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Understanding the determinants of household fuelwood consumption in Jemma'a Local Government Area, Kaduna State – Nigeria

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Abstract

Understanding the determinants of household fuelwood energy consumption and the reason for such decisions is important in designing policies and programs that will address the household energy needs as well as measures to eliminate deforestation caused by fuelwood consumption. This study provides a road map for understanding the household's fuelwood consumption behavior for meaningful energy planning and environmental sustainability. A questionnaire is used to collect information from the household fuelwood consumers and fuelwood traders respectively. 300 fuelwood consumers and 60 sellers were given a questionnaire using systematic random sampling for consumers and snowball sampling for sellers. The results of the study show that fuelwood is the main energy source for household activities, and the reason for choosing fuelwood is because it is a cheap energy source compared to other energy types. Furthermore, the outcome indicates that household circumstances such as income and affordability have a direct relationship with fuelwood consumption. The study has important policy implications on household energy supply and environmental management.

Keywords: Understanding, determinants, household fuelwood, consumption.

1. Introduction

Over the years, the link between energy use and environmental degradation has been the focus of academics, practitioners, and policymakers. Many think that one of the causes of climate change is deforestation triggered by fuelwood consumption. While others are less optimistic and warned that exposure to the rapidly changing world economy has rendered many households in a difficult position concerning their decision on energy choice like never before (Maconachie et. al, 2009). As a result, fuelwood energy consumption that causes deforestation, air pollution, and climate change will continue unabated due to incidents of poverty, low income, and poor energy policy despite the availability of clean energy in many developing countries. For example, Muazu (2020) found that despite Nigeria's fossil fuel production, many households used different energy types with more emphasis on fuelwood instead of kerosene, gas, and electricity because of household size, price, and culture. In South Africa, a country that attained the highest level of electrification in Africa, empirical studies have confirmed many households in some parts of the country have reverted to the

use of biomass (especially fuelwood) despite the availability of electricity due to socioeconomic factors (Uhunamure et al. 2017). This means that the tendency for the households in developing countries to abandon clean energy and continue using fuelwood for domestic activities due to socioeconomic reasons is very high. However, understanding those important issues that have to do with the household energy choice (between clean and dirty energy systems) is relegated to the background. The main preoccupation of the policymakers is how to provide clean energy without taking cognizance of whether households are socioeconomically capable of using the energy. Therefore, strengthening institutional capacity on energy policy at different levels to accelerate the use of clean energy by the households in different economic strata requires policymakers to understand these dynamics. Understanding household fuelwood energy choices and the reason for such decisions is important in designing policies and programs that will address the energy needs as well as measures to eliminate environmental problems caused by dirty energy intake. This study provides a road map for understanding the household's energy transition patterns, perceptions, and behavior to find out what energy type they desire for meaningful energy planning and environmental sustainability. In developing countries like Nigeria, studying household fuelwood energy use is necessary since it accounts for more than 80% of household energy demand in the Northern where Jemma'a Local Government Area is located. It will also give us an important indication of the level of environmental sustainability, economic, and business activities as well as poverty and standard of living of a country, shedding light on energy policies and programs as they provide an estimate of what types of energy are needed and what types are not needed, and why. There are many literatures on household's fuelwood consumption and the factors responsible for such pattern e.g. Ujih et al. (2016) and Muazu (2020). However, these studies dwelt on a particular region, state or local government. Therefore, this paper bridges a gap in providing the determinants of fuelwood consumption in Jemma'a Local Government Area of Kaduna State.

2. Theoretical framework

a. The Tragedy of the Commons (Hardin's Commons Theory)

