Comparative Analysis of Household Energy Consumption in Ibadan Region; A Spatio-quantitative Approach

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ABSTRACT

Understanding locational variations in household energy consumption is critical to ascertaining dichotomies of energy use, need and wellbeing. In recognition of this, the study compares quantities of household energy consumption among urban, peri-urban and rural areas in Ibadan region, Nigeria using Net Heating Value (NHV). It employs a stratified random sampling of 166 households across the three zones. Results show that electricity, majorly used for appliances is dominant in the urban in contrast to fuelwood at the peri-urban and rural areas where cooking is the major end use. Though the quantities of total household energy consumption do not vary significantly at $p < .05$, electricity consumption is however significantly higher in urban households than in peri-urban and rural households. The Multiple Regression Analysis (MRA) and Analysis of Variance (ANOVA) indicate that socioeconomic characteristics significantly influenced quantity of household energy consumption at the urban area only. Major variations between locations appear to be in energy types and end uses rather than quantity consumed.

Key words: household; energy consumption; spatio-quantitative; net heating value, urban, peri-urban, rural

1 Introduction

The Ibadan region is located near the forest-grassland boundary of south western Nigeria. The region lies between latitude $7^{\circ}18'$ and $7^{\circ}34'$ North of the equator and between longitude $3^{\circ}49'$ and $3^{\circ}59'$ East of the Greenwich (Figure 1). The region consists of the city of Ibadan and its immediate suburban districts. The city-serving non-basic activities which are concerned with meeting the needs of the city population take place within this area, which is sometimes referred to as the Ibadan Metropolitan district as depicted in Figure 1 [1]. Ibadan region has a population of about 2,615,000 [2] half of which lives in Ibadan city, and is characterized as the territory which looks to the city of Ibadan as the center for its cultural, administrative and commercial activities. The newer low to medium quality, medium density residential districts comprise the newer eastern and western suburbs as well as the post 1952 suburbs while the high quality, low density residential districts comprise housing estates and other government and private layouts. These three residential districts are quite distinct from one another but there is an element of homogeneity within each district in terms of population density, housing density, housing quality, and the general neighborhood conditions [3].

The peri-urban area represents extension of Ibadan city along its fringe, thus, are found along the edges of Ibadan city. Little studies have been carried out in this area which provides information on its true description, coverage and nature of activities within the area. However, by observation it is evident that the area is mainly

used for residential purposes and urban agriculture. Commercial and industrial activities are few. Category of income group here ranges from high through medium to low. Many inhabitants are those who have seized the opportunity of relatively cheap price of land and house rent in the area.

Agriculture dominates in rural suburbs of Ibadan city followed by residential and commercial uses. This area does not possess a distinct functional division of residential areas along spatial scales as we have in the city due to the homogeneity of rural environments. Relatively, it is essentially made up of low and medium income earners.

Figure 1: Ibadan Metropolis

Ibadan region is connected to the national grid from which it derives its electricity supply and it is regulated by the Ibadan Electricity Distribution Company (IEDC). As at the time of this study, no known independent power project exist but there are plans towards establishing such infrastructures. Although commercial fuels are available in most parts of the region, the price however varies, usually increasing with increasing distance away from the city while opposite is the case with respect to traditional fuels (biomass).

Energy is essential to all human activities and, indeed is critical to social and economic development. Energy is only one of the many important inputs for production, conversion, processing and commercialization in all sectors. It is generally recognized that energy, plays a significant role in the economic development of a country as it enhances the productivity of the nation. In addition, the increased consumption is an indication of increase in economic activities, and by inference, an improvement in economic development of energy signifies that a country has high economic ranking [4].

In Geography, it is believed that ‘everything is related to everything else, but nearer things are more related than distant things’ [5]. This suggests that similar people tend to live near each other, therefore, within residential areas, a level of homogeneity and heterogeneity is created which could translate to consumption zones. Although in each zone created, intra-zone variation will exist, however, it is expected that there will be more similarities than dissimilarities allowing for a useful generalization.

According to the Marxian school of thought, the consumption of households within a developed capitalist society is more a reflection of the specific characteristics of such a society, than it is of the specific characteristic of the household consuming within it. Therefore, individual preferences merely adapt to choices made available [6]. Class structure, division of labour and specialization of functions, authority relations, class consciousness and ideology in capitalist society all work to create and sustain distinctive consumption classes which transforms into spatial scales. This implies that in capitalist economies (including partial capitalist economies like Nigeria) accessibility, influenced by availability and affordability, is a crucial determinant of household energy consumption and it also constrains preferences of the households. For instance, much needed commercial fuels in the rural areas are usually unavailable due to low economic viability and difficult accessibility which discourages the much-needed investment of required energy infrastructure while opposite is the case in the urban areas. As a result of this constraint, such rural communities turn to alternatives such as fuelwood, bringing about spatial variability in household energy consumption.

