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APPRAISAL OF ACCESS TO CLEAN FUELS BY FOOD VENDORS IN ILARO, YEWA SOUTH LOCAL GOVERNMENT AREA, OGUN STATE, NIGERIA

Ademola Lukman Lasisi [1],Vincent Abimbola Uwala [2]*
[1]*Department of Urban and Regional Planning, Federal Polytechnic, Ilaro, Nigeria*
[2]*Department of Urban and Regional Planning, Federal Polytechnic, Ilaro*
**Corresponding Author*

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ABSTRACT
The extensive use of solid fuels in food preparation such as firewood and charcoal presents problems for the environment, human health, and the economy. In Nigeria, more than 175 million people rely on traditional biomass for daily cooking. While significant research has been done on access to clean cooking fuels among households, particularly households in rural areas, there is a gap in the study of access to clean fuels among food vendors in developing countries, including Nigeria. This study explores factors influencing access to clean cooking fuel among food vendors in Nigeria. The study adopts a cross-sectional survey design, a pretested questionnaire was administered to all the registered food vendors in the study area. The results show that a significant number of the food vendors in the study area use solid fuels such as firewood and coal. Probit regression result indicates that education and income are significant factors that increase predicted probability of the use of clean fuel among food vendors. Empirical findings also show that financial constraints, availability and distribution of clean fuel, technical issues, and lack of information on the importance of clean fuel usage are some of the attention-seeking challenges inhibiting the adoption of clean cooking fuels among food vendors. Thus, the study suggests the need for integrated strategies that aim at increasing awareness of the benefits of adopting clean cooking fuels among food vendors, improving the affordability of clean cooking fuels, and providing technical assistance for transitioning into clean cooking fuels.

KEYWORDS: *Cooking Fuels, Food Vendors, Clean Energy Nigeria*

1.0 INTRODUCTION

Access to clean, modern fuels at affordable prices is a global challenge with significant threats to well-being, health, and environmental sustainability. Consequently, access to clean fuels and technologies by a greater number of people has been a major issue globally in the last few decades. For instance, as part of the global attempts at tackling this problem, Goal 7, of Sustainable Development Goals (SDGs) aims at ensuring access to modern energy and technology at an affordable price for all by 2030. However, despite academic and policy attention, an estimated 2.4 billion people still rely on dirty and solid fuel for cooking (United Nations, 2021).

This issue is particularly prominent in the rural areas of developing Asia, Africa, and Latin America (Mottaleb, 2022; United Nations, 2021). For example, it was reported that an estimated 970 million people do not have access to clean cooking fuels and technology in Africa (International Energy Agency, 2022). In the same vein, World Bank (2022) avers that only 11 percent of Nigerians have access to clean cooking fuels, making the country one of the leading countries without access to clean fuels and technologies in Africa.

Annually, an estimated number of 4 million premature deaths are recorded globally due to the use of inefficient, dirty, and highly polluting cooking fuels and technologies (World Health Organisation, 2020). In many developing countries, food vendors play a crucial role in the food supply chain, providing competitively priced and easily accessible meals that large portions of the urban population rely on exclusively. Given the scale of their operations, these vendors are major consumers of cooking fuels, making them key contributors to the broader issue of harmful emissions and environmental degradation.

However, little is known about access to clean cooking fuels by food vendors. The majority of the studies on access to clean cooking fuels usually focus on households in urban and rural areas (see Wassie *et al.* 2021; Makonese *et al.* 2018). However, Nwankwo *et al.* (2018) study attempted to examine knowledge, attitudes, and beliefs about the health hazards of biomass smoke exposure among commercial food vendors in Nigeria. Yet, this study and other similar studies like Dienye *et al.* (2016); Awopeju, *et al.* (2014); and Adewole, *et al.* (2013) focused on the health implications of using clean fuels. The problem of access to clean cooking fuels among food vendors who consume a large proportion of key cooking fuels is overlooked. This exclusion creates a challenge for policy formulation. As the UN aims to

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increase access to clean cooking fuels and technology, a thorough knowledge of the problem may greatly aid in the development of successful policies.