The concept of the Tragedy of the Commons is extremely important for understanding the link between fuelwood consumption and environmental degradation. The tragedy of the commons is a problem arising from the situation in which multiple individuals, acting independently and rationally consulting their self-interest which ultimately exhausts a shared limited resource, even when it is clear that it is not in anyone's long-term interest for this to happen. It arises in a situation where people find themselves in either economic or social cul de sac and there is the availability of natural resources that has no protection. To contextualize energy transition using the concept of the tragedy of common, poverty and low income often propels individuals to exploit natural resources such as fuelwood without any recourse to the eventual danger it may pose to the environment. Hardin's Commons theory is frequently cited to support the concept of sustainable development, interconnecting economic growth, and environmental protection, and affects numerous current issues, including the debate over global warming. "Freedom in a common brings destruction to all." To avoid the ultimate destruction, the human values and ideas of morality must be changed. At the point when the carrying capacity of the commons was fully reached, an exploiter

might ask himself, "Should I continue my actions?" Because the gain of so doing would come only to him, but the loss from his actions would be "Commonized" he will not give up his action. Based on the fact that the theory has been used in explaining the linkage between environmental protection and the quest for economic growth the study underpinned the theory to expound the nexus between household fuelwood consumption determinants and fuelwood trade that households are involved for survival.

b. Energy Ladder and Fuelwood Consumption

Fuelwood is the predominant fuel used in the rural areas and many urban areas of developing countries. Most often, charcoal is the preferred fuel in urban centers replacing firewood as incomes rise. So also, the household will move to kerosene from charcoal as their income increases, and to LPG, then electricity (Arnold *et al*., 2006; Kituyi, 2002). This transition is often referred to as the "energy ladder". These energy movements are often conceptualized as forming an energy ladder that describes transitions in fuel use at different levels of economic development (Holdren and Smith, 2000). Households at lower levels of income and development tend to be at the bottom of the energy ladder, using fuel that is cheap and locally available but not very clean nor efficient. According to the World Bank (2011), over three billion people worldwide are at these lower rungs, depending on biomass fuels, crop waste, dung, wood, leaves, and coal to meet their energy needs.

c. Fuel Stacking/Multi Fuel Model

During the past decade, a growing number of empirical studies on household energy consumption have shown that fuel switching is not unidirectional and people may switch back to traditional biomass even after adopting modern energy carriers; fuels are imperfect substitutes and often specific fuels are preferred for specific tasks; instead of simply switching between fuels, households choose to use a combination of fuels and conversion technologies depending on budget, preferences, and needs (Heltberg, 2004). Empirical studies such as the study done by Maconachie et al. (2009) in the Kano metropolis indicate that some forms of traditional energy are still used by the wealthiest households. Furthermore, a study of Mexican households by Masera et al. (2000) confirms this model by showing that, as households get wealthier, the change in energy use can be characterized as an ''accumulation of energy options'' rather than as a linear switching between fuels. This process is termed ''fuel stacking'' (Masera et al., 2000). Fuel stacking is commonly practiced in rural regions of the developing world and, to a lesser extent, in urban centers (Heltberg, 2004). In some countries, such as Ghana and Nepal, it is practiced by a majority of the population (ESMAP, 2003; Heltberg, 2005).

3. Empirical Literature

Fuelwood is a source of the energy derived by burning wood biomass like logs and twigs, a practice that is very common among low-income households in developing countries. Wood energy has remained the major fuel for over half of the world's population (World Bank, 2011). However, the consumption of fuelwood has some negative influences on the environment beyond its sustainable use such as complex deforestation (Abdullahi et al, 2017), loss of biodiversity, and soil erosion. Additionally, when these problems persist, desert encroachment is inevitable. In the past, the source of fuelwood was simple, and the environmental impacts arising from its exploitation were minimal due to the low human population. In the present time, fuelwood exploitation has gone beyond

mere gathering of deadwood to a deliberate and wanton cutting of trees with a power saw on a large scale (Umar et al., 2016). Therefore, understanding the driving force of this large-scale deforestation is important. For instance, Bamiro and Ogunjobi (2015) show that prices of kerosene and electricity have a significant and positive influence on the household choice of fuelwood in Ogun state. In Tigrai, northern Ethiopia, Gebreegziabher et al. (2012) show the higher the education level the less likely households could choose fuel-wood, and the more likely households could choose electricity. The study of Muazu (2020) in Katsina State Northern Nigeria (2020) shows that household size, marital status, and culture propelled households to consume fuelwood among the energy mix. The work of Baiyegunhi and Hassan (2014) in rural Giwa, Nigeria observed that an increase in the age of household heads has induced many households to shift away from natural gas towards fuel-wood. The study of Bugaje and Saad (2016) shows how the culture of Hausa-Fulani in Northern Nigeria influence household decision to use fuelwood instead of kerosene or gas that are perceived to have an unpleasant odor. The study of Peng et al. (2010) in Hubei, rural China shows how high coal prices have increased the probability of choosing biomass especially fuelwood suggesting that coal and biomass may be substitutes. The work of Özcan et al. (2013) revealed how larger households or household sizes prefer dirty fuels over clean fuels.

