WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Demostic Energy Consumption and Environmental Sustainability in Urban Centre of Ikom Local Government Area of Cross River State, Nigeria

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ABSTRACT

The research aims at eliciting environmental and health effects of domestic energy in both rural and urban areas of Ikom Local government area of Cross River State, Nigeria. It is also focused on evaluating the sustainability of house hold use of renewable and non-renewable energy. The problem statement directs attention to the fact of assessing the true perspective of household energy consumption and the true perspective of its effects on the environment and human health effects.

The objectives focuses on (i) appreciation inherent constraints to energy utilization, (ii) understanding of the variety of energy available to households in the area, (iii) evaluation of the rate of energy consumption by households and (iv) investigation of the health impact of energy consumption by households in the area.

The literature covered the essence of household every categories and their relevance to environmental sustainability, impact of outdoor and indoor pollution from household energy consumption and human health implications.

The methodology considers study design, area of study, study population, sampling procedure, instruments for data collection, method of data collection and data analysis technique.

Energy efficiency is considered based on used and the extent of production of externality (Waste-Emeh, 1996). While the first relates to first relates to the essence of environmental sustainability, the second is termed the law of entropy or decay. While the categories clean energy support the principle of the first law, the second category manifests in the law of entropy or degradation. Energy consumption generally has an ambivalent ascriptions as to whether they are friendly (sustainable) or unfriendly (unsustainable).

Much of the earlier categories of energy in use at all levels fall within the range of the second category while currently there is an emerging shift (paradigm change) towards the first category which is the clean energy sources. The New paradigm change followed the Kyoto protocol of (1997) as reported by Law and Smith (1993).

Inherently, the express direction this study on elucidating the true perspective of domestic energy consumption in the area of study on the frequent of environmental sustainability towards the realization of the 1995. Sustainable Development Goal (SDG) of the Rio De Janiero earth summit which was a follow up of the Kyoto protocol (Upla and Utang, 2004).

INTRODUCTION

The inevitability of energy demand and utilization at all levels has never been contentious. At the domestic levels energy is required to facilitate the numerous domestic engagements by its members for cooking lighting, laundry, Warming (heating) and so on.

Corresponding in line with Zhao et al (2012) the available sources of energy include electricity, coals, natural gas, liquefied petroleum gas, (LPA), solar energy, bio gas and biomass (fuel wood). Further on these are further sub-divided into two categories which are clean energy and dirty energy.

Similarly Elvis et al (2022) described these categories as renewable energies and non-renewable energy respectively. Specifically the outline of the two broad classes includes solar energy, biogas and natural gas which are clean energies or renewable energies while coal, gasoline and biomas energy belong to the dirty energy category or non-renewable class. A significant concern about the environmental sustainability perspective of the energy consumption is the essence of the environmental friendliness or otherwise. While the first class is environmentally enhancing (friendly) the second category is environmentally degrading (unfriendly). This introduces another consideration on the essence of the sustainability concern and that is the question of energy efficiency.

STATEMENT OF THE PROBLEM

Numerous efforts have been directed at the study of many aspects of domestic and/or house activities and their impacts such "housing quality assessment and its impact on the health of residents, (Lucia et al 2022), "effect of indoor air pollution on women and children (World Resources Institute (WRI 2003). "Impact of domestic noise pollution on children (Simon et al 2015) and a plethora of other such too numerous to list.

The current study essentially focuses on elucidating the true perspective of domestic energy or household energy consumption on the overall sustainability of the environment. Here, the environment is viewed from the whole ecological stand point and sustainability is viewed from the point of view of the positive and negative impacts of energy use. The distinctive direction of this study is contained in its interest in evaluation of the negative and positive sides of household energy consumption in a bid to proffering useful prognosis in the direction of environmental capacity building through attitudinal re-orientation of house hold members in the study area.

JUSTIFICATION OF THE RESEARCH

Energy consumption is an inevitable and vital aspect of human existence and livability. Livability is a crucial factor in urban life sustainability. Mabogunju (1974) made allusion 'to this concept when he undertook an enquiry into the livelihood condition of urban dwellers in the second part of the 70s.

