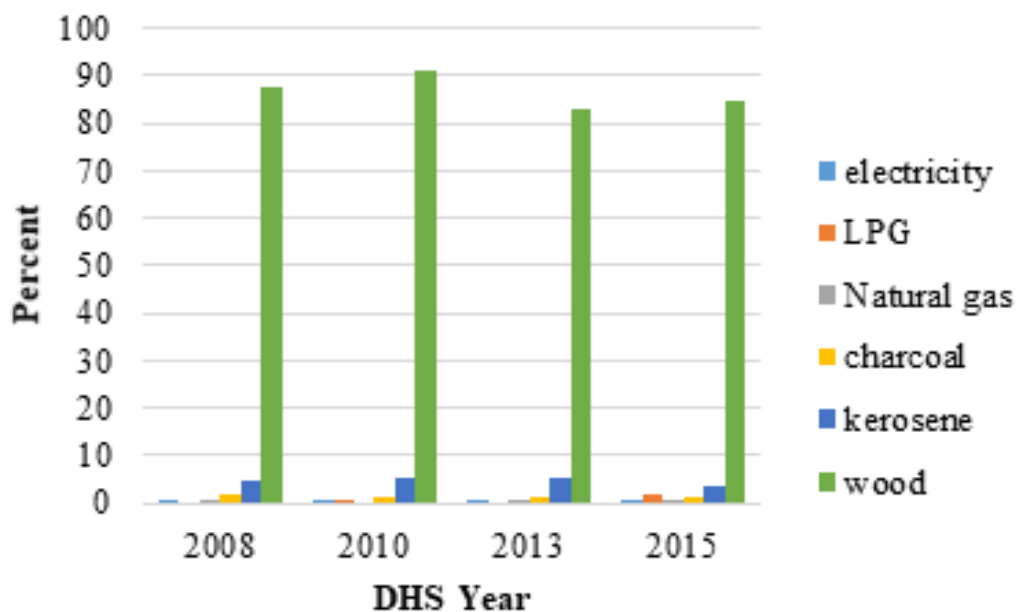| DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	-	-	-	1.5	4.9	87.4
2010	-	-	-	1	5.1	91.2
2013	-	-	-	1.2	5.4	83.2
2015	0.6	1.5	0.1	1.2	3.6	84.8

Figure 4: Fuel usage pattern in the North West region

What the fuel pattern indicates could be that either alternative fuels are rarely available or the households prefer wood for cooking. The result served to determine fuel affordability and acceptability. As a large majority of households directly depend on wood for their cooking needs, the National Energy Policy [18] developed a biomass fuel policy and strategy for implementation.

"Kerosene is sold at N2200 per litter even in urban areas, so I have resorted to firewood and forgotten about it" (Female: Household Survey, Ordinary Resident, Semi-Urban)

"I can't remember the last time I saw the fuel [kerosene]…..these people [the government] are not sincere. I use firewood to cook, and my daughter uses charcoal" (Female: Household Survey, Ordinary Resident, Rural)

The fact that electricity is subsidized [19], but only a small percentage of households used it for cooking reflects the impact of the fuel policy in Northern regions indicating that the fuel has different cycles of availability. In southern regions, households do not rely on wood as do households in Northern regions. Figure 5 shows the type of cooking fuel used in the South East region. It can be seen that households use kerosene alongside wood. Kerosene use remains stable between the DHS surveys indicating that additional factors, aside from availability influence kerosene use.

Table 6: The main fuel used by households in the South East region (NDHS)

