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Promoting Clean Household Cooking Energy Sources in Rural Areas: A Case Study of Obio/Akpor Local Government Area, Rivers State, Nigeria.

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Article information	Abstract
 	The decade of gas as declared by the federal government of Nigeria, requires more proactive and deliberate ways and means to expand domestic gas utilization. This study assessed the use of Liquefied Petroleum Gas (LPG) as a cooking energy source among rural households in the Obio/Akpor Local Government Area of Rivers State. A multistage sampling procedure was used to sample 416 respondents from residents within the Ikwerre communities of River State. A structured interview questionnaire was used to collect data from the respondents, these were analyzed using descriptive (frequencies, percentages, means, and ranks) and power BI. The study revealed that the mean age of respondents was 36.5 years with the majority being married (55.8%), with the highest educational qualification belonging to the 64.5% bracket of secondary school certificate holders. 94% of low-income earners of less than N30,000 per month are major users of other fuel sources other than LPG, with higher-income earners more likely to use LPG. 76.9% of the respondents asserted that their choice of cooking fuel type is influenced by the high cost of available alternatives. Though LPG is cleaner and most preferred amongst the higher income and middle-class earners, it is generally affected by price instability, frequency of re-filling, fear of explosion, and inadequate refilling stations in interior residential areas. To sustain increasing LPG domestic demand, more awareness amongst rural areas needs to be created, Government must create the enabling economic and infrastructural environment to reach and penetrate rural communities.

1. Introduction

Power Oil and Gas (Petroleum) play a crucial role following the huge natural resources present in Nigeria [1]. This natural endowment has strategically positioned Nigeria, globally. according to [2], about 90% of Nigeria's foreign exchange earnings are derived from this sector, and the

provision of unemployment is not left out. Nigeria can relate effectively at the international level due to the growth witnessed in oil earnings.

Nigeria has an oil reserve of 31.2 billion barrels, and 5.0 billion barrels of Condensate, amounting to a total of Total 36.2 billion barrels. Nigeria is ranked the 12th largest oil producer in the world, the 8th largest exporter in the world, the 10th largest proven oil reserve in the world and the 2nd largest proven oil reserve in Africa respectively [3]. Similarly, Nigeria has associated gas reserves of 92.6 trillion cubic feet, and non-associated gas reserves of 90.2 trillion cubic feet, amounting to a total of 182.8 trillion cubic feet with the following ranking: 7th largest proven gas reserve in the world and 1st largest proven gas reserve in Africa. The projection is about 600 trillion cubic feet with dedicated gas exploration. A recent report shows that Nigeria has a proven natural gas reserve at 203.16 tcf [4] as against the 202 tcf earlier reported in 2019 by DPR. This implies that the nation, literally, sits on a wealth of reserves which, if well utilized, can serve as a catalyst for her economic growth and national prosperity [5] following the dominant role played by natural gas in Nigeria. One way of utilizing natural gas in Nigeria is through Liquified Petroleum Gas (LPG), a vital part of natural gas with its potency to replace gasoline as fuel for cooking gas, is mostly operated at low pressure with C3H8 and C4H10 as major compositions [6]. Methane, a colorless and odorless gas is a major component in the LPG mixture [7]. LPG has over the years been identified as a clean source of energy both for cooking and industrial uses.

Nigeria happens to be the leader in gas production in Africa and also the leader in the dual purpose Kerosine (DPK), firewood and other unconventional sources of energy as cooking fuels. As such there is still much to be desired in the utilization of LPG as domestic cooking fuel in Nigeria, this is evident in the low LPG per capita consumption of the country standing at below 1.5kg when compared to those of other sub-Sharan African countries with more impressive LPG per capita consumption [8]. Unarguably, Liquefied Petroleum Gas (LPG) has proven to be a promising gas that could result in a revolutionary change and transform the existing state of the rural areas in Rivers State regarding domestic gas utilization as evidence abounds; serves as a substitute cooking energy to Kerosene, possess the potential in serving as an automobile fuel substitute to petrol in Nigeria [9], utilized to drive country's economy that will transcend to greater development [10], capable of increasing and improving the benefits derivable from Nigerian gas through the LPG in the next decades to come [6].

This study attempts to unravel the above-outlined LPG benefits in the rural area of Rivers State. Rivers State is one of the states in Nigeria with high natural gas reserves. Companies such as Nigeria Agip Oil Company (NAOC), Total Energies, and Shell Production and Development Company (SPDC) amongst others that produce this natural gas are domiciled in the rural areas of Rivers State. Utilizing natural gas domestically has lots of economic benefits in Rivers State considering its great value and positive contributions. This unique endowment in natural gas has necessitated the need to raise the needed awareness of domestic gas utilization in the rural area of Rivers is apt and timely, hence, the main motive for carrying out this study.

