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Household Cooking Energy Use in Nigeria: Case of Ado Ekiti Local Government Area of Ekiti State

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Abstract

The relevance of energy in households' cooking activities cannot be over-emphasised in the well-being of household members. And its use is being influenced by socio-economic and cultural factors. With high level of education of the Nigeria populace in Africa, yet the country has the highest number of persons who do not access clean-modern cooking energy (like electricity and liquefied petroleum gas), as an average of its populace still rely on biomass sources of energy for cooking, which culminates into deforestation, soil erosion, and desertification. Against this backdrop, this study was carried out to examine the socio-economic and cultural factors influencing households' cooking energy use in Nigeria; specifically in Ado Ekiti Local Government Area of Ekiti State. In order to achieve the objective of this study, a semi-structured questionnaire was used for data collection. The data collected were analysed using the Multinomial Logistic and Marginal Effects Regression Models with Maximum Likelihood Estimation Technique. The study reveals that thedeterminants of households' cooking energy choice were found to be the size of household, household heads' average income, accessibility of clean energy, availability of clean energy and traditions/cultural belief and taste preferences. Also the electricity utilised for cooking is at less than 1% in the study area. The findings also reveal that a mix of clean and polluting cooking energy is being utilised by households when their economic status advances. Hence, the study recommends that grassroots government should ensure that households have adequate access to clean cooking energy sources that are environmentally friendly by encouraging installations of gas stations closer to users' doorsteps in the study areas.Also, the private sector should create promotional incentives for households to encourage them for more patronage which will reduce the utilization of polluting cooking energy among households in Nigeria.

Keywords: *Cooking Energy Consumption, Cooking Energy Determinants, Household, Nigeria, Socio-economic and cultural factors*

Introduction

The basic energy needed for cooking is essential to end-users (particularly households) to subsist in their environment, thus, energy enhances all human activities in life, and so it plays a vital role in the livelihoods of households. Household energy utilised for cooking which does not include energy used for food processing and preparation before purchase, thus, forms a major part of the overall energy that is domestically consumed. The household sector itself consumes enormous proportion of cooking energy in Nigeria; with it accounting for more than 25 percent of total commercial energy and over 90 percent of traditional fuels especially fuel wood(Dayo2008,5).

There is no doubt; household energy is greatly receiving global attention particularly as the world becomes increasingly urban (Kawu 2012,13); thus, the 2018 world health organisation stat isticsrevealed that 2.5 to 3 billion people rely on firewood/fuel wood for cooking (Kuo and Azam 2019, 15-16) with about 1.5 million of them experiencing difficulty in finding adequate fuel wood for cooking (Emodi, and Boo 2015, 582). However, in most African cities, the commonest cooking energy source for low income people is biomass (comprises of firewood, charcoal, animal dung, crop residue) and the highest proportion of the population using the biomass energy sourcesfor cooking are in sub - Saharan Africa, Nigeria inclusive (Ogunniyi, Adepoju and Olapade 2012, 12).

The household sector accounts for the largest share of energy consumption in Nigeria with about 64 percent with energy consuming activities such as cooking, lighting and use of electrical appliances but, cooking averagely account for about 71 percent out of the 64 percent of the total energy consumed in the household (Energy Commission of Nigeria [ECN], 2012). Likewise, 65 percent of households' cooking is done mainly with home - made traditional stoves or open fires(Kulla, Suleiman, and Ishaya 2012, 237); and these stoves are fired by various forms of biomass fuels such as firewood, animal residue, charcoal, and saw dust, as against the 35 percent that uses the conventional energy like kerosene, liquefied petroleum gas(LPG), and electricity (Yakubu 2014, 35). The free availability of these fuels from nature makes them the primary fuel source for households' cooking purpose. In Nigeria, the dependence on traditional energy fuels for cooking increases energy-related pollution at the household level, which are harmful to human existence, and somehow contribute to environmental degradation. It’s being revealedthat, household cooking practices such as the type of fuel used and the participation in food preparation can pose serious implications on the environment (Arnold, Köhlin, and Persson 2006, 598).Moreover, it is assumed that household energy consumption normally varies according to the levels of the household income. This is to say that, the differences in energy consumption pattern of households are solely the reflection of the differences in the monetary income; and this is regarded as the "energy ladder hypothesis".

The energy ladder hypothesis "states that people with low incomes generally use traditional fuels as their major cooking energy source and people with higher incomes tend to use clean-modern fuels" (Nicolai and Fiona 2008, 57); Sa’ad&Bugaje (2016, 129) thereby suggested that with rising income households generally move up towards the peak of the energy ladder from firewood to charcoal or kerosene and then to liquefied petroleum gas (LPG), or electricity for cooking. That is, when income increases households no more consume the same cooking fuel, but they completely shift to consuming higher quality cooking fuel(s) with no greenhouse emissions during usage-cooking fuels that are truly clean at point of use.Thus, the concept of energy ladder hypothesis has severally been used to explain how the pattern of energy use in different households varies with their economic status and each step of the ladder corresponds to different energy source, and the step to which the household climbs the ladder depends mainly on income.