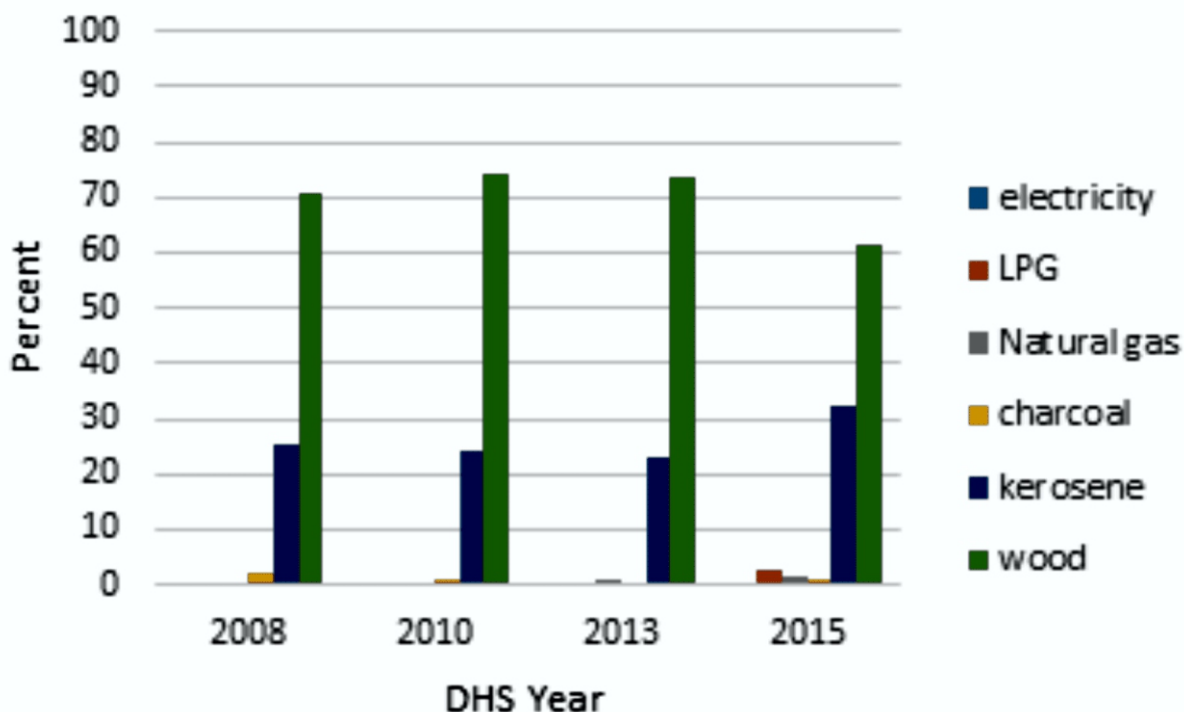| DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	-	-	-	2.3	25.2	71
2010	-	-	-	0.9	24.2	74.2
2013	-	-	1.2	0.5	23.2	73.8
2015	-	1.5	-	.8	32.3	61.7

Figure 5:Fuel usage pattern in the South East region

Figure 6 shows fuel used in the South-South region with households showing equal preference for kerosene and wood. This is interesting due to the fact that kerosene use is stable despite the high-cost experience with its use over time, and a small percentage of households use LPG.

Table 7: The main fuel used by households in the South-South region (NDHS)

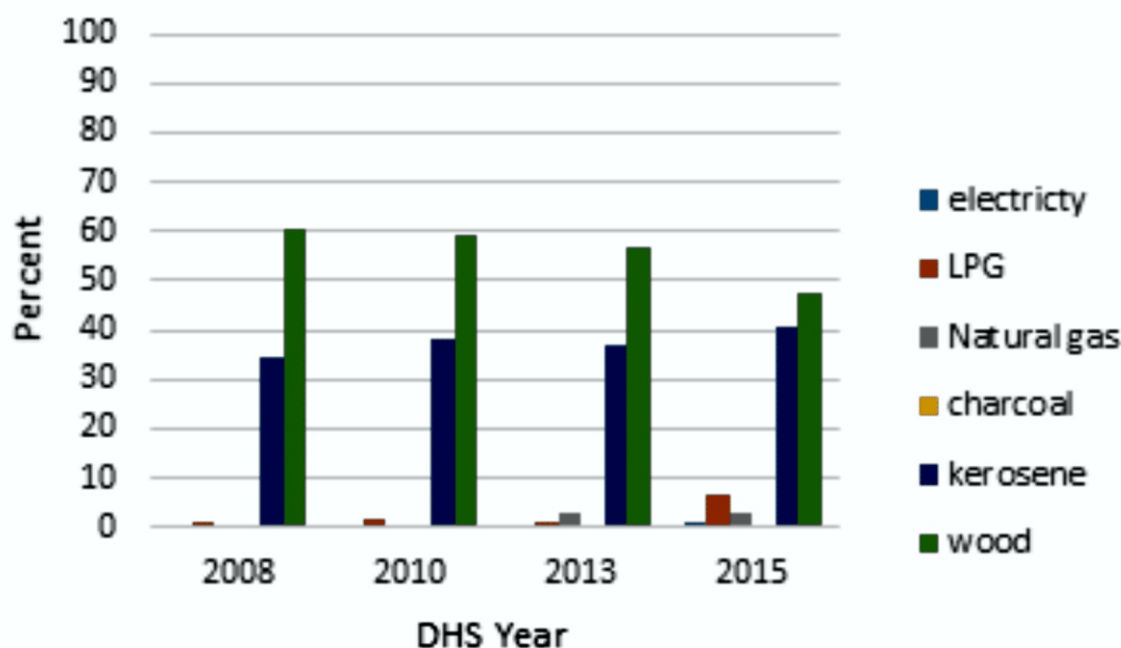| DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	-	1.1	0.7	2.3	-	60.3
2010	-	1.8	-	0.3	38.4	58.9
2013	-	1.2	2.7	0.5	37.2	56.9
2015	0.9	6.8	2.9	-	40.7	47.6