4. Methodology

Jema'a Local Government Area of Kaduna State, Nigeria is located between latitude 9^{o} 11' and 9^{o} 30' N and longitude 8^{o} 00' and 8^{o} 30' E. The Local Government is bounded in the East by Kagoro in Kaura Local Government, in the North by Zonkwa and UngwaRimi District of Zangon Kataf Local Government, to the West by Jaba Local Government and in the South by Nassarawa State and to the South-East by Sanga Local Government Area respectively. The dominant economic activity in the study area is farming, and 50% of the farmers are smallholders.

In the study, the questionnaire was used to collect information from the household fuelwood consumers and fuelwood traders respectively. To capture the 300 fuelwood consumers and 60 sellers. The study used the ten electoral wards, and in each of the ward, thirty fuelwood consumers were given questionnaires using systematic random sampling and six fuelwood sellers were given questionnaires using purposive sampling based on Mbaezue (2013) method which involves the purposive sampling of villages in the Local Government Area that have a high flow of fuelwood.

5. Findings

The table below explains the responses on fuelwood as the major source of household energy.

5.1 Fuelwood as a major source of household energy

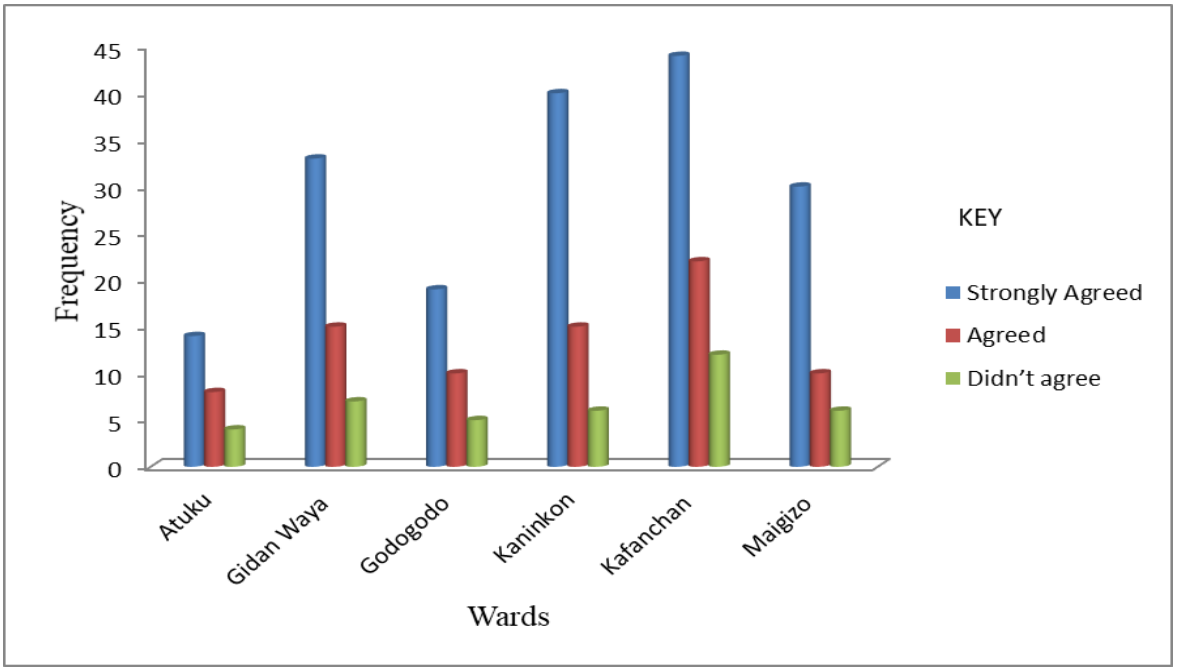

Figure 5.1, shows the distribution response on the consumption of fuelwood as the major source of energy. From the result it can be seen that in Atuku 14 respondents strongly agreed that fuelwood is their major source of energy, 8 respondents agreed that fuelwood is their major source of energy while 4 didn't agree that fuelwood is their major source of energy. The same trend was observed in Gidan Waya, where 33 respondents strongly agreed that fuelwood is their major source of energy, 15 respondents agreed while 7 didn't agree. In Godogodo 19 respondents strongly agreed that fuelwood is their major source of energy, 10 respondents agreed while 5 didn't agree. In Kaninkon, 40 respondents strongly agreed that fuelwood is their major source of energy, 15 respondents agreed while 6 didn't agree. Kafanchan had 44 that strongly agree that fuelwood is the major source of energy, 22 respondents agreed while 12 didn't agree. In Maigizo 30 respondents strongly agreed that fuelwood is their major source of energy, 10 respondents agreed while 6 didn't agree. The above result signifies that fuelwood is the major source of household energy in the study area corroborating the findings Naibbi and Healy (2013) and Muazu and Ogujiuba (2020) showing northern Nigerians households depend on fuelwood as the main source of household energy for domestic activities.