Therefore, the authors of this paper intend to create the needed awareness concerning domestic gas utilization in the jurisdiction under study through the following objectives: (1) To ascertain preferred cooking fuel in the rural area of Rivers State. (2) To examine the level of awareness of LPG consumption in the rural area of Rivers State. (3) To recommend a policy to boost natural gas utilization in the rural area of Rivers State. Methodologically, the econometric analytical tool known as E-views was implored to carry out the analysis through the aid of a questionnaire issued to the parties concerned. Overall, qualitative and quantitative approaches were used in carrying out the research. The result is expected to unravel the needed awareness in order to effectively

utilize the domestic gas available in the jurisdictions under study. This study will provide illumination that will in turn enable the needed awareness on how Governments, Oil companies and citizens of Nigeria can effectively harness the benefits derivable from domestic gas utilization in the jurisdiction under study.

Natural gas represents a quantum portion of the energy resources in Nigeria. Before now, the Nigerian government and international oil companies (IOCs) concentrated mainly on oil exploration, neglecting natural gas development in the process. A recent report shows that Nigeria has a proven natural gas reserve at 203.16 tcf [4] as against the 202 tcf earlier reported in 2019 by DPR. Although Nigeria's proven gas reserves were valued to be 190.4 tcf at the end of 2019 [11], the said valuation appears to be a conservative estimate of Nigeria's natural gas reserves when matched with DPR'ˢ report. Hence, Nigeria holds the 10th position in the world regarding natural gas reserves, following Nigeria's capacity to house 2.7% of the world's proven reserves [11]. No doubt, because no substantial effort has been directed towards natural gas exploitation, the natural gas reserves currently found in Nigeria are mostly associated with oil search. So, an outright search for natural gas as against serendipitous discovery, while prospecting for oil, has a greater tendency of discovering reserves amounting to 600 tcf [12]. Worthy of note is the quality of Nigeria's natural gas reserves as it contains little amount of Sulphur and is also rich in natural gas liquid (NGLs) [13]. Thus, making gas commands a good premium in the market. It is, however, sad to note, a large portion of these premium resources end up at the flare tips in most oil facilities spread around the country. Gas flaring from Nigeria once accounted for 16% of the total worldwide quantity of gas flared in 2013 according to the US Energy Information Administration but has now reduced to about 10% of the total global figure as of 2018 [14]. Even though Nigeria has witnessed a good reduction in the quantity of gas flared in recent times, when compared to previous reports on gas flaring from the country, it still portends an economic woe for the country to have lost so much in value that could have been harnessed for posterity. World Bank estimated the cost of gas flaring on the global economy at US$20 billion in 2018. PWC report, [14], valued Nigeria's loss to gas flaring in 2018 as US$761.6 million which represents 3.8% of the world's total loss to gas flaring in 2018, without considering the environmental effect of the flared gas and its implication for Nigeria and the world at large.

The oil-rich Niger Delta region of the country covers about 11.5% of Nigeria's total land mass where Nigeria's proven gas reserves are predominantly sited. The total reserves are distributed between land (70%) and offshore locations (30%) of the total reserves respectively. It is found in gas reservoirs as Non-Associated Gas (NAG) or produced along with oil as Associated Gas (AG). In recent times, 70-75% of the associated gas is flared. The reason is due to inadequate gas extraction, processing and transportation infrastructures. Only about 12% of the produced gas is re-injected back into the reservoir [12]. Oil companies prefer to flare the associated gas, thereby reducing the overpressure of downstream equipment as they are unable to handle the gases as a result of infrastructure limitations. A number of the IOCs in conjunction with NNPC now embark on gas-gathering solutions across their facilities in order to aggregate natural gas from different fields and process for pipeline and market specifications. This tends to align with the government's gas policy. However, NAG constitutes a chunk of the nation's gas resources but had received minimal attention in time past until recently when multinationals, in Nigeria, now invest in the development of the NAG fields.

Globally, natural gas represents the third largest energy source, and its consumption is required to grow substantially in the nearest decades. Gas has been tipped to overtake oil in the nearest future as a major fuel between 2020 and 2030 [12].

Several studies on Liquified Petroleum Gas as a cooking energy substitute for kerosene showed the need to provide a pathway for having a framework and structured blueprint to successfully embark on a Switch-to-LPG programme as a better energy source of energy for cooking [8]. The nexus of Gas consumption and Industrialization in Nigeria unravels the causal flow, if any, between the two variables using an econometric model [15]. The result shows that industrialization drives gas consumption in Nigeria in the long run. Nigeria's Natural Gas Utilization and Sustainability of Supply ensure that Nigeria Nation has enough gas to meet her domestic and export commitments in the next 3 decades or more [16].

