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Determinants of Household Fuelwood Consumption in Nigeria

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ABSTRACT

Fuelwood is an important source of biomass which in particular is a renewable energy source that contributes to the energy needs of modern societies. Low and unstable income coupled with poor access to cleaner and efficient energy make fuelwood an essential source of energy in Nigeria despite its negative externality on the environment and human health. However, the knowledge of the determinants of household fuelwood is limited which is of importance in formulating energy policies that help in promoting economic development, reducing poverty as well as promoting gender equality. This study, therefore, examines the demographic and socioeconomic determinants of household fuelwood consumption in Nigeria. The study is anchored on the energy ladder theory. Following the work of Wiafe and Kwakwa (2013) and Muller and Yan (2018), a logit regression model was estimated to determine the factors that influence fuelwood consumption in Nigeria. The result reveals that factors such as formal education, male-headed households, employment status of household head, age of household head were significant in explaining the demand for fuelwood consumption in Nigeria. Government policy aimed at promoting the use of cleaner energy should be encouraged. This includes improvements of the economic welfare of households such as the expansion of the non-agriculture sector and building human capital via education.

Keywords: *Fuelwood Consumption, Household, Logit Regression, Nigeria.*

1. INTRODUCTION

Fuelwood is an ancient energy source, derived from burning wood materials and its usage cutting across developing countries (FAO, 2001). Fuelwood is the main source of energy used in cooking among rural households in developing countries like Nigeria, and essential raw material for rural industries in an attempts to boost the economy and meet the basic needs of the households as well as improve their welfare (Adeyemi & Adereleye, 2016). In terms of usage, the African continent as a whole accounts for the highest per capita fuelwood consumption in the world (Alem, Beyene, Köhlin, & Mekonnen, 2016). Fuelwood consumption is a predominant source of energy in developing countries owing to several factors among which are own price of fuelwood, unaffordable price of other sources of energy such as kerosene, gas and electric cookers, coupled with low generation and high cost of electricity. Other factors are household size, high poverty rate, low earning associated with agricultural self-employment, small scale businesses and informal activities that characterized the labour market in developing countries.

Similarly, urbanization and lack of equity in land holding, gender differential along with socioeconomic roles result in rising demand for fuelwood in developing countries (Abebaw, 2007; Onoja & Idoko, 2012). This raises concern about the effects of global warming and climate change. For any country that wants to alleviate poverty and achieve sustainable growth and development over time, there is a need for affordable, clean, environmentally friendly and efficient energy. This is because access to efficient energy source helps reduces pollution

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emanating from energy usage, brings about fewer diseases and decline in child mortality (Alem *et al.* , 2016; Adeyemi & Adereleye, 2016).

In developing countries, most households do not have adequate access to clean and modern energy thereby the need to utilize fuelwood (Bello, 2010; Rahut, Das, De Groote, & Behera, 2014). Fuelwood usage by the urban and rural household has adverse effect on the environment and human health in the long run. Problems such as environmental degradation, deforestation, erosion and subsequent influence on the ozone layer that alters the climatic condition, were associated with the demand for fuelwood. Despite the rate of deforestation and the real cost of fuelwood consumption, many households in developing countries still rely on fuelwood as a source of cooking energy. This has been attributed to several factors by different authors, hence, the lack of consensus as to the choice of fuelwood among households. For instance, Abebaw (2007) observed that households in some areas such as Wolong in China with access to electricity still depend on fuelwood. Meanwhile, some studies argued that, whenever there is an improvement in the level of income, households would shift towards modern fuels. In Nigeria, fuelwood is commonly utilized among rural and urban households, however, the forces that influence the pattern and magnitude of fuelwood usage are not fully known.

Rural dwellers with very little or no access to alternative energy source rely on fuelwood to meet their energy demand. Thus, fuelwood plays an important role in meeting basic energy requirements of rural dwellers who are mostly engaged in subsistence primary activities. This is basically because fuelwood can be obtained easily and used cheaply in the rural areas (Ismai'il *et al.* , 2014). Biomass fuel consumption has been proven to be a major cause of health challenges in developing countries like Nigeria especially among women and children, due to indoor air pollution (Ezzati & Kammen, 2001; Bruce, Perez-Padilla, & Albalak, 2000). There are 1.6 million premature deaths per year according to the world health organization (WHO) that are directly attributed to indoor air pollution from the use of solids fuels (Bagnara et al., 2018). The influence of fuelwood consumption on human and environment varies according to a range of factors. Notwithstanding, the identified effects of fuelwood consumption include: environmental effects, health effects, and conservative effects.

