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EXPLORING THE DRIVERS FOR HOUSEHOLD COOKING ENERGY TRANSITION IN GOMBE METROPOLIS, NIGERIA

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ABSTRACT

Transition to sustainable energy in the household sector is a one-way solution to significantly reducing the contending problem of forest exploitation on one hand and on the other hand an important effort to minimizing the challenging subject of climate change. This study aimed at exploring the drivers for household cooking energy transition in Gombe metropolis with a view to providing detailed information on the transition pathways in the area for policy implications. The study used quantitative research method with structured questionnaire as the instrument for data collection, while secondary data was obtained from the Gombe State Bureau of Statistics. For data collection, systematic sampling strategy was used to select sampling locations and the households to be administered the questionnaire. The quantitative data was analysed using descriptive statistics and multinomial logistic regression analysis. Result from descriptive analysis revealed that household size (69.5%), households' level of income (65.5%) and public influence (65.5%) were the major factors influencing modern energy choice in the study area on one hand and on the hand environmental consequences (35.8%), health risks (34%) and seasonal changes (49.5%) has no significant influence on household modern energy choice for cooking. Multinomial logistic regression analysis showed the likelihood of respondent's socio-demographics and modern energy adoption (p-value <0.05). The study recommends conducting public awareness campaigns on the benefits of modern energy services for cooking through media and public gatherings. It also suggests providing adequate access to affordable modern energy to encourage households to adopt and shift to modern energy consumption for cooking.

Keywords: Energy, Energy Transition, Household, Gombe Metropolis, Climate Change

INTRODUCTION

Consumption of hydrocarbon-based energy and climate change are among the foremost environmental problems of the twenty-first century and have become subjects of considerable debate. Global energy production and consumption have been issues of public and environmental concern today as they are associated with the emissions of greenhouse gases resulting majorly from the combustion of fossil fuels such as oil, natural gas, and coal leading to global warming and climate change (Intergovernmental Panel on Climate Change [IPCC], 2007). Climate change is primarily caused by energy consumption. Therefore, a sustainable energy transition can have a significant impact on achieving the objective of climate change mitigation (Adom, 2015; Adom and Adams, 2018).

Globally, more significantly in developing part of the world, the household consumes majority of the energy produced (Kayode, 2016; Shi et al., 2019). Africa has inadequate access to modern energy systems, the majority of the population depends largely on fossil fuel and other forms of hydrocarbon-related energy sources for domestic and commercial use (Okpara, 2020). The continent has become increasingly influential in shaping global energy trends owing to its growing urban population which resulted in rapid growth in energy demand for domestic, commercial, and industrial activities and mobility (IEA, 2019).

Roughly around 3 billion individuals in developing part of the world, particularly in rural regions depends largely on solid forms of fuels to meet their basic energy requirements (WHO, 2018). This is alarming given that this incidence affects the majority of the global population. The sub-Saharan African region suffer more from global energy poverty; only one in every three individuals is connected to an energy source in its reliable, clean and affordable form (Bode et al., 2020). Energy poverty is a circumstance where a household can hardly meet the minimum energy required to guarantee its basic needs (Karakara, 2018). More so, Li et al (2020) defined energy poverty as the inability to access cleaner energy services by households. Therefore, in order to address the problem of climate change and reduce energy poverty in Africa, sustainable energy transition is required.

The National Bureau of Statistics (NBS) (2020) revealed that the majority of Nigerian households depended solely on hydrocarbon-based fuels to satisfy their domestic requirements. These statistics were further validated by the International Energy Agency in 2019, which revealed that 76% of Nigerian households consumed energy largely from unsustainable sources to meet their domestic needs. Household cooking alone accounts for approximately 91% of the total domestic energy consumption. Household energy consumption refers to the total amount of energy used for domestic activities (Danlami et al., 2015).