This empirical study was carried out during the non festive period of year 2020, to determine the socio-economic and cultural factors influencing the choice of cooking energy among households in Ado Ekiti Local Government Area of Ekiti State, Nigeria. Hence, the findings from this study provides information on factors that either motivate or discourage households on their cooking energy choices and provide a yardstick for evaluation of the implemented energy policies that address people's basic needs and the preservation of the environment. Moreover, this study concentrated only on households' cooking energy use unlike most previous studies, whose concentrations were on general energy consumption of households (that is, cooking, lighting, heating and cooling), because the main domestic use of energyin Nigeria, and in particular Ado Ekiti Local Government Area of Ekiti State is for cooking.

Literature Review

Several related research though with different proxy has been conducted on the household energy used for cooking; as well as its determinants in developing countries, including Nigeria. However, a number of studies provided empirical evidence of household cooking energy use, alongside the key determinants and pattern of households' cooking energy/fuel choice. The first set of literature (Megbowon *et al.*2018,286; Maurice, Umar, and Zubairu 2017, 165; Maina, Dantama, and Kyari2017, 28; Alem, Hassen, and Köhlin, 2015, 17; Onoja, and Idoko 2012, 118; Abd'razack *et al.* 2012, 21; Abrahamse, and Steg 2009, 36) focused on the socio-economic determinants of households' energy use such that numerous factors other than income influence the energy cooking choice and pattern, these include: the price of cooking energy/fuel, the availability of the energy, cultural preference, household size, household location, taste, and season. Megbowon *et al.*(2015, 290),assessed households' energy situation in Nigeria with respect to the choice of cooking energy using data from Nigeria's Malaria Indicator Survey of 2015, and argued that the factors influencing households main cooking energy are not uniform but varies among the different households; thus, factors like gender, age, education, number of children, access to electricity, and wealth status significantly affect households' energy choices. Empirically, the influence of socio-economic variables on domestic cooking energy choices in Nigeria was analysed using a multinomial logit regression method (Nsikak-Abasi, Thompson, and Etefia, 2018,4). The study revealed that age of household heads, house type, household income, educational level of heads,and occupation of household heads are significant determinants of energy used by households. Similarly, Maina, Dantama, and Kyari (2017, 30) identified household monthly income,sex of household head, family size and rural-urban dichotomy as the major determinants of households' cooking energy choices.

The second set noted that behavioural and cultural factors like household preferences, food taste, cooking practices and cultural beliefs also influence households' cooking energy use.Studies like(Heltberg 2005, 347; Taylor *et al.*2011, 921), argued that traditional cooking habits and food tastes might make households in Guatemalan prefer to use firewood, even in conditions where firewood is expensive as the cleaner cooking energy.Similarly, (Rao, and Reddy2017, 148)used the multinomial logit method to analyse the 1999 India National Sample Survey, and found that households in India with Islamic religion are less likely to use LPG than firewood. That is, cultural beliefs and taste of the delicacies is the reason for household energy choice, also longer cooking time cause households much inconveniency, and using a particular energy type helps to reduce the cooking time.

And the third set of literature will investigate the external factors such as availability of energy type, physical environment (i.e. region of residence) and government policies also influence households' choice of cooking energy. For instance, Wickramasinghe(2011, 7571) affirmed that external environment is a major determinant of households' energy use in Sri Lanka; such that women are more likely utilised cleaner energy for cooking activity if they are employed in activities outside of their matrimonial home. That is such women have much preference cleaner cooking energy such as LPG, because they have the financial authority to make the purchase (Miller, and Mobarak 2013, 232). Likewise, Macht, Axinn, and Ghimire (2007) studied the impact of community context on households' use of cooking energy in Nepal; thus indicated that community context has important consequences for household cooking energy choices such that the more the exposure to nonfamily organizations in the local community increases households' use of cleaner energy for cooking.

In spite of the many research work and contributions that have been made to energy studies, there is still much left to do. Sequel to the fact that cooking energy is important to everyone, thus, makes this field unending and challenging.

Materials and Methods

Study Area

Ado Ekiti local government area of Ekiti State, Nigeria has its headquarters located in Ado Ekiti town, which also domicile as the capital city of Ekiti state; having a land size of 297.852 kilometres square, with a population figure of 313,960 based on 2006 population census (National Population Commission [NPC] 2010, 9), and with the projected population of 333,754 and 344,253 for year 2008 and year 2009, 355,102 and 366,283 for 2010 and 2011 respectively (National Bureau of Statistics [NBS] 2012, 27), and thus indicates the annual population growth rate of 3.15 per cent for Ado Ekiti Local Government Area of Ekiti State hence, its projected population for the year 2020 is 483,763. Also, the local governmentAdo Ekiti is located on latitude 70 40' North of the equator and longitude 50 16' East of the Greenwich meridian

(Akintan 2014, 52); and is situated in the south senatorial district of Ekiti state. It is bordered to the north by Ido-Osi and Oye Local Government Areas, to the south by Ikere and Ise Orun Local Government Areas, to the east by Gbonyin (Aiyekire) Local Government Area, to the west it is bounded by Ekiti west and Ijero Local Government Areas respectively.