According to the GHS (2016), about 45 per cent of Nigerian households rely on fuelwood. This tends to be associated with environment and health problem. For instance, the partial burning of firewood results in indoor air pollution, often related to exhaust fumes, and propellant. These pollutants contribute to diseases such as Pneumonia, Whooping cough, asthma attack, and adult respiratory distress. The consumption of fuelwood generates carbon dioxide into the atmosphere that brings about climate change, climate change in turns destroy plants and threatens human wellbeing (Muller & Yan, 2018). However, research that focuses specifically on the socio-economic driving forces influencing fuelwood consumption with national coverage is scarce in Nigeria.

Some studies (Onyeneke, 2015; Onoja & Idoko, 2012) that deal with the determinants of household fuelwood consumption in Nigeria are mainly state-level analysis and lack national coverage. For instance, Onoja & Idoko (2012) examined the determinants of fuelwood consumption in Enugu state, while Onyeneke (2015) investigated the socioeconomic determinants of fuelwood consumption among farming households in Imo State. This study adds to knowledge by utilizing the General Household Survey (2015) data set for Nigeria in the determination of the factors that influence household demand for fuelwood.

This paper is structured as follows. Following the introduction is Section two, it provides the review of the literature. Section three comprises the theoretical framework, methodology applied in the study, as well as data type and source. Section four presents the empirical results, and discussions of the determinants of fuelwood consumption. Implications of findings,and recommendations are specified in section five.

2. LITERATURE REVIEW

The study of energy preferences of households in relation to socioeconomic forces generally relies on the energy ladder hypothesis (Akther, Danesh Miah, & Koike, 2010). The energy ladder model reveals the interrelation between preference for energy/fuel and the socioeconomic status (especially income) of household (Wiafe & Kwakwa, 2013; Muller & Yan, 2018). It is assumed to be the most suitable model in explaining the choice of fuel in developing countries like Nigeria (Akther *et al.* , 2010). The energy ladder hypothesis explains the energy transition of households from dirty fuels to cleaner and environmentally friendly fuels. An increasing number of studies assess the extent to which socioeconomic factors affect the choice of energy usage by households in Nigeria.

Adeyemi & Adereleye (2016) examined the factors that influence the choice of fuelwood in Ondo State, Nigeria and found that about 64 per cent of the rural household used fuelwood while approximately 23 per cent of the urban dwellers utilize fuelwood for cooking. Factors such as household earning, education attainment of household head, occupation type of the respondent, type and ownership of residential place are important factors in the choice of cooking energy. In a similar study, Nnaji, Uzoma, & Chukwu (2012) investigated the effects of socio and economic factors on the likelihood of households in Nsukka area of Enugu State, Nigeria on the demand of fuelwood using the logistic regression model. The study found that educational attainment, low income and large family size are the main drivers of fuelwood consumption in the area of study. In the same vein, Onyekuru & Eboh (2011) found that family size, income, occupation type, and level of education affect fuelwood consumption. The result further suggests that household that engaged in an occupation other than farming, and well-educated families tend to use less of fuelwood than rural farming household. In Ogun state, Bamiro & Ogunjobi (2015) discovered that household choice of energy is influence by household size and price of fuelwood. However, these studies are limited by the sample size, hence not a good representative of the Nigeria case.

Besides that, Bello (2011) carried out a state analysis of the determinants of fuelwood consumption in Gombe and reports that the socio-economic status of the household is the major force that influence the use of fuelwood. Specifically, the study shows that low-income households main source of cooking energy is fuelwood, hence, the study associate the use of fuelwood in Gombe to widespread poverty. Other drivers of fuelwood consumption are household size and level of educational attainment within the household, while the level of economic wealth is mainly responsible for switching energy source. Household in the lower-income class relies on fuelwood, while those in the upper-income class demand for more efficient energy type. Onoja & Idoko (2012) taking into account simultaneity problem, found that rural and Peri-urban farm households in Kogi State demand for fuelwood, is anchor on the own price of fuelwood, price of alternative (kerosene) energy, and household size as well level of income of household

In a similar study, Onoja & Emodi (2012) found most households depend on fuelwood as their source of energy and that the profitability of fuelwood business is significantly influenced by the prevailing price of fuelwood in the market, level of education, and distance of the seller from the forest. Olugbire *et al.* (2016) found that low-income households in Oyo state utilize fuelwood as cooking energy. Other main determinants of energy choice identified in the study are residential area, household earnings, price of cooking energy, taste and preference for a given energy type, and closeness to the source of energy. The major weakness of these studies is the fact that the studies are limited to state analyses.