Household size often has a great or greater effect on energy consumption as other major variables such as income [7]. In some countries, household size is strongly associated with income; on average, large families tend to have more income earners, while high income household may attract family relatives.

Other important variables of household energy consumption from previous studies [7] [8] include number of rooms (indicating floor size), type of living house (differentiating single and multi-household buildings), level of education of household head, climate conditions and cultural practices. Several surveys have been carried out in Nigeria that focused on various issues concerning household energy consumption pattern. Some of these studies concentrated on general consumption patterns [9 - 27] while others focused on urban [3] [7] [28 – 36] and rural areas [37 – 40].

It is evident that national and regional studies which consider side by side comparison between urban, peri-urban and rural household energy consumption patterns in Nigeria are not readily available. Since peri-urban zone is a product of urban expansion, it is important in understanding the dynamics of household energy consumption in the urban areas and its intervening function between urban and rural zones. It is therefore the focus of this study to examine the locational variations in household energy consumption by comparing urban, peri-urban and rural areas in Ibadan Region, Nigeria.

2 Methodology

2.1 Types and Sources of Data

Data for this research was collected from both primary and secondary sources. Primary data source was derived from questionnaire survey while secondary data was obtained from National Population Commission, Journals, Publications, Newspapers, Magazines, Periodicals and other existing literature relevant to the study.

2.2 Sampling Techniques and Method of Data Collection

Areas to be surveyed were selected by random sampling. The districts in each zone (urban, peri-urban and rural) of the region were randomly listed and table of random numbers was used to select a total of seven districts. Three districts were selected in the urban area while two districts were selected to represent each of rural and peri-urban areas. New Bodija, Molete and Mapo representing high, medium and low income areas respectively within the city [3] [7] [34] were selected to represent the urban area. Aiyegun and Awotan were selected to represent the peri-urban area based on their location along the urban fringe and finally, Onidundu and Akufu were selected to depict rural area as they are essentially rural in nature. This is illustrated in figure 2.

Figure 2: Map of Ibadan Region Showing Urban, Peri-urban and Rural Areas

Systematic sampling method was used to administer the questionnaires. A sampling gap of 5 was used in the urban areas and 3 in the peri-urban and rural areas. A total of 189 questionnaires were administered using an adjusted sampling fraction of estimated number of households (derived from total number of households in Oyo state which is 1,248,105 [2], making 4.47 the average household size) as shown in table 1.

Table 1: Sample Size

Districts	Estimated No of Households	Adjusted Sampling Fraction	Sample Size
New Bodija (UH)	1294	0.03	39
Molete (UM)	1,984	0.03	60
Mapo (UL)	708	0.03	21
Aiyegun (PU)	99	0.06	6
Akowo (PU)	617	0.06	37
Onidundu (R)	312	0.06	19
Akufo (R)	124	0.06	7
Total	5138		189

Note: UH = Urban High Income, UM = Urban Medium Income, UL = Urban Low Income, PU = Peri-urban, R = Rural

2.3 Questionnaire Design

The questionnaire is divided into two sections, A and B. Section A relates to the general information about the respondents as regards their socio-economic characteristics. Information collected include location of household; size of household; employment status of household head; household income; occupation of household head; level of education of household head; type of living house; ownership tenure; number of rooms; and commercial activities carried out in the household. Section B on the other hand collected information pertaining to household energy consumption. These include electricity, petroleum fuels, biomass and others used by type, end uses, price per unit, quantity, expenditure and availability.

2.4 Measurement and Conversion Factors

Electrical energy consumption was estimated by power demand value of electrical appliances available in a household by the number of each of these appliances multiplied by the number of hours it is used per time period by each household. Energy from oil fuels was estimated based on volume of consumption or expenditure per period converted to volumetric consumption. LPG consumption estimations were based on weight and cylinder size. Biomass (charcoal and wood fuel) was quantified based on either weight or expenditure which was converted into weight using a standard price per unit weight measurement. Standard price per unit weight of biomass for each location was derived from direct weights taken from wood fuel and charcoal sellers in the areas. Estimates were derived using specific fuel consumption approach where only delivered energy (energy in the form purchased by households) is measured. All estimates derived were converted to Joule as the standard unit of measurement of total energy consumption by households. Conversion factors employed were based on the World Bank Reference Manual [41] using Net Heating Values (NHV) meaning energy available from combustion after allowing for energy losses. These factors are presented in table 2.

