International Journal of Agriculture, Environment and Bioresearch

Vol. 2, No. 04; 2017

ISSN: 2456-8643

ECONOMIC INCENTIVES CAN ALLEVIATE RURAL HOUSEHOLDS' ENERGY POVERTY IN NIGERIA

A.O. Kolawole[1]* and A. B. Sekumade[2]

1'2Department of Agricultural Economics and Extension

Ekiti State University Ado Ekiti, Nigeria. +234-8034965672

ABSTRACT

Rural households' access to the use of modern fuels for cooking and lighting is crucial to alleviating energy poverty and achieving environmental sustainability. This study examined the energy poverty status of rural households and the role which economic incentives contribute. Descriptive Statistics and Multinomial Logit Regression Model were used to analyze survey data for 225 households. The results showed that majority (96%) of the respondents had no access to modern sources of energy for cooking and lighting in their houses, as 40 percent utilized firewood while 34.7 percent utilized charcoal as their main energy options. About 77.3 percent of the respondents use kerosene as a catalyst for fuelwood combustion and lighting. Monthly income and prices of energy resources was revealed to be the most significant variable ($p< 0.001$) influencing energy options utilization. The negative coefficients of income (-0.0000178, -0.0000098) implies that household that are poor tend to be disposed to the use of forest resources while those that were better-off tend to augment with non-forest alternative fuels. More precisely, an average income that is ^1000 lower increases this probability by one point. Since biomass use is an indirect act of deforestation, effort should be geared towards agro forestry. Government can adopt the beneficiary-pays-principle by compensating agro forestry growers and discouraging undesirable practices. They must provide abatement technology incentives like energy saving firewood and improved stoves. Also, government can use the polluter-pays-principle which can help to stop treating the environment as a 'free good'. Subsidizing fossil fuel price to initiate an energy switch among rural households is also essential.

Keywords: Energy poverty, Economic Incentives (EIs) and Rural Households

INTRODUCTION

According to the United Nations Environment Programme(UNEP, 2006), energy poverty arises when households are unable to cook with modern cooking fuels and lacks a minimum availability of electric lighting to read or to carry out productive activities at sunset. This has made renewable energy sources like biomass dominate households' energy consumption in many developing countries today (Amie, 2007).The lack of access to fossil fuels and electricity is more

Vol. 2, No. 04; 2017

ISSN: 2456-8643

devastating in Sub-Saharan Africa (SSA)where 89 per cent of their populations still rely on biomass energy (Modi *et al*., 2005). Unfortunately, SSA's energy condition is paradoxically and desperately in need of a great deal of energy for economic growth and development, yet it is a net exporter of fossil fuels. In spite that SSA contributes to about 7 per cent of world's commercial energy need, it accounts for only 3 per cent of global commercial energy utilization (Amie, 2007).

Since the government of other developing country consider continued dependence on forest resources a challenge to promoting environmental sustainability (UBOS, 2007), economic incentives have to come in place. This has been the policy focus by environmental economists to influence decision-making and behavior in such a way that energy options utilization are promoted to an environmentally friendly and more desirable situation than in their absence. These incentives affect the estimates of the costs and benefits of alternative course of action or choices opened to households. The rationale to substitute more polluting fuels with less polluting ones is aimed at saving health and other related costs.

The rising dependence and consumption of renewable energy resources mostly fuelwood is becoming worrisome in Nigeria. Faced with the fluctuation in fossil energy prices in Nigeria, the exploitation of forest resources will however be inevitable. The government's rationale and financial commitment to improving poor people's access to cheap and/or renewable energy is still anchored on environmental, economic and social grounds. Experience from other developing countries like, Barbados, Senegal, Botswana and India have demonstrated that economic incentives have at least delivered environmental, economic and health impacts. In these countries, the positive impacts took a very long time to be realized. Nigeria should not expect the story to be different, particularly with the current hike in fuel price and a sharp decline in the world oil market price. Therefore, access to modern energy by the poor will still remain very low.

However, this study aims at:

i. ascertaining the energy poverty status of rural households in Nigeria;
ii. analyzing those factors influencing rural households' energy poverty status;
iii. recommending workable economic incentive policies to diversify households' energy choices towards ensuring environmental sustainability.