Empirical Studies in some developing and developed countries have examined the preferences for fuelwood among households in relation to socioeconomic forces. Alem, Beyene, Köhlin & Mekonnen (2016) using a random effect multinomial logit show that education, access to an

alternative source of energy and household income are the key determinants of fuelwood consumption among Ethiopian household. In Uganda, Egeru (2013) found that fuelwood is the main source of energy for cooking and preservation of food among rural households. In addition, the study reveals that weekly food consumption, the number of people in a given household, income of the household, own price of fuelwood and spending on alternative (substitute) source of energy are the key drivers of fuelwood consumption.

Another Uganda study found that in general, demographic and socio-economic factors are the main determinants of fuelwood consumption. Evidence suggested that female-headed households, a distance of the place of residence from the point of collection of fuelwood, and price of charcoal are negatively associated with demand for fuelwood, while expenditure on food and size of the household positively impact the demand for fuelwood (Egeru, Majaliwa, Isubukalu, Mukwaya & Katerega, 2010).

In Timor-Leste, Rahut, Mottaleb & Ali (2017) found that low-income household depends on fuelwood for energy. Further, the result revealed that male-headed household, high-income household, households that are residing in the urban area, and household with higher education attainment tend less to use fuelwood and depend more on other efficient sources of energy such as electricity, while female-headed households seem to demand more for fuelwood. Abebaw (2007) investigated the choice of fuelwood amid urban households in Ethiopia and found that the education of the household head, number of people in a family, per capita income and ownership of refrigerator significantly influence the fuelwood consumption of the household. Specifically, the results show that household size is inversely associated with fuelwood usage and households with higher educational level demand are less likely to demand fuelwood than those households with less education. The study suggests that at a given threshold level of per capita income, fuelwood consumption is minimized.

Several studies analyze the determinants of fuelwood consumption in developed countries. For instance, in Northern Greece, Arabatzis & Malesios (2011) empirically analyzed the factors responsible for fuelwood consumption (heating and cooking) and found that environmental factor and socioeconomic characteristics of household are the main determinants of fuelwood consumption. Specifically, the factors are annual household income, number of members in the household, the ease of fetching fuelwood, price of fuelwood, and type of dwelling. Other factors are membership of the environmental or ecological organization, contribution to the promotion of renewable energy by state, and awareness on a global environmental issue.

Arabatzis, Kitikidou, Tampakis & Soutsas (2012) observed that fuelwood is an important source of energy in the rural area of Greece due to the economic crisis. The study found that the size of household and changes in land use from agricultural purposes to forestry are the main determinants of fuelwood consumption. Wiafe & Kwakwa (2013) assessed the determinants of fuelwood consumption among rural households in Ghana and found that employment status, a household earning, and the degree of utilization of Liquefied Gas (LG) importantly determine fuelwood usage. Meanwhile, the utilization of fuelwood was characterized by frequent challenges such as limited use during raining season, problems associated with supply, air pollution from smoke, the smell of smoke in food as well as the stress and time required in cooking.

In Bangladesh, Akther, Danesh Miah & Koike (2010) investigated the socioeconomic factors that influence the household choice of energy and observed that fuelwood is still an important source of energy in developing countries. The result revealed that household income is the most important driving force that dictates a household preference for fuelwood.

3. THEORETICAL FRAMEWORK

This study is an anchor on the Energy Ladder model that explains the choice of fuel by household. The hypothesis suggest that as household socioeconomic conditions improve, the preference for a cleaner source of energy rises. Given household income, and some socioeconomic factors, the hypothesis assumes that the choice of energy usage by household involves three sequential order. In the first stage, the household completely relied on biomass. This was closely followed by the reliance on charcoal, coal, and kerosene. In the third stage, households relied on Liquefied Petroleum Gas (LPG), natural gas and electricity (Akther *et al.* , 2010; Lee, 2013).