Table 2: Conversion Factors; Source: Leach and Gowen (1987)

Energy Type	Conversion Factor (NHV) into Mega Joules (MJ)
Electricity	3.6 MJ/kWh
LPG	45.6 MJ/kg
Kerosene	35.0 MJ/Litre
PMS/Gasoline	32.6 MJ/Litre
Diesel	36.0 MJ/Litre
Charcoal	29 MJ/kg
Woodfuel	15.5 MJ/kg

2.5 Hypothesis and Method of Analysis

For this study, it is hypothesized that:

1. There is a significant difference in the quantity of household energy consumption between urban, peri-urban and rural areas
2. There is a significant positive relationship between quantity of energy consumed and household socioeconomic characteristics:
 - a. Income
 - b. Household size
 - c. No of rooms available for use
 - d. Level of education of household head
 - e. Type of living house

The first hypothesis was tested using Analysis of Variance (ANOVA) while the second hypothesis was tested with a combination of Multiple Regression Analysis (MRA) and Analysis of Variance (ANOVA).

3 Results and Discussion

3.1 Household Socio-Economic Characteristics

Table 3 presents and analyzes the socioeconomic characteristics of households surveyed which shows that in the urban area, most of the households (40.7%) lives in a tenement house while traditional houses have the least number of households, accounting for 13.9% of the total. This is also the case in the peri-urban and rural zones where most households dwell in tenement structured buildings representing 60.6% and 42% respectively while only 3% of the households live in block of flats in the peri-urban and none in the rural zone.

Ownership wise, more than 50% of the households rented their houses in the urban and peri-urban areas with 39.8% and 42.4% respectively owning their houses. The opposite is the case in the rural area where 52% own their houses and 40% rented. This can be attributed to the fact that houses in the rural area were inherited or owned by extended families.

In terms of number of rooms, a larger percentage of the houses surveyed in the urban and rural areas consist of 2-4 rooms precisely accounting for 39.8% and 52% respectively. Conversely, about 42% representing the largest share in the peri-urban dwell in single room. Households living in more than 5 rooms account for the least share across the three zones. The distribution of number of rooms is observed to be closely related to type of housing unit. Tenement consists of single rooms while detached houses tend to consist of more than one room. More than half, precisely 56% of the households in the rural zone consist of 5-6 persons while that of the urban is 29.7%. In contrast, 36.4% which represent a majority at the peri-urban consist of 1-2 persons. This is in consonance with the earlier findings [42] that indicated average size of Nigerian households to be 5-7. Also, the significantly high percentage of households with more than 7 persons in the urban area (27.8%) can be explained using earlier submission that urban households, especially high income households tend to attract relatives from poorer households. In addition, many people migrate to the urban area for various perceived opportunities. 51.9% and 30.3% attained post-secondary education in the urban and peri-urban areas respectively while 11.2% and 18.2% have no formal education in these zones. In contrast, a whopping 56% have no formal education in the rural zone with only 4% attaining post-secondary level. This can be linked to availability of educational facilities and school enrolment behaviours across the zones. Expectedly, more than half (52%) of household heads in the rural area are farmers followed by traders which accounts for 28%. Most household heads in the peri-urban area are traders (60.6%) followed by farming with 21.2% while private corporation have the majority in the urban with 27.8% followed by civil service with 24.1%. This follows the spatial division of labour and specialization of functions.

Table 3: Socio-economic Characteristics of Households

S/N	CHARACTERISTICS	URBAN (%)	PERI-URBAN (%)	RURAL (%)
1	TYPE OF HOUSING UNIT			
	Detached	26.9	24.2	21.5
	Traditional	13.9	12.2	36.5
	Block of Flats	18.5	3	0
	Tenement	40.7	60.6	42
	Total	100	100	100
2	TENURE STATUS			
	Owned	39.8	42.4	52
	Rented	52.8	54.5	40
	Others	7.5	3.1	8
	Total	100	100	100
3	NUMBER OF ROOMS			
	1	34.3	42.4	32
	2 – 4	39.8	27.3	52
	More than 5	25.9	30.3	16
	Total	100	100	100
4	HOUSEHOLD SIZE			
	1 – 2	16.7	36.4	28
	3 – 4	25.8	30.3	8
	5 – 6	29.7	12.1	56
	More than 7	27.8	21.2	8
	Total	100	100	100
5	EDUCATIONAL LEVEL OF HOUSEHOLD HEAD			
	No Formal Education	11.1	18.2	56
	Primary	13.9	24.2	24
	Secondary	15.7	15.2	7
	Post-secondary	51.9	30.3	4
	Others	7.5	12.1	9
	Total	100	100	100
6	OCCUPATION OF HOUSEHOLD HEAD			
	Trading	25	60.6	28
	Artisan	9.3	6.1	8
	Civil Servant	24.1	6	4
	Private Corporation	27.8	4.1	4
	Farming	-	21.2	52
	Others	13.8	2	4
	Total	100	100	100
7	ESTIMATED HOUSEHOLD MONTHLY INCOME			
	Below N15,000	29.7	54.5	52
	N15,000 – N50,000	22.2	24.2	32
	N51,000 – N100,000	18.5	9.2	8
	Above N100,000	29.6	12.1	8
	Total	100	100	100