Figure 6:Fuel usage pattern in the South-South region

This finding echoes a qualitative study by [20] indicating that urban households in Edo State made use of LPG stoves although households are not aware of the benefits of using clean fuel. The use of LPG was more noticeable in Southern regions unlike households in other regions where the majority of households expressed concerns that:

"….[..]…For gas stoves, I am always afraid of using it. I just have a feeling that the cylinder might explode anytime soon" (Female, Household Survey, Urban)

"We do not use it [a gas stove] again because of what we have experienced [..]" (Female, Interview, Community Elder, Semi-Urban)

The safety concern expressed by respondents in the Northern regions above coupled with awareness of LPG as cooking fuel could be the reason why LPG is not widely used in the region. Figure 7 illustrates the fuel used in the South West region where there is a clear preference for kerosene, used by more than half of the sampled population. The use of kerosene is stable suggesting that it was available and affordable from 2008-2015, although households still rely quite strongly on wood and charcoal, some use LPG and natural gas. This finding suggests that the households had alternative fuel however; cooking with electricity was rarely reported.

Table 8: The main fuel used by households in the South West region (NDHS)

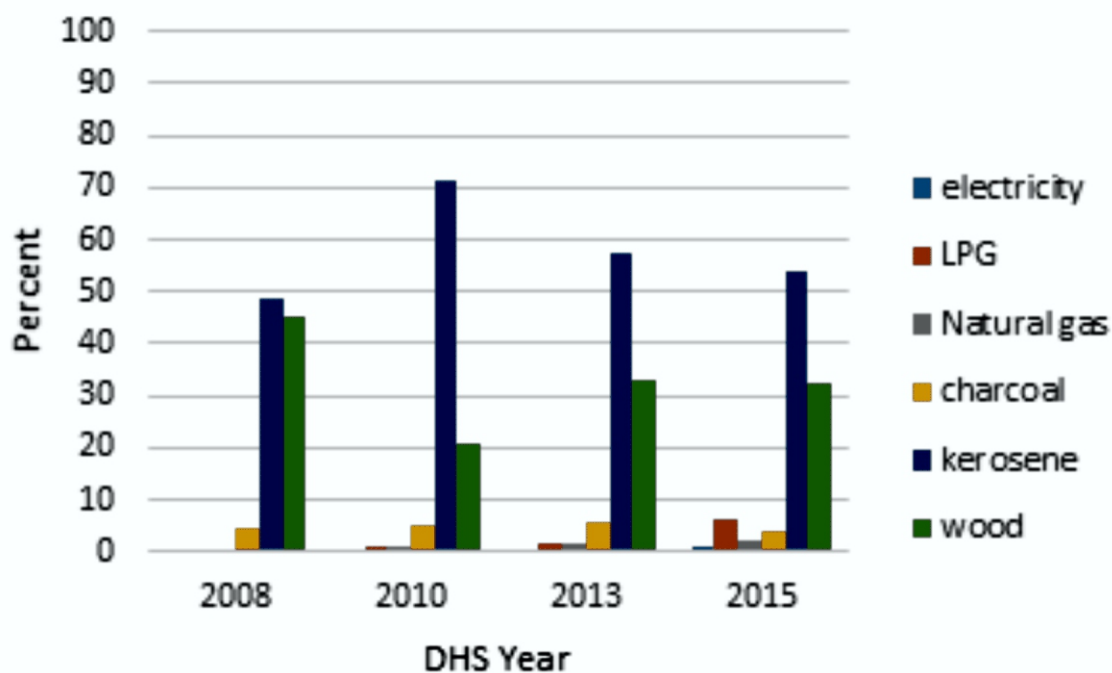| DHS Year	Electricity (%)	LPG (%)	Natural gas (%)	Charcoal (%)	Kerosene (%)	Wood (%)
2008	-	-	-	4.2	48.9	45.4
2010	-	0.9	1	5.3	71.6	20.9
2013	-	1.7	1.5	5.8	57.5	33
2015	1	6.4	-	3.9	53.7	32.6