Van Ruijven *et al.* (2008) argued that the Energy Ladder hypothesis reveals a gradual movement from dirty and traditional energy to clean, convenient, efficient, low-cost and modern source of energy as households attain a higher level of income. This is synonymous to the typical income effect in the theory of consumer behaviour, that specifies the substitutability of normal goods and luxury goods for inferior goods, as households face rising income level. This implies, as households income rises, they tend to shift away from the less advanced energy source to a more sophisticated fuel as they choose from an array of increasing sophisticated energy sources (Link, Axinn, & Ghimire, 2012; Muller & Yan, 2018). However, the Energy Ladder theory has been criticized on the ground that it only accounts for household socioeconomic characteristics but failed to focus on the macroeconomic implication of energy choice on household welfare (Akther *et al.* , 2010). Also, Njong and Johannes (2011) argued that the energy ladder theory suggests that an introduction of technologically sophisticated energy will drive away the traditional fuels and that the term fuel choice can be easily mistaken as fuel switch.

Some studies (Jan, Khan, & Haya, 2012; Wiafe & Kwakwa, 2013) emphasized the need to investigate several factors other than income that can influence the choice of energy among households and also, factor that allow households demand bundle of energy sources at varying stage of the energy ladder.

3.1 Model and Data

In this paper, the Logic Regression Model is employed to establish the factors that influence fuelwood consumption in Nigeria. The logit regression model is a binary response model that predicts the likelihood of occurrence of a discrete variable and is utilized on the condition that the dependent variable has two responses. The outcome (response) variable in this study is binary (0/1), hence the reason the logistic regression model is used. The dependent variable is the decision of the household to utilize fuelwood or not. Therefore, the response variable is '1' if the household uses fuelwood and '0' otherwise.

The binary response model is expressed as a linear function of a set of regressors as:

$$\Pr(y = 1/X) = g(X\beta) \qquad (1)$$

Equation 1 expresses the conditional probability of $y = 1$ (that is, y occurring) given X. Where $\Pr$ is the probability of occurrence, $y = 1$ implies household utilizes fuelwood, X is the vector of explanatory variables that determine the consumption of fuelwood. β is the coefficient of the explanatory variables.

In the Logit model above, $\lambda(X\beta)$ can be expressed as:

$$\lambda(X\beta) = \frac{\exp(X\beta)}{1+\exp(X\beta)} \qquad (2)$$

Equation 2 is the cumulative (logistic) distribution function, it ranges between 0 and 1 for all values of $X\beta$. It is assumed that λ is a non-linear function of $X\beta$, therefore, linear estimators such as ordinary least squared (OLS) cannot be used. The error term follows standard logistic distribution, therefore, it tends to exhibit heteroscedasticity. Thus, the application of OLS will bias the standard errors and inferential statistics from such standard errors will be misleading. Therefore, the model is estimated using the Maximum Likelihood estimator. The explanatory variables included in the model are age, gender of household head, marital status, the highest level of education attained by the household head, occupation type, access to electricity, and income.

The gender of the household head is a binary variable that assumes the value of one if a household head is male, and zero if otherwise. Njong & Johannes (2011) opined that female-headed households are more likely to utilize fuelwood for cooking than male-headed households because women tend to participate more in cooking activities than men. Meanwhile, women have a preference for cleaner and more efficient energy than fuelwood, and since they do more of the cooking it is expected that demand for fuelwood will be less (Abebaw, 2007). Therefore, the influence of gender of the household head cannot be readily determined a priori.

The relationship between fuelwood usage and age is expected to be positive. This is because older or aged people tend to favour traditional fuel (Wiafe & Kwakwa, 2013). Marital status of the household head is a binary variable that takes one when the household head is married and zero if single. This should have a negative impact on household fuelwood usage because the couples will be able to pull resources together and demand cleaner and more efficient energy.

Education attainment can alter the taste and preference of household away from fuelwood towards other sources of energy, therefore, education is expected to have a negative effect on fuelwood usage (Njong and Johannes, 2011; Wiafe & Kwakwa, 2013). High-income households are expected to increase the consumption of alternative source of energy, hence less of fuelwood usage. Employed household heads are more likely to use an alternative source of energy other than fuelwood because they tend to have higher resources than those without employment (Njong and Johannes, 2011). Access to electricity assumes the value one (1) if the household can afford it, and zero (0), if otherwise. Access to electricity, other things being equal, should reduce fuelwood usage.

