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ECONOMIC ANALYSIS OF FUELWOOD PRODUCTION AND UTILIZATION IN BOSSO LOCAL GOVERNMENT AREA OF NIGER STATE

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ABSTRACT
The present domestic energy situation in Nigeria has made many families to go back to the use of fuel wood/charcoal owing to high prices or scarcity of kerosene and other alternative cooking fuels. Therefore, this study analysed the economic determinants of quantity demanded and supplied, cost and returns and the cost advantages of fuel wood utilization by consumers to other substitutes in Bosso Local Government Area of Niger State, Nigeria. Data were collected from 50 randomly selected fuel wood (charcoal and firewood) producers from Beji and Garatu communities and 60 randomly selected consumers from Maikunkele, Bosso/Maitumbi, Dutsenkura/Kpakungu communities. Analysis of data was done with the use of descriptive statistics, multiple regression analysis, cost and return analysis. Result shows that 72.2% of the variation in quantity demanded by the fuel wood consumers in the study area was explained by the identified determinants, 94.6% of the variation in the quantity the producers supplied. The average return realized by the charcoal producers per quantity produced in bags /month is ₦ 7800.The average return realized by the firewood producers per quantity produced in Dyna truck/month is ₦ 6600. The average return realized by the firewood producers per quantity produced per pickup truck/month is ₦ 1600. A more comprehensive and increased education and enlightenment campaign against deforestation as well as provision of employment for the teeming youth and alternative cheap, eco-friendly energy sources were recommended.

Key words: Fuel wood, Utilization, energy and cooking

INTRODUCTION

The society is inextricably linked with the environment, this linkage is made through societal extractive, processing and consuming activities on the available natural resources (mineral and forestry resources) (Ayodele *et al,* 1996). A way the society is linked with the environment is in its extraction, processing and consumption of wood from trees in our forest which is used for the purpose of generating fuel for households and industries. These are rural activities which are undertaken for survival, but which seem to have adverse environmental consequences (Alimba, 2004)

Farmers produce fuel wood in the farm during cultivation or from the available forest around them, thus contributing to their net farm income and takes care of the energy needs in their house hold. Studies have only begun to address the issues such as the income earning potential for rural households from firewood trade (Kamara, 1986). Firewood business is a common business among the villagers since trees are a free gift of nature except for the cost of labour and transportation, and this labour most times are not quantifiable as it is done by the house hold members.

Nash and Ceceila (2006) gave some reasons for the rise in the use of firewood to include rural and urban poverty, low agricultural productivity, inequalities in land holding and security of tenure, the collapse of traditional resource sharing produces, rapid urbanization, sharp division in the socio-economic role of women and men and in some countries external pressure resulting in economic crises and war. On the other,

Oronsanye, 2003; identified two reasons for the growing global use of fuel wood namely due to population growth and because of the low energy consumption in rural areas of Africa which are limited almost exclusively to fuel wood.

Fuel wood production and consumption has an implication on the physical, chemical and biological state of the environment. Though the impact is gradual, there is the need for awareness in our local communities because of their ignorance on environmental issues and the lack of human capacity, technology, political and financial support to remedy it. The impact of these destructive acts have posed an imbalance to the ecological system, such as coastal and gully erosion, bush fires, sea incursion, air pollution, increase intensity of sunlight, change in climate, and exposure to destructive rays whereby endangering our lives and properties (Edu, 2009). Therefore to maintain a healthy and productive environment so as to meet the increasing demand of consumers and the needs of producers not to disrupt the balance in our environment there is a need to study the benefit and provide an option in other to discourage them from engaging in these destructive activities. The indiscriminate felling of trees for fuel wood production and the use of fuel wood as a source of cooking energy in our household is depleting our forest reserve. Fuel wood production is an all year round activity that is passed on from generation to generation, in which the natives are not aware of the ecological and environmental impact (pollution and desertification) of their indiscriminate deforestation activities. This is because their ancestors have engaged in same practice without any obvious negative impact on their environment for centuries.

Moreover, there has been an increase in population over the years thereby aggravating the need for wood and consequentially deforestation, they now travel farther with longer hours to acquire wood. Aina (2001) observed in his study of domestic energy situation in Nigeria that many families have gone back to the use of fuel wood (firewood/charcoal) owing to high prices or scarcity of kerosene, liquefied gas and electricity. This development has increased fuel wood demand both in towns and villages and also the number of persons involved in the business of production and marketing of charcoal and firewood. Nigeria has been rated as the worst deforested country in the world with an annual deforestation rate of 11.1% which is the highest in the world and is a treat as it could lose virtually all of its primary forest within few years. This is alarming and calls for awareness and redirecting the mind of our people towards knowing the importance of our vegetation and the need to keep it alive. Although Anderson (1988), suggested the adoption of aforestation programmes through agro-forestry practices as a way of managing deforestation, there can't be afforestation and sustainability if the villagers lack the basic knowledge of the impact of their activities and possibly provided a better approach for survival.

However, because of its importance, Anon, 2005 asserted that fuel wood will continue to be a key energy source for cooking and heating in poor homes where fuel wood could be considered the fuel of the poorest of the poor. Therefore, the major objective of this study is to assess the benefit of fuel wood business to the producers and consumers. The specific objectives are to; describe the socio-economic characteristics of the fuel wood producers, estimate the determinants of demand and supply of fuel wood in the area, estimate the cost and returns of fuel wood enterprises to the producers, and estimate the cost benefit of fuel wood utilization.