A greater proportion of households earns below N15,000 per month as income across the three zones. This reflects the predominance of low income group in the study area. However, this low-income category is higher in the peri-urban and rural areas accounting for 54.5% and 52% respectively. What can be regarded as medium income class constitute about 40% in both the urban and rural areas while that of the peri-urban area is about 35%. The high-income group is as high as 29.6% in the urban zone while that of the peri-urban and rural areas

account for only 12.1% and 8% respectively. This income structure follows the pattern and level of economic activities in each zone. Secondary, tertiary and quaternary economic activities which offer higher wages are concentrated in the urban area while primary activities which offer relatively lower wages predominate in the rural areas. This is reflected in the fact that about 92% of rural households are either in low or medium income group. In the peri-urban area, there appears to be a blend, this is because of the relatively cheap house rent and land available as a result of the distance to the city which serves as an attraction to prospecting tenants and house owners that cuts across all income categories.

3.2 Total Household Energy Consumption

Figure 3 shows the distribution of annualized households total energy consumption across the three zones. The urban zone has the highest consumption being the only zone with households recording excess of 100gj/yr. This reflects energy consumption capacity as conditioned by income distribution. As shown earlier in table 3, there are more high-income earners (households with above N100,000 monthly income) in the urban area compared to the peri-urban and rural areas. This implies that the urban zone has greater capacity to consume more energy directly and indirectly through their ability to acquire energy consuming household appliances and equipment. In addition, biomass constitute the majority of energy consumed at the peri-urban and rural areas which has lower net heating values compared to commercial fuels that dominate household energy consumption at the urban zone.

Figure 3: Total Household Energy Consumption.

3.2.1 Analysis of Variations in Total Household Energy Consumption

The first hypothesis for the study states that there is a significant difference in quantity of household energy consumption between urban, peri-urban and rural areas. This hypothesis was tested by the use of Analysis of Variance (ANOVA) and the summary of result is presented in Tables 4 and 5.

Table 4: Household Energy Consumption

Zone	Mean	Standard Deviation	Sample Size
Urban	42206.994	31437.9584	108
Peri-urban	36921.715	19177.0741	33
Rural	33776.592	23300.2111	25
Total			166

Table 5: Analysis of Variance on Total Household Energy Consumption

Source of Variation	Sum of Square	DF	Mean Square	F	Sig
Regression	1804889715	2	902444857.74	1.127	.327
Residual	13055E + 11	163	800925527.83		
Total	1.6236E + 11	165			

The ANOVA table 5 reveals that the calculated F-ratio of 1.127 is less than the F-table value of 3.00 at 0.05 significance level under 2 and 163 degrees of freedom. Although there is variation in the mean values of the three zones as urban records 42,206.994, peri-urban has 36,921.715 and rural with 33,776.592 as shown in Table 4, however, the model summary clearly indicates that large variations exist within the zones such that the difference between intra and inter-zonal variations is not significant. Therefore, it can be concluded that there is no significant difference in the quantity of household energy consumption between urban, peri-urban and rural areas.

Some earlier surveys [43] posit that energy consumption is much lower in the urban than rural areas. The divergence observed is due to the fact that high quantity of primary energy consumed at the rural and peri-urban areas has lower net heating values (which is the approach employed in this study) compared to commercial fuels used in the urban area. Consequently, per capita household energy consumption is higher in the urban than in the peri-urban and rural areas.

3.3 Impact of Household Socioeconomic Characteristics on Quantity of Energy Consumption

The second hypothesis for the study states that there is a significant positive relationship between quantity of energy consumed and household socio-economic characteristics. This hypothesis was tested by the use of Multiple Regression Analysis (MRA). Summary of findings is presented in Tables 6 and 7.