3.2 Data Source

The study utilized survey data obtained from the Nigerian General Household Survey (GHS) 2015, developed by the National Bureau of Statistics (NBS) in collaboration with World Bank. The surveys include about 5000 Nigerian households that span rural and urban areas. The GHS data covered socioeconomic indicators such as demographics, education, family's earning activities, household income. The same sampling frame comprised of 774 LGAs. The sample frame was constructed into replicates, each state in Nigeria and FCT have 60 Primary Sampling Units (PSUs). A total of 2,220 Enumeration Areas (EA) was surveyed. Ten households were drawn from each EA, hence, a sample size of 22,200 households across the federation. Five thousand households were randomly selected from the sampled households. Meanwhile, 4,581 households completed the interviews. General population distribution revealed that the survey comprised 50.62% males and 49.38% females. Information on age distribution showed that the population comprised more of those in the working-age. Persons aged 0 to 14 years accounted for 42.2% of the population. Individuals aged 15 to 64 years (working-age population) comprised 52.5% of the populace and those aged 65 and above made up 5.1%. Area distribution of persons shows that the Nigerian population was predominantly made up of rural dwellers (74.88%). Urban residents accounted for 25.12% of the population. In terms of education, the highest literacy rates were reported for those whose age was between 15 to 19 years. 86% of the male-headed households are educated while 85% of the female population are literate.

The school enrolment rate shows that 71% of boys were in school while 32% of girls were neither enlisted in primary nor secondary school. The data further show that, nationally, men and women spend similar amounts of time collecting firewood, though men were less likely to collect firewood than women. Regionally, the difference between male and female participation is generally greater. For example, in the North Central region, 71.3% of women collected firewood compared to only 42.5% of men.

4. RESULTS AND DISCUSSION

Regression results for the determinants of household fuelwood consumption in Nigeria are presented in Table 1.

Table 1 Determinants of household consumption

Variables	Fuelwood coefficient
Household income	-0.0588
	(0.0604)
Age of the head of household	1.694***
	(0.275)
Employment in the non-agric sector	-3.686***
	(0.596)
employed in the Agriculture sector	3.841***
	(0.624)
Access to electricity	0.792
	(0.623)
Christianity	13.27
	(857.2)
Islam	10.46
	(857.2)
Male headed household	-0.283*
	(0.146)
Household head completed primary	0.0545
	(0.206)
Household head completed secondary	-1.532***
	(0.259)
Household head completed tertiary	-0.667
	(0.488)
Marital status of the household head	-0.272
	(0.382)
Alternative energy source (Gas)	-0.126
	(0.785)
Constant	-18.25
	(857.2)
Observations	2,510

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' competition

The likelihood ratios of the estimated regression are statistically different from zero, therefore, we reject the hypothesis that all the regressors used in the model did not influence the dependent variable. Most of the explanatory variables were rightly signed based on a prior expectation, that is, the sign of the coefficient of the variables included in the analysis is consistent with fuelwood consumption. The estimated results show that the probability of household utilizing fuelwood has a negative relationship with the variables married household head, education attainment

(Secondary, tertiary), the usage of gas, employment status (non-agriculture sector), and income. This is revealed by the negative coefficient associated with these variables, though only employment of the household head in the non-agriculture sector, male-headed household, secondary, and tertiary are statistically significant. Meanwhile, factors such as age, electricity usage, religions, agricultural self-employment, and attainment of only primary education by the household head are positively related to fuelwood consumption by household.

The fact that age is significant favourably compares with Njong and Johannes (2011) study in Cameroon but unfavourably with Wiafe and Kwakwa (2013) in Ghana. The result that gender is significant in explaining the consumption of fuelwood by household is in line with the result of Abebaw (2007) whose findings reveal male-headed household is less likely to use fuelwood as a source of cooking energy in Urban Ethiopia. However, the result contradicts the work of Njong and Johannes (2011) that reported a negative relationship for households with female heads implying that male-headed household is more likely to utilize fuelwood as a source of cooking energy in Cameroon.