2.0 MATERIALS AND METHODS

This research work was carried out in South-west geographical area of Nigeria. This area has a total area of 80,012.55km^2 and population of 26,742,465 (NPC 2006). Both the forest zone and the savannah zone are peculiar to this area of Nigeria. Forested land occupies about 14 percent of total land area in Nigeria. Her natural resources include petroleum, tin, columbite, iron ore, coal, limestone, lead, zinc, natural gas, hydropower, and arable land (Wikipedia, 2013, 2014).

Vol. 2, No. 04; 2017

ISSN: 2456-8643

A multi-stage sampling technique was employed to draw the sample for the survey. First, three (3) states were randomly selected; followed by the random selection of three (3) Local Government Areas (LGA) and the third stage involved the random sampling of five (5) communities from each LGA. The final stage involved the random sampling of five (5) rural households. This equal order of selection was to ensure equal representation and to reduce biasness. In aggregate, 225 households were selected and interviewed through the aid of a well-structured questionnaire. Data were sought on rural household's sources of energy for cooking and lighting.

For the Multinomial Logit Regression Model, energy options variables were categorized into 3 levels;

- Traditional cooking fuels or forest resources= 0
- Modern or non-forest energy resources = 1
- Traditional cooking fuels augmented with modern /non-forest resources = 2

The probability that *i*th households will belong to the *j*th energy options is denoted as;

$$P_{ij} = \frac{e\beta_j X_i}{\sum_{k=j}^{\infty}(e\beta_j X_i)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where i = 1, 2, -----------------*n* variables

k = 0, 1, --------------------------- j energy options

β_j= vector of parameters that relates X_{is} to the probability of being in energy options j. The linear equation for multinomial logit regression is represented below;

$$Y_1 = \alpha o + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + + \alpha_6 X_6 + U_1 \ldots\ldots\ldots\ldots (2)$$

Y = Energy options utilized by rural households (0, 1, and 2)

X_1 = Monthly income of household head (Naira, ^)

X_2 = Household size

X_3 = Age of household head (years)

X_4 = Educational years of household head

X_5 = Prices of non-forest energy option (kerosene, gas, electricity) in Naira

X_6 = Prices of forest energy option utilized (firewood, charcoal, and sawdust) in Naira

αo = Intercept coefficient

αi = Slope coefficient (δy/ δx)

U_1 = Stochastic error terms.

Vol. 2, No. 04; 2017

ISSN: 2456-8643

3.0 RESULTS AND DISCUSSION

3.1 Energy poverty status of rural households in Nigeria

3.1.1 Traditional Cooking Fuels Utilized for Domestic Energy Purposes

Forty percent of respondent in South-west Nigeria utilized firewood as their major source of domestic energy (Figure 1). In the same vein, charcoal consumption takes precedence as 34.7 percent of the respondents utilized it as their main energy option. This study revealed that the charcoal being used by the households were the end product of their firewood combustion, although charcoal became a popular source of energy with households not almost in the core rural areas of Nigeria. From Fig. 1, the dominance of firewood and charcoal as a major source of domestic energy (74.7 percent) conforms with studies like Nabinta*et al*., (2007)., Adepoju*et al*.,(2012) and Mwangi,(2013) that these sources of energy have been a traditional means and will still remain popular despite the fact that supplies are dwindling (Mwangi, 2013). Few respondents utilized more of sawdust (16.4 percent) for cooking. Since fuelwood/biomass is a combination of both firewood, charcoal, sawdust and forest residues, it can be indirectly stated that majority (96%) of the rural households in South-west Nigeria still subsist on fuelwood as their main source of domestic energy use. This result may not be true for rural areas in Nigeria where there is no vegetation, or where there is relative comparative disadvantage for biomass growth. For instance, the core Niger Delta regions where there are crude oil explorations and mining sites. Only 4 percent of the entire sample did not use forest resources for domestic energy purposes. This category of people could be the elite in rural areas or mobile government workers whose income exempts them from the vicious cycle of energy poverty. Thus, they prefer to utilize non-forest energy sources like kerosene, gas, electricity, petrol and solar.

