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Rural Households' Sources and Demand for Cooking Energy During Kerosene Subsidy in Oluyole Local Government Area of Oyo State, Nigeria

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ABSTRACT This study investigated rural households'sources and demand for biofuel, before and after kerosene subsidy in Nigeria. The data were randomly obtained from 120 respondents and analyzed with descriptive statistics and logit regression. Results of the analyses revealed that the main sources of biofuel before and after the subsidy were charcoal and firewood. The proportion of households that depended on kerosene increased from 49.2% before the subsidy to 60.83% after the subsidy. Also, 6.67% of the respondents indicated that kerosene was scarce after the subsidy, as against 41.67% that indicated same before the subsidy. The logistic regression analysis revealed that high income households, who were married and employed prefer firewood and charcoal before and after the subsidy. Therefore, to ensure a significant increase in the demand for kerosene in order to save the degrading forest resources, availability of kerosene is an important factor.

INTRODUCTION

In the 1970s, the wood fuel situation in developing countries could be described as desperately retrogressive. There were serious concerns because citizens of many developing countries used more wood for fuel than was being regenerated by different projects and natural forest re-growth (Eckholm 1975; Eckholm et al. 1984). The expected implications were massive deforestation followed by environmental problems, increased collection times and reduced energy consumption with some adversely compounded implications for households' nutrition and healthy living. Based on those agitations, a number of interventions were launched during the 1980s and 1990s, in order to increase the supply of biomass as well as reduce the demand through substitution to other forms of energy. However, both the underlying assumptions and the relevance/efficiency of the resulting interventions were already heavily criticized by the late 1980s (Priscilla et al. 2008).

Wood fuel and charcoals are solid agricultural products classified as biofuel. They are arguably part of the most important products from the local forests, especially for the majority of rural poor in Nigeria. Similarly, forest resources are diverse and can be put into many uses. People have therefore depended on forests and trees for their economic livelihood and improvement in quality of life. Forests, as an economic resource provides food, fuel, fibre, timber and various non-wood products (World Bank 1991; Sharma 1992).

It should be noted that the purpose of domestic demand for energy in Nigeria is cooking. Government has realized that increasing population pressure is directly exerting more pressure on the fragile ecosystem, thus subjecting it to further degradation. An important aspect of this degradation is deforestation, which also subjects the nation to serious economic losses as a result of the compounded influence of climate change, soil erosion, land degradation and declining agricultural productivity, among others. Although policy makers in Nigeria are very much aware of the fact that the urban and rural poor derive the highest proportion of their domestic energy from kerosene, promoting access of people to this essential product had been largely done with mere lip services. Abject neglect of issues that border on availability of kerosene in Nigeria is therefore giving rise to product adulteration, which already resulted into loss of several lives, while many are permanently disabled. The marketers of the product are also fixing its price without due monitoring and proper regulation from appropriate government agencies.

Moreover, government had attempted to staunch her legislative power to make kerosene easily accessible to the poor masses under the pretence of "supposed subsidies" on other petroleum products. Many rural and urban households therefore resort into using wood fuel, agricultural wastes, charcoal, among others. The implication of this for increasing deforestation in Nigeria can be well conceptualized if one realizes about two decades ago, 80 percent of the Nigerian population who are mostly rural dwellers depended solely on traditional fuel wood suppliers for their domestic energy needs (Adegoke 1993). The percentage should now have increased with the growing unavailability of kerosene and sharp drop in rural and urban purchasing power due to increasing prices of petroleum products and global economic meltdown.

It should be noted that although Nigerian government had long insisted on deregulation of the downstream sector of oil sector, labour and other civil protests have always made them have a rethink on the issue. By July 2008, however, government not only fixed petroleum price at N65/litre, but at one time promoted availability of kerosene and reduced its official price to N50/litre. This reduction was effected for one year and it represents about 50 percent of the average black market and retail prices that the product were sold before. The government's position then was to subsidize the product for the people. However, subsidies on petroleum products are often pocketed by the marketers through illegal fuel exportation, fuel diversion and unnecessary creation of artificial scarcity.

Objectives of the Study

This study therefore intends to fulfill the following objectives:

i. examine the pattern of domestic energy demand by rural households before and after
kerosene subsidy and
ii. identify the factors that influence the choice of biofuel before and after the subsidy.

MATERIAL AND METHODS

The study was carried out in Oluyole Local Government Area of Oyo State in February, 2009. The population is predominantly rural. Data were collected with the aid of well-structured questionnaires supplemented with interview schedules. A multi-stage random sampling technique was used to select the respondents. The first stage was the random selection of three wards from a total of ten wards in the area. The second stage involved the selection of three villages from the selected wards. A total of 120 respondents were selected in proportion to the population of the villages based on preliminary results from 2006 Census.