The findings show that attainment of secondary education by household head reduces the usage of fuelwood among household as expected, while the attainment of tertiary education was negative but insignificant statistically. This finding is in line with the works of Njong and Johannes (2011), Bello (2011) and Abebaw (2007) that reported a significant negative relationship. Meanwhile, some studies such as Wiafe and Kwakwa (2013) found a positive insignificant relationship between education and the use of fuelwood.

Marital status and the usage of alternative source of energy (gas) have the expected negative sign but statistically insignificant in explaining fuelwood consumption. This contradicts the finding of Wiafe and Kwakwa (2013) that found a significant relationship between fuelwood consumption and liquefied Petroleum Gas in Ghana.

The household head employment status in the non-agriculture and agricultural occupations are statistically important in explaining fuelwood consumption in Nigeria. While household head that engaged in the non-agriculture occupation has a negative sign, a household whose occupation is agriculture has a positive sign. This implies the probability of utilizing fuelwood among households reduces if the family head is employed in the non-agriculture occupation, while household heads who are employed in agriculture occupation tend to use more of fuelwood. Households whose head are employed in the non-agriculture sector are more likely to make more money than their unemployed counterparts and can go for a cleaner source of energy (Wiafe & Kwakwa, 2013; Arabatzis *et al.* , 2012; Alem et al., 2016). However, household heads who are engaged in agricultural activities are more likely to use fuelwood because they are likely to have access to more wood than their unemployed counterparts (Arabatzis *et al.* , 2012).

Household income is negatively signed though not significant, it tends to suggest that the probability of fuelwood usage reduces as income increases. Therefore, the important determinants of fuelwood consumption in Nigeria are employment status, education, access to an alternative source of energy, and gender of the household head.

5. CONCLUSION

These findings imply that fuelwood consumption in Nigeria is not only influenced by the increasing access to cleaner energy but also by promoting the economic wellbeing of households via human capital development. There is a need for the government to embark on policies that promote formal education in order to reduce dependence on fuelwood and encourages the use of cleaner energy source. Working in the non-agriculture sector tends to reduce the demand for fuelwood by household probably because of higher earnings associated with such sectors.

Therefore, there is a need to raise household income. Furthermore, many households still demand fuelwood in the face of rising access to an alternative source of energy, thus commercial plantation of wood may be necessary for the short term.

REFERENCES

Abebaw, D. (2007). Household determinants of fuelwood choice in urban Ethiopia: a case study of Jimma Town. *The Journal of Developing Areas*, 117-126.

Adeyemi, P. A., & Adereleye, A. (2016). Determinants of household choice of cooking energy in Ondo state, Nigeria. *Journal of Economics and Sustainable Development*, *7*(9), 131-142.

Akther, S., Danesh Miah, M., & Koike, M. (2010). Driving forces for fuelwood choice of households in developing countries: environmental implications for Bangladesh. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *6*(1-2), 35-42. doi:10.1080/21513732.2010.505011

Alem, Y., Beyene, A. D., Köhlin, G., & Mekonnen, A. (2016). Modeling household cooking fuel choice: A panel multinomial logit approach. *Energy Economics, 59*, 129–137. doi:10.1016/j.eneco.2016.06.025

Arabatzis, G., & Malesios, C. (2011). An econometric analysis of residential consumption of fuelwood in a mountainous prefecture of Northern Greece. *Energy Policy*, *39*(12), 8088-8097.

Arabatzis, G., Kitikidou, K., Tampakis, S., & Soutsas, K. (2012). The fuelwood consumption in a rural area of Greece. *Renewable and Sustainable Energy Reviews*, *16*(9), 6489-6496. doi:10.1016/j.rser.2012.07.010

Azam, M., Khan, A. Q., Zafeiriou, E., & Arabatzis, G. (2016). Socio-economic determinants of energy consumption: An empirical survey for Greece. Renewable and Sustainable Energy Reviews, 57, 1556–1567. doi:10.1016/j.rser.2015.12.082

Bagnara, S., Tartaglia, R., Albolino, S., Alexander, T., & Fujita, Y. (Eds.). (2018). *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018): Volume I: Healthcare Ergonomics* (Vol. 818). Springer.

Bamiro, O. M., & Ogunjobi, J. O. (2015). Determinants of household energy consumption in Nigeria: Evidence from Ogun State. *Research Journal of Social Science and Management*, *4*(12), 35-41.

Bello, M. (2011). Impact of Wealth Distribution on Energy Consumption in Nigeria: A Case Study of Selected Households In Gombe State.

Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge. *Bulletin of the World Health Organization*, *78*, 1078-1092.

Egeru, A. S. (2013). *Rural Households' Fuelwood Demand Determinants In Dryland Areas of Eastern Uganda. Energy Sources, Part B: Economics, Planning, and Policy, 9(1), 39–45.* doi:10.1080/15567241003716688

Egeru, A., Majaliwa, J. G. M., Isubukalu, P. S., Mukwaya, P., & Katerega, E. (2010). The determinants of fuelwood demand: A case of Olio sub-county eastern Uganda. In *Second RUFORUM Biennial Meeting* (pp. 1593-1598).

Ezzati, M., & Kammen, D. M. (2001). Quantifying the effects of exposure to indoor air pollution from biomass combustion on acute respiratory infections in developing countries. *Environmental health perspectives*, *109*(5), 481-488.

FAO. 2001. State of the World's Forests 2001. Rome. ftp.fao.org/docrep/fao/003/y0900e/.

Isma'il, M., Maiwada, A., Bashir, A., Musa, I., Adamu, G., & Babajo, H. (2014). Comparative Analysis of Fuelwood Utilization In-and-Aroud Ikara Local Government Area of Kaduna State, Nigeria. *Global Journal of Research and Review 1*(3), 125 - 135

Jan, I., Khan, H., & Hayat, S. (2012). Determinants of Rural Household Energy Choices: An Example from Pakistan. *Polish Journal of Environmental Studies*, *21*(3).

Lee, L. Y. T. (2013). Household energy mix in Uganda. *Energy Economics*, *39*, 252-261.

Link, C. F., Axinn, W. G., & Ghimire, D. J. (2012). Household energy consumption: Community context and the fuelwood transition. *Social science research*, *41*(3), 598-611. doi:10.1016/j.ssresearch.2011.12.007

Muller, C., & Yan, H. (2018). Household fuel use in developing countries: Review of theory and evidence. *Energy Economics*, *70*, 429-439.

Njong, A.M., Johannes, T.A. (2011). An Analysis of Domestic Cooking Energy Choices in Cameroon. *European Journal of Social Sciences, 20*(2), 336–347.

Nnaji, C. E., Uzoma, C. C., & Chukwu, J. O. (2012). Analysis of factors determining fuelwood used for cooking by rural households in Nsukka area of Enugu State, Nigeria. *Continental Journal of Environmental Sciences*, *6*(2), 1-6.

Olugbire, O. O., Aremu, F. J., Opute, O. H., Ojedokun, C. A., Olawale, O. O., & Adisa, A. (2016). Determinants of household cooking energy choice in Oyo State, Nigeria. *Russian Journal of Agricultural and Socio-Economic Sciences*, *52*(4).

Onoja, A. O., & Emodi, A. I. (2012). Economic analysis of fuelwood production and consumption: evidence from a Nigerian state. *Journal of Economics, Management and Trade*, 13-23.

Onoja, A. O., & Idoko, O. (2012). Econometric analysis of factors influencing fuelwood demand in rural and peri-urban farm households of Kogi state. *Consilience*, (8), 115-127.

Onyekuru, N. A., & Eboh, E. C. (2011). Determinants of cooking energy demand in the rural households of Enugu State, Nigeria: An application of the Bivariate Probit Model. *Asian Journal Experimental Biological Science*, *2*(2), 332-335.

Rahut, D. B., Das, S., De Groote, H., & Behera, B. (2014). *Determinants of household energy use in Bhutan. Energy, 69, 661–672.* doi:10.1016/j.energy.2014.03.062

Rahut, D. B., Mottaleb, K. A., & Ali, A. (2017). Household energy consumption and its determinants in Timor-Leste. *Asian Development Review*, *34*(1), 167-197.

Van Ruijven, B., Urban, F., Benders, R. M., Moll, H. C., Van Der Sluijs, J. P., De Vries, B., & Van Vuuren, D. P. (2008). Modeling energy and development: an evaluation of models and concepts. *World Development*, *36*(12), 2801-2821.

Wiafe, E. D., & Kwakwa, P. A. (2013). Fuel-wood usage assessment among rural households in Ghana. *Spanish Journal of Rural Development*, *4*(1), 41-48.

World Health Organization (WHO). (2018). Fact sheets.