The table below explains the household's reason for choosing fuelwood as energy

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Table 5.1: Reason for choosing fuelwood

Variable	ATK (N=26)		GDW (N=55)		GDG (N=34)		KNK (N=61)		KFC (N=78)		MGZ (N=46)		AVR (N=300)	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Cheap	15	57.69	38	69.09	16	47.06	30	49.18	37	47.44	19	41.30	155	51.96
Available	7	26.92	10	18.18	11	32.35	18	29.51	24	30.78	21	45.65	91	30.57
Affordable	4	15.38	6	10.90	7	20.59	11	18.03	13	16.67	6	13.04	47	15.77
Others	0	0.00	1	1.82	0	0.00	2	3.28	4	5.13	0	0.00	7	1.70

The result in Table 5.1 explained the reason respondents chooses fuelwood. In Atuku, 15 or 57.69% said fuelwood was a cheap energy source, while 7 or 26.92% indicated that fuelwood was the available energy source, and 4 or 15.38% said it was an affordable energy source. Similarly, in Gidan Waya, 38 or 69.09% indicated that fuelwood is a cheap energy source, while 10 or 18.18% explained available as a reason, and 6 or 10.90% indicated fuelwood as an affordable energy source. While in Godogodo 16 (47.06%) shows that they choose fuelwood because it is cheap while 11 or 32.35% indicated availability and affordable has 7 or 20.59%. The result in Kaninkon shows the reason for using fuelwood is being it cheap with 30 or 49.18% and, availability has 18 or 29.51% while affordable has 11 or 18.03% respectively. In the case of Kafanchan, 37 or 47.44% indicated fuelwood as a cheap energy source, while 24 or 30.78% of respondents shows availability, and 13 or 16.67% indicated affordability respondents and the lowest was in others (i.e. either cheap, available, not affordable) with 4 (5.13%) respondents. Maigizo had its highest number is available with 21 or 45.65% then cheap with 19 or 41.30% followed by affordable with 6 or 13.04% respectively. The cumulative data shows that the highest number was in cheap with 155 or 51.96% respondents while available has 91 or 30.57% and 47 or 15.77% respondent believe that fuelwood is affordable with and the lowest was observed in others (i.e. either cheap, available or affordable) with 7 or 1.70% respondents, and this may be due to the low income of most people in the region where this research was conducted and this report corroborates the findings of Aliyu *et al*. (2014) in Akwanga, Nasarawa State Nigeria.

The table below explains other sources of energy households used.