Despite several inroad policies by the government to encourage her growing populace to transit to LPG utilization from firewood, there seem to be holdbacks in the rural areas. Some of the reasons deduced for this abnormality include.

- Poor road access
- Cultural biases which lead to a preference for traditional modes of energy
- Low purchasing power
- Lack of infrastructure
- Lack of investment in the Gas sector
- Lack of awareness

2. Materials and Methods

This cross-sectional, population-based study was conducted in Ikwerre Local Government Area (LGA) of Rivers State, Nigeria. The State is situated in the south-south oil-rich Niger Delta region of the country with Port Harcourt as its commercial center. Rivers State is home to about 5,198,716 people of which 51% are male and 48% female. Adults and adolescents within the age range of 15-64 years account for 61% of the population while children below 15 years account for 36% of the population and the aged account for the remaining 3% [17].

Ikwerre LGA where this study was conducted is one of the 23 LGAs in Rivers State with a land mass of 655 km^2. The rural area is made up of 13 communities with a population of approximately one hundred and ninety thousand people. This study focuses on the Obele-Ibaa community which has a population of about 5000 people whose main occupation is subsistence agriculture and petty trading.

2.1 Participant Selection

Residents of Obele-Ibaa live in small clusters of about 30 households. 10 participants above 18 years of age who were primary decision makers on the choice of cooking fuel or the main family chef were randomly chosen from each of the 15 clusters understudied.

2.2 Data Collection

The study was conducted over a 7-day period in September of 2021. Trained interviewers administered a structured questionnaire to participants during a face-to-face interview. The interviewers were trained in their local dialect on the aim of the study and how to administer the questionnaires which had only open-ended questions. The questionnaires were administered in English. However, interviewers were sometimes required to communicate in their local dialect. Data obtained from participants include their status, choice of cooking fuel, income level and reasons for non-usage of LPG.

3. Result and Discussion

3.1 Analyses And Interpretation

Table 1: Demographic profile of respondents

Demographic Profile	Category	Frequency	Percent	Cumulative Percent
Gender	Male	193	47.3	47.3
	Female	215	52.7	100.0
	Total	408	100.0	
Marital Status	Single	133	32.0	32.0
	Married	232	55.8	87.7
	Widow	40	9.6	97.4
	Separated	8	1.9	99.3
	Divorced	3	0.7	100.0
	Total	416	100.0	
Age	18-21years	74	18.3	18.3
	22-34years	120	29.6	47.9
	35-50years	148	36.5	84.4
	Above 50years	63	15.6	100.0
	Total	405	100.0	
Education	Primary	39	10.0	10.0
	Secondary	252	64.5	74.4
	Tertiary	100	25.6	100.0
	Total	391	100.0	
Income Level	10,000-30,000	314	93.7	93.7
	31,000-50,000	2	0.6	94.3
	51,000-70,000	14	4.2	98.5
	Above 70,000	5	1.5	100.0
	Total	335	100.0	

Table 1 indicated that 193 (47.3%) respondents were male while 215 (52.7%) of them were female. This shows that the majority of the respondents are female. The marital status shows that respondents who are single accounted for 133 (32%) while 232 (55.8%) are married. 40 (9.6%) and 8 (1.9%) of the respondents are widows and separated respectively. Only 3 (0.7%) of the

respondents are divorced. On age profile, Table 1 revealed that 74 (18.3%) of the respondents were between 18 and 21 years old, 120 (29.6%) of the respondents are between 22 and 34years old while 148 (36.5%) are within the age bracket of 35 – 50 years. 63 (15.6%) of the respondents are above 50 years Profile on the educational qualification of respondents further showed that only 39 (10%) respondents have primary education as their highest educational qualification. 252(64.5%) of them were secondary school certificate holders, while 100 (25.6%) of the respondents are tertiary education (first degree, Master, or PhD) holders.

Regarding the monthly income of respondents, Table 1 revealed that 314 (93.7%) of the respondents earned between N30,000 & below on a monthly basis, 2 (0.6%) of the respondents earned between N30,001 and N50,000 per month, 14 (4.2%) of the respondents earned between N51,00 and N70,000 monthly. Only 5 (1.5%) of the respondents earned above N70,000.

3.2 Respondents' Demographic Profile and Preference for Cooking Fuel

Table 2: Gender and preference for cooking fuel

Choice Of Cooking Fuel	Gender		Total
	Male	Female	
Coal	5	2	7 (1.7%)
Kerosene	45	48	93 (23 %)
Wood	120	136	256 (63.2%)
LPG	21	28	49 (12.1%)
Total	191 (47.2%)	214 (52.8%)	**405**

Table 2 shows that 256 (63.2%) respondents prefer wood. 23% and 12.1% prefer kerosene and LPG respectively. Only 7 (1.7%) of the respondents prefer coal. The results also show that the preference based on gender is 52.8% and 47.2% for females and males respectively.