Against this backdrop, this study aims to fill the gap in the existing evidence by conducting a cross-sectional study of commercial food vendors in Ilaro. The study examines the types of fuels used by these vendors, investigates the factors influencing their choice of different fuel types, assesses their access to clean cooking fuels, and explores the challenges they face in adopting cleaner alternatives

2.0 MATERIALS AND METHODS

2.1 Research locale

This study investigates the type and usage of clean fuels among food vendors in Ilaro town. The ancient town, Ilaro, is the headquarter of Yewa South local government of Ogun State in Nigeria. The town is located on latitude 6^0 53' 24" and longitude 3^0 01' 20". The development of the town has been influenced by certain important factors. These include colonial urbanization, the establishment of the Federal Polytechnic Ilaro, and the citing of the Dangote cement factory in Ibese. Moreover, Ilaro town has experienced a high degree of urbanization and rapid growth in both spatial and demographic terms, with the developed land area increasing by 20 square kilometers between 1990 and 2018 (Adewara *et al.*, 2019). However, the lack of collar-white jobs in the study area has resulted in a robust informal economy and a predominance of informal incomes. This high level of informality in the economy and the low income of the majority of the households in the area perhaps make commercial food vending a popular business activity in the town.

2.2 Methods

Strategically, this study adopts a cross-sectional survey design. For this study, a total enumeration approach was used. Consequently, all 60 registered members of the association of food vendors in Ilaro were considered as the target population of the study. However, it was discovered during the pre-survey exercise via headcount of food vendors in randomly sampled enumerated areas that there is a high concentration of food vendors in the study area. Thus, available evidence from the pilot study indicates that the current number of operating food vendors in the area quadrupled the number of registered food vendors in the study area. This difference might be due to poor social awareness and a lack of understanding of the importance of belonging to business associations among other factors. Notwithstanding, the current study makes use of 60 registered food vendors in the area to determine the sample size for the study using Krejcie and Morgan (1970) scientific formula as previously used in extant studies (for instance, see Saka & Akinde, 2022; Saka & Fatogun, 2021). The formula is provided thus:

$$\mathbf{S} = \frac{X^2 \; NP(1-P)}{d^2 \; (N-1)+X^2 \; P(1-P)}$$

Where s = sample size; X^2 = table value of chi-square at 1 degree of freedom for desired confidence level (0.95); N = population size (60); and P = population proportion (0.5). The result yields a sample size of 52 Food Vendors.

A closed-ended form of structured questionnaire is used in this study as a data collection instrument followed by interviews. However, despite the simplicity of the questions contained in the data instrument, the researchers along with four other research assistants helped some target respondents who were observed as semi-illiterates or uneducated to read out the questionnaire and obtain their responses accordingly.

Furthermore, the researchers rely on cumulative normal distribution function as an econometric strategy to specify the probit model for the study. The probit model is often used to model the functional relationship between binary response outcome and a set of explanatory variables (Anaeto et al., 2017; Kim, Albuquerque, & Bronnenberg, 2016; Horowitz & Savin, 2001). The econometric technique, probit model, has been previously applied to model choice of selection between two outcomes by Kim *et al* (2016) and for the estimation of factors that determine user selection between two choices by Anaeto *et al* (2017). Therefore, the use of probit model in this study to examine choice of food vendors in selecting their choice between solid and clean fuels and subsequently analyze the determinants of usage is plausible and asymptotically efficient. The econometric procedures for specification of the study probit model are provided as thus:

$$P(Y = 1|X) = F\left(\alpha_0 + \sum_{i=1}^{n} \beta_n X_n\right) \ldots (1)$$

Where,

$P =$ Conditional probability; $F =$ cdf (cumulative distribution function) $Y =$ Choice of Fuel (solid fuel or clean fuel); $X =$ a set of explanatory variables; $\alpha_0 =$ model constant; $\beta =$ vector of X's coefficient; n = number of X factors.

Equation (1) can be written in equation (2) as thus:

$$P(Y = 1|X) = F(\alpha_0 + \beta_1 X_1 + \cdots + \beta_n X_n) \ldots (2)$$

From equation (2), $X_1 \; to \; X_n$ represent individual explanatory variables (1…n)

Consequently, equation (2) is further calibrated in equation (3) to take account of the study predicted outcome (choice of fuel) and a set of explanatory variables (determinant factors). Thus, the cross-sectional based probit model in equation (3) is given as:

$$P(cof = 1|X) = F(\alpha_0 + \beta_1 edu_i + \beta_2 inc_i + \beta_3 soo_i + \beta_4 dis_i + \beta_5 cos_i + \beta_6 exp_i + \beta_7 tas_i + \beta_8 now_i) \ldots (3)(Study\ Model)$$

Where,

$cof =$ Choice of Fuel (Clean Fuel = 1 or Solid Fuel = 0); $edu = education$; $inc = income$; $soo = operation\ size$; $dis = distance$; $cos = cost/affordability$; $exp = experience$; $tas = taste$; $now = number\ of\ workers$; $i =$ individual food vendor; $\beta_1 - \beta_6 =$ slope coefficients of explanatory variables of the study. Equation (3) implies that $Y = 1\ (use\ of\ clean\ fuel)$ is chosen conditional on a set of

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predictors that include education, income, operation size, distance, cost, experience, and vendor taste. Number of workers is used in the study model as a control variable.