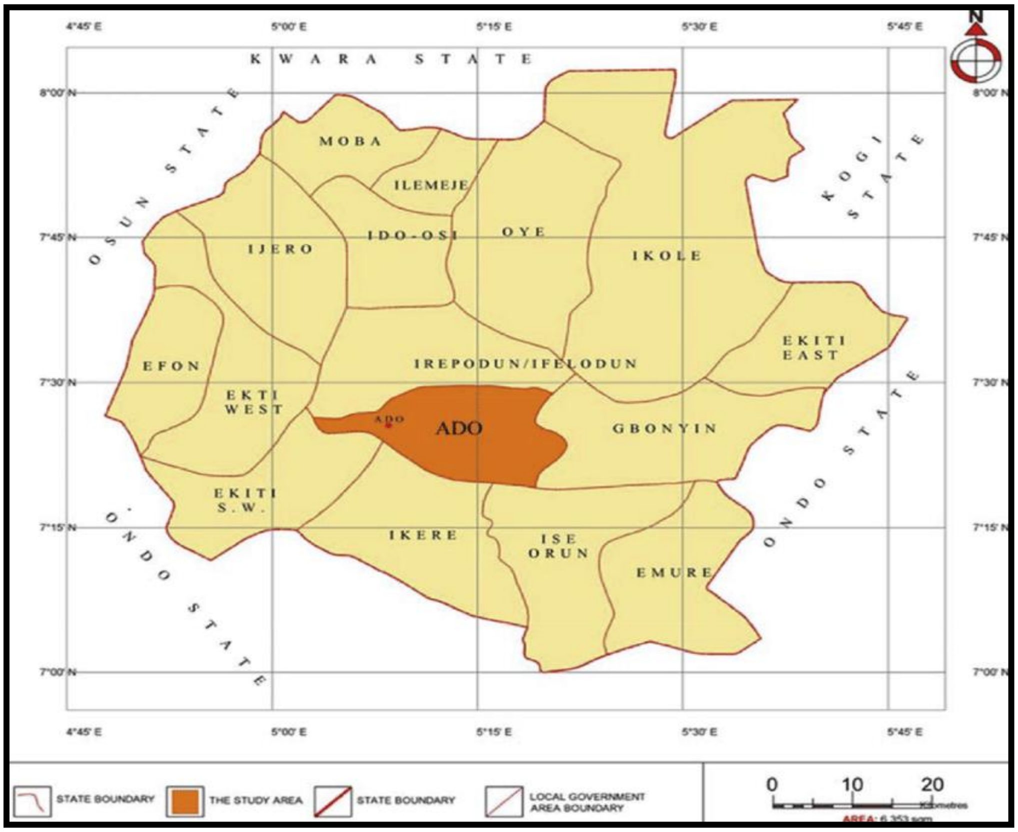

Figure 1.Momoh and Oladebeye.Map of Ekiti State showing Ado Ekiti Local Government Area, which is the study area. 2010, 99

Sampling Method

This study utilised a survey research method as the study design, and the survey covered a sample of households purposively selected fromthe 13 electoral wards that constituted Ado Ekiti Local Government Area of Ekiti State.Thusa semi-structured questionnaire containing both open-ended and close-ended questions, as they favours the non- standardisation of the process, for which reason they are often employed in quantitative-based research (Bryman, 2008, 23).This was designed as the research tool to elicit information from the respondents on household socio-economic and socio-cultural characteristics as they relate cooking energy use in the household.

Sample Size and Survey Process

Using the Taro Yarmane formula, Yarmane (1967, 45), a sample size of 420 householdswas randomly selected from 26 communities in the 13 electoral wards constituting Ado Ekiti L.G.A of Ekiti State. Thus, $n = \frac{N}{1+N(e^2)}$

Where;n= Sample size, N= Population size, 1= Adjusted constant, e= Level of Precision/Sampling Error margin.

The sample size for the study area is;

$$n = \frac{96,753}{1+96,753(0.05^2)} = 398.353$$

Hence, approximately this study in sum utilised 400 households (but distributed 420 copies of questionnaire in order to account for the non-return or incomplete filled questionnaire) in the purposively selected communities having more adequate infrastructural facilities. However, the primary data were collected with the aid of questionnaire from individuals in charge of cooking energy decision making in the household. The survey was conducted by5 field enumerators under the supervision of the researcher, for four (4) weeks – (three (3) days per week i.e. Tuesday, Wednesday, and Thursday) equivalent to twelve (12) days of administration. Each of the field enumerator administered seven (7) copies of questionnaire daily; which is equal to thirty-five (35) copies of questionnaire a day, and 105 copies of questionnaire a week, and hence a sum of 420 copies of questionnaire was administered for four weeks in the study area. Thus, the copies of questionnaire were distributed proportionately in each ward, and then based on the proportion of houses in the selected communities of the study area.