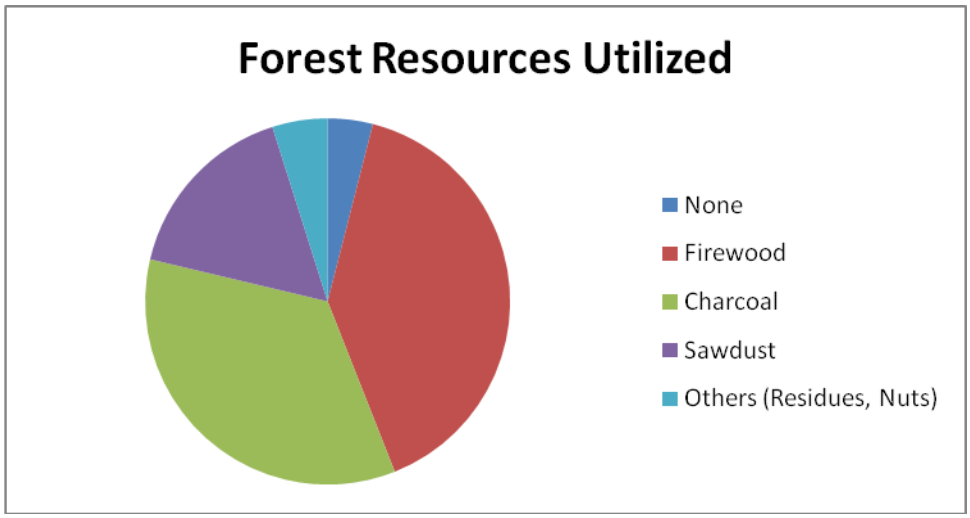

Figure 1: Source of traditional cooking fuels (Field Survey, 2016)

Vol. 2, No. 04; 2017

ISSN: 2456-8643

3.1.2 Modern or Non-forest Resources Utilized for Domestic Energy Purpose

Figure 2 show that 77.3 percent of the respondents utilized kerosene as their major source of energy for cooking and lighting. It serves as a catalyst for fuel wood combustion and lamp lighting. Very few of the respondents (about 4.4 percent) utilized gas for cooking, 4.9 percent made use of petrol to power appliances to provide lighting at sunset, 3.6 percent relied on electricity, while 1.8 percent uses solar to meeting their domestic energy purpose. The implication of this finding is that kerosene is the only non-renewable resources that have the greatest pressure of utilization in rural Nigeria (Fig. 2). Other non-forest resources were not exploited like kerosene.

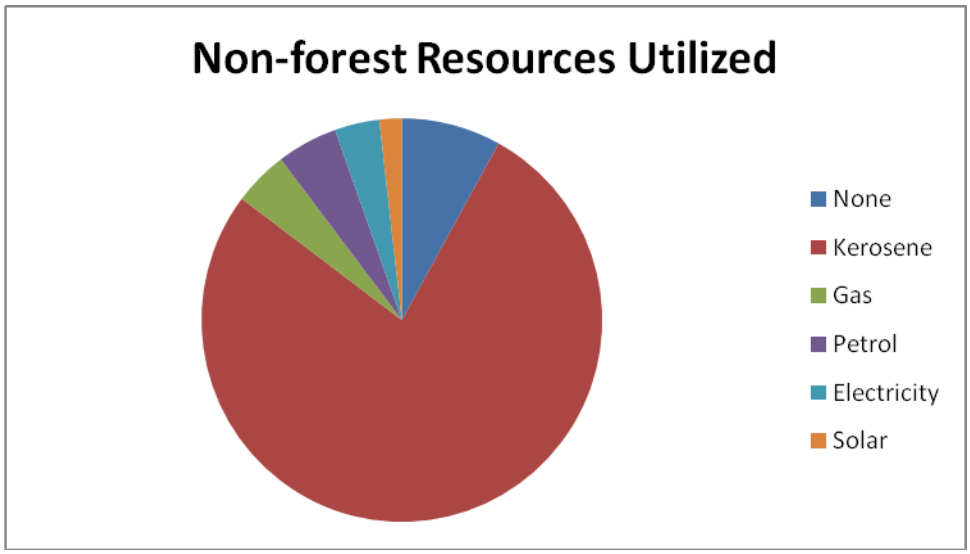

Figure 2: Source of modern/non-forest energy resources (Field Survey, 2016)

3.2 Factors influencing rural households' energy poverty status

The indicator of energy poverty is households' disposition to traditional cooking fuels and local lamps for lightening at sunset. Table 1 show factors that explain rural households' disposition to the use of forest or traditional cooking fuels (firewood, charcoal, sawdust, residues) and modern or non-forest resources (kerosene, gas, petrol, electricity and solar) based on multinomial logit estimates results. For the determination of biomass augmented with non-forest resources, variables that were significant include; income, age, and prices of forest energy option. Monthly

