African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)
www.abjournals.org

COOKING ENERGY CONSUMPTION, PREFERENCES AND EFFECT AMONG RURAL AND URBAN HOUSEHOLDS IN KATSINA STATE, NIGERIA

Mannir Sani[1], Abubakar Y.[2], and Ikwuakam O. T.[3]

[1]Department of Agricultural Education, Federal College of Education, Katsina.
Email: smunirh1963@gmail.com

[2]Department of Agricultural Education, Federal College of Education, Katsina.
Email: abubakar.yusuf5@gmail.com

[3]Department of Agricultural Education, Federal College of Education, Katsina.

Email: ikwuosca@yahoo.com

*Corresponding Author's Email: ikwuosca@yahoo.com

Cite this article:

Mannir Sani, Abubakar Y., Ikwuakam O. T. (2024), Cooking Energy Consumption, Preferences and Effect Among Rural and Urban Households in Katsina State, Nigeria. African Journal of Environment and Natural Science Research 7(3), 125-141. DOI: 10.52589/AJENSR-79QC5UXW

Manuscript History

Received: 22 May 2024

Accepted: 25 Jul 2024

Published: 9 Aug 2024

ABSTRACT: *Despite efforts by Nigerian government, the country has continuously faced immense challenges in providing clean, safe and sustainable cooking energy solutions for its citizens. This seems to characterize distinctive households. The study investigated cooking energy (CE) consumption preference and effect among rural and urban households in Katsina State. A sample of 192 rural and urban households was selected using multistage sampling technique from all Katsina State households. Descriptive survey design and structured questionnaire were adopted in collecting data on CE forms, preference, reasons, effect, and constraints. Frequency counts, percentages, means, PPMC, Chi-square, and t-test were used in data analysis. Results revealed that mean age and income were similar across groups. Urban households (UB) had higher educational attainment compared to rural households (RH). Both households were characterized by married individuals with children. Charcoal and firewood emerged preferred CE sources, with unexpectedly higher among UB. Gas usage was prevalent, while rising kerosene and electricity prices drove shifts away from these sources. RH exhibited high consumption of charcoal, firewood, and biomass residues. Ease of use, versatility, better taste, and cleanliness were key reasons for CE preferences across households. Statistical analyses revealed a significant positive but weak to moderate relationship between effects scores and CE preferences among RH. Education and gender demonstrated significant associations with CE preferences, in RH. The comparison of mean CE consumption showed a slightly higher level in RH, but the difference was not statistically significant. The findings underscore the importance of tailored energy policies and interventions, addressing constraints related to fire risk, costs, access, technical knowledge, and income opportunities. Consideration of demographic factors is crucial, especially in rural settings where disparities in income, education and preference may persist.*

KEYWORDS: Rural households, urban households, cooking energy, preference, effect, constraints.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)

www.abjournals.org

INTRODUCTION

Access to clean and sustainable cooking energy remains a major developmental challenge in Nigeria. A large proportion of the population, particularly in rural areas, continues to rely heavily on polluting solid biomass fuels like fuelwood, charcoal and agricultural residues for meeting their cooking energy need (Dioha & Emodi, 2019; Manya, Inuwa, Wakkala, & Aminu, 2024). This has adverse effects on human health, the environment and social well-being.

Household air pollution from inefficient burning of solid fuels is estimated to cause over 95,000 premature deaths annually in Nigeria Ozoh, Eze, Lakpo, Chukwu-Okeah, Maduka, Gueguim & Nwachukwu, (2020). Women and young children face the highest risk due to their high exposure levels while cooking (Ibikunle, Asongu, Ozorchen, & Urama, 2023). The drudgery of collecting fuelwood also imposes huge time burdens, limiting economic opportunities, especially for women (Maina, Hyseni, Yaro, & Mahmoud, 2021).

While modern fuels like kerosene, liquefied petroleum gas (LPG) and electricity are more widely utilized in urban centers, erratic supply chains and high costs hamper complete transition away from traditional biomass, even among city dwellers (Edomah, 2022). Thus, the use of multiple cooking energy sources in a household is evidently prevalent (Maina et al., 2021).

Cultural preferences around food types, tastes and cooking practices also influence fuel choices and act as barriers to adopting clean cooking solutions in certain contexts (Manya et al., 2024). As of 2022, over 85 million Nigerians still lacked access to clean cooking energy services, as defined by the UN's Sustainable Development Goal 7 (Ibikunle et al., 2023).

Understanding the disparities in cooking energy consumption patterns, preferences and impacts between rural and urban households is crucial for designing effective policies and interventions to accelerate the transition to clean cooking in Katsina State and Nigeria as a whole.

Statement of the Problem

Despite efforts by the Nigerian government and international development agencies, the country has continued to face immense challenges in providing access to clean, safe and sustainable cooking energy solutions for a large segment of its population. The over reliance on polluting solid biomass fuels like fuelwood, charcoal and agricultural residues, especially in rural areas, pose severe risks to human health, environmental sustainability and socio-economic development.

According to estimates, over 85 million Nigerians lacked access to clean cooking services that meet the standards defined by the UN's Sustainable Development Goal 7 as of 2022 (Ibikunle et al., 2023). Household air pollution from inefficient burning of solid fuels is a leading risk factor, causing over 95,000 premature deaths annually in the country (Ozoh et al., 2020). Women and children disproportionately bear this health burden due to their high exposure levels while cooking.