Statistical Technique

This study adopted the Nsikak-Abasi, Thompson, and Etefia (2018, 5) multinomial logit model, which concludes that a household makes a choice as to which energy to use for cooking among the alternative energy types at a particular time. The multinomial logistic regression model which is also known as polychotomous logistic regression model,is the most popular discrete choice model in empirical research (McFadden 1974, 323); which is simply an extension of thebinomial logistic regression technique utilizing cross sectional data. The advantage of cross-sectional data is that the assumption- multiple observations within a choice are independent.Hence, it is assumed that household utility function is given as:

$V_{ijt} = f(Z_j, X_i) + \varepsilon_{ij}$ ---(1)

Where, every household i level of utility in time t is associated with any alternative energy choice j for cooking purpose. However, the utility obtained from any alternative cooking energy type depends on the attributes (Z) of the energy type in terms of their various prices and individual household characteristics (X) that is, socio-economic and socio-cultural factors such as age, gender, household size, family traditions/cultural practice, etc. affecting households' cooking energy consumption patterns. X_i is the vector of explanatory variables that is, the socio-economic and socio-cultural factors considered affecting household energy decision and consumption patterns (which are prices of cooking energy types, household income level, age, gender of cooking energy decision maker, accessibility to cooking energy, education, household size, dwelling unit type, house ownership status, cultural practice/ habits). And $\mathcal{E}_{ij}$ is a normally distributed random error term of zero mean which is assumed to be correlated with errors associated with the other alternatives j, j =1, … j; j ≠ i.

However, the choice of explanatory variables in this study is based on theory and previous studies on the subject matter.The choice made by householdi among the alternative energy types is a function of the probability that the utility attached to a particular option (j) is higher than that attached to another alternative energy types. Therefore, the probability model P_{itj}that alternative j is chosen by household i among a set of J_{it} choices in choice situation time t is specified as:

P_{itj} = Prob (V_{ij}> V_{im}); m =1,... j; m ≠ j --- (2)

Prob (Y_{it} =j) = f ($\beta_j X'_{it} + \mathcal{E}_{it}$); i= 1,..., n; j= 1, 2, 3 -- (3)

The above equation (2) and (3) implies that if the i[th] household gets a certain level of utility from each of the three cooking energy type at each time: clean energy only (j = 1), and polluting only (j = 2), and a mix of clean and polluting energy (j = 3), and chooses that alternative that maximizes his utility. Thus, V_{ij} is the maximum utility the household receives from among the j possible choices. However, it is assumed that preferences adhere to the familiar axioms – completeness, transitivity, reflexivity, etc. of utility theory (Rhodes *et al.* 2014, 319). Also, the cooking energy choices j may vary across households i (Allenby, Garratt, and Rossi 2010, 46).

The probability function of selecting j alternative is:

$$\text{Prob}\,(Y_{itj}=1) = \pi j(Xit) = \frac{\exp(\beta j\, X'it)}{\sum_{k=1}^{j} \exp(\beta k\, X'it)}; j = 1,2,3 \text{ -- } (4)$$

The outputs of multinomial logit model are interpreted in terms of the odds ratios, i.e. the ratios of the probability of choosing one outcome category over the reference category are defined as:

$$l_n = \frac{P_{ij}}{P_{ik}} = X(\beta_j - \beta_k) = X_i\beta_j \;\; if\; k = 1 \text{ -- } (5)$$

However, a positive parameter indicates that the relative probability of choosingother cooking energy type increases relative to the probability ofchoosing the reference category over the other cooking energy types. And a negative parameter indicates that the relative probability of choosing other cooking energy type decreases relative to the probability of choosing the reference category over the other cooking energy types.

And the likelihood for the multinomial logit is specified as:

$$L = \prod_{i=1}^{N} \int_{-\infty}^{\infty} \prod_{t=1}^{T} \prod_{j=1}^{J} \left\{ \frac{\sum_{k=1}^{j} \exp(\beta k\, X'it)}{\sum_{k=1}^{j} \exp(\beta k\, X'it)} \right\} \text{ -- } (6)$$

Also, the log likelihood for the multinomial logit shown in equation (6) is as follows

$$\ln L = \prod_{i=1}^{N} \int_{-\infty}^{\infty} \prod_{t=1}^{T} \prod_{j=1}^{J} \ln \left\{ \frac{\sum_{k=1}^{j} \exp(\beta k\, X'it)}{\sum_{k=1}^{j} \exp(\beta k\, X'it)} \right\} \text{------} (7)$$

X_{it}denotes the explanatory variables influencing households' energy choices for cooking.

ε_{ijt}denotes the random error term that is independent and identically distributed- iid. It also includes the impact of unobserved characteristics.

β represents the coefficients for the vector of explanatory variables. Moreover, the βcoefficients are not readily interpretable, instead the marginal effectscomputed from each observation with respect to an exogenous variable over the entire sample, are used (Greene 2007, 283). The marginal effect (δ) of a continuous variable on the probability of adopting the j^{th} fuel for a representative household with characteristics $\beta_h$can be established by differentiating equation (5),

$$\delta j = \frac{\partial P_J}{\partial \beta_{hk}} = P_j \left[X_j - \sum_{k=1}^{J} P_k X_k \right] = Pj\left[x_j \right],\ j=1,\text{---},k \text{ ------} (8)$$

Thus, P_j denote the choice probability.