Vol. 2, No. 04; 2017

ISSN: 2456-8643

income of household head was significant at 1% and had negative coefficient. This implies that as rural income tends to reduce, there is greater likelihood for household to augment forest and non-forest energy resources together to meet domestic energy purposes. The implication is that household that are poor tend to be disposed to the use of forest resources while those that were better-off tend to augment with non-forest alternative fuels (Fakayode*et al.*, 2013). In the case of non-forest energy options alone, variable income was also significant at 1% but had negative coefficient. Household head income appears to be one of the most decisive variables in the choice of non-forest resources as the main source of energy. The marginal effect for the average household was revealed to be -0.000001. These results can be interpreted as follows; a low income increases the probability of choosing non-forest resources as the main energy option than not using fuel wood at all. More precisely, an average income that is ^1000 lower increases this probability by one point. This however contradicts *apriori* expectation. This result agrees with that of Stephane *et al.* (2006) but the only difference was that Stephane *et al.* (2006) carried out the research using Urban. Since poorer households tend to be disposed to the use of fuelwood, then this resource appear to be an inferior goods. But when it is augmented or used as back-up with non-forest resources, it has the characteristic of a normal good. This result was also justified by that of Stephane *et al.* (2006) which have the estimate of income to be negative and significant. Prices of non-forest energy option seems to have positive effect on the probability of choosing non-forest resources as main source of energy, but it was not significant when augmented with fuelwood. This implies that as the price of the non-forest energy sources increases, there is low demand for such products. This conforms to the theory of demand, considering these products to be a normal good. The variable age tend to influence households' deposition to the use of biomass augmented with non-forest resources. The variable (age) has positive coefficient (0.006) and significant at 5% level. The implication of this is that, the higher the age of household head, the higher the augmentation in the use of both forest and non-forest energy sources. This effect plus that of income will make such household to move from a particular energy option, either biomass or non-forest resources. Prices of forest energy option significantly affect the choice of both biomass and non-forest energy option. This variable exhibited positive coefficient and significant at 1% and 10% for forest augmented with non-forest resources and non-forest resources alone respectively. The significance of the prices of fuelwood / charcoal does not truly reflect its consumption pattern in the developing world today. The estimates show that as their prices increases, so also is the disposition to the use of biomass and non-forest resources.

Vol. 2, No. 04; 2017

ISSN: 2456-8643

Table 1: Multinomial Logit Regression Estimation Results

	Traditional Cooking Fuels Augmented with Non-forest Resources				**Modern or Non-forest Resources**			
	Coeff.	*Std. Err.*	*t value*	*p>/t/*	*Coeff.*	*Std. Err.*	*t value*	*p>/t/*
Monthly Income of Household Head (X_1)	-.0000178	5.69e-04	3.130***	0.002	-.0000098	3.46e-06	2.832***	0.005
Household Size (X_2)	-.1511012	.1587197	-0.952	0.342	.0282592	.060642	0.466	0.642
Age of Household Head (X_3)	.0060142	.0026921	2.234**	0.026	.0128456	.029328	0.438	0.662
Educational Years of Household Head (X_4)	-.0160003	.0098602	-1.623	0.106	-.0287523	.049065	-0.586	0.558
Prices of Non-forest Energy Option (X_5)	-.0853682	.02326109	-0.367	0.714	2.9244361	.240853	12.142***	0.000
Prices of Forest Energy Option (X_6)	.0064168	.0022900	2.802***	0.006	.0324092	.017211	1.883*	0.061
Cons	-267.27621	495.874221	-0.539	-0.615	6.5262218	23.30792	0.280	1.230
# Observations	225							
Log-likelihood	-151.35							
LR Test χ^2_{60} (p-value)	273.34 (0.000)							
Pseudo-R^2	0.682							
Reference Category	Non-users of Biomass/forest Resources							