The drudgery associated with collecting fuelwood also imposes significant time costs and limits economic opportunities for many rural Nigerians, particularly women (Maina et al., 2021). This perpetuates gender inequalities and inhibits human capital development.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

Additionally, unsustainable harvesting of fuelwood contributes to environmental degradation, deforestation and ecological imbalances.

While a transition towards modern cooking fuels like kerosene, liquefied petroleum gas (LPG) and electricity has occurred in urban areas facilitated by higher incomes, erratic supply chains, high costs and market failures impede complete fuel switching even among city dwellers (Edomah, 2022; Maina et al., 2021). The practice of fuel stacking compounds these issues.

Moreover, socio-cultural factors like food preferences, tastes and cooking traditions act as barriers against wholesale adoption of clean cooking solutions across many Nigerian households (Manya et al., 2024). Lack of awareness about health impacts and the benefits of modern cooking technologies also hamper behavior change. Overcoming these multifaceted challenges requires a comprehensive understanding of the rural-urban disparities in cooking energy usage patterns, preferences and associated effects in Nigeria and Katsina State in particular.

Objectives of the Study

The general objective of the study was to examine cooking energy consumption, preferences and effect among rural and urban households in Katsina State. The specific objectives included to:

1. Find out forms of cooking energy consumed by rural and urban households.
2. Find out the scale of consumption by rural and urban households.
3. Find out preferred forms of cooking energy by rural and urban households.
4. Identify reasons for the preferred forms of cooking energy.
5. Identify the effect of cooking energy forms consumed by rural and urban households.

LITERATURE REVIEW

Nigeria continues to grapple with issues of household energy access, with significant rural-urban disparities in cooking fuel choices and consumption patterns. A study by Dioha and Emodi (2019) analyzed cooking energy use across the six geographical zones of Nigeria. They found that fuelwood remained the predominant fuel in rural areas across all zones, ranging from 61% in the South-South to 89% in the North-West while kerosene and LPG were more widely used in urban centers.

Ozoh et al. (2020), whose study focused on the health effects of cooking energy, estimated that exposure to pollutants from solid fuel use caused over 95,000 premature deaths in Nigerian households in 2019. Of this figure, women and children faced the highest risk due to their high exposure levels while cooking. In the same vein, Maina et al. (2021) reported that over 70% of rural households in northern Nigeria primarily used solid biomass fuels compared to only 20% of urban households in 2020. Higher income earning was further revealed to have facilitated greater LPG (43%) and electricity (22%) uptake among urbanites (Maina et al. (2021). Added

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

to finding is fuel stacking of multiple energy sources which reportedly was also more prevalent in cities.

On the other hand, Edomah (2022) highlighted how disruptions in the supply chain negatively impacted the availability and affordability of kerosene and LPG for many households in 2021-2022, forcing them back towards fuelwood and charcoal use despite their health and environmental concerns.

A comprehensive assessment by Ibikunle et al. (2023) has also revealed that as at 2022, over 85 million Nigerians still lacked access to clean cooking services, as defined by Sustainable Development Goal seven (SDG 7). They projected that under current policies, 32% of the population could still be using polluting biomass cooking by 2030, far off-track for achieving universal access. In collaboration, Manya et al. (2024) added that fuelwood has remained the primary cooking fuel in 63% of rural households surveyed across the six states in 2023. Cultural preferences, fuel costs and supply issues were further revealed to impede transition to LPG and electricity (Manya et al., 2024).

METHODOLOGY

The study was conducted in Katsina State located in the North-Western zone of Nigeria. The state covers an area of 23,938 sq. km. and is located between latitudes 11Â°08'N and 13Â°22'N and longitudes 6Â°52'E and 9Â°20'E (Adewale, Olowu & Ladele, 2005). It has 34 local government areas (LGAs) from three senatorial districts, shares a common boundary with Niger Republic in the North, Jigawa and Kano States in the East, Kaduna State in the South and Zamfara State in the West. All rural and urban household members from the three senatorial districts formed the population of the study. Multistage sampling procedure was used for the study. In the first stage, 4 LGAs were selected from each senatorial district to give 12 LGAs using the purposive sampling procedure. These included Batsari, Jibia, Katsina, Kaita, Malumfashi, Dutsinma, Bakori, Kafur, Daura, Bauer Mashi, and Maidua. The second stage involved using systematic sampling procedure to select 4 households from each selected rural and urban characterized LGAs to give 48 households. In the third stage, systematic sampling technique was employed to select 2 urban and 2 rural household members each to give 192 household members used for the study.

A descriptive survey design was adopted for the study due to its high propensity of inclusiveness and the ease with which participants' opinions on the variables under study were obtained. A structured questionnaire was developed, validated and tested for reliability using Cronbach Alpha. A reliability index of .086 was obtained adjudged good for the instrument. The questionnaire comprised Sections A, B, C, D and E based on the study objectives (forms of CE consumed, preferred CE, consumption reasons, effect and constraints).

The forms CE consumed were measured by asking respondents to respond to a list of CE on a 2-point scale of Consumed (1) and Not consumed (0). Respondents who responded Consumed were awarded 1 and Not consumed 0. A total score was obtained and items that scored below the mean value were rated low while those whose score equalled or was greater than the mean were scored high. Preferred forms of cooking energy were measured based on level of preference ranging from Highly preferred (2), Preferred (1) and Not preferred (0). The mean

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)
www.abjournals.org

score was obtained and used to categorize CE consumption into high preferred (scores of mean and above mean) and low preferred cooking energy (for scores below mean).