Energy consumption and management in the context of urban centres of the development regions of Nigeria is formidable enterprise.

The necessity of investigating into the environmental consequences of household energy consumption is derived from the need to adequately understand primarily the environmental quality impact of the energy use, appreciate the human health impact of the externalities produced by the energy use, understand the full view of the ecological consequences of the consumption pattern by households and finally, provide information that will be useful in mainstreaming knowledge in the direction of environmental capacity building.

It is also pertinent to undertake an enquiry into the aspect of knowledge due principally to the fact that urban authorities in Cross River State as well as other part of Cross River lack well organized environmental monitoring agencies that will regulate activities that will contribute in deteriorating the environment. Therefore, a study of this nature may serve as an edge-cutting research that may open new vistas to further inquiry in the field.

OBJECTIVES OF THE STUDY

This research study is informed by the following specific objectives.

i. The need to adequately understand the variety of energy utilized by households in the area under investigation

ii. Examination of the rate of energy consumption by individual households in the area

iii. To investigate the health impact of the energy use on those immediately exposed to it in the area

LITERATURE REVIEW

AN OVERVIEW

Domestic energy involves the use of a wide variety of energy sources such as electricity, coal, natural gas, solar energy, biogas, biomass, diesel, kerosene etc. (Zhao et al 2012). Some of these energy used are environmentally friendly while others are harmful or unfriendly. The friendly ones fall in the category of renewable energy or clean while the unfriendly belong to the category of unclean energy. While the friendly energy source are environmentally enhancing and facilitate environmental sustainability, the other is otherwise so (Op cit). The various was by which the sustainability impacts are reflect in both the physical and social environment will readily will be presented below. Broadly impacts are felt in both the outdoor and indoor environment in the activity incident area or the ambient air domain.

Economic growth, living standards improving and consumer attitudes changing inevitably lead to diversification of household energy consumption. It is essential to conduct energy saving and emission reduction in life aspect. A lot of pollutants from household energy consumption are harmful to human health, particularly for women and children in rural areas. The World Health Organization estimates that household air pollution from the use of biomass in inefficient stoves would lead to over 1.5 million premature deaths per year in 2030. There have been more findings on the study of household energy consumption and environmental impact. Feng et al. (2010) used CLA method to comparatively analyze CO2 emissions caused by residents consuming at different income levels in various regions of China. Li et al. (2008) discussed energy consumption structure of rural households and environmental impact in the Loess hilly region of China. Yao et al. (2011) accounted CO2 emissions implied in resident consumption by the integrated life-cycle approach, and analyzed factors that impact carbon emissions.

DOMESTIC ENERGY CONSUMPTION AND OUTDOOR ENVIRONMENTAL IMPACTS

Following the report by Zhao et al (2012) "Economic growth, living standard improving and consumer attitudes change inevitably lead to diversification of household energy consumption and that a lot of pollutants from household energy consumption are harmful to human health particularly women and children in rural areas. Along similar lines, a source from International Energy Agerby (2002) held that World Health Organization has reported that household air pollution from use or biomass in inefficient stoves would lead to 1.5 million premature death per annum in 2030.

Further findings by Feng et al (2010) provided that c02 emissions from residents' energy consumption at different income levels in China have caused a rise in greenhouse gas effects in the atmosphere. Impliedly, increase in greenhouse effects will exacerbate climate change by rising temperature of the air and invariably global warming. This statement was vividly substantiated by Feng et al (2010) who stated categorically the "Emissions of household energy consumption include c02, N20, CH4, N03, S02, TSP etc. and that these emissions impact on climate change and human health. In the same report, it was stated categorically that domestic energy impact on the environment is higher in rural areas than in the urban areas due principally to the point that rural residents engage more in domestic cooking than urban residents and also that they concentrate more in the use of biomass fuel than urban residents who diversify their energy use sources.

In further findings by Liu et al (2022) and Zafar et al (2021) renewable energy consumption degrades the environment. In this regard, energy consumption and environmental sustainability can be viewed from two perspectives –the positive and negative, resulting in part from the use of fluoride rich fuels (Ando et al 1988). It is also reported that arsenic, another contaminant of coal, is associated with greater risks of lung cancer in China (Fin Kelman, Bekin and Zeng, 1999).