Data were collected some months after the subsidy policy had been implemented and households had adjusted expenditure patterns. The data covered socio-economic characteristics, main source of energy for cooking, quantity of biofuel and kerosene consumed, costs of biofuel and kerosene and factors influencing the consumption of firewood, charcoal and kerosene.

Specification of the Logit Models

The Logit model was used to determine the factors that influence the probability of rural households choice of biofuel (firewood, charcoal) denoted as 1, rather than kerosene before and after kerosene was subsidized. The model estimates the effect of explanatory variables on the probability of choosing a particular dependent variable. The approach to logit model estimation is to denote one of the dependent variable categories as 1, while the other is given zero.

The linear probability model can be expressed as:

$$P_i = E(Y = 1/X_i) = \beta_1 + \beta_2 X_i \quad \text{.....1}$$

The explanatory variables Xi are defined as: X_1 = age of respondents (in years), X_2 = income of respondents (measured in naira), X_3 = price of energy used (measured in naira), X_4 = marital status (married =1, 0 otherwise), X_5 = primary education (yes = 1, 0 otherwise), X_6 = secondary education (yes = 1, 0 otherwise), X_7 tertiary education (yes = 1, 0 otherwise), X_8 = number of dependants, X_9 = Student (yes = 1, 0 otherwise), X_{10} = civil servant (yes =1, 0 otherwise), X_{11} = trading (yes =1, 0 otherwise), X_{12} = source of wood (own farm = 1, 0 otherwise), X_{13} = decision on choice of energy (spouse =1, 0 otherwise).

$$P_i = E(Y = 1/X_i) = \frac{1}{1 + \exp(\beta_1 + \beta_2 X_i)} = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \quad \text{..... 2}$$

Where Zi = $\beta_1 + \beta_2 X_i$

Equation 2 is the cumulative logistic distribution function. Zi ranges from - ∞ to + ∞, Pi ranges between 0 and 1 (Vasisht, no date).

The probability of using biofuel is specified as , while 1-Pi is the probability of not using it which can be expressed as $\frac{1}{1+\exp(Z_i)}$

Therefore, it can be said that

$$\frac{P_i}{1-P_i} = \frac{1+\exp(Z_i)}{1+\exp(-Z_i)} \quad \text{.....3}$$

$P_i/1-P_i$ is the odd ratio in favour of using biofuel to the probability of not using biofuel. Taking natural log of 3, we obtain

$$L_i = \ln[P_i/(1-P_i) = Z_i = \beta_1 + \beta_2 X_i \quad \text{..... 4}$$

The log of the odds is not only linear in X, but also linear in the parameters.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

Table 1 shows that 40.8% of the respondents' fall between the age range of 21-30 years. Also, 90.8% of the respondents were females, while 78.3% were married, 16.7% were singles and 5% were widows. Similarly, 83.4% of the respondents had formal education while 16.7% had informal education. Also, 8.3% of the respondents consumed the energy on his/her own that is, no dependant, 87.2% had 1-10 and 5.0% had 11-15 number of dependants. The modal dependant is 3 persons while the mean is 3.97 persons. This implies that large percentage had small number of dependants and this could reduce the consumption pattern/rate of biofuel /kerosene.

The table also shows the occupation of each of the respondents. Trading contributed the largest percentage of 46.7%. Others were artisans (28.3%), civil servant (5.8%), student (5%), farming (5%), youth corper (2.5%), and none (5.8%). In the table, the average monthly income of the rural households is ₦18, 461.54, with standard deviation of ₦18, 146.93. The distribution also shows that only 47.5% of the respondents had up to ₦10, 000 as their monthly income. This denotes that rural household income level is low with uneven distribution.

Sources of Energy and Demand Before and After Subsidies on Kerosene

Table 2 shows the main sources of biofuel (firewood and charcoal) before and after subsidy. The proportion of the respondents that used biofuel before subsidy was 50.83%, while 39.17% used it after subsidy. This shows that the proportion of rural households that depended on kerosene increased from 49.2% before the subsidy to 60.83% after the subsidy. Also, 16.67% and 14.17% of the respondents collected firewood from the farm before and after subsidy, respectively. At the same time, 8.33% and 7.50% purchased firewood before and after subsidy, respectively. All these results show that with reduction in price of kerosene, more households stopped depending on biofuel as the main source of fuel. This change in resource allocation is expected to have some positive implica-