For effects of forms of CE consumed, a five-point Likert-Type scale was used to assess respondents' level of agreement to each of the effects. A score of 5, 4, 3, 2 and 1 were assigned to each Strongly agree, Agree, Undecided, Disagree and Strongly disagree, for positively worded statements and a reverse for negatively worded statements. An index of each perceived effect was computed, and the mean was used to categorize the level of perceived effects into High (≥ mean score) and Low (< mean score) respectively. Descriptive (frequency counts, percentages and means} and inferential statistics (PPMC, Chi-square and t-test) were employed in data analysis. The constraint to CE consumed was measured by asking respondents to respond to a list of forms of constraints.

RESULTS

Respondents' Personal Characteristics

Table 1 presents the results on respondents' personal characteristics. The result shows that overall (34.6%), rural (30.2%), and urban (38.9%) were within the same age range of 31-40 years with a mean age of overall (41.59), rural (41.00) and urban (41.00) years. The result further reveals that overall (55%) earned up to <₦250000 annually. Also, rural (64.6%) and urban (45.3%) respondents earned <₦250000 with mean income earning of ₦991,125.13, ₦566,843.75 and ₦1,419,872.63. The result on educational qualification showed that overall (33%) and rural (59.4%) possessed quaranic education while 54.7% attained tertiary educational. On respondents' marital status, the result revealed that overall (54.7%) were married. In the rural and urban areas, 93.8% and 86.3% were married respectively. The result further revealed that overall (51.3%), rural (50%), and urban (52.6%) were females respectively.

Table 1: Distribution of respondents based on personal characteristics

Category	Level	Overall %	Mean±sd	Rural %	Mean±sd	Urban %	Mean±sd
Age	<=20	2.1	41.59±11.50	4.2	41.00±13.49	0	42.18959.0±96
	>60	5.8		6.2		5.3	
	21-30	16.8		24		9.5	
	31-40	34.6		30.2		38.9	
	41-50	26.7		19.8		33.7	
	51-60	14.1		15.6		12.6	
Annual income	<250000	55	991125.13±2399143.54	64.6	566843.75±1651257.09897	45.3	1419872.63±2917012.76
	>1000000	21.5		9.4		33.7	
	251000-500000	9.4		8.3		10.5	
	501000-750000	7.3		7.3		7.4	

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

	751000-1,000000	6.8	10.4	3.2
Education	Primary	6.8	9.4	4.2
	Quranic	33	59.4	6.3
	Secondary	30.4	26	34.7
	Tertiary	29.8	5.2	54.7
Marital status	Divorced	2.1	0.0	4.2
	Married	54.7	93.8	86.3
	Single	2.1	0.0	4.2
	Widowed	5.8	6.2	5.3
Gender	Female	51.3	50	52.6
	Male	48.7	50	47.4

Consumption Preferred Cooking Energy (CE)

Table 2a presents results on frequency of consumption of preferred CE. The result shows that overall, 60.7%, 52.9%, and 51.8% of the respondents never consumed electricity, material residues and gas respectively. However, consumption of firewood (67.5%), kerosene (41.4%) and charcoal (38.2%) as cooking energy were always, rarely and occasionally respectively. The result further indicated that based on the weighted score, firewood, charcoal and gas ranked 1st, 2nd, and 3rd respectively as CE consumed overall.

In urban areas, 62.1% never consumed material residues unlike kerosene (54.7%), electricity (43.2%), gas (38.9%), charcoal (37.9%) and firewood (35.8%) that were respectively consumed rarely, occasionally, and always. Using the weighted scores also, gas, charcoal, and firewood ranked 1st, 2nd, and 3rd respectively as CE consumed, whereas electricity (94.8%), gas (92.7%), kerosene (60.4%), and (43.2%) were never consumed in the rural area. Firewood (99%) and charcoal (38.5%) were consumed always and occasionally respectively. Using the weighted scores, charcoal, firewood, material residues, and electricity ranked 1st, 2nd, and 3rd respectively as energy sources consumed.

The result in Table 2b shows that overall (62.3%) CE consumption is high. The result on urban areas indicates that 57.9% of the respondents had high CE consumption while the situation differed in rural areas as 82.3% recorded low level of CE consumption.

Table 2a: Distribution of respondents based on consumption of preferred CE

Energy forms	Not preferred	Rarely	preferred	Highly preferred	Weighted score	Rank
Overall						
Electricity	60.7	10.5	22.5	6.3	0.7435	7th
Gas	51.8	8.4	20.9	18.8	1.0681	3rd
Kerosene	38.7	41.4	17.8	2.1	0.8325	4th
Charcoal	17.8	19.9	38.2	24.1	1.6859	2nd
Firewood	12	7.9	12.6	67.5	2.356	1st
Material residue	52.9	20.9	21.5	4.7	0.7801	5th

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

Urban						
Electricity	26.3	17.9	43.2	12.6	1.4211	5th
Gas	10.5	13.7	38.9	36.8	2.0211	1st
Kerosene	16.8	54.7	24.2	4.2	1.1579	4th
Charcoal	8.4	25.3	37.9	28.4	1.8632	2nd
Firewood	24.2	14.7	25.3	35.8	1.7263	3rd
Material residue	62.1	18.9	17.9	1.1	0.5789	7th
Rural						
Electricity	94.8	3.1	2.1	0	0.0729	3rd
Gas	92.7	3.1	3.1	1	0.125	5th
Kerosene	60.4	28.1	11.5	0	0.5104	4th
Charcoal	27.1	14.6	38.5	19.8	1.5104	1st
Firewood	0	1	0	99	2.9792	2nd
Material residue	43.8	22.9	25	8.3	0.9792	2nd