Table 6: Summary of Regression Result for Effect of Household Socioeconomic Characteristics on Quantity of Energy Consumed in the Urban Area

Variables	β	Standard Error of β	T	Sig
Household Income	3101.174	1794.784	1.728	.087
Household Size	1749.240	3730.145	.469	.640
Number of Rooms	3049.031	7169.147	.425	.672
Type of Housing Unit	-5220.489	3060.867	-1.706	.091
Educational Level of Household Head	-3540.944	3008.779	-1.177	.242
Constant	36621.287	14601.752	2.481	.015

Multiple R = .480 R square = .231 Adjusted R square = .193 Standard Error = 28239.5654

Table 7: Analysis of Variance for Urban Regression

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig
Regression	2.44E+10	5	4882137540.8	6.122	.000
Residual	8.13E+10	102	797473056.57		
Total	1.06E+11	107			

Table 6 shows that income, household size and number of rooms are positively related to total household energy consumption while type of housing unit and educational level of household head are negative. However, none of the variables significantly singularly explain quantity of household energy consumption at 0.05

significance level. Nevertheless, all the five variables explain about 23% of the quantity of household energy consumption as shown by R^2 which can be regarded as a weak positive relationship.

However, the ANOVA table 7 shows that calculated F-ratio of 6.122 is greater than F-table value of 2.21 at 0.05 significance level with 5 and 160 degrees of freedom. This suggests that the quantity of household energy consumed significantly vary as household socioeconomic characteristics vary in the urban area.

Table 8: Summary of Regression Result for Effect of Household Socioeconomic Characteristics on Quantity of Energy Consumed in the Peri-urban Area

Variables	β	Standard Error of β	T	Sig
Household Income	-2369.478	2189.878	-1.082	.289
Household Size	5277.967	4254.150	1.241	.225
Number of Rooms	1897.808	7109.993	.267	.792
Type of Housing Unit	6957.417	4900.580	1.420	.167
Educational Level of Household Head	674.450	4915.736	.137	.892
Constant	5559.843	28743.402	.193	.848

Multiple R = .377 R square = .142 Adjusted R square = -.017 Standard Error = 19336.7680

Table 9: Analysis of Variance for Peri-urban Regression

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig
Regression	1.67E+09	5	334547862.47	.895	.499
Residual	1.01E+10	27	373910596.48		
Total	1.18E+11	32			

Here, all socioeconomic variables have a positive relationship with the quantity of household energy consumed except income (Table 8). None of the variables however individually and significantly explain quantity of household energy consumption. There is a weak positive relationship between the socioeconomic variables and total household energy consumption in this zone as all the variables jointly explain only 14.2% of variations observed. Also, the ANOVA table 9 shows that the calculated F-ratio of .895 is less than the table value of 2.57 at 0.05 significance level with 5 and 27 degrees of freedom. This implies that quantity of household energy consumption do not vary significantly as socioeconomic characteristics of households vary in the peri-urban zone.

Table 10: Summary of Regression Result for Effect of Household Socioeconomic Characteristics on Quantity of Energy Consumed in the Rural Area

Variables	β	Standard Error of β	T	Sig
Household Income	1340.633	4034.594	.332	.743
Household Size	-385.585	6957.721	-.055	.956
Number of Rooms	280.254	15705.306	.018	.986
Type of Housing Unit	-1988.087	7363.012	-.270	.790
Educational Level of Household Head	1370.032	6802.287	.201	.843
Constant	27589.645	37631.803	.733	.472

Multiple R = .216 R square = .047 Adjusted R square = -.204 Standard Error = 25566.7355

Table 11: Analysis of Variance for Rural Regression

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig
Regression	6.10E+08	5	122018974.12	.187	.964
Residual	1.24E+10	19	653657961.83		
Total	1.30E+10	24			

Table 10 indicates that income, number of rooms and educational level of household head have positive relationship with quantity of energy consumed. There is a very weak relationship between the variables and total household energy consumption as they explained a meager 4.7%. This is further confirmed in the ANOVA

table 11 where calculated F of .187 is lower than table F of 2.74 at 0.05 significance level with 5 and 19 degrees of freedom. Therefore, it can be concluded that quantity of household energy consumption does not vary significantly with variations in household socioeconomic characteristics in the rural area.

Although it is claimed that [41] [44 - 45] there is a strong and steady relationship between income and total household energy consumption, this is not the case for this study except at the urban zone where it was significant together with other variables. Rather, the study seems to be in tandem with the findings [7] [46 – 47] which indicated that amount of household fuel consumption does not vary substantially with household income. This is particularly true for the peri-urban and rural zones which can be attributed to the fact that a significant proportion of the energy requirements of households in these zones are obtained from fuelwood.