Table1: Socio-economic characteristics of respondents Oyo state, Nigeria, 2009

	Number of respondents	*Percentage*
Age Group (yrs)		
Up to 20	16	13.3
21-30	49	40.8
31-40	28	23.3
41-50	16	13.3
Above 50	11	9.2
Sex		
Male	11	9.2
Female	109	90.8
Marital Status		
Married	94	78.3
Single	20	16.7
Widow	6	5.0
Educational Level		
Informal	20	16.7
Primary	39	32.5
Secondary	50	41.7
Tertiary	11	9.2
Number of Dependants		
0	10	8.3
1-5	80	66.7
6-10	24	20.5
11-15	6	5.0
Total	120	100.0
Distribution of Respondents by Occupation		
Trading	56	46.7
Artisans	34	28.3
Civil servants	7	5.8
Students	6	5
Farming	6	5
Corper	3	2.5
None	7	5.8
Average Income per Month (N)		
Up to 10,000	50	47.5
10,001-20,000	30	25.0
20,001-30,000	13	10.8
30,001-40,000	3	2.5
40,001-50,000	11	9.2
Above 50,000	6	5.0

Table 2: Main source of biofuel before and after subsidy

Categories	*Before subsidy*				*After subsidy*			
	Firewood		*Charcoal*		*Firewood*		*Charcoal*	
	Freq	*%*	*Freq*	*%*	*Freq*	*%*	*Freq*	*%*
Farm	20	16.67	3	2.50	17	14.17	3	2.50
Purchase	10	8.33	27	22.50	9	7.50	18	15.00
Others(gift)	1	0.83	0	0.00	0	0.00	0	0.00
Total	31	25.83	30	25.00	26	21.67	21	17.50

tions for forest resource conservation and utilization of the labour time that is required for gathering fuelwood for other economically productive activities. Similar result was obtained for charcoal in which 22.50% and 15.00% purchased it before and after subsidy. This finding also implies less dependence on the forest for domestic energy.

Table 3 shows the monthly average amount spent on energy products. The average amount of money spent on firewood decreased from ₦1425.29 before subsidy to ₦1337.85 after the subsidy. Average amount of money spent on charcoal significantly decreased ($p<0.05$) from ₦2092.43 before the subsidy to ₦1253.10 after the subsidy. The average quantities of kerosene that were consumed before and after subsidy were 3.53 litres and 3.79 liters, respectively. These do not show any statistical significance ($p>0.10$). However, the average amounts being spent on kerosene statistical significantly decreased ($p<0.05$) from ₦2607.51 before the subsidy to ₦1329.47 after the subsidy. Also, total amount spent on all the three categories of energy products statistical significantly decreased ($p<0.01$) from ₦2173.33 before subsidy to ₦1317.92 after the subsidy.

Table 4 shows the major reasons for rural households' choice of the cooking fuel. Before, the subsidy, 18.33% indicated that kerosene was available, while this increased to 20.83% after subsidy. Also, 12.50% indicated that firewood was available before subsidy and this reduced to 9.17% after subsidy. The same proportion of the respondents (6.67%) indicated that firewood was cheap before and after the subsidy. Howev-

Table 3: Biofuel energy expenditure before and after

Energy groups	*Qty before subsidy*			*Qty after subsidy*				*Amount before subsidy*		*Amount after subsidy*		
	Freq	*Mean*	*Std. dev*	*Freq*	*Mean*	*Std dev.*	*T-stat*	*Mean*	*Std. deviation*	*Mean*	*Std. deviation*	*T-stat*
Firewood	31	14.14	14.03	26	13.24	14.58	.235	1425.29	1398.49	1337.85	1453.17	.230
Charcoal	30	4.37	3.31	21	5.36	3.99	-.938	2092.43	1316.61	1253.10	635.15	3.024**
Kerosene	59	3.53	1.64	73	3.79	2.07	.813	2607.51	1292.87	1329.47	853.30	6.530**
Total	120	6.48	8.62	120	6.12	8.03		2173.33	1403.94	1317.92	976.16	8.758***

** - statistically significant at 5 percent; *** - statistically significant at 1 percent

Table 4: Major reasons for rural households' choice of the sources of cooking fuel

Period	*Energy groups*	*Availability*	*Cheapness*	*Interest*	*Time saving*	*Total*
Before Subsidy	Firewood	12.50	6.67	0.83	5.83	25.83
	Charcoal	7.50	3.33	5.83	8.33	25.00
	Kerosene	18.33	1.67	11.67	17.50	49.17
	Total	38.33	11.67	18.33	31.67	100.00
After Subsidy	Firewood	9.17	6.67	0.83	5.00	21.67
	Charcoal	7.50	1.67	2.50	5.83	17.50
	Kerosene	20.83	4.17	15.00	20.83	60.83
	Total	37.50	12.50	18.33	31.67	100.00

er, the proportion of households that indicated that kerosene was cheap increased from 1.67% before subsidy to 4.17% after subsidy. Furthermore, 17.50% indicated that kerosene was time saving before subsidy and this increased to 20.83% after subsidy.