Table 2b: Level of preferred CE consumption

Consumption category	F	%	Mean	SD
Overall				
High	72	37.7	8.768	2.336
Low	119	62.3		
Urban				
High	55	57.9	8.768	2.336
Low	40	42.1		
Rural				
High	17	17.7		
Low	79	82.3	6.177	2.210

Reasons for CE Consumed

Table 3 presents respondents' reasons for the type of CE used. Overall, easy to use (92%), used for any cooking (70%), gives better taste (64%), clean cooking (62%), and close to source (50%) constituted the reasons for using electricity. In urban areas, easy to use (93.88%), used for any cooking (71.43%), gives better taste (65.31%), and clean cooking (63.27%) constituted the reasons for the use of electricity. Reduction of fire accidents (100%) and status (100%) were the reasons in rural areas.

Overall also, easy to use (82.67%), used for any cooking (78.67%), gives better taste (72.00%), and clean cooking (70.67%) were the reasons for respondents' use of gas. In urban areas, easy to use (84.51%), used for any cooking (81.69%), gives better taste (71.83%), and clean (70.42%) were the reasons while clean cooking (75%), gives better taste (75%), and easy to use (50%) constituted the reasons for gas utilization. The result further reveals that easy to use was advanced as the reason for the use of kerosene among overall (62.96%), urban (62.96%), and rural (80%) respondents.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)
www.abjournals.org

The use of charcoal recorded easy to use (85.95%), used for any cooking (71.07%), and close to source (52.89%) as reasons for the overall respondents. In urban areas, easy to use (85.07%), used for any cooking (76.12%), and close to source (56.72%) were the reasons for charcoal usage while easy to use (87.04%), used for any cooking (64.81%), and close to source (48.15%) were the reasons. Reasons for overall utilization of firewood included close to source (78.95%), easy to use (74.34%), used for any cooking (67.11%), and our tradition (50.66%). In urban areas, easy to use (85.88%), used for any cooking (81.36%), and close to source (78.95%) were the reasons for firewood usage. In the same vein, close to use (81.72%), easy to use (75.27%), used for any cooking (58.06), and tradition (51.61%) constituted the reasons.

The reasons for overall use of material residues were easy to use (68.97%), close to source (55.17%), and used for any cooking (58.62%). In urban areas, close to source (66.67%), easy to use (66.67%), and fire accident reduction were pointed out as reasons for utilization of material residues, while in rural areas, close to source (70.59%), easy to use (66.67%) and tradition (64.71%) were the reasons for the utilization of material residues.

Table 3: Distribution of respondents based on reasons for CE used

Reasons	Electricity	Gas	Kerosene	Charcoal	Firewood	Material residue
Overall						
Close to source	50	24	25.93	52.89	78.95	55.17
Our tradition	2	4	3.7	20.66	50.66	41.38
Reduces fire accident	16	12	29.63	38.84	15.79	24.14
Cooks faster	32	24	7.41	9.09	7.24	3.45
Clean cooking	62	70.67	22.22	21.49	9.21	3.45
Used for any cooking	70	78.67	37.04	71.07	67.11	58.62
Easy to use	92	82.67	62.96	85.95	74.34	68.97
Gives better taste	64	72.00	11.11	28.1	21.71	0.00
Status symbol	12	13.33	11.11	0.83	1.32	13.79
Urban						
Close to source	51.02	25.35	29.41	56.72	74.58	66.67
Our tradition	2.04	4.23	5.88	11.94	49.15	8.33
Reduces fire accident	14.29	11.27	35.29	49.25	30.51	50
Cooks faster	32.65	25.35	11.76	14.93	16.95	8.33
Clean cooking	63.27	70.42	17.65	34.33	22.03	8.33
Used for any cooking	71.43	81.69	47.06	76.12	81.36	75
Easy to use	93.88	84.51	52.94	85.07	72.88	66.67
Gives better taste	65.31	71.83	5.88	47.76	22.03	0.00
Status symbol	10.2	14.08	17.65	1.49	3.39	33.33
Rural						
Close to source	0.00	0.00	20	48.15	81.72	47.06
Our tradition	0.00	0.00	0.00	31.48	51.61	64.71
Reduces fire accident	100	25	20	25.93	6.45	5.88
Cooks faster	0.00	0.00	0.00	1.85	1.08	0.00
Clean cooking	0.00	75	30	5.56	1.08	0.00

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

Used for any cooking	0.00	25	20	64.81	58.06	47.06
Easy to use	0.00	50	80	87.04	75.27	70.59
Gives better taste	0.00	75	20	3.7	21.51	0.00
Status symbol	100	0.00	0.00	0.00	0.00	0.00

Effect of CE Consumed

Table 4 presents results on the effect of CE consumed. The result indicates that overall, CE consumed caused eye irritation (37.2%), body wounds (36.6%), respiratory diseases (30.9%), and pollution increase (30.9%). The result further shows that 43.5% disagreed that cooking energy used had caused climate change. The result further indicates that based on the weighted score, body wounds, eye irritation and respiratory diseases ranked 1st, 2nd, and 3rd respectively as effects of CE consumed.