Finally, the study uses a maximum likelihood estimator to examine equations (3) (the study probit-based model) while the conditional marginal effect technique is employed for interpretation of results. The use is premised on the fact that the maximum likelihood technique is asymptotically efficient for both small and large samples and as such produces precise estimations (Horowitz & Savin, 2001). The estimation of the study econometric models follows initial descriptive analysis to examine the first objective. It is important to state that all analyses are conducted at both 5% and 10% levels of significance with the use of STATA 12.1 as statistical software.

3.0 RESULTS AND DISCUSSION

3.1Presentation of Results

This sub-section presents both outcomes of the study descriptive and probit regression analyses. These results are presented in Table 1 and Table 2 as thus:

Table 1: Descriptive Analysis of Food Vendors in Ilaro Town

Indicator	Category	Frequency	Percentage (%)
Gender	Male	3	5.77
	Female	49	94.23
	Total	52	100
Marital Status	Single	6	12.25
	Married	43	87.75
	Total	**49**	**100.00**
Age Group	15-24 years	1	1.96
	23-34 years	8	15.69
	35-44 years	21	41.18
	45-54 years	13	25.49
	55 years and above	8	15.69
	Total	**51**	**100.00**
Education	Primary	15	29.41
	JSS/Modern School	8	15.69
	SS/SEC/TTC	18	35.29
	ND/NCE	6	11.76
	B.Sc./HND	4	7.84
	Total	**51**	**100.00**
Income Level	N20,000 and below	5	10.00
	N20,001- N40,000	3	6.00
	N40,001- N60,000	8	16.00
	N60,001- N80,000	5	10.00
	N80,001- N100,000	8	16.00
	N100,000 and above	21	42.00
	Total	**50**	**100.00**
Used Fuel Type	LPG (liquefied petroleum gas)	20	38.46
	Firewood	27	51.92
	Coal	5	9.62
	Total	**52**	**100.00**

Source: Authors' Computation from STATA 12.1 (2024)

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Table 2: Probit Regression Estimation (Conditional Marginal Effect) Results of Determinants of Choice of Fuel

Predictor	Coeff.	Std. Error	z-score	p-value
edu	.625	.282	2.22	0.027**
inc	.756	.328	2.31	0.021**
soo	.187	.728	1.63	0.103
dis	-.640	.379	-1.69	0.091***
cos	-.533	.532	-2.40	0.016**
exp	.203	.327	0.62	0.535
tas	-.487	.287	-1.69	0.090***
now	-.814	.617	-2.94	0.003**
_cons	-3.225	3.509	-0.92	0.358
Model Summary				
No. of obs.			49	
LR chi2(8)	33.28			0.0001
R-squared	0.5086			
Pearson chi2(37)	35.80			0.5250

Note: DV = Choice of Fuel (Clean Fuel = 1 or Solid Fuel = 0); IV = Independent Variable; cons = model constant; coeff. = slope coefficient; Significance at 5% = **; Significance at 10% = ***

Source: Authors' Computation from STATA 12.1 (2024)

3.2 Interpretation of Results

The information in Table 1 illustrates the description of socio-economic conditions of sampled respondents (food vendors) using measures such as frequency, percentage, and cumulative percentage. As stated earlier in the methodology section, the two researchers along with four other enumerators as research assistants conducted the survey among subjects of the study. This combined effort makes it easier to obtain very impressive and satisfactory responses from the studied food vendors in Ilaro town. For instance, the responses obtained over many important questions range between 50 and 52 feedbacks (recall, the study uses a sample size of 52 food vendors). However, there are a few cases of missing responses due to personal decision of certain respondents not to disclose what they perceived as sensitive answers. However such incidence of missing cases is minimal and does not in any way affect the study analysis particularly econometric estimation of probit regression that is sensitive to missing values. On the basis of gender analysis, Table 1 shows that 94.23% of the food vendors in the study area are female while 5.77% are male. This gender analysis indicates that plurality of current food vendors in Ilaro town are female, either ladies or women.