Income as a household energy consumption variable tends to be significant essentially at the urban area especially in the high-income group [7]. Also influence of income is made more evident when changes in household energy consumption is considered with changes in household income over a period of time [8] [44] [48]. This study however dealt with consumption level at a point in time.

The relative insignificance of household size can be linked to the fact that as the number of individuals increase in a household, per capita consumption decreases thereby reducing total household energy cost and bringing about a kind of 'household energy economies of scale'. For instance, the quantity of energy required to cook a meal for two people will not be substantially different from that of six people. This is in contrast to an earlier work [35] where household size explains 45% of household energy consumption. This difference may be attributed to the approach, as household expenditure was used rather than actual quantity of energy consumed. Expenditure approach is clearly insufficient in providing accurate measure of energy consumption as many households especially in the peri-urban and rural areas acquire a large proportion of their energy free.

Number of rooms essentially affects electricity consumption, which in any case has been demonstrated to be insignificant. Type of living house and educational level of the household head are also individually insignificant because regardless of the type of house a household dwells in and irrespective of the household head educational status, households share common energy needs which they strive to meet. Therefore, the difference will come from how these needs are met rather than quantity that is used. In other words, type of living house and educational status of household head are likely to affect types of fuels consumed by a household rather than quantity of heat utilized. For instance, a tenement or block of flats with no space for the use of fuelwood are likely to find alternatives while an uneducated household head might prefer charcoal to LPG.

Overall, income, household size, number of rooms, type of living house and educational level of household head jointly and significantly influence the quantity of household energy consumption at the urban area.

However, in the peri-urban and rural areas, these variables had a lesser influence. This can be attributed to the homogeneous nature of these zones revealed in their socioeconomic profile in Table 3. Also, biomass, specifically woodfuel, is the major household fuel consumed which is in most cases free. Critical variables at these locations (peri-urban and rural) could be availability of fuelwood in terms of distance and quality, collection time etc. From the foregoing, a major difference between this study and some of the previous studies is that quantities of net heat (NHV) of the various fuels were utilized as against expenditure, frequency and primary energy consumption.

4 Conclusion

This study has revealed that variations in the quantity of energy consumed by households within the urban, peri-urban and rural areas do not differ significantly from the differences between the three locations. In other words, the difference in household energy consumption between urban, peri-urban and rural areas is not really in the quantity of energy consumed, rather it is in the type of energy used and the use to which it is put. This implies that regardless of location and to some extent socioeconomic characteristics, households require energy

for sustenance and will look for ways to meet their energy requirements. Since households share numerous needs, difference in total quantity used to meet the basic energy needs do not differ substantially especially if electricity is excluded. This is because the same meal that a litre of kerosene will sufficiently cook, more than 2kg of wood might be required, but at the end, the total net heat utilized will not be substantially different. Finally, this study employed the net heating values of specific fuels consumed by households to ascertain variations between locations. Efficiency of end-use equipment to determine quantity of useful energy that is eventually consumed by the households was not incorporated. The use of total useful energy that is available to households might be a better approach to revealing locational variations in household energy consumption.

5 Declaration

5.1 Informed Consent

The introduction section of the questionnaire that states that “This questionnaire is designed to elicit information on the research topic above. Information provided is strictly for academic purpose and shall be treated with utmost confidence.” was read to all respondents to seek their consent which was subsequently acquired verbally from all participants.

5.2 Competing Interests

The author declares that there is no conflict of interest.