In urban areas, 43.5%, 32.6%, and 30.5% of the respondents strongly agreed that cooking energy used caused body wounds, respiratory diseases, and eye irritation respectively while 37.9% disagreed that it caused climate change. Using weighted scores also, the result shows that in the urban areas body wounds, eye irritation and respiratory diseases ranked 1st, 2nd, and 3rd as effects of cooking energy used.

In rural areas also, body wounds **(**38.5%) and respiratory diseases (35.4%) were agreed to have been the effects of CE used while eye irritation (41.7%) and pollution increase (37.5%) were strongly agreed to have been caused by CE used. Similarly, body wounds, eye irritation and respiratory diseases ranked 1st, 2nd, and 3rd as the effects.

Table 4: Distribution of respondents based on effect of CE consumed

Effect of CE consumed	SD	D	U	A	SA	weighted score	Rank
Overall							
Causes body wounds	3.1	16.2	13.1	30.9	36.6	3.8168	1st
Causes respiratory diseases	7.3	23.6	7.3	30.9	30.9	3.5445	3rd
Eye irritation	6.8	24.6	6.3	25.1	37.2	3.6126	2nd
Increases pollution	7.3	28.3	6.8	26.7	30.9	3.4555	4th
Causes climate change	15.7	43.5	20.9	14.7	5.2	2.5026	5th
Urban							
Causes body wounds	4.2	18.9	11.6	23.2	42.1	3.8412	1st
Causes respiratory diseases	8.4	25.3	9.5	26.3	30.5	3.4526	3rd
Eye irritation	8.4	26.3	7.4	25.3	32.6	3.4737	2nd
Increases pollution	12.6	25.3	7.4	30.5	24.2	3.2842	5th
Causes climate change	24.2	37.9	13.7	14.7	9.5	2.4737	4th
Rural							
Causes body wounds	2.1	13.5	14.6	38.5	31.2	3.8333	1st
Causes respiratory diseases	6.2	21.9	5.2	35.4	31.2	3.6354	3rd
Eye irritation	5.2	22.9	5.2	25	41.7	3.7512	2nd
Increases pollution	2.1	31.2	6.2	22.9	37.5	3.6251	4th
Causes climate change	7.3	49	28.1	14.6	1	2.5312	5th

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)

Constraints to CE Use

Table 5 presents results of constraints to household CE consumption. Overall, dirty to use constituted the major concern to gas (61.54%) and kerosene (88.52%) while risk of fire accidents constrained the consumption of electricity (70%), gas (62.67%), and firewood (51.02%). Low technical know-how was a moderate concern to charcoal (3.29%) and electricity (42%) consumption. Low income majorly constrained the use of charcoal (47.37%), electricity (36%), and gas (24.59%).

The result further shows that scarcity was a significant issue with gas (61.54%), electricity (46.67%), kerosene (40.16%), and charcoal (32.89%). Poor education posed relatively low concern to gas (3.85%) and firewood (28.57%) consumption. High cost was a major constraint to electricity (80%), gas (77.33%), and charcoal (21.71%) utilization.

Among urban households, high costs of CE were a significant constraint to electricity (93.88%), gas (84.51%), kerosene (85.07%), firewood (72.88%), and material residues (66.67%) consumption. Poor education was also a major issue with electricity (71.43%), gas (81.69%), kerosene (76.12%), firewood (81.36%), and material residues (75%) consumption. Scarcity of energy sources was a significant concern, particularly for electricity (63.27%) and gas (70.42%), followed by kerosene (34.33%) and charcoal (22.03%). Materials residue (8.33%) was less affected by scarcity. Low income was a moderate constraint, with electricity (32.65%), gas (25.35%), kerosene (14.93%), and charcoal (16.95%) being affected. Material residues (8.33%) were less affected by low income. Low technical know-how was a constraint to kerosene (49.25%), material residues (50%), gas (35.29%), and charcoal (30.51%), but less so for electricity (14.29%). The risk of fire accidents was relatively a low constraint to urban households, with firewood (49.15%), gas (5.88%), kerosene (11.94%), and materials (8.33%) being perceived as potential fire hazards. Electricity (2.04%) was considered the least risky. Firewood (74.58%), charcoal (56.72%), and material residues (66.67%) were constrained by dirty to use, while gas (29.41%) and electricity (51.02%) were less associated with the constraint of being dirty.

Among rural households also, the result as shown in Table 5 reveals that high cost was a significant constraint for rural households, with gas (80%), firewood (75.27%), material residues (70.59%), and kerosene (87.04%) being perceived as expensive. Electricity (0%) was not considered expensive. Poor education was a major issue for kerosene (64.81%), firewood (58.06%), and material residues (47.06%) consumption, but less so for gas (25%) and electricity (0%). Scarcity of energy sources was a concern for gas (75%) and kerosene (30%), but less of an issue for charcoal (5.56%), firewood (1.08%), material residues (0%), and electricity (0%). Low income was not a significant constraint for rural households, with only charcoal (1.85%) and firewood (1.08%) being affected. Electricity (0%), gas (0%), kerosene (0%), and material residues (0%) were not affected by the low income earning strength. Low technical know-how was a major constraint for electricity (100%), followed by gas (25%), kerosene (20%), and charcoal (25.93%). Firewood (6.45%) and material residues (5.88%) were less affected by this constraint. The risk of fire accidents was also a significant concern for material residues (64.71%), firewood (51.61%), and charcoal (31.48%) consumption but less so for kerosene (0%), gas (0%), and electricity (0%). Firewood (81.72%), charcoal (48.15%), and material residues (47.06%) were perceived as dirty to use, while kerosene (20%), gas (0%), and electricity (0%) were not associated with being dirty among rural households.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)
www.abjournals.org