Table 5.2 Other sources of energy

Variable	ATK (N=26)		GDW (N=55)		GDG (N=34)		KNK (N=61)		KFC (N=78)		MGZ (N=46)		AVR (N=300)	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Electricity	4	16.67	10	18.18	6	17.65	7	11.47	9	11.54	3	6.52	39	13.67
Kerosene	13	50.00	21	38.18	10	29.41	22	36.07	26	33.33	17	36.96	109	37.33
Coal	7	26.92	18	32.73	17	50.00	29	47.54	35	44.87	24	52.17	130	42.37
Gas	2	7.69	6	10.09	1	2.94	3	4.92	7	8.97	2	4.35	21	6.49
Others	0	0.00	0	0.00	0	0.00	0	0.00	1	1.28	0	0.00	1	0.21

Table 5.2 presents the results of other sources of energy used besides fuelwood. Even though fuelwood is the main household source of energy in the study area but there are other sources of energy household used often leading to stacking behavior, which includes electricity, kerosene, coal, and gas. Also, biomass such as corn stalks, animal dung, and sawdust are still being used in the area. In Atuku, 13 or 50% use Kerosene being next after fuelwood, then coal 7 or 26.92%, followed by electricity 4 or 16.67% and gas 2 or 7.69% respectively. Still, kerosene is the second energy source after fuelwood in Gidan Waya with 21 or 38.18%, then coal 18 or 32.73%, followed by electricity with 10 or 18.18% and gas 6 or10.09%. While, in Godogodo, coal is the second energy source for the households after fuelwood with 17 or 50.00%, then followed by kerosene with 10 or 29.41%, electricity has 6 or 17.65% and gas 1 or 2.94% respondents. Similarly, coal is the second energy source in Kaninkon with 29 or 47.54%, then Kerosene with 22 or 36.07%, electricity with 7 or 11.47%, and gas 3 or 4.92% respectively. In Kafanchan

coal is the second energy source after fuelwood 35 or 44.87%, then 26 or 33.33% respondents indicated kerosene followed by 9 or 11.54% shows electricity while 7 or 8.92% respondents show gas. The lowest record is on others (i.e. neither kerosene, electricity, coal nor gas) with 1 or 1.28%. Maigizo had its highest number of respondents indicating in coal 24 or 52.17%, then kerosene with 17 respondents 36.96%, electricity 3 or 6.52% and gas 2 or 4.35%. The cumulative data showed that most of the respondents make use of coal with 130 or 42.37%, then kerosene with 109 or 37.33% respondents, electricity with 39 or 13.67% respondents and gas 21 or 6.49% respondents and the lowest was in others (i.e. neither kerosene, electricity, coal nor gas) with 1 or 0.21% respondents. Similar report was made by Elijah, (2012) which indicate that charcoal, wood biomass accounts for 31% and 50% of cooking energy sources for urban and rural areas in Nigeria thus making it to be the dominant cooking fuel source.