Figure 7:Fuel usage pattern in the South West region

The result from the analysis shows that electricity was rarely used by households, even though it is subsidized. Instead, many of the households used wood and open fires for cooking. The households also used kerosene, charcoal, LPG, and natural gas, however, they do not use these fuels as much as they use wood. It is interesting to note that kerosene use was indeed stable in Southern regions; this suggests that the fuel was available and affordable by the households during the period of the survey. There are limited studies on household stove use and information on kitchen location by region in Nigeria. This comparative analysis shows the households that used different stoves in Benue (See Table 9 and Figure 8) and regions in Nigeria.

Table 9: Stoves used by households in the study sites

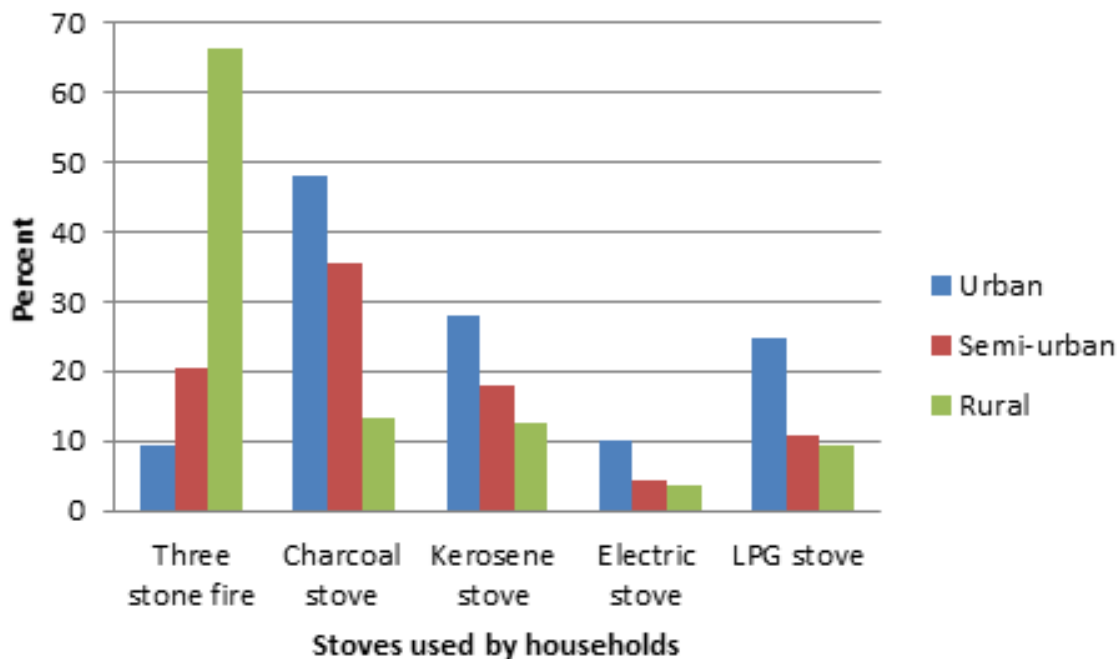| Stove	Urban (%)	Semi-urban (%)	Rural (%)
Three stone fire	9.42	20.4	66.2
Charcoal stove	48.2	35.4	13.4