Table 5: Distribution of respondents based on constraint to CE consumption

Sector	Constraints	Electricity	Gas	Kerosene	Charcoal	Firewood	Material residues
Overall	Dirty to use	0	4	61.54	88.52	71.05	0
	Risk of fire accidents	70	62.67	15.38	6.56	28.95	51.02
	Low technical know-how	42	37.33	3.85	4.1	3.29	34.69
	Low income	36	36	26.92	24.59	47.37	10.2
	Scarcity	62	46.67	61.54	40.16	32.89	18.37
	Poor education	18	10.67	3.85	14.75	14.47	28.57
	High cost	80	77.33	57.69	17.21	21.71	14.29
Urban	Dirty to use	51.02	25.35	29.41	56.72	74.58	66.67
	Risk of fire accidents	2.04	4.23	5.88	11.94	49.15	8.33
	Low technical know-how	14.29	11.27	35.29	49.25	30.51	50
	Low income	32.65	25.35	11.76	14.93	16.95	8.33
	Scarcity	63.27	70.42	17.65	34.33	22.03	8.33
	Poor education	71.43	81.69	47.06	76.12	81.36	75
	High cost	93.88	84.51	52.94	85.07	72.88	66.67
Rural	Dirty to use	0	0	20	48.15	81.72	47.06
	Risk of fire accidents	0	0	0	31.48	51.61	64.71
	Low technical know-how	100	25	20	25.93	6.45	5.88
	Low income	0	0	0	1.85	1.08	0
	Scarcity	0	75	30	5.56	1.08	0
	Poor education	0	25	20	64.81	58.06	47.06
	High cost	0	50	80	87.04	75.27	70.59

Relationship Between Variables

Table 6 presents correlation results assessing the relationship between age, income, effects scores, and the level of consumption of energy sources across different sectors (overall, urban, and rural).

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)

www.abjournals.org

For the overall data, age, income, and effects scores showed no statistically significant correlation with energy consumption, with p-values above 0.05. The correlation coefficients (r values) are close to zero, indicating weak or negligible linear relationships.

In the urban sector, similar to the overall, age and income exhibited no significant correlation with energy consumption, as their p-values exceeded 0.05. Effects scores also showed no significant correlation, although there is a slightly stronger positive correlation compared to the other sectors.

In the rural sector, age and income continued to show no significant correlation with energy consumption, with p-values above 0.05. However, effects scores showed a significant positive correlation ($p = 0.0415$) with energy consumption. The positive correlation coefficient (0.2085) suggests a weak to moderate positive relationship between effects scores and energy consumption in the rural areas.

These results imply that while age and income did not appear to significantly influence energy consumption across sectors, effects scores (indicative of factors like environmental consciousness or awareness) demonstrate a significant positive relationship with energy consumption, specifically in rural areas.

Table 6: Pearson Product Moment Correlation showing personal characteristics and level of consumption of CE

Variable	P= value	r = value	Decision
Pooled			
Age	0.7571	-0.0225	NS
Income	0.8564	-0.0132	NS
Effects scores	0.0903	0.1229	NS
Urban			NS
Age	0.829	-0.0224	NS
Income	0.2538	-0.1182	NS
Effects scores	0.0752	0.1834	NS
Rural			NS
Age	0.4297	-0.0815	NS
Income	0.2023	-0.1313	NS
Effects scores	0.0415	0.2085	S

Test of Association Between Selected Personal Characteristics and Cooking Energy Consumption

Table 7 presents Chi-square results on the association between respondents' personal characteristics (marital status, education status, and sex) and CE consumption for the overall, urban, and rural areas). The results indicate that significant relationships were observed overall for educational qualification (Chi-square value = 8.376, $p = 0.039$) and sex (Chi-square value = 9.946, $p = 0.002$). This implies that these factors were associated with cooking energy preferences. Interestingly, in rural areas, both education qualification (Chi-square value = 7.528, $p = 0.057$) and sex (Chi-square value = 10.293, $p = 0.001$) demonstrated significant

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

associations with CE consumption. This suggests potential socioeconomic and gender-related influences on energy choices in rural areas. These findings underscore the importance of considering demographic factors when designing energy policies and interventions tailored to specific areas, particularly in rural areas where disparities in energy access and utilization may exist. Moreover, the results imply a need for targeted initiatives aimed at addressing gender and education differentials to promote equitable and sustainable energy practices across diverse communities.

Table 7: Chi-square test of association between selected personal characteristics and CE consumed

Variable	Chi-square value	Df	P = value
Overall			
Marital status	3.109	3	0.375
Education	8.376	3	0.039
Sex	9.946	1	0.002
Urban			
Marital status	0.603	3	0.896
Education	0.822	3	0.844
Sex	2.186	1	0.139
Rural			
Marital status	0.234	1	0.629
Education	7.528	3	0.057
Sex	10.293	1	0.001

Test of Differences on Types of CE Consumed

Table 8 presents the results of the t-test comparing the type of energy consumed between urban and rural areas in Katsina State. The mean consumption in rural areas (17.375) is slightly higher than in urban areas (16.484), with a mean difference of 0.891 units. However, the t-value of 1.223 and the associated p-value of 0.223 indicate that this difference is not statistically significant at $p < 0.05$). Therefore, we fail to reject the null hypothesis of no difference in energy consumed between urban and rural areas in Katsina State. This suggests that, based on this prevailing data, there is insufficient evidence to conclude that a significant disparity exists on the type of energy consumed between urban and rural households in the state.