When the explanatory is a discrete variable, the marginal effect is an arithmetic difference, rather than a derivative (Sui and Yu 2012, 348). That is

$\delta j = E(y/X_1{=}1)E - (y/X_1{=}0)$ -- (9)

Also, since the sub-vector X' enters every marginal effect, then it follows that both the sign and magnitude δ_j and X'_j are not related (Greene, 2005).

Nevertheless, the estimation of the multinomial logit model on a cross sectional data is best carried out by the maximum likelihood estimation technique (Wooldridge 2013, 53; Gujarati and Porter 2009, 476). And the maximum likelihood estimation technique gives parameter estimates that are asymptotically efficient, consistent and normal, and the analogue regression z-test can be applied.

Results

Questionnaire Distribution and Retrieval

The questionnaires were distributed and collected back as follows:

Table 1: Questionnaires Distribution and Return Rate

ElectoralWards	Communities	Number of Questionnaires Administered	Number of Questionnaires Retrieved
Ado Ekiti 1	Idofin	19	13
	Olokuta	13	16

AdoEkiti 2	Inisa	19	16
	Owode	13	13
AdoEkiti 3	Idolofin	19	18
	Idemo	13	11
AdoEkiti 4	Ijigbo	20	18
	Oke-Oniyo	13	12
Ado Ekiti 5	AjibadeLane	20	19
	Orereowu	13	10
AdoEkiti 6	Okeyinmi	13	12
	Ugbaletoro	19	19
Ado Ekiti 7	Oke-Ila	13	13
	Housing Estate	20	20
Ado Ekiti 8	Ereguru	19	15
	Ogbon-Oba	13	14
Ado Ekiti 9	Dalimore	19	18
	Olora Lane	13	13
Ado Ekiti 10	Basiri	19	17
	Awedele	13	13
Ado Ekiti 11	Irona	20	19
	Isato	13	13
Ado Ekiti 12	Igbeyin	19	16
	Atikankan	13	11
Ado Ekiti 13	Erinfun	19	18
	Emirin	13	13
Total 13	26	420	390

Source: Author's Field Survey, February/March 2020

390 copies of questionnaire from Ado Ekiti L.G.A. of Ekiti state were completely filled and returned (while 3 copies of questionnaire were discarded for being incompletely filled-omitting questions in the first and last pages of the questionnaire). However, the return rate of the questionnaire was about 92 percent, quite impressive. However, in the questionnaire cooking gas was used in place of LPG so that respondents could understand. After sorting out the valid copies of questionnaire, a codebook was prepared to define each variable and assign numbers to all responses.

Table 2: Description and Measurement of Variables

List of Coefficients	List of X_i Explanatory Variables	Explanatory Variables Name	Description
β_1	X_1	Household Size	Number of persons that resides/lives in the house.
β_2	X_2	Gender of Household Head	1 if household head is a male, and 2 if otherwise.
β_3	X_3	Gender of Respondent	1 if the respondent is a female, and 2 if otherwise.
β_4	X_4	Age of Household Head	This is expressed in years
β_5	X_5	Household Head Highest Education level attained.	Yes=1 if household head attended formal schooling, and No=0 if otherwise. 11 if household head highest level of education is below primary school, 12 if household head completed secondary school 13 if household head completed a tertiary qualification.
β_6	X_6	Respondent Highest Education level attained	Yes=1 if household head attended formal schooling, and No=0 if otherwise. 11 if household head highest level of education is below primary school, 12 if household head completed secondary school 13 if household head completed a tertiary qualification.
β_7	X_7	Awareness on clean energy	Yes= 1 if aware of its convenience and safety No = 0 if otherwise
β_8	X_8	Awareness on polluting energy	Yes = 1 if aware that biomass sources and kerosene are harmful No = 0 if otherwise

β_9	X_9	Type of Dwelling unit/ house	Modern house type (Block house) =1, and 2 if otherwise (Plank, thatch, or mud house)
β_{10}	X_{10}	Dwelling unit ownership status	= 3 if Owned =2 if Rented =1 if Others
β_{11}	X_{11}	Household head Income	The average monthly money received as income by the household head (in naira- ₦).
β_{12}	X_{12}	Price of firewood	Based on the estimated price (in naira- ₦) per bundle in the enumeration area the household is situated in.
β_{13}	X_{13}	Price of charcoal	Based on the reported price (in ₦) per pack (i.e.1.5kilogram) in the enumeration area the household is situated in.
β_{14}	X_{14}	Price of LPG	Based on the LPG price watch (in naira) per kilogram as given by NBS national household LPG price watch, for year 2019 and 2020.
β_{15}	X_{15}	Price of Kerosene	Based on the average price per litre (in naira) in the household's enumeration area specified in (NBS national household kerosene price watch, 2019 & 2020).
β_{16}	X_{16}	Price of electricity	Based on the electricity tariffs of the study area's electricity distributed company (Kaduna electricity distribution company- KAEDC, and Benin electricity distribution company- BEDC) (in naira/kWh) for domestic consumption. All sourced from their official websites.
β_{17}	X_{17}	Accessibility to energy supply	Proximity to supply/purchase point (Very close= 1, Not too close = 2, Very far= 3). And it is relative.
β_{18}	X_{18}	Availability of energy supply	Readiness at supply /purchase point (Always available=1, seasonal/not available=2)
β_{19}	X_{19}	Type of food cooked	Yes = 1, and = 0 if otherwise

β_{20}	X_{20}	Traditional/Cultural belief and taste	Yes =1, and = 0 if otherwise
β_{21}	X_{21}	Price of main energy	Yes =1, and 0 = if otherwise

Source: Author's compilation, 2020.