Gombe state consumed 95.9% of hydrocarbon-based fuels with fuelwood and charcoal constituting 65.8% and 30.1% respectively of the energy mix while 4.1% utilized energy from modern energy sources like liquefied petroleum gas and electricity as well as renewable energies such as solar photovoltaic for domestic, commercial, and other households needs (NBS, 2020). This highlights the task before policymakers in the country to ensure access to efficient sources of energy before the cessation of the United Nations' Sustainable Development Goals by 2030 (Buba et al., 2017). Households in developing countries' such as Nigeria are confronted with various obstacles in changing their patterns of energy consumption and transition to sustainable energy sources (Okpara, 2020). The aim of this study was to investigate the factors driving the transition process of cooking energy to a more sustainable energy by the households in Gombe metropolis. The study provides detailed information on the transition pathways in the area to inform policy decisions.

MATERIAL AND METHOD

Study Area

Gombe State is in the Centre of the North-East geographical zone of Nigeria. It shares common boundaries with Adamawa and Taraba States to the south, Bauchi State to the west, Borno State to the east, and Yobe State to the north. It lies between Latitudes 10^{0}0'0"N to 11^{0}0'0"N and between Longitudes 11^{0}0'0"E to 12^{0}0'0"E, with a total landmass of about 20,265 square kilometres (Hamisu, 2013).

The city of Gombe is the capital city of the State, located on Latitude 10^{0}17'30"N to11^{0}7'30"E (see figure 1). It is the administrative headquarter of Gombe L.G.A with an area of 52 km² and a population of 268,000 according to the 2006 population and housing census. The city is also the headquarters of the Gombe Emirate, a traditional state that covers most of Gombe State (Geohack, 2014).