Table 8: Difference between urban and rural areas in CE consumption

Groups	N	Df	Mean	SD	Mean Difference	t-value	p-value
Rural	96	178	17.375	0.126	0.891	1.223	0.223
Urban	95	178	16.484	0.126			

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)

www.abjournals.org

DISCUSSION OF RESULTS

Notably both rural and urban households showed the same mean age which depicted young and active dispositions of the respondents. The mean annual income implied that both households were low income earners and as such were finding it difficult to meet their CE requirements. This is in tandem with the findings of Tchereni (2013) that income level of a household is a determinant of CE choice and utilization. Expectedly, most urban households attended tertiary education while rural households were dominated by those who attained Quaranic education. This means the existence of disparity in literacy level, which may determine CE preference (Karakara, Dasmani, and Buchenrieder, 2019), also revealed similar results emphasizing that one's educational attainment could have an effect on the type of CE used by the household. The composition of married people in both households was also in line with the a priori observation and further explains the complex nature of the households with parents and children. In terms of female gender dominance in rural and urban households, the result was expected given the dominant role of in CE consumption in most households. Mbaka, Gikonyo, and Kisaka (2019) showed a similar result and attributed it to the fact that most decisions in the household on what to cook, CE to use and actual cooking are the exclusive prerogative of the female gender.

Although the preferred CE (charcoal and firewood) consumption was high, their preference and frequent was among urban households was not expected. However, while the dominant consumption of gas may be as a result of availability, the shift from the expected use of kerosene and electricity may be attributed to their price increases. Also, while the consumption of charcoal, firewood, and material residues by rural households were in line with the a priori observation, this could not be said of electricity considering their low income and literacy levels. Mbaka et al. (2019) revealed the possibility of this scenario while insisting that there could be a shift in CE consumption when females and children are the main household decision makers.

The reasons adduced for preferred CE sources by most rural and urban households were similar and included easy to use, used for any cooking, better taste, and clean cooking. This indicates that the disparities in households' literacy and income levels did not create different reasons for CE preferences. It has correspondingly been revealed that people still hold on to better tastes, low fire accidents, clean cooking, and easy to use as major reasons for CE preference (Onyekuru, Ifejirika, Onuigbo Mebo, & Eboh, 2020). Also, that body wounds, eye irritation, and respiratory diseases ranked as major effects of preferred CE among rural and urban households was also in line with the a priori observation. Onyekuru et al. (2020) also confirmed that charcoal and firewood, which were most preferred CE, are known to produce a lot of black soot and carbon dioxide that are injurious to health and the environment.

Addressing significantly the identified constraints of risk of fire accidents, costs, improving access, and availability of CE, technical knowledge and education about CE sources and usage as well as prompting income-generating opportunities of the households at various levels are crucial. The results were in line with the earlier findings of Adewuyi, Ademulegun, and Ajayi (2019) on factors influencing CE; Rahut, Das, and Bauer (2020), and Mensah and Adu (2022) on determinants of household energy consumption pattern; and Osiolo et al. (2021) on CE preference.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 3, 2024 (pp. 125-141)
www.abjournals.org

The PPMC result reveals that while age and income did not significantly correlate with CE preference, effects scores showed a statistically significant positive relationship with energy consumption preference for the rural households. The correlation coefficient indicated a weak to moderate positive correlation, suggesting that as the effects scores increase, the preference for energy consumption tends to increase as well for rural households. This finding aligns with Osiolo et al. (2021) who identified the determinants of household cooking energy preference and consumption intensity in Kenya.

The Chi-square results on the association between respondents' personal characteristics and CE consumption for the overall reveal a significant association between educational qualifications, sex, and CE preferences. Interestingly, in the rural households, educational qualification and sex demonstrated significant associations with CE consumption. This suggested potential socioeconomic and gender-related influences on energy choices in rural households. These findings underscore the importance of considering demographic factors when designing energy policies and interventions tailored to specific areas, particularly in rural areas where disparities in energy access and utilization may exist. This finding aligns with the study by Malla, Mayer, & Nizami (2021), which revealed that households with higher education levels in Nepal were more likely to adopt cleaner cooking fuels, such as LPG and biogas, compared to households with lower education levels. Similarly, Mensah and Siaw (2022) reported a positive association between educational attainment and the likelihood of using modern cooking fuels among households in Ghana. The study by Elu, Yeboah, Mahmud, & Kamil (2021) in sub-Saharan Africa highlighted gender-based disparities in access to clean cooking fuels, suggesting that women's decision-making power within households can influence cooking energy choices.

The t-test result comparing CE consumption between urban and rural households indicated that the mean consumption in rural households is slightly higher than that of the urban households. However, because the difference is not statistically significant, we fail to reject the null hypothesis of no difference in cooking energy consumption between urban and rural areas in Katsina State. This suggests that, based on this prevailing data, there is insufficient evidence to conclude that a significant disparity exists in energy consumption between urban and rural households in the state. These findings are consistent with the study by Mensah and Adu (2022), who investigated the determinants of household cooking energy transition in Ghana's Volta Region.