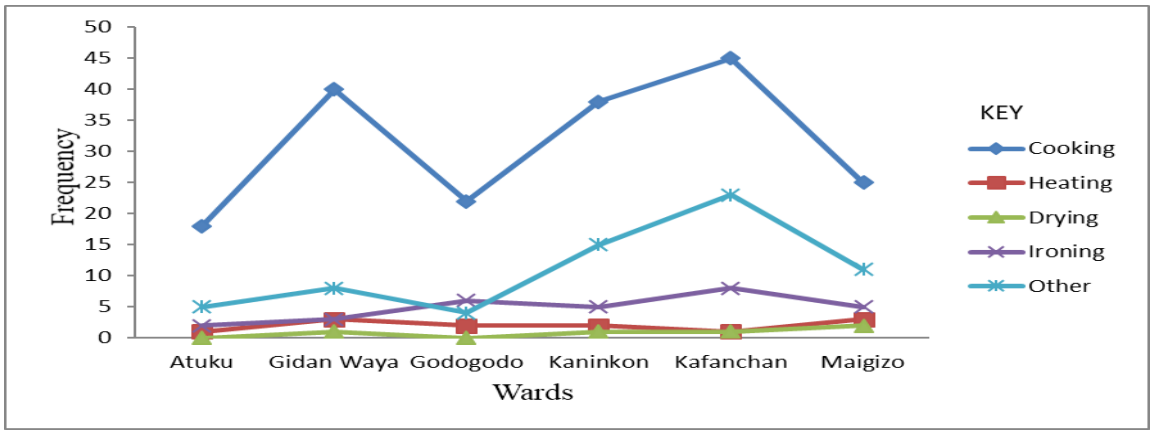

Figure 5.2 Uses of fuelwood

Figure 5.2 explains how households use fuelwood energy in the study area. In Atuku 18 of the respondents reported they use the fuelwood for cooking purposes, 5 for heating their homes during cold weather while 5 use fuelwood for more than one purpose and 2 respondents use it for ironing clothes, but drying has no record. In Gidan Waya 40 respondents indicated that they use fuelwood for cooking, 8 use fuelwood for more than one purpose, and 3 respondents for heating and drying. Similarly, in Godogodo 22 of the respondents use fuelwood for cooking purposes, 6 respondents use fuelwood for ironing, 4 use fuelwood for more than one purpose and there is no record for drying. Furthermore, in Kaninkon 38 of the respondents use fuelwood for cooking, and 5 respondents reported using fuelwood for heating and 2 respondents said they use it for drying. Additionally, in Kafanchan, 45 respondents indicated that they use fuelwood for cooking purposes, and 23 respondents use fuelwood for more than one purpose, while 8 said they use fuelwood for clothes ironing and 1 said fuelwood is used for heating and drying. In Maigizo 25 respondents said they use fuelwood for cooking, and 11 indicated that they use fuelwood for more than one purpose, while 11 revealed that they use fuelwood for ironing followed by 5 respondents showing that they use fuelwood for heating and 2 used fuelwood for drying.

In all the wards the result shows that 62.67 percent of the respondents use fuelwood

for cooking, a similar report was made by Eleri, *et al.* (2012)in their work on Expanding Access to Pro-poor Energy Services in Nigeria where they reported that about 72 percent of the population depend on fuelwood for cooking, Onyeneke *et al* (2015) made a similar observation in their work on Determinants of Fuelwood Consumption among Farming Households in Imo State, Nigeria that fuelwood consumption in the area is very high showing greater dependence of fuelwood as a source of energy for cooking and other related chores at the households.

6. Conclusion

The results of our study show that fuelwood is the main energy source for household activities in the study area. In all six locations, respondents strongly agree that fuelwood is the major source of energy for household activities. Respondents indicated that their reason for choosing fuelwood is because it is a cheap energy source compared with other energy types. Furthermore, the result shows that fuelwood is being used for cooking, heating, drying, and ironing purposes. From the result, household circumstances such as income and affordability have a direct relationship with fuelwood consumption. Based on the outcome of the study, Nigerian energy policy should put more emphasis on addressing the household energy needs since from all indications consumption of fuelwood is inescapable in northern Nigeria.

References

Abdullahi B., Musa A.., Idi A., Adamu J., Yusuf I. U. (2017). Socio-economic determinants of household consumption in Nigeria. *International journal of research- Granthaa,* 5:348-360

Aliyu, A., Modibbo, M.A. Medugu, N.I. and Ayo, O. (2014). Impacts of Deforestation on

Arnold, J.E.M., Kohlin, G. & Persson, R. (2006). Woodfuels, Livelihoods, and Policy Interventions: Changing Perspectives. *World Development,* 34(3); 596–611.

Baiyegunhi L.J.S and M.B. Hassan (2014). Rural household fuel energy transition: Evidence from Giwa LGA Kaduna state, Nigeria. *Energy for sustainable development. 20:30-5.* Maconachi R. Tanko A, and Zakariyau (2009). Descending the Energy Ladder? Oil Price Shocks and Domestic Fuel Choice in Kano, Nigeria. Journal land use policy, 26 (4): 1090- 1099. Gegreegziabher, Z., Alemu, M., Menele K., Gunnar, K. (2012). Urban energy transition and technology adoption: The case of Tigrai, Northern Ethiopia. *Journal of Energy Economics*, 34 (2): 410-418.

Bamiro, O. M and Ogunjobi, J. O. (2015). Determinants of Household Energy Consumption in Nigeria: Evidence from Ogun State. *Research Journal of Social Sciences and Management,* 4(12).