Out of 49 respondents who provided responses to interrogation on marital status, 87.75% affirmed that they are married while 12.25% confirmed their marital level as single. The result shows that preponderance of food vendors in the study area are married individuals. Age analysis of 51 responses obtained, a paltry 1.96% of the target population are between 15 and 24 years old; 15.69% of the sampled population have their age ranges between 25 years to 34 years. The greater number of the target population who are processed food sellers in the study area are between 35 and 44 years of age. This group is closely followed by those food vendors that are in the age bracket at intervals of 45 and 54 years while the old vendors (aged 55 years and above) constitute 15.69% of the target population. From the result, approximately 84% of the total sampled food vendors are between 15 and 54 years. Thus, greater number of the target population in the study area are young and adult food vendors.

Furthermore, on education basis, the descriptive result in Table 1 reveals that 29.41% of the target population have elementary (primary) education. Similarly, 15.69% of the sampled population has either Junior Secondary School education or attended and finished Modern School. Those who obtained either ND or NCE certificate from higher institutions represent 11.76% of the total population followed by minute number of respondents who either earn a B.Sc. or HND certificate constituting 7.84% of the target population. However, greater part of the population possesses SS/SEC/TTC certificates. From education analysis result, 80.39% of the study research interests have less than secondary education or put safely did not attend tertiary institutions. Thus, a low level of education is predominant among food vendors in Ilaro town. Income analysis shows that 10% of the sampled food vendors earn below ₦20,000 per month. Similarly, another 10% of the target population makes between ₦60,001 and ₦80,000 as monthly income. A measly proportion of the food vendor population in the study area takes home between ₦20,001 and ₦40,000 as income every month. While 16% of the population earn between ₦40,001 and ₦60,000 as monthly income another 16% of the sampled food vendors also obtain income figures between ₦80,001 and ₦100,000 monthly. However, out of 50 responses obtained on monthly income inquiry, 42% of them asserted that they earn above ₦100,000 every month.

From the income analysis, 58% of the target population earns below ₦100,000 every month. Thus, food vendors in Ilaro town are generally low-income earners. Moreover, the result in Table 1 further reveals descriptive analysis of the type of fuel currently used for cooking by food vendors in the study area. The indicator

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on such inquiry exhibits that 38.46% of the studied population uses LPG (Liquified Petroleum Gas) while 51.92% utilizes firewood as fuel for cooking foods. A negligible proportion representing 9.62% of the target population currently employs coal energy as fuel for cooking in their business operations. From the fuel type analysis result, it can be inferred that 61.54% of the sampled respondents currently use either firewood or coal energy for cooking. Hence, the use of solid fuel is predominant or common among food vendors in Ilaro town.

Furthermore, the estimation results of inferential analysis conducted with the aid of probit regression as econometric strategy employed in this study are displayed in Table 2 above. As noted earlier, probit regression technique is adopted in this study to analyze determinants of choice of clean fuel which has two categories (use clean fuel or solid duel). The values of slope coefficients in Table 2 represent predicted probabilities of predictors and a control variable (*now*). A total number of 49 observations was finally used by the system software (STATA 12.1) as data points for the maximum likelihood estimation of the study probit regression estimation procedures. The constant value of the model indicates that if all the predictors *(edu, inc, soo, dis, cos, exp, and tas)* and control factor (now) are examined at zero then predicted probability of using clean fuel reduces by 3.225 point. However, such possibility of reduced predicted probability would be insignificant *(_cons: p-value = 0.358)* at either 5% or 10% level of significance. In term of prediction, factors such as education level *(edu),* income *(inc),* size of operation *(soo),* and user experience *(exp)* positively increase predicted probability of the use of clean fuel while other predictors like distance (dis), cost *(cos),* taste *(tas)* and number of workers (*now*) as control variable reduce predicted probability that food vendors in the study area will use clean fuel. However, factors such as size of operation *(soo),* and user experience *(exp)* are insignificant predictors to cause changes in the predicted probability of the use of clean fuel by the food vendors in the study area.