SPSS and Stata Intercooled statistical software programmes were used to enter and analyse the quantitative data gathered via the household questionnaire after coding.The descriptive details of the analysis captured household socio-economic and demographic characteristics, domestic cooking energy sources/fuels in the study area.

Socio-Economic and Demographic Characteristics of the Respondents

Findings presented in Table 3 below shows that 14.87% (58) were males while 85.13% (332 respondents) were females. This shows that most of the respondents that participated in the study were female thereby indicated that females do the cooking in homes as most traditions discourage males from participating in cooking activity and thus, all decisions pertaining tochoice of cooking energy is usually the sole responsibility of female in the household (Dzioubinski and Chipman1999, 124). In addition, the findings from this study reveal that both sample area have majority of the female respondents as housewives, coincidentally with same frequency of 218 married female respondents.

From the findings, 67.95% (265) of the respondents in the study area have tertiary education, which confirms the existence of tertiary institutions located in the study area.The finding also shows that the average household size in the entire study as 6.12 persons per household (that is in every household in the entire study area in this study there is an average of 6 persons approximately).

	Status	Frequency	Percent (%)
Gender	Male	58	14.87
	Female	332	85.13
	Total	390	100.0
Marital Status	Married	218	55.90
	Divorced	11	2.82
	Widow/Widower	14	3.59
	Single	147	37.69
	Total	390	100.0
Dwelling Type	Modern (Block house)	349	89.49
	Traditional (Plank, thatch, or mud house)	41	10.51

	Total	390	100.0
Ownership of dwelling/house	Owned	212	54.36
	Rented	159	40.77
	Others	19	4.87
	Total	390	100.0
Educational Attainment	Tertiary	265	67.95
	Secondary	94	24.10
	Primary	19	4.87
	No Education	12	3.08
	Total	390	100.0
Average Household Size	6.12		

Table 3: Socio- Demographic Characteristics of the Respondents

Source: Author's Analysis, 2020.

Findings in table 4 indicates that majority of household heads in the study area have tertiary education; specifically, households having females as their cooking energy decision maker. The value 295(75.64%) for household heads have tertiary education in Ado Ekiti L.G.A of Ekiti state respectively; thereby having 245(63.59%) household heads with tertiary education where female respondents are households' cooking energy decision maker.

Table 4: Distribution of Household Heads Educational Level by Gender of Respondents

Gender of Respondents	Educational Level of Household Heads				Total
	No formal	Primary	Secondary	Tertiary	
Female	52 (13.33%)	16 (4.10%)	16(4.10%)	248(63.59%)	332(85.13%)
Male	7 (1.79%)	1 (0.26%)	3(0.77%)	47(12.05%)	58 (14.87%)
Total	59 (15.13%)	17 (4.36%)	19(4.87%)	295 (75.64%)	390(100%)

Note: Figures in parentheses are percentages

Source: Author's Analysis, 2020.

Table 5: Descriptive Statistics of Variables

Variable	Mean	SD	Min	Max

Household head gender	1.2205	0.4213	1	2
Household head age	1.8128	0.6902	1	3
Household head occupation	6.179487	12.3444	0	134
Marital status of cooking energy decision maker	2.230769	1.43338	0	4
Household head average income	1.625641	1.0208	0	4
Cooking energy decision maker maximum education	12.262	2.2591	0	13
Household head maximum education	9.0718	5.6799	0	13
Household size	6.1077	2.2352	1	15
Type of dwelling/house	1.1077	0.3104	1	2
Ownership status of house	2.4795	0.6070	1	3
Gender of cooking energy decision maker	1.1487	0.3563	1	2
Household financial decision maker(s)	2.0051	0.9699	1	3
Household main cooking energy type used	2.4872	0.7943	1	3
Frequency use of main cooking energy choice	1.0487	0.2155	1	2
Awareness of clean energy	0.8103	0.3926	0	1
Awareness of polluting energy	0.7487	0.4343	0	1
Firewood for cooking	0.5077	0.5006	0	1
Charcoal for cooking	0.3564	0.4796	0	1
Kerosene for cooking	0.7538	0.4313	0	1
Cooking gas for cooking	0.7872	0.4098	0	1
Cooking gas accessibility	1.7230	0.8082	1	3
Cooking gas availability	1.4180	0.4939	1	2
Household electricity connection	0.8615	0.3458	0	1
Electricity for cooking	0.0103	0.5005	0	1
Main cooking energy price	0.7179	0.4506	0	1
Willingness to switch	0.6308	0.4832	0	1
Household cooking energy preferences	3.602564	.997938	1	3
Type of food cooked	0.6878	0.4637	0	1
Traditions/cultural beliefs and taste	.7230769	.4480529	0	1
Electricity price	.3589744	.4985048	28.05	34.4
Cooking gas price	363.4848	35.28117	316.66	390