A recent World Health Organization (WHO) report estimated that indoor smoke from solid fuel ranked as one of the greatest top ten for the global burden of disease, accounting for an estimated 1.6 million premature death each year. And also among the environmental risks indoor air pollution is said to be second to poor water sanitation hygiene (WHO, 2021/2022)

Considering the entire gamut of the review, it is at once evident that non-renewable energy categories are quite environmentally degrading and also that rural women and children are more at risk than those in the urban area.

It is also discovered that whereas urban households have access to a variety of domestic energy sources including the renewable category, rural dwell depend mostly on biomass energy which is less environmentally friendly and unsustainable.

METHODOLOGY OF THE STUDY

The study methodology is designed along the following thematic areas:

Research Design:

This research is a descriptive field exploratory survey design aimed at collecting information from the field using such instrument as the questionnaire, check lists air samples and observation schedules for practically recording images of environmental degradation caused possibly by energy consumption activities by households.

Area of Study:

The area of study is Ikom Local Government Area in Cross River State, Nigeria. Ikom is one of the 18 geo-political units that make the state, Cross River State, Nigeria. The specific domain of study is Ikom urban area which is formed within the radius of 2 kilometers from the Central Business Hub (CBH) at the four corner central area. Ikom is situated on both sides of the Cross River. Ecologically, it belonged to the rainforest equatorial biome but currently it has significantly lost this natural ecosystem due to urbanization process and other anthropogenic activities. In the State, Cross River State, it is the most thriving business centre due to its strategic location as a junction town between Ogoja/Abakaliki route, Obudu/Obanliku artery, Cameroun boarder route and Calabar "trunk A" federal road. The activity of cocoa cultivation has also bolstered its business advantage. Like most urban centres, the population is mostly of different parts of Nigeria and beyond.

Population of The Study

The population of this study comprises all households permanently residing in the central business district of Ikom. The specific targets are households with study family aggregations which are engaged in study energy utilization. those engaged in hospitality industries such as hotels and other eateries are equally to be included.

Sampling techniques:

The technique of sampling involved the following:

1. Inclusion-exclusion criterion. This primarily involved delineation of areas to be considered as urban within a determined radius from the central business hub at the four-corner' area. the inner radius will be included while the outer perimeter will be excluded. The second perspective of inclusionexclusion will involve discrimination of respondents on the bases of household size age and soci-economic size. This will be contemplated insitu in field.

2. The second approach involved systematic serpentine housing enumeration where houses were selected in alternate forms along a street or an artery by assigning even-odd number systematic listing.
3. The third involved stratified sampling involving categorization of households into domestic and commercial respectively.

Sample size:

A total of four hundred respondents were utilized in the study

Instrument for Data Collection:

Instruments employed in field data collection included the following

i. Structured questionnaire
ii. Observation schedule
iii. Air samplers
iv. Digital cameras

Methods of Data Collection

Data was collected using the following procedures:

i. Pre-field delineation of population clusters
ii. Mock field data embarkation
iii. Field data collection using questionnaire administration
iv. Environmental quality assessment using sampled air specimen for laboratory analysis

Method of Data Analysis

Information collected from respondents was statistically analyzed using chi square x^2 distribution and one way analysis of variance

DATA PRESENTATION AND ANALYSIS

Hypothesis I

H0: There is no significant variation in the categories of energy in use by households in the area under investigation.

The field data collected were presented in tables as follows

Table Ia: Categories of Energy utilized by individual households in the area

(Ikom Local Government Area)

S/No.	**Energy type**	**Household categories**			**Total**
		Lower class	Middle class	Upper class	
1.	Biomass Fuel wood	150	110	40	300
2.	Gasoline (Fuel)	88	140	160	388
3.	Gas	90	108	202	390
4.	Kerosine	40	52	40	132
5.	Bitumen	10	18	0	28
6.	Solar Energy	64	104	214	382
7.	Biogas	0	10	32	42

Note: table 1 above conveys information on domestic energy use by households in the area of study. Six varieties of energy were featured in the interview process. Following the hypothesis set below, the chi-square was employed for determination of the results.