From Table 2, the conditional marginal effect *(CME)* is used to analyse the magnitude of change in the outcome variable by each predictor at both 5% and 10% significance levels while holding other predictors constant. *CME* result shows that at both 5% and 10% significance levels, one additional level of education of food vendors will significantly *(edu: p-value = 0.027)* lead to an increase in the predicted probability of the use of clean fuel by 0.63 point. Again, one naira (₦1) increase in the food vendor monthly income will significantly *(inc: p-value = 0.021)* lead to an increase in the predicted probability of clean fuel usage by .76 at 5% and 10% significance levels. On the contrary, one meter increase in the distance covered by the food vendor to access a given clean fuel will significantly (dis: p-value = 0.091) lead to decrease in the predicted probability of the use of clean fuel at 10% level of significance. Similarly, at the same significance level, increase in preference for a given clean fuel due to social status significantly *(tas: p-value = 0.090)* reduces the predicted probability that another choice of clean fuel will be used by a food vendor. For cost as a predictor, one naira (₦1) increase in the cost of clean fuel energy or its affordability will significantly *(cos: p-value = 0.016)* bring about a decrease in the predicted probability of the use of clean fuel by .53 at both 5% and 10% significance levels respectively. Again, at the same significance levels, one additional labour employed by a food vendor will prompt a significant *(now: p-value = 0.003)* decrease in the predicted probability for the use of clean fuel by .84 point. Further analysis reveals that a greater number (more than 60%) of food vendors in the study area face certain critical challenges for the use of clean fuel. As observed from the field, these challenges include financial constraints, availability and distribution of clean fuel, technical issues (like equipment availability), and lack of information on the importance of clean fuel usage. Moreover, the model summary statistics is also shown Table 2 with important indicators to determine the suitability and goodness-of-fit of the study model. The software used 49 for final estimations and chi-square estimate of log-likelihood ratio is found to be significant at both 5% and 10% levels of significance. Thus, the study model fits well and behaves better than a model without predictors. Also, chi-square of Pearson statistics implies the non-rejection of null hypothesis that the model really fits the data employed for the study.

4.0 DISCUSSION OF RESULTS

The current study examines the type of fuels used by food vendors in Ilaro town and factors responsible for the use of clean among the vendors using cross-sectional data from a sampled 52 food vendors. From the analyses conducted, it is discovered that preponderance of food vendors in the study are married young and adult female with less than secondary education and make less than ₦100,000 as income every month. It is further revealed that greater number of food vendors in the study area use solid fuels such as firewood and coal due to critical challenges faced by them to adopt and apply clean fuel technologies in their operations. As revealed by on-field analysis, these important attention-seeking challenges include financial constraints, availability and distribution of clean fuel, technical issues and lack of information (or poor education) on importance of clean fuel usage. Thus, estimating factors that determine the use of clean among food vendors in Ilaro town is further reinforced by the current study. The probit regression result (using *CME* for interpretation) indicates that education and income are significant factors that increase predicted probability of the use of clean fuel among food vendors in the study area. This evidence is consistent with previous findings by Kapsalyamova *et al.* (2021) and Ali and Khan (2022). On the contrary, the study observed that distance, cost, taste (or preference) and number of workers (as a control variable) significantly reduce predicted probability that a given food vendor from the study area will use a clean fuel. Similarly, such empirical evidence on distance and cost has been documented in existing literature as important economic factors that affect decision to use clean fuel (e.g. Kapsalyamova *et al.*, 2021; Ali & Khan, 2022). However, the evidence on taste as observed by this study is unprecedented in existing literature on the use of clean fuel. The reason for this unexpected result might be due to rigidity or special likeness for a particular energy fuel

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among people or lack of belief in other related fuels. Also, the result on number of workers is as well unexpected. But to reduce the cost of operations a large food vendor with more employees may decide to use solid fuel (e.g. firewood) for cooking purposes instead of using clean which is presumably and relatively expensive.

5.0 CONCLUSIONS

The findings from this study revealed that the cooking energy portfolio of food vendors in Ilaro is dominated by solid fuels such as firewood and charcoal. The result of the study confirms that education and income are significant factors that increase predicted probability of the use of clean fuel among food vendors in the study area. The findings also showed that financial constraints, availability and distribution of clean fuel, technical issues, and lack of information on the importance of clean fuel usage are some of the attention-seeking challenges inhibiting the adoption of clean cooking fuels among food vendors. The study suggests the need for integrated strategies that aim at increasing awareness of the benefits of adopting clean cooking fuels among food vendors, improving the affordability of clean cooking fuels, and providing technical assistance for transitioning into clean cooking fuels.

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