CONCLUSION

Based on the findings, it is concluded that both rural and urban households have a relatively young and active population, but differ in income levels and educational attainment. Also, rural households are predominantly dependent on traditional cooking energy sources like charcoal, firewood, and agricultural residues, while urban households have higher consumption of gas and electricity. The reasons for energy source preferences, such as ease of use, better taste, and clean cooking, are similar across rural and urban households, despite disparities in literacy and income levels. Age and income did not significantly correlate with cooking energy preferences, but the "effects scores" showed a positive relationship with energy consumption preference, especially for rural households. Additionally, educational qualifications and gender demonstrated significant associations with cooking energy consumption, particularly in rural

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

households, indicating potential socioeconomic and gender-related influences on energy choices. Interestingly too, there was no statistically significant difference in overall cooking energy consumption between urban and rural households in Katsina State.

RECOMMENDATIONS

Based on the above conclusion, it is recommended that:

1. Addressing the constraints and barriers related to the risk of fire accidents, costs, access and availability, technical knowledge, and education about cooking energy sources and usage is germane.

2. Promoting income-generating opportunities for households at various levels to improve their economic capacity and energy access is crucial.

3. The demographic factors of the households, such as educational qualifications and gender, should be put into cognizance when the government is designing energy policies and interventions, especially for rural areas where disparities in energy access and utilization may exist.

4. Government and non-governmental agencies should conduct targeted awareness campaigns and educational programs to address the misconceptions or preferences related to taste, cleanliness, and ease of use, especially for traditional cooking energy sources.

5. Innovators should explore more sustainable and affordable cooking energy alternatives that can cater to the needs and preferences of both rural and urban households while minimizing their environmental and health effects.

REFERENCES

Adewale A. A, Olowu T.O & Ladele, A.A (2005) Bridging the Communication Gap between Scientists and Farmers in Katsina State of Nigeria: A review of the activities of the Information and Communication Support for Agricultural Growth in Nigeria (ICS-Nigeria) Project in Katsina State of Nigeria. Ibadan: International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria

Adewuyi, O. B., Ademulegun, T. P., & Ajayi, V. O. (2019). Cooking energy preference among rural dwellers in Osun State, Nigeria. Journal of Renewable Energy and Environment, 5(1), 1-7.

Dioha, M. O., & Emodi, N. V. (2019). Exploring sustainable cooking fuels for sub-Saharan Africa. Renewable and Sustainable Energy Reviews, 116, 109394.

Edomah, N. (2022). Energy poverty coping costs for households in Nigeria. Energy for Sustainable Development, 67, 161-177.

Elu, I., Yeboah, F. E., Mahmud, M., & Kamil, N. F. (2021). Gender and clean cooking energy choice in Sub-Saharan Africa. Environmental Science and Pollution Research, 28(24), 30611-30625. https://doi.org/10.1007/s11356-021-13113-z

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW

Ibikunle, R., Asongu, S., Ozorchen, H., & Urama, K. (2023). Achieving universal access to clean cooking in Nigeria: Status, prospects and policy options. Energy Policy, 174, 113411.

Karakara A.A., Dasmani I. and Buchenrieder G. (2019). An econometric analysis of domestic fuel consumption in Ghana: Implications for poverty reduction. Cogent Social Sciences, 5 (1). DOI: 10.1080/23311886.2019.1697499

Maina, D. M., Hyseni, B., Yaro, M. A., & Mahmoud, Y. (2021). Household use of cooking energy in Northern Nigeria. Energies, 14(7), 1955.

Malla, S., Mayer, A. L., & Nizami, A. S. (2021). Determinants of household cooking energy choice in Nepal. Renewable and Sustainable Energy Reviews, 137, 110662. https://doi.org/10.1016/j.rser.2020.110662

Manya, D. S., Inuwa, I. I., Wakkala, A. M., & Aminu, Y. D. (2024). Determinants of cooking energy choices in rural Northern Nigeria: A case study. International Journal of Sustainable Energy Planning and Management, 32, 21-36.

Mensah, E. R., & Siaw, K. A. (2022). Determinants of modern energy consumption for cooking in Ghana: Evidence from household data. Energy Policy, 165, 112975. https://doi.org/10.1016/j.enpol.2022.112975

Mensah, J., & Adu, G. (2022). Determinants of household cooking energy transition in Ghana: Evidence from the Volta Region. Energy Policy, 170, 113275.

Onyekuru N.A., Ifejirika C.A., Onuigbo D.M., Mebo R.A. and Eboh E.C. (2020) Factors Affecting Households' Choice Of Cooking Energy In Enugu State, Nigeria. Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension Volume 19 Number 4 pp. 6 – 13

Osiolo, H. H., Masaviru, W. K., & Mulwa, R. M. (2021). Determinants of household cooking energy preference and consumption intensity in Kenya. Renewable and Sustainable Energy Reviews, 139, 110710.

Ozoh, O. B., Eze, C., Lakpo, S., Chukwu-Okeah, G., Maduka, O., Gueguim K.E. B., & Nwachukwu, E. (2020). Premature mortality due to air pollution in Nigeria. Heliyon, 6(6), e04145.

Rahut, D. B., Das, S., & Bauer, S. (2020). Household energy consumption patterns and determinants of energy transition across income groups in India. Energy Policy, 147, 111824.

Acknowledgement

We gratefully acknowledge the financial support from TETFUND. The authors also extend enormous gratitude to the anonymous reviewers, for their helpful review and critical comments.

Article DOI: 10.52589/AJENSR-79QC5UXW
DOI URL: https://doi.org/10.52589/AJENSR-79QC5UXW