Kerosene price	270.7712	73.90746	162.02	320.87
Charcoal price	132.0513	24.01579	100	150
Firewood price	106.7949	39.9065	0	150

Source: Author's survey analysis, 2020

Table 5clearly reveals, among other things, that about 1.62 percent of household heads in the study area earn an average income of ₦61,000 and above, and about 9.1 percent of the household heads have attained higher/tertiary educational level, while the mean household size is about 6. About 51 per cent of the households use firewood for cooking, while only about 36 percent use charcoal for cooking, and about 75 percent use kerosene for cooking; and about 78 percent use cooking gas (LPG) for cooking; also, less than 2per cent use electricity for cooking.

Table 6: Share of Household Principal Cooking Energy Used

Principal Cooking Energy Used	Number of Household Principal Energy users	Percentage
Firewood	91	23.3
Charcoal	55	14.1
Kerosene	68	17.4
Cooking Gas	176	45.1
Electricity	0	0
Total	390	100.0

Source: Author's survey analysis, 2020

Table 6 shows the distribution of household by their main cooking energy choice. The domestic cooking energy used by households in Ado Ekiti L.G.A. of Ekiti State 45.1% of households dwelling there largely have cooking gas as their main cooking energy, followed by firewood (23.3%), kerosene (17.4%), charcoal (14.10%), with none having electricity as their main cooking energy due to frequent outages reported by the sampled households.

Factors Influencing Household's Cooking Fuel Choice: Multinomial Logit Regression Result.

This study estimated the multinomial logit model with robust errors using STATA software program, and the results are presented in Table 7. The estimated coefficients of the multinomial logit model only provide the directional effect of the independent variables on the dependent (response) variable. Hence, the need for the estimation of marginal effects from the multinomial logit model as shown in Table 8, which measures the expected change in probability of a particular choice being made with respect to a unit change in the independentvariable. This study however compared polluting cooking energy; being the baseline or reference category with estimated coefficients for all the cooking energy choice alternatives.This is so being that it's the households' main cooking energy type with robust errors. From the output, the model is fit with 390 observations, having no missing/dropped variables; likewise, the iteration log shows that the maximum likelihood (ML) algorithm converged after 6 steps. That is, the maximum likelihood method calculated the multinomial logit model by using an iterative fitting process that attempts to cycle through repetitions to arrive at a result.

Table 7: Multinomial Logit Regression Result of Households' Cooking Energy Preferences

Dependent Variable: Household Cooking Energy Use			
E=1 (Clean Cooking Energy)			
Variables	Coefficient	SE	Z
Household head average income	-0.554	0.299	-1.85*
Household energy decision maker	0.100	0.164	0.61
Household head education	0.044	0.056	0.79
Gender of household energy decision maker	0.863	0.943	0.92
Household clean energy awareness	-0.028	0.804	-0.03
Household polluting energy awareness	1.507	0.743	2.03**
Gender of household head	0.747	0.705	1.06
Household head age	-0.108	0.404	-0.27
Household head occupation	-0.023	0.035	-0.65
Household size	-0.231	0.118	-1.96**
Cooking gas availability	-0.234	0.591	-0.40
Cooking gas accessibility	-3.478	0.602	-5.78***
Type of food cooked	0.187	0.713	0.26
Traditional/cultural belief and taste	-0.578	0.605	-0.96
Cooking gas price	0.020	0.020	1.00
Kerosene price	-0.003	0.010	-0.35
Charcoal price	0.003	0.014	0.23
Firewood price	0.005	0.008	0.65

Constant	-0.652	6.708	-0.10
E=3 (Mixed Cooking Energy)			
Household head average income	-0.239	0.267	-0.90
Household energy decision maker	-0.010	0.118	-0.08
Household head education	0.011	0.050	0.40
Gender of household energy decision maker	-0.123	0.895	-0.14
Household clean energy awareness	-0.491	0.649	-0.76
Household polluting energy awareness	1.380	0.626	2.20**
Gender of household head	0.395	0.631	0.63
Household head age	0.135	0.350	0.38
Household head occupation	0.009	0.027	0.33
Household size	-0.181	0.094	-1.92**
Cooking gas availability	-0.146	0.517	-0.28
Cooking gas accessibility	-3.129	0.561	-5.58***
Type of food cooked	0.230	0.649	0.35
Traditional/cultural belief and taste	-0.317	0.533	-0.59
Cooking gas price	0.003	0.015	0.19
Kerosene price	0.002	0.007	0.21
Charcoal price	0.000	0.012	0.01
Firewood price	0.001	0.006	0.11
Constant	8.098	5.32	1.52
Observation 390			
Log likelihood -201.76391			
LR Chi^2 (36) 149.49			
Prob> Chi^2 0.0000			
Pseudo R^2 0.27			

Note: Polluting cooking energy is base category

(***) denotes probability statistically significance at 1% probability level; (**) denotes probability statistically significance at 5% probability level; (*) denotes probability statistically significance at 10% probability level