Table 3: Marital status and preference for cooking fuel

Choice Of Cooking Fuel	Marital Status					Total
	Single	Married	Widow	Separated	Divorced	
Coal	2	4	1	0	0	7 (1.7%)
Kerosene	49	41	5	1	1	97 (23.5%)
Wood	54	166	30	5	1	256 (62.2%)
LPG	25	20	4	2	1	52 (12.6%)
Total	130 (31.6%)	231 (56.1%)	40 (9.7%)	8 (1.9%)	3 (0.8%)	**412**

Table 3 shows that 256 (62.2%) respondents prefer wood. 23.5% and 12.6% prefer kerosene and LPG respectively. Only 7 (1.7%) of the respondents prefer coal. The results also show that the preference based on marital status are 31.6%, 56.1%, 9.7%, 1.9% and 0.8% for single, married, widow, separated and divorced respectively.

3.3 Justification for the Choice of Cooking Fuel

Table 4: Reasons for cooking fuel preference

Options	Frequency	Per cent	Cumulative Percent
High cost of cooking gas	320	76.9	76.9
Preference for traditional cooking	53	12.7	89.7
No Reason	43	10.3	100.0
Total	416	100.0	

The results delineated in Table 4 underscore various significant determinants that impact the selection of cooking fuel in Nigeria. The primary factor reported by the participants for abstaining from the use of cooking gas is its exorbitant cost, as reported by 76.9% of the respondents. The aforementioned observation suggests that the lack of affordability poses a substantial obstacle to the acceptance and utilization of liquefied petroleum gas (LPG) as a cooking fuel within the nation. Furthermore, a proportion of 12.7% of the participants indicated a predilection towards conventional culinary techniques. Conventionally, the practice of culinary preparation involves the utilization of organic matter-based sources of energy, such as timber, charcoal, or remnants of farming activities. The inclination towards conventional culinary techniques may be attributed to various factors such as cultural norms, accessibility to biomass fuels, and inadequate knowledge regarding the advantages of LPG. The persistent dependence on biomass fuels carries adverse consequences for the natural world, public well-being, and gender equity. Furthermore, a proportion of 10.3% of the respondents refrained from providing explicit justifications for their selection of cooking fuel. The insufficiency of data highlights the necessity for additional inquiry aimed at comprehending the determinants that shape their decision-making mechanism. The observed phenomenon may be ascribed to a lack of awareness, indifference, or other variables that were not comprehensively documented in the research.

4. Conclusion and Recommendations.

4.1 Conclusion
The study revealed that the mean age of the participants was 36.5 years, and a significant proportion of them were in a marital relationship (55.8%). Additionally, the predominant segment of participants (64.5%) possessed a secondary school certificate as their utmost educational attainment. The findings of the analysis indicate that a significant proportion of individuals with low-income earnings tend to rely on fuel sources other than liquefied petroleum gas (LPG). In

order to meet the increasing need for LPG in residential settings, it is crucial to raise awareness in rural regions and establish a conducive economic and infrastructural framework that expands the accessibility and distribution of LPG within these populations.

4.2 Recommendations

The results of this study hold noteworthy ramifications for the formulation of novel policies designed to encourage the adoption of LPG in Nigeria. The following are the recommendations to address the challenges associated with the findings of this research work which are a preference for biomass fuels and the high cost of cooking gas.

- **Affordability:** Policymakers should investigate strategies to reduce the high cost of cooking gas, such as subsidies, tax incentives, and financial aid initiatives, to make it more accessible and affordable to a wider demographic.
- **Awareness and Education:** Initiatives should focus on raising awareness and educational programmes about the benefits of using LPG, such as health, environmental, sustainability, ease of use, and safety, particularly in rural areas.
- **Infrastructure Development:** Infrastructure development is essential to promote the utilization of LPG, such as widening the distribution network, establishing LPG refilling stations in remote regions, and guaranteeing supply chain efficacy.
- **Substitutes for Biomass Fuels:** Policymakers should investigate alternative cooking fuels that are environmentally sustainable and have superior cleanliness than conventional biomass fuels in order to address cooking-related environmental concerns.
- **Socio-economic Considerations:** Poverty reduction measures should be implemented to promote the adoption of LPG, such as income-generation programmes, microfinance initiatives, and targeted subsidies.

Policymakers must collaborate with private sector stakeholders and international organizations to implement a comprehensive strategy to encourage the adoption of LPG in Nigeria. This strategy must address cost-effectiveness, knowledge dissemination, necessary facilities, and socio-economic considerations.

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