Table 5 further reveals that only 6.67% of the respondents indicated that kerosene was scarce after the subsidy, as against 41.67% for before subsidy. This implies that kerosene was readily available to the rural households during the subsidy. Furthermore, 11.67% and 19.17% of the respondents experienced scarcity of firewood and charcoal, respectively before subsidy. These percentages declined to 9.17% and 8.33% for firewood and charcoal, respectively after the subsidy. This shows that with kerosene subsidy and its availability, demand for firewood and charcoal must have declined, making them to be readily available.

Table 5: Rural households' experience of scarcity across different energy sources

Period	*Energy groups*	*Yes*	*No*	*Total*
Before	Firewood	11.67	14.17	25.83
Subsidy	Charcoal	19.17	5.83	25.00
	Kerosene	41.67	7.50	49.17
	Total	72.50	27.50	100.00
After	Firewood	9.17	12.50	21.67
Subsidy	Charcoal	8.33	9.17	17.50
	Kerosene	6.67	54.17	60.83
	Total	24.17	75.83	100.00

Factors Explaining Households' Choice of Biofuel Before and After Subsidy

Table 6 shows the results of the logit regression. The estimated equations for biofuel before and after the subsidy have the log likelihood chi square values being statistically significant ($p<0.01$). This implies that the models produced a good fit of the data. The results further show that income parameters for the before subsidy and after subsidy analyses are statistically significant ($p<0.10$). This implies that if the log of income increases, the probability of using biofuel will significantly increase. The variable married is not significant before subsidy and it has a positive sign ($p>0.10$). The model for after subsidy however has the marital status parameter being negatively signed ($p<0 .05$). This implies that those who were married have significantly lower probability of using biofuel after the subsidy.

Table 6: Determinants of biofuel utilization before and after the subsidy

Variables	*Before subsidy*		*After subsidy*	
	Parameter	*t-value*	*Parameter*	*t-value*
Log age	-0.6321	-0.28	-1.8124	-0.82
Log income	1.6118**	1.98	1.7146*	1.94
Married	1.4025	1.44	-1.7653**	-2.13
Primary education	-2.9788***	-2.97	-2.0889**	-2.30
Secondary education	-2.6317***	-2.64	-2.2697**	-2.21
Tertiary education	-3.2723***	-2.83	2.9702**	-2.16
Log dependants	-0.7455	-0.90	1.5359	1.61
Student	3.2974**	2.37	-1.2995	-1.01
Civil servants	0.9986	0.99	0.1632	0.13
Trading	-0.0102	-0.02	0.4326	0.67
Decision on fuel	1.0791*	1.86	-0.7807	1.26
Constant	-5.5962	-1.13	-1.2783	-0.71

* Significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Primary education variable has a negative sign ($p<0.05$) before subsidy and after subsidy indicating that those with primary education have lower probability of using biofuel. The parameters of secondary education have negative sign before subsidy and after subsidy and statistically significant ($p<0.05$). These indicate that those with secondary education have lower probability of using biofuel. The parameters of tertiary education have negative sign and statistically significant ($p<0.05$) before and after subsidy. These imply that those with tertiary education have significantly lower probability of using biofuel.

The parameter of student has a positive sign and statistically significant ($p<0.10$) before subsidy meaning being a student increases the probability of using biofuel. The parameter of decision on fuel is positively significant ($p<0.10$) before subsidy. This implies that involvement in decision increases the probability of using biofuel.

CONCLUSION

The demand pattern for energy products in some rural households has been analyzed. The findings show that kerosene was not only available when subsidized, its price also reduced drastically. Due to this, many more households desisted from using biofuel whether purchased from the markets or collected from the farms. No doubt, therefore, policy makers can utilize propoor spending to prevent excessive degrada-

tion of natural resources. This is important because poverty is a major driver of environmental degradation. The Nigerian case which had been presented in this study reveals that when appropriately targeted at the primary beneficiaries, government is able to use product subsidies to realize some environmental conservation objective, especially if there is a kind of substitution among those products. Ensuring reduction in the use of biofuel so as to reduce the rate of deforestation in the rural areas requires appropriate education targeted at the women who hold the primary responsibility of household keeping. Demand for kerosene in the rural areas will also increase if the subsidy is sustained and efforts are being made to prevent unintended beneficiaries from fuel diversion.

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