Source: Field Survey, 2016

*** Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

Vol. 2, No. 04; 2017

ISSN: 2456-8643

4.0 CONCLUSION AND RECOMMENDATION

This study analyzed the energy poverty status of rural households in Nigeria and the role with which economic incentive can play in alleviating energy poverty. Descriptive Statistics and a multinomial logit regression model were used to analyze survey data for 225 households. Descriptive statistics results showed that majority (96%) of the respondents have no access to modern sources of energy for cooking and lighting in their house. Forty percent of respondent utilized firewood while 34.7 percent respondent utilized charcoal as their main energy option. Biomass use is an indirect act of deforestation and consequently leads into carbon emission.Since market mechanism does not deal with negative externalitieslike carbon emission and problem induced by cutting down trees without replacement, EIs can be used in these settings for environmental management and sustainability. When markets provide surplus of certain goods and services that exhibit negative external effects and at the same timeproviding deficitamount of useful serviceslike ecosystem services; it is imperative that government intervenes. This intervention can be by applying *"the polluter pays principle"***.** Byeffectively targeting the polluters (both producers and consumers of forest resources) for energy use – ensures that they in turn absorb the costs that are likely to be imposed on the society through their negligence, production and consumption decisions. In this way, the polluters would stop treating the environment as a 'free good' and would no longer pass their pollution-related costs on to other segments of society or future generations.

Similarly, the Government can use EIs to compensate rural households as a result of their encouragement in adopting sustainable environmental management practices like reforestation, afforestation, watershed management, ecosystem conservation that can equally benefit the society. To recognize their contributions, government should compensate them on behalf of the society for the extra effort they make to ensure other societal benefits, hence the principle: *beneficiary-pays-principle***.** Thus, EIs can be offered to discourage undesirable practices, in which case they can be termed *disincentives*or to encourage the good ones, and hence termed *incentives.*

Government that wants to reduce the pressure on forest resources in rural areas must provide abatement technology incentives, like energy saving firewood and improved stoves, so as to reduce fuelwood consumption. Politicians canvassing for the votes of rural populace during power transition can make provision for these incentives to achieve their political will and at the same time sustaining the environment.

The assertion that the use of energy from fuelwood does not contribute to global warming (UNECE/FAO, 2005) could only be true if effort is geared towards the promotion of fast growing agroforestry and hedge/boundaries tree species so as to match fuelwood consumption. Agroforestry practices would be a formidable tool to combat the negative effect of fuelwood

Vol. 2, No. 04; 2017

ISSN: 2456-8643

consumption at the expense of renewing these resources. Government should greatly encourage agroforestry practices among rural households and give financial incentives to achieve this purpose.

Since rural households consider fuelwood to be a 'free good', increase in the cost of accessing or buying fuelwood to reduce the pressure exerted on forest resources may not be an effective economic instrument in Nigeria, rather, subsidizing fossils fuel price. This can lead to an energy switch among rural households.

REFERENCES

Adepoju A.O., Oyekale A.S. and Aromolaran O. (2012) Factors influencing domestic energychoice of rural households in Ogun state, Nigeria. *Journal of Agriculture & Social Sciences* ISSN Print: 1813–2235; ISSN Online: 1814–960X 12–029/AWB/2012/8–4–129–134.

Amie Gaye(2007) Access to Energy and Human Development. Human Development Report 2007/2008

Fakayode S.B.,Animashaun J.O., Babatunde R.O. and Salau R.A. (2013) Determinants of forest resources uses and its implications for environmental sustainability in Nigeria. *Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists*, September 22-25, 2013, Hammamet, Tunisia.

Modi V., McDade S., Lallement D. and Saghir J. (2005) Energy Services for the Millennium Development Goals. Achieving the Millennium Development Goals.*Millennium Project.*

Mwangi V.W. (2013) Energy consumption among rural households in Mukaro location of Nyeri county, Kenya.*Unpublished M.A thesis* in Environmental planning and management, university of Nairobi, Department of Geography and Environmental studies.

Nabinta R.T., Yahya M.K. and Olajide B.R. (2007). Socio-economic implications of rural energy exploitation and utilization on sustainable development in Gombe State, Nigeria. *J.Soc.Sci*.,15(3); 205-211.

NPC (2006) Report of Nigeria's National Population Commission on the 2006 census.

Stephane C., Serge G. and Arnand R. (2006) Household energy choices and fuel woodconsumption: An econometric approach to the French Data. *INRA, UMR 365 EcocnomicForestiere*, F-5400 Nancy, France.

UBOS (2007) Statistical Abstract 2007/2008. Kampala.

UNDP (2006) Energizing Poverty Reduction.A Review of Energy-Poverty Nexus in Poverty Reduction Strategy Papers.

Wikipedia (2013) Renewable energy resources, www.wikipedia/renewable energy.

Wikipedia (2014) South-western geographical zone of Nigeria.