Eleri, E.O. Ugwu, O. and Onuvae, P. (2012). Expanding Access to Pro-poor Energy Services in Nigeria. A Consultation Paper prepared by International Centre for Energy, Environment and Development (ICEED) with support from Christian Aid. Clean Energy Solution Centre

Elijah, I. O. (2012). The benefits and potential impacts of household cooking fuel substitution with bio-ethanol produced from cassava feedstock in Nigeria. *Energy for Sustainable Development*. 16, 352-362. http://dx.doi.org/j.esd.2012.06.003.

ESMAP. 2003. Sustainable Woodfuel Supplies from the Dry Tropical Woodlands. Joint UNDP/World Bank Energy Sector Management

Assistance Programme (ESMAP), Washington. United Nations Food and Agricultural Programme.

Gegreegziabher, Z., Alemu, M., Menele K., Gunnar, K. (2012). Urban energy transition and technology adoption. The case Tigrai, Northern Ethiopia. *Journal Energy Economics*, 34 (2): 410-418

Heltberg, R. (2004). Fuel Switching: Evidence from Eight Developing Countries. *Energy Economics.* 26: 869-87.

Holdren, J.P. and Smith, K.R. (2000). Energy, the Environment and Health. In G. J., The World Energy Assessment: Energy and the Challenge of Sustainability. New York: UNDP.

Kituyi, E. (2002). "Towards Sustainable Charcoal Production and Use: a Systems Approach." Maconachi R. Tanko A, and Zakariyau (2009). Descending the Energy Ladder? Oil Price Shocks and Domestic Fuel Choice in Kano, Nigeria. *Journal land use policy, 26* (4); 1090-1099.

Masera, S. B & Kammen D (2000). From linear Fuel Switching to Multi Cooking Strategies: A Critique and Alternative to the Energy Ladder Model. *A world development.* 2000: 28: 2083-103.

Mbaezue, F. O., (2013). Rural-Urban Interdependence on Fuel Wood in Anambra State, Nigeria. A Dissertation Submitted to the Department of Agricultural Economics, University of Nigeria, Nsukka.

Muazu, N. B (2020). Energy and Development: A review of the Challenges in Household Energy Usage in Nigeria and South Africa. *Journal of science technology and education* 8(3):1-11

Onyeneke R. U., Nwajiuba C. U. & Nwosu C. S. (2015). Determinants of Fuelwood Consumption among Farming Households in Imo State, Nigeria. *Journal of Environment Protection and Sustainable Development*: 1(2): 54-58

Özcan, K. M., Emrah G., and Şenay Ü. (2013). "Economic and Demographic determinants of household energy use in Turkey. *Journal of Energy Policy*, 60 (C): 550-557.

Peng, W. Zerriff, H. and Jiahua, P. (2010). Household level Fuel Switching in Rural Hubei: Energy for Sustainable Development. 14(3):238-244. *Proceedings of a Regional Workshop on Woodfuel Policy and Legislation in Eastern and Southern Africa*. RELMA, Nairobi, Kenya

Saad, S., Bugaje, I. M. (2016). Biomass Consumption in Nigeria. Trend and Policy issues. *Journal of Agriculture and Sustainability*, 9(2): 127-157.

Uhunamure SE, Nethengwe NS, Musyoki A (2017). Driving force for fuelwood use in the Thulamela Municipality, South Africa. J Energy South Afr 2017; 28:25–34

Ujih, O.U., Dahiru, S. U., Musa, M & Azare, M. I. (2016). Effects of fuel wood exploitation on the environment: A case study of Nasarawa Local Government area, Nasarawa State, Nigeria. *Dutse Journal of Pure and Applied Sciences* 2(1): 195-201,

Umar, O. U., Nura, S., Dahiru, M. M. and Isa, M. A. (2016). Effects of fuel Wood exploitation on the environment: A case study of Nasarawa Local Government Area, Nasarawa State, Nigeria. *Dutse Journal of Pure and Applied Sciences* 2(1): 195 – 201.

World Bank (2011). Wood-Based Biomass Energy Development for Sub-Saharan Africa: Issues and Approaches: 1-64. The World Bank African Renewable Energy Access Programme.