Table Ib: Observed Values

S/No.	Energy type	Household categories			Total
		Lower class	Middle class	Upper class	
1.	Biomass Fuel wood	150	110	40	300
2.	Gasoline (Fuel)	88	140	160	388
3.	Gas	90	108	202	390
4.	Kerosine	40	52	40	132
5.	Bitumen	10	18	0	28
6.	Solar Energy	64	104	214	382
7.	Biogas	0	10	32	42

Table Ic: Expected Value

S/No.	Energy type	Household categories			
		Lower class	**Middle class**	**Upper class**	**Total**
1	Biomass Fuel wood	79.7833935	97.833935	124.187726	**301.8**
2	Gasoline (Fuel)	103.186522	126.531889	160.616125	**390.3**
3	Gas	103.718412	127.184116	161.444043	**392.3**
4	Kerosine	35.1046931	43.0469314	54.6425993	**132.8**
5	Bitumen	7.44645006	9.13116727	11.5908544	**28.17**
6	Solar Energy	101.590854	124.575211	158.132371	**384.3**
7	Biogas	11.1696751	13.6967509	17.3862816	**42.25**
	TOTAL	**442**	**542**	**688**	**1672**

TABLE Id: (O-E)2/E

S/No.	Energy type	Household categories			
		Lower class	**Middle class**	**Upper class**	**Total**
1	Biomass Fuel wood	1.760	0.249	(1.356)	**0.653**
2	Gasoline (Fuel)	(0.294)	0.213	(0.008)	**(0.089)**
3	Gas	(0.265)	(0.302)	0.502	**(0.064)**
4	Kerosine	0.279	0.416	(0.536)	**0.159**
5	Bitumen	0.686	1.943	(2.000)	**0.628**
6	Solar Energy	(0.740)	(0.330)	0.707	**(0.364)**
7	Biogas	(2.000)	(0.540)	1.681	**(0.859)**
	TOTAL	**(0.574)**	**1.648**	**(1.009)**	**0.065**

$X^2 = 0.065$

Decision Rule:

For an alpha level of 0.05 and 12 degrees of freedom, the critical statistic is 21.026, which is greater than our obtained statistic of 0.065. Hence we can accept our null hypothesis because the critical statistic is greater than obtained statistic. Suffice to say that There is no significant variation in the categories of energy in use by households in the area under investigation.

Hypothesis Two

Ho: There is no significant variation in the health/environmental impact of the energy categories in use by Households in the area.

Table II: Environmental and Human Health impact of domestic energy consumption by households in Ikom Urban Local Government Area of Cross River State.

S/No.	Energy Category	Health/Environmental Impact				Total
		Low	Moderate	High	Very High	
1.	Biomass/Fuel wood	42	65	96	101	322
2.	Liquified Gas	68	70	123	145	406
3.	Petrol/Gasoline	77	63	105	112	357
4.	Kerosine	86	91	110	107	394
5.	Bitumen	63	76	117	102	358
6.	Solar Energy	136	46	0	0	186
6.	Biogas	106	92	40	32	270

Note: In table two above, the approach involves an assessment of the health/environmental impact of energy categories through responses elicited through interviews with household residents in the area. The impact of assessment rating followed a 4 point impact scaling such as (i). Low, (2). Moderate, (3). High and (4). Very High. In all cases respondent ratings are presented against the impact ration scale. The total values shown against each energy reflects the respondent affirmation drawn from the sampled population. Following the table a hypothesis formulation for testing based on the technique of analysis of variance (ANOVA)

ANOVA:

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Biomass/Fuel wood	4	304	76	767.3333
Liquified Gas	4	406	101.5	1489.667
Petrol/Gasoline	4	357	89.25	534.9167
Kerosine	4	394	98.5	139
Bitumen	4	358	89.5	599
Solar Energy	4	182	45.5	4110.333
Biogas	4	270	67.5	1366.333

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	9336.929	6	1556.155	1.209458	0.340249	2.572712
Within Groups	27019.75	21	1286.655			
Total	36356.68	27				

** 0.05 alpha Level*

Decision Rule:

Since our *f Critical* Value *(*2.572712) is greater than our *F value (*1.209458) at an alpha level of 0.05, we therefore accept the null hypothesis and reject the alternative hypothesis which means There is no significant variation in the health/environmental impact of the energy categories in use by Households in the area

DISCUSSION AND CONCLUSION

From the findings from the data collected and analysed, it is evident that domestic energy consumption in the urban area of Ikom Local Area does not has a significant effect on the environment as do the rural areas. This finding was vividly substantiated by Feng et al (2010) who stated categorically the "Emissions of household energy consumption include c02, N20, CH4, N03, S02, TSP etc. and that these emissions impact on climate change and human health. In the same report, it was stated categorically that domestic energy impact on the environment is higher in rural areas than in the urban areas due principally to the point that rural residents engage more in domestic cooking than urban residents and also that they concentrate more in the use of biomass fuel than urban residents who diversify their energy use sources.

When the evaluation is taken as a whole, it becomes clear that non-renewable energy sources have a negative impact on the environment and that women and children in rural areas are more vulnerable than those in urban areas.

The environment, energy use, and poverty are all directly correlated. Because it is readily available and reasonably priced, biomass energy is primarily employed in traditional African cities. Approximately 40% of the world's hardwood supply comes from Sub-Saharan Africa (FAO, 2004).

According to Abd'razack and Ahmad Nazri (2011), households in Nigeria consume between 70% and 90% of their domestic energy through the use of fuel wood. This finding supports Kerekezi's (1999) estimate that 91% of Nigerian households use biomass for domestic energy. All energy use has an influence on the environment, but varying depending on the source—LPG has the lowest impact while biomass has the largest.

In Nigeria, the environmental impact of biomass consumption has been identified as the loss of many forest resources, including animals and trees, as well as soil erosion, deforestation, and desertification. Approximately 75% of Nigeria's population uses this biomass as a source of energy (Adelekan and Jerome, 2006). The unlawful felling of trees and bushes for domestic biomass and charcoal manufacture has resulted in an estimated annual loss of 45,000 hectares of woods, placing significant pressure on the nation's forest resources. By 2020, all forest resources would be gone if the current trend keeps on its current trajectory (Oladosu and Adejulugbe, 1994).

The buildup of CO2 in the atmosphere, which is over the necessary atmospheric limit, is one of the elements contributing to climate change; this has resulted in the thinning of the ozone layer and global warming. The primary gas that contributes to the production of greenhouse gasses is CO2. One of the main causes of Nigeria's ecological footprint has been the country's consumption of biomass (Abd'razack and Ahmad Nazri, 2012).

There are a number of emissions kinds in rural areas that are significantly greater than in metropolitan areas. The reason is that a lot of biomass energy was used by rural households. Towns are much higher than large and medium-sized cities in urban regions because locals burn coal more frequently. It demonstrates how the impact of energy use on locals' health is progressively growing from metropolitan areas and county towns to rural locations. The valleys in this area are home to numerous villages. The atmosphere's ability to purify itself is diminished. For a considerable amount of time, the emissions accumulate in the atmosphere above the towns and villages. In urban environments, household emissions are low since general emissions do not show up in the habitation.

From whole society, electric power and heating produce also same emissions. On this basis, regional emissions.

GGE from a social and household standpoint differ significantly between urban and rural locations. The GGE of rural homes is significantly higher than that of urban households due to lower power use. From the viewpoint of the entire community, the GGE is nearly equal for households in rural and urban areas. In other words, the shift in energy consumption habits from rural to urban homes only serves to raise the standard of living for locals. Reducing emissions has little impact on society as a whole.

CONCLUSION

Fossil energy predominates in urban families while biomass and fossil energy coexist in rural households. Urban families' energy consumption falls into the development or enjoyment category when it comes to energy usage purposes, whereas rural households' energy consumption falls into the conventional survival category. The household and social perspectives show that there are significant differences in GGE between rural and urban locations. The production and consumption of heat and electricity result in a spatial utopia. The emissions from society are far greater than those from homes. The differences between household and societal GGE are significant due to the comparatively higher usage of electricity and pipe heating by urban dwellers. The usage of fuels puts rural dwellers' health at greater risk than that of urban residents.

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