Source: Author's analysis, 2020

Table 8: Marginal Effect of Households Cooking Energy Preferences

Variables	Clean Energy	Polluting Energy	Mixed Energy
Household head average income	-0.046(0.022)**	0.004(0.004)	0.043(0.022)**
Household energy decision maker education	0.016(0.017)	-0.000(0.002)	-0.016(0.017)
Household head education	0.004(0.004)	-0.0003(0.001)	-0.003(0.004)
Gender of household energy decision maker	0.144(0.057)***	-0.001(0.011)	-0.143(0.057)***
Household clean energy awareness	0.061(0.063)	0.005(0.007)	-0.066(0.063)
Household polluting energy awareness	0.023(0.062)	-0.027(0.021)	0.005(0.064)
Gender of household head	0.052(0.053)	-0.006(0.008)	-0.046(0.053)
Household head age	-0.035(0.034)	-0.001(0.004)	0.036(0.034)
Household head occupation	-0.005(0.003)	-0.004(0.000)	0.005(0.003)
Household size	-0.008(0.012)	0.002(0.002)	0.005(0.012)
Cooking gas availability	-0.013(0.047)	0.002(0.007)	0.011(0.047)
Cooking gasaccessibility	-0.058(0.034)*	0.041(0.019)**	0.017(0.038)
Type of food cooked	-0.006(0.049)	-0.003(0.009)	0.009(0.050)
Traditional/cultural belief and taste	-0.0380(0.046)	0.005(0.008)	0.033(0.046)
Cooking gas price	0.003(0.002)	-0.008(0.000)	-0.002(0.002)
Kerosene price	-0.001(0.001)	-8.650(0.000)	0.001(0.001)
Charcoal price	0.0004(0.001)	-8.790(0.000)	-0.000(0.001)
Firewood price	0.001(0.001)	-0.0001(0.000)	-0.001(0.001)

Note: Standard error in parentheses

(***) denotes probability statistically significance at 1% probability level; (**) denotes probability statistically significance at 5% probability level; (*) denotes probability statistically significance at 10% probability level

Source: Author's analysis, 2020

The findings from table 7 and table 8 reveal the factors influencing the cooking energy use of households in Ado Ekiti L.G.A. of Ekiti state. When compared to polluting cooking energy,households in Ado Ekiti L.G.A of Ekiti state have a decrease probability usingonly clean cooking energy by 0.046% and a increase probability using mixed energy for cooking purpose by

0.043% as their household heads' income rises at 5% level of significance.This implies that in the study area wealthy households significantly usemore of multiple cooking energy types, ceteris paribus (Mekonnen and Köhlin2008, 22).

In addition, households having female as their cooking energy decision maker were more likely to choose using only clean energy for domestic cooking in comparison to polluting energy, and less likely to prefer using mixed cooking energy. Thus, this does not only conform to apriori expectation but, it is also strongly significant at 1% probability level. This empirical finding supports the general notion that female involvement in cooking activity is cultural; while males spend most of the time outside home to fulfil the households' demands (Ahmed 2016, 38).

Households having accessibility to cooking gas supply point were significantly less likely to use only clean energy for cooking by 0.058% (as compared to polluting energy), and more likely to prefer mixed energy for domestic cooking by 0.017%. This is perhaps ceteris paribus; in the study area cooking gas retail outlets are rampant, making it close to households' doorsteps though at a high cost.Moreover,the variables type of food cooked and traditional/cultural belief make households in both sampled areas less likely to prefer clean energy in comparison to polluting energy, and more likely to prefer mixed energy. For instance, the cooking of 'Otile' or 'Feregede' (local meals) by households in the study area are most preferably done using polluting energy- specifically firewood because it takes longer duration cooking it and its believed to have more palatable taste (Sa'ad and Bugaje 2016, 130).

Conclusion

This study estimated the multinomial logit and marginal effect regression models on households' cooking energy use in Ado Ekiti local government area of Ekiti state, Nigeria, in order to ascertain the factors that determine households cooking energy choice. However, the multiple use of energy (mix of clean and polluting energy) for domestic cooking activity in the study area; with households adapting to the saying 'variety is the spice of life' is a detrimental way of living. Households' awareness of clean and polluting energy include only the convenience in usage, neglecting the health, economic and environmental gain of using only clean energy for domestic cooking. The continuing use of polluting energy-specifically biomass energy sources and kerosene for cooking has health consequences on family members breathing (especially the females), and culminates into forest degradation, deforestation, lands degradation and all other severe environmental problems; and thus the resultant climate change. However, the use only clean energy for domestic cooking will improve the health and socio-economic welfare of households and the general environment (Alem, Hassen and Köhlin 2015, 19; Organization for Economic Cooperation and Development [OECD] and International Energy Agency [IEA] 2010, 1783). Hence, having the right strategy in the promotion of households' cooking energy transition requires a good understanding of the driving factors that influence energy choice for domestic cooking. Hence, the grassroots government should ensure that households have adequate access to clean cooking energy sources that are environmentally friendly by encouraging installations of gas stations closer to users' doorsteps in the study area.

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