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References

- [1] R.K. Udo. “Ibadan in its Regional Setting” In: M.O. Filani *et al.* (eds) Ibadan Region. University of Ibadan. Pp 9 – 17. 1994.
- [2] Legal Notice on Publication of 2006 Census Final Results. Federal Republic of Nigeria Official Gazette. Printed and Published by The Federal Government Printer, Abuja, Nigeria. FGP/22009/10000(OL02). 2009.
- [3] I.O. Adelekan and A.T. Jerome. “Dynamics of Household Energy Consumption in a Traditional African City, Ibadan”. *Environmentalist*. Springer. 26: 99–110. 2006.
- [4] A.B. Onakoya, A.O. Onakoya, O.A. Jimi-Salami and B.O. Odedairo. “Energy Consumption and Nigerian Economic Growth: An Empirical Analysis”. *European Journal of Scientific Research*. 9(4): 25 – 40. February 2013.
- [5] W.R. Tobler. “A Computer Movie Simulating Urban Growth in the Detroit Region”. *Economic Geography*, 46(Supplement): 234-240. June 1970.
- [6] G. Nueman. “Institutional Choices and the Theory of Consumer Behaviour”. Unpublished Master of Arts thesis. Department of Economic and Commerce. Simon Fraser University. 1970.
- [7] O.E. Ayantoye. “Spatial Variations in the Residential Demand for Electricity: A Case Study of Ibadan Local Government Area”. An Unpublished MSc Thesis. Department of Geography, University of Ibadan, Ibadan, Nigeria. 2003.
- [8] R.A. Garcia, F. Manehdeg and N.D. Raneses. “Household Energy Consumption Survey in Three Philippine Cities”. *Energy* (Oxford), 19(5), pp 539 – 548. 1994.
- [9] S. Ayodele. “An Econometric of the Pattern of Nigeria’s Energy Use”. Akintola Printing Works. 1978.
- [10] A. Iwayemi. “An Econometric Analysis of Demand for Electricity in Nigeria”. Research for Development. *The Journal of the Nigerian institute of Social and Economic Research*. Vol 1, No 1, pp 23 – 31. 1981.
- [11] A.E. Emilefo. “A Geographical Analysis of Electricity Consumption in Nigeria”. An Unpublished MSc Thesis. Department of Geography, University of Ibadan, Ibadan, Nigeria. 1991.
- [12] O.J. Ebohon. “Empirical Analysis of Energy Consumption Behaviour: An Input to an Effective Energy Policy in Nigeria”. *Energy Policy*. 20 (8), pp 781 – 796. August 1992.
- [13] S.O. Adegoke. “The Conventional Energy Resources of Nigeria”. In Sereki, O.A. and Adegbulugbe (eds). *Energy Issues in Nigeria, Today and Tomorrow*. Conference Proceedings. 1992.
- [14] B.C. Arimah. Electricity Consumption in Nigeria: A Spatial Analysis. *OPEC Review*. Vol 17 (1), pp 63 – 82. 1993.
- [15] G.A. Oladosu and A.O. Adegbulugbe. “Nigeria’s Household Energy Sector: Issues and Supply and Demand Frontiers”. *Energy policy*. 22 (6), pp 538 – 549. June 1994.
- [16] A.O. Aweto. “A Spatio-Temporal Analysis of Fuelwood Production in West Africa”. *OPEC Review*, Winter 1995, pp 333-347. December 1995.
- [17] M. Alabe. “Household Energy Consumption Patterns in Northern Nigeria”. Published Project. Bayero University, Kano. 1996.
- [18] O. Ajani. “Household Energy Use Patterns in Ogun State”. Published Project presented to Department of Agricultural Economics, University of Ibadan, Ibadan. 1996.