Figure 8: Stoves used in the sample households

Table 10: Type of stoves used by households in the six-geopolitical regions (NDHS)

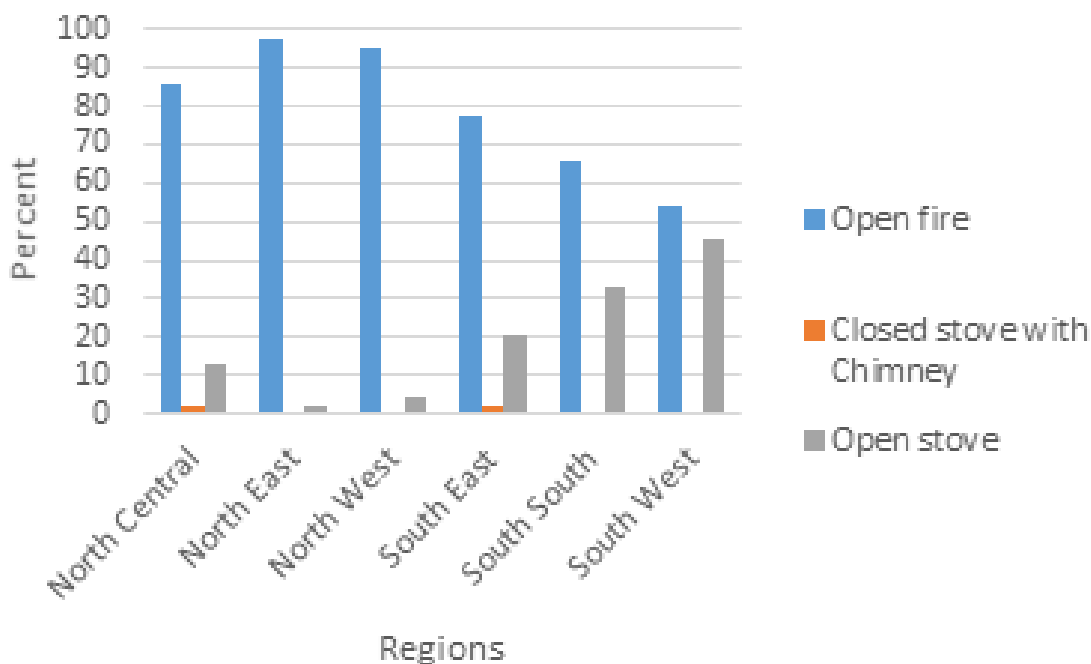|	Open fire (%)	Close stove with chimney (%)	Open stove (%)
North Central	85.6	1.7	12.7
North East	97.7	0.1	2.2
North West	95.2	0.3	4.4
South East	77.3	2.1	20.5
South South	66	0.9	33
South West	54.2	0.2	45.6

Figure 9:Household stove ownership by region

There is a clear preference for open fires for cooking in Benue State as Figure 8 depicts, this reflects the information in Figure 9 wherein the North East and the North West regions, are used by more than 80 percent of the households however these figures appear different in Southern regions. The number of households that used open stoves in Northern regions is more than the percentage that used closed stoves with chimneys in Southern regions.

5.0 Conclusion

There are many barriers to energy transition especially where government energy policies and service providers overlook clean fuel and efficient stove use as important indicators for sustainable development. The study identified the pattern of fuel use by households in Benue State and potential for multiple fuels and stove ownership. Findings from this study highlight the decision that guide cooking choices with biomass-reliant population. In particular, the study illustrates how end-uses stack fuels/stoves in order to reduce the risk associated with their cooking needs (fuel cost, availability/affordability). It would be useful to track, monitor and evaluate the components of household fuel and stove stacks as well as more linear shifts between the main fuels and stoves used. This would enable better insights to be gained on how the components of stove and fuel stacks vary in different settings and over shorter as well as longer time periods. The use of electricity for cooking was not widespread as expected and could be linked to supply and distribution consideration and the weak energy infrastructure in Nigeria. The explanation suggests that households have LPG safety concerns and awareness on the use of LPG stoves. It is important to note that for sustainable use of clean fuel/stove, the government should employ a wider awareness campaign on the promotion of LPG stove safety, and also improve on electricity generation and distribution to encourage its use as cooking fuel.

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