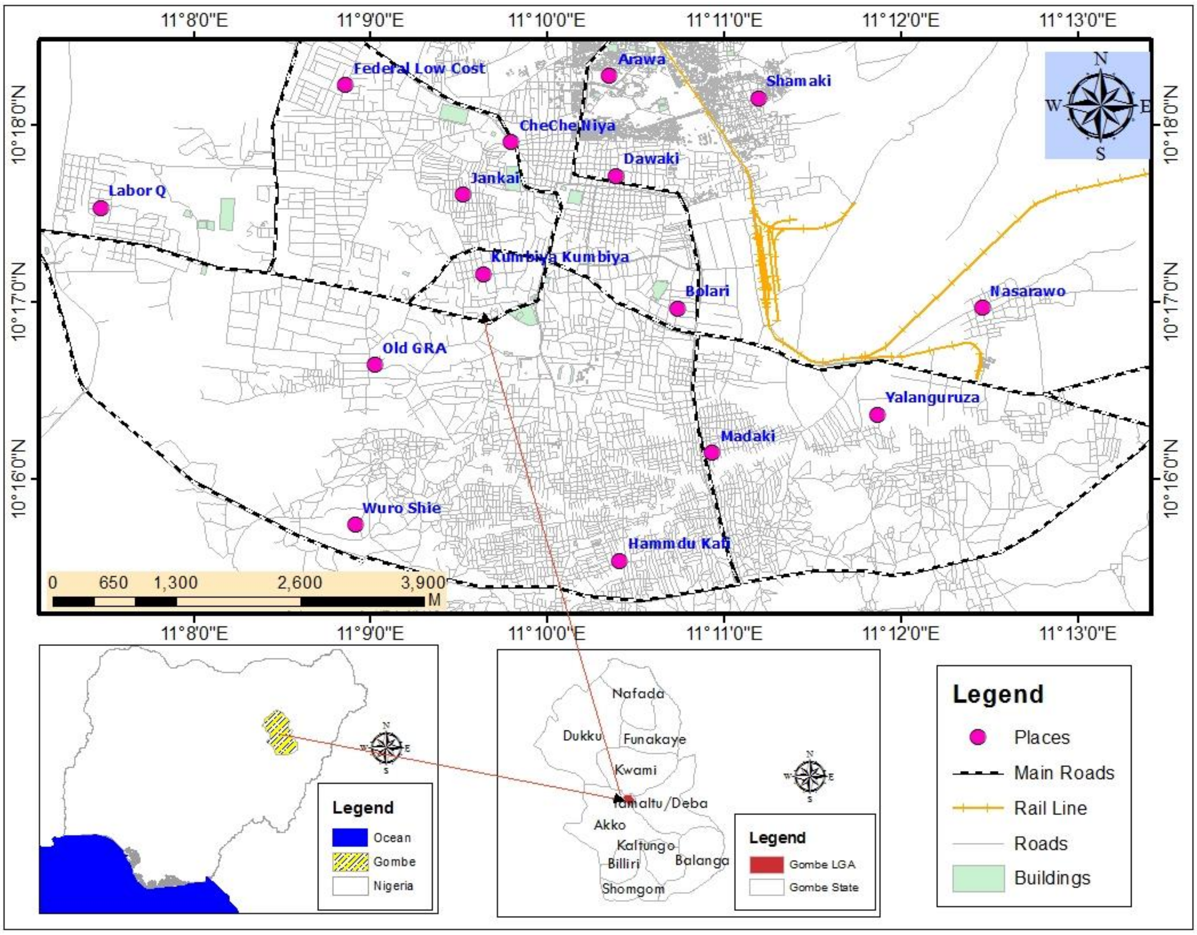

Figure 1: Map of Gombe Metropolis Showing Sampling Locations
Source: Modified from administrative Map of Gombe State (2021)

Methodology

Procedure for sampling

This study partly adopted the method used by Kiyawa and Yakubu (2017) in categorizing the study area into different residential zones based on the socio-economic status of the households. These divisions are still believed to persist, although with a few are changes taking place over time. For instance, in Gombe Metropolis, Federal low cost and G.R.A, formerly residential areas of expatriates, are now dominated by businessmen and other elites, but still retain their features as zones of high-income earners. Other areas such as State low cost and Yalanguruza are classified as middle-income earners areas. Furthermore, areas such as Pantami, Tudun-Wada, and Jekadafari are classified as areas of low-income earners. Households for this study were selected systematically across the study area (see Table 1).

Table 1: Selected Residential Clusters

S/N	High income earners	Middle income earners	Low-income earners	Total Number of Residential Zones
1	Federal Low Cost	Dawaki	Arawa	3
2	Labor Quarters	Hammadu Kafi	Bolari	3
3	Old GRA	Yalanguruza	Checheniya	3
4			Jankai	1

5			Kumbiya-Kumbiya	1
6			Madaki	1
7			Nasarawo	1
8			Shamaki	1
9			Wuro Shie	1
Total	**3**	**3**	**9**	**15**

Source: Author's Computation, 2021

The households were picked systematically and thereafter, the sampled households were selected using a proportionate ratio of 1:1:2 with an interval of 7 households in the high-density area (due to a large number of households) and 4 in moderate and low-density areas. With this, a total of 400 households was sampled.

For every household, the head was selected for questionnaire administration due to the tradition of the Hausa/Fulani land, where housewives are prohibited from contact with strangers. However, when the household head was not available, a male family representative was chosen. In addition, in a situation where a single residential building contains multiple households, one of them is chosen conveniently. The number of households in each residential cluster was determined using a proportionate ratio by dividing the number of residential areas in each cluster by the total number of residential areas in all clusters, and multiplying by the sample size. Similarly, the number of households that completed the questionnaire in each residential area within each cluster was determined using a proportionate ratio. Table 2 shows the number of households in each residential area within each cluster that were administered the questionnaire. In summary, the selected residential zones are shown on a map (see Figure 1).

Data used and sources

For this research, primary and secondary sources of data was utilized from different sources. Table 2 lists the types and sources of data required.