- [19] F.O. Ogwumike, U.M. Ozughalu and G.A. Abiona. "Household Energy Use and Determinants: Evidence from Nigeria". *International Journal of Energy Economics and Policy*. Volume 2, No 6, pp 248 – 262. 2014.
- [20] M.O. Oseni. "Households' Access to Electricity and Energy Consumption Pattern in Nigeria". *Renewable and Sustainable Energy Reviews, Elsevier*. 16(1): 990 – 995. January 2012.
- [21] P.A. Nwofe. "Comparative Analysis of Domestic Energy Use in Nigeria – A Review". *Wiloloud Journals*. 4(1): 7 – 17. 2013.
- [22] K.O. Kadiri and O.A. Alabi. "Household Energy Consumption Pattern in Offa City, Kwara State, Nigeria". *Journal of Scientific Research & Reports* 3(11), pp 1499 – 1506. 2014.
- [23] C.E. Madukwe. "Domestic Energy Usage Pattern of Households in Selected Urban and Rural Communities of Enugu State". Unpublished MSc. Thesis. Institute for Development Studies, Enugu, Nigeria. March 2014.
- [24] O.M. Bamiro and J.O. Ogunjobi. "Determinants of Household Energy Consumption in Nigeria: Evidence from Ogun State". *Research journal of Social Science and Management*. 4(12): 35 – 41. April 2015.
- [25] P.A. Adeyemi and A. Adereleye. "Determinants of Household Choice of Cooking Energy in Ondo State, Nigeria". *Journal of Economics and Sustainable Development*. Vol.7, No.9. 2016.
- [26] S. Sa'ad, and I.M. Bugaje. "Biomass Consumption in Nigeria: Trends and Policy Issues". *Journal of Agriculture and Sustainability*. Volume 9, No 2, 127 – 157. 2016.
- [27] A.E. Obayelu, I.B. Lawal and I.A. Omotuyole. "Comparative Analysis of Access and Preference of Rural and Urban Household for Cooking Energy and the Determinants in Nigeria: A Case of Ogun State". *Agricultura Tropica Et Subtropica*. 50/1, 45 – 53. 2017.
- [28] N.E. Edu. "Consumption of Domestic Fuel in Jos Town". Unpublished MSc Thesis, University of Jos. 1981.
- [29] Y. Omidiji. "Energy Supply and Use in Lagos, Nigeria". An Unpublished MSc Thesis. Department of Geography, University of Ibadan, Ibadan, Nigeria. 1984.
- [30] I. Inyang. "Household Energy Options in Urban Nigeria". *Third World Planning Review*, 11(4), pp 429 – 444. 1989.
- [31] O. Adeoya. "Urban Spatial Structure and Residential Electricity Consumption in Ogbomoso". An Unpublished MSc Thesis. Department of Geography, University of Ibadan, Ibadan, Nigeria. 1990.
- [32] A.O. Adegbulugbe and J.F.K. Akinbami. "Urban Household Energy Use Patterns in Nigeria". *Natural Resources Forum*, Vol. 19, No. 2., pp 125-133. May 1995.
- [33] J.O. Olajide and P.O. Odugbenro. "Urban household energy and food preparation in Nigeria". *Boiling Point*. Issue 44 Fuel Options for Household Energy. 1999.
- [34] I.O. Adelekan. "Gender, Economic Policy and Domestic Energy Use in Nigeria". *Ibadan Journal of the Social Sciences*. Volume 3, Number 1, pp 1 – 15. 2005.
- [35] Y.B. Akut. "The Economic Implications of Household Energy Consumption in Jimeta". In *Urbanisation, Resource Exploitation and Environmental Stability in Nigeria. The Association of Nigerian Geographers Conference Proceedings*. Pp 368 – 374. 2007.
- [36] E. Emagbetere, J. Odia and B. U. Oreko. "Assessment of Household Energy Utilized for Cooking In Ikeja, Lagos State", Nigeria. *Nigerian Journal of Technology (NIJOTECH)*. Vol. 35, No. 4, pp. 796 – 804. October 2016.
- [37] A.O. Adegbulugbe. "Energy master plan for rural Development; Nigeria case study", Vol. I- IV. Study report of EEC project submitted to the EEC delegation in Nigeria. 1992.
- [38] F.O. Akintola, A.O. Aweto, A.S. Gbadegesin and M.M. Daura. "Rural Energy Consumption Patterns and Deforestation in Nigeria". *Science Council of Nigeria/IDRC Research Project Report*. 1995.
- [39] M.O. Adetunji, I.O. Adesiyun and W.A. Sanusi. Household Energy Consumption Pattern in Osogbo Local Government Area of Osun State. *Pakistan Journal of Social Sciences*. Medwell Online Journals. Vol.4 No 1. Pp 9 – 13. 2007.
- [40] A.S. Onawumi, I.S. Dunmade, O.O Ajayi, E.O. Sangotayo, M.O. Oderinde. "Investigation into House-Hold Energy Consumption in Saki, Southwestern Nigeria". *International Journal of Scientific & Engineering Research*, 7 (3). pp. 720-727. November 2016.
- [41] G. Leach and M. Gowen. "Household Energy Handbook", World Bank Technical Paper No. 67. 1987.
- [42] A.S. Momodu, O.E. Abraham, I.O. Ogundari, O.A. Jesuleye, M. Sanni, T.F. Ibuoye and W.O. Siyanbola. "Promoting Energy Efficiency Diffusion in Nigeria's Residential and Commercial Buildings: System Dynamics Approach". 2009.
- [43] J. Goldemberg. "Energy Use in Brazil: A study on Enduse Energy Strategies". *Companhia Energetica de Sao Paulo*. 1984.
- [44] R.H. Hosier and W. Kipondya. "Household Energy Use in Tanzania: Prices, Substitutes and Poverty". *Energy Policy*, 21(5), pp 454 – 473. May 1993.
- [45] T.G. Bensele and E.M. Remedio. "Residential Energy Use Patterns in Cebu City, Philippines". *Energy (Oxford)*, 20(3), pp 173 – 187. March 1995.
- [46] J. Dunkerley, M. Macauley, M. Naimuddin and P.C. Agarwal. "Consumption of Fuelwood and Other Household Fuels in Indian Cities". *Energy Policy*, 18(1), pp 92 – 99. February 1990.
- [47] P. Hills. "Household Energy Transition in Hong Kong". *Energy (Oxford)*, 19(5), pp 517 – 528. 1994.
- [48] B.S. Reddy. "Overcoming the Energy Efficiency Gap in India's Household Sector", *Energy Policy*, Vol 31, N. 11, pp 1117-1127. 2003.

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