Table 2: Data Used for the Study and Sources

Data Used	Sources of Data
Socioeconomic characteristics of the households	Questionnaire
The population of the Study Area	National Population Commission
Current household energy sources	Gombe State Buarea of Statistics and Questionnaire

Source: Author's Computation, 2021

Procedure for data collection

The structured questionnaire was directly administered to the respondents using Kobo Collect mobile application because of its accuracy and reliability. Questions on the household energy type and household socio-economic and demographic factors such as household size, occupation, income, level of education of the household head, and that of the wife was the main content of the questionnaire. Also, focus group discussion and key informant interview was conducted to enable the researcher to have deeper insight on the phenomenon in question.

Computer-Assisted Personal Interview (CAPI Software): Kobo Collect mobile application was used during the questionnaire administration to the selected households. Computer-assisted interview (KoboCollect) data collector tool is a computer-oriented software used for field survey where a well-structured questionnaire is coded into the software in which questions are read from the android device, and that responses are entered directly into the device by the questionnaire administrator. Thereafter, the data was generated directly from the server immediately after the interview in an XLS format ready for analysis. The major advantage of using Kobo Collect mobile application in data collection over the traditional paper and pen method includes more data accuracy, quality, and reliability, and also time and cost-effectiveness (Randolph, Virnes, Jormanainen, and Eronen, 2006); Mao et al. (2018) and Samantara and Ratha (2020). The questionnaire admistration was carried out with the aid of research assitants for about one week around the study area.

RESULTS AND DISCUSSION

Factors Influencing Household Energy Transition

This section presents the factors influencing energy transition in the study area.

Knowledge of the Factors Determining Modern Energy Choice

Table 3 present the respondents knowledge on the factors determining modern energy choice.

Table 3: Knowledge of the Factors Determining Modern Energy Choice

Knowledge of the factors determining modern energy choice	Yes (%)	No (%)
Does your household size affect your modern energy choice?	69.5	30.5
Does level of income influence your modern energy choice?	65.5	34.5
Does media/public influence your adoption of modern energy?	65.5	34.5
Do environmental consequences influence your choice of moder energy?	35.8	64.3
Does human health risk influence your choice of modern energy?	34.0	66.0
Does seasonal changes influence your choice of modern for cooking energy?	49.5	50.5

Source: Field Survey, 2021

Table 3 shows the distribution of respondent's responses on the effects of household size on modern energy choice. Majority of the respondents were on the view that household size influences their choice for moder energy services for cooking accounting for 69.5% while some respondents (30.5%) claimed that household has no influence on their choices of energy for cooking. This shows that the size of the household determines the type of energy to be consumed by the household particularly when dealing with energy switching. Similar findings have been found by Mensah and Adu (2013) in Ghana who revealed that household size influences energy choice. Table 3 further revealed that majority of the respondents claimed that level of income influence household energy choice constituting for 65.5% however, some respondents were on the view that income has no influence on household energy choice accounting for 34.5%. This implies that economic wellbeing of households has great influence on energy choice more significantly the modern systems for cooking energy. This findings is consistent with that of Zhang et al. (2020) found that household income have significant influence on modern energy choice in China.

Result further shows that majority of the respondents claimed that their choices of modern energy was influenced by media/public constituting for 65.5% while 34.5% of the respondents argued that they were not influence by neither the media no the public to adopt modern energy systems for cooking. Table shows that lesser number of the respondents considered the impact of energy consumption on their immediate environment before choosing the type of energy to be used for cooking constituting 35.8% while 64.3% of the respondents choose energy for cooking without considering its environmental impact. This implies that majority of the respondents in the area choose fuel for cooking without given attention to environmental issues that will result from using such energy.

Table 3 shows that smaller number (34%) of the respondents claimed that they were influenced by the health risk associated with traditional fuels to adopt modern energy such as LPG for domestic cooking while majority (66%) of the respondents argued that they were not influence by health-related issues associated with the consumption of hydrocarbon-based fuels to adopt modern systems of energy for cooking. Table 3 indicated that majority of the respondents claimed that seasonal change affects the choice of energy used for cooking constituting for 50.5% however, some respondents argued that seasonal change does not affect their choice of energy accounting for 49.5%.

Modern energy choice and households' socio-demographics

Socio-demographic characteristics of households help in determining energy choices for cooking particularly when dealing with sustainable energy transition to modern forms of energy. Table 4 shows the distribution of the factors enhancing energy choice.

Table 4: Multinomial Logit Regression Analysis for LPG, Electricity, Kerosene and Firewood Consumption as Compared to Charcoal

Variable Name	LPG			Electricity			Kerosene			Firewood		
	Estimated Coefficient	p-value	Odds Ratio	Estimated Coefficient	p-value	Odds Ratio	Estimated Coefficient	p-value	Odds Ratio	Estimated Coefficient	p-value	Odds Ratio
Constant	1.173 (1.640)	0.475	-	-6.469 (5.344)	0.226	-	-16.796 (7036.256)	0.998	-	3.503 (1.369)	0.010*	-
Sex (Household Head)	0.077 (0.042)	0.865	1.080	0.764 (1.138)	0.566	2.147	-16.081 (7056.256)	0.998	1.038	0.057 (0381)	0.882	0.502
Age	-0.888 (0.227)	0.000*	0.412	-0.014 (0.729)	0.984	0.986	-0.918 (1.072)	0.392	0.399	-0.485 (0.178)	0.007*	0.434
Marital Status	-0.091 (0.317)	0.774	0.913	0.146 (1.013)	0.885	1.157	15.117 (0.000)	0.921	3676572.695	0.009 (0.251)	0.972	0.617
Level of Education	0.671 (0.195)	0.001*	1.957	0.409 (0.562)	0.467	1.505	0.643 (0.438)	0.439	1.903	0.336 (0.147)	0.022*	1.050
Occupation	-0.201 (0.094)	0.033*	0.818	0.018 (0.254)	0.944	1.018	0.502 (0.438)	0.252	1.651	0.064 (0.068)	0.345	0.933
Average monthly income (Household Head)	0.279 (0.143)	0.050*	1.322	0.133 (0.448)	0.766	1.143	-0.530 (0.954)	0.578	0.589	0.428 (0.124)	0.001*	0.511
Religion	-0.169 (0.429)	0.692	0.845	0.167 (1.312)	0.889	1.182	-16.092 (4702.764)	0.997	1.027	-0.867 (0.427)	0.042*	0.182
Household Size	-0.393 (0.186)	0.035*	0.675	0.432 (0.628)	0.491	1.540	-0.761 (0.957)	0.467	0.467	-0.017 (0.157)	0.912	0.722
Home ownership	-0.067 (0.380)	0.860	0.935	-0.281 (1.301)	0.829	0.755	-0.678 (1.559)	0.664	0.508	-0.215 (0.336)	0.521	0.418

$^*p<0.05$

Model Fitting information (chi-square) =188.286, with p=0.000. McFadden pseudo-R^2 = 0.212.

Source: Result from the multinomial logit regression.

Note: Reference category is Charcoal. Standard errors are in parentheses.

The results of the multinomial logit analysis comparing household fuel choices are presented in Table 4. The analysis compared LPG, electricity, kerosene, and firewood with charcoal. The study expected the sex of respondents to be a significant factor in determining fuel choice. The results revealed that sex had a negative estimated coefficient for kerosene and a positive estimated coefficient for LPG, electricity, and fuelwood. However, the analysis did not find the results significant at the 5% confidence level. The table indicates that age is a significant factor in determining household fuel choices. An increase in the age of the respondent household was expected to make a household less likely to switch from charcoal. However, the results showed that age had a negative estimated coefficient for LPG, electricity, kerosene, and fuelwood, but it was not significant at the 5% confidence level. The effect of age may become clearer only at older ages because most of the respondents were young people. The estimated coefficients of marital status of the respondents were not significant, and they were negative for LPG and positive for electricity, kerosene, and fuelwood. On the other hand, the positive and statistically significant coefficients of the education status of the respondent and the spouse of the respondent for LPG and fuelwood in the regression indicate that, with everything else held constant, the respondent having more education is more likely to switch over to modern energy alternatives. This conforms with the theoretical expectation that as households gain more education, they demand more modern energy alternatives because education improves their knowledge of fuel attributes, taste, and preference for better fuels. For a unit addition in level of education, the odds of education adoption probability of LPG increased by 95.5% (1.957-1.0= 0.957), while the odds of LPG adoption probability dropped by 5.0% (1.050-1.0= 0.05). The negative estimated coefficient for LPG and positive estimated coefficients for electricity, kerosene, and fuelwood of the occupation respondents agree with the theoretical expectation that respondents employed in white-collar jobs are more likely to use modern energy alternatives. However, the estimated coefficients of the average monthly income of the respondent households are positively significant for LPG and fuelwood and not significant for electricity and kerosene, indicating that with everything else held constant, the respondent with a higher income is more likely to switch over to modern fuel. This coincides with the theoretical expectation that, as household income increases, household demand for these fuel alternatives will increase. Household size has negative and statistically significant coefficients only for LPG with positive and not statistically significant coefficients, indicating a decrease in the likelihood that these fuel types would be used by households with more members. For an additional unit of household size, the odds of a household's adoption probability of kerosene decreased by 32.5% (0.675-1.0= -0.325), other things being equal. This conforms to the prior expectation that larger households would prefer to use firewood because it is comparatively easier to use than charcoal to cook for many people.

Home ownership has negative and not statistically significant coefficients for LPG, electricity, kerosene, and fuelwood, indicating a decrease in the likelihood that these fuel alternatives would be used by households who own dwelling units. This concurs with the theoretical expectation that a household head who owns permanent accommodation would prefer to use charcoal since the household often shares a dwelling with a large family member and is in charge of the management of the space of his dwelling (mainly for storing wood energy). As previously noted, large households have a high rate of charcoal utilization. In addition, this contrasts the hypothetical expectation that if a household dwells in a modern house, it is most likely to use LPG and charcoal alternatives. One possible explanation is that a household may have maintained a certain societal lifestyle of using charcoal and had an outdoor cooking place built to accommodate the requirement of charcoal use so that smoke does not pollute the main dwelling house. The present result is in agreement with that of Danlami (2017), who used multinomial logit regression to analysed household energy choice in Bauchi and revealed that higher income, higher education level, and location in urban areas have positive impacts on the probability of adopting cleaner sources of cooking fuel such as LPG. Similarly, the present result is consistent with that of Adeyemi and Adereleye (2017), who also used multinomial logit in their study and revealed that household income, level of education, household size, and occupation of the respondent were significant factors influencing fuel choice in Ondo State, Nigeria.

CONCLUSION

The study concluded that the major factors that influence energy transition are income, household size, environmental consequence, human health risk on energy choice and media thus, energy transition is an indispensable phenomenon in this era due to its significance in tackling major global environmental challenges of climate change, desertification, deforestation. Furthermore, socio-demographic characteristics of the households played a crucial role in determining the type of energy to be used for cooking. The household sector consumes nearly one-third of the worldwide primary energy demand and significantly affects the environment and human health. Access to sustainable, dependable, and inexpensive modern energy services has long been regarded as a point of human development. The majority of Nigeria's population has limited access to modern energy services and, as a result, suffers from various negative consequences. Therefore, moving away from hydrocarbon energy sources to eco-friendly sources is a panacea that addresses global environmental problems that are currently threatening humanity.

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