METHODOLOGY

Data for the study were collected from two communities in Bosso Local Government Area (LGA) of Niger State. The two communities are the ones most noted for Charcoal production this include Beji and Garatu communities. The Local

Government is geographically located on longitudes 66 ° 28' E and 09°4' N of the equator respectively. The climate is guinea savanna with its wind direction moving along south west and north east axis, rainy season last for about 190-200days with September recording its highest mean of about 300mm while temperature varies from 25°C 75° F in August to 35° C 88° F in March. It has a fertile land for the cultivation of crops like yam, cassava, guinea corn, rice, millet, sweet potatoes, and maize etc. The major occupation is farming while others are fishing, cloth weaving, and black smiting.

A survey was carried out and primary data were collected through oral interview and structured questionaire 40 charcoal producers and 10 firewood producers were studied from the 2 communities (Beji and Garatu) and 60 household consumers of fuel wood(firewood and charcoal) from 5 communities (Maikunkele, Bosso, Maitunbi, Dutsenkura, and Kpakungu) were also studied. For the analysis of the data, descriptive statistics, multiple regression analysis, cost and return analysis, and cost benefit analysis were used.

Regression Analysis

According to the works of De-Montalembert and Clement (1983); Imran and Barnes (1990) and Ayodele *et al* (1996), the demand for fuel wood should depend on: average price of fuel wood, average price of fuel wood substitutes, average household income and season of the year while, the supply of fuel wood is determined by the average price, average cost of production, average quantity produced per person per day, and the season of the year.

Regression model used for this study is $Y= f(X_1, X_2 \ldots X_n)$
Where Y is the dependant variable and $X_1, X_2 \ldots X_n$ are the independent variables. The functional forms are presented below;

Demand Function

Yd=average quantity of fuel wood demand per month (kg) (Dependent variable)
Xd=all the factors that determines the quantity demanded. (Independent variable)

Yd=f(X1,X2,X3,X4,e)

1. Linear form

$Yd= a + ß_1X_1 + ß_2X_2 + ß_3X_3 + ß_4X_4 + Є$

$\mathbf{X_1}$ = average price of fuel wood(fire wood and charcoal) in the market (naira)
$\mathbf{X_2}$= average price of alternatives of fuel wood(fire wood and charcoal) (naira)
$\mathbf{X_3}$= average household income (naira)
$\mathbf{X_4}$=season of the year
e= error term

Supply Function

Therefore the supply function of fuel wood (charcoal and fire wood) is **Ys=f(Xs)**
Where:
Ys = quantity supplied per month (kg)(dependent variables)
Xs = involves all the factors that determine the quantity supplied (independent variables)
i.e **Ys=f(X1,X2,X3,X4,e)**
Thus,
1. Linear form

$Ys= a + ß_1X_1 + ß_2X_2 + ß_3X_3 + ß_4X_4 + Є$

$\mathbf{X_1}$=average price of fuel wood (fire wood and charcoal) (naira)
$\mathbf{X_2}$=average cost of firewood production
$\mathbf{X_3}$=average quantity of fuel wood produced (fire wood and charcoal) produce per month/kg)
$\mathbf{X_4}$=season of the year

e=error term

Cost and Return Analysis

GM=GI-TC

Where, GM=Gross Margin

GI= Gross Income

TC= Total Variable Cost + Total fixed cost

Results and Discussion

Socio-economic Characteristics of Respondents

On the socio-economic attributes of the entrepreneurs, 64% were aged between 21 – 30 years, 58% of respondents are male who engage in charcoal production while 42% of the respondents are females who engage in firewood and charcoal production. About 50% of the producers had household size between 6 and 10, 90% of the respondents attained only Islamic education; this can justify why they are ignorant of the implication of their activities, 50% of the fuel wood producers in the study area travel as far as 21km to 30km from the main road to acquire wood; this could be attributed to government campaign against deforestation and the gradual effect of deforestation activities. While average monthly income on fuel wood production ranges from ₦7400 to ₦9600, average quantity consumed per household per month is ₦1538.5, average price of charcoal is ₦750 and a truck load of wood ranges from ₦4500 to ₦17000 while the estimated average cost of production was ₦3185 per quantity produced (Table 1).

Table 1: Socio-Economic Characteristics of Respondents

Variables	Frequency	Percentage
Age		
21-30	32	64.0
31-40	16	32.0
41-50	2	4.0
Gender		
Male	29	58.0
Female	21	42.0
Household Size		
<10	2	4.0
11-20	13	26.0
21-30	25	50.0
31-40	7	14.0
>40	3	6.0
Educational Qualification		
Islamic education	45	90.0
No education	5	10.0
Distance Travelled(km)		
<10	2	4.0
11-20	13	26.0
21-30	25	50.0
31-40	7	14.0
>40	3	6.0

Demand Function

Qd=-248.514+0.764pc***+0.585ps+0.008y-124.944s*

Linear regression was chosen as the lead equation for demand function (Table 2). The value of coefficient of determination variable, R^2 indicates that about 72.2% of the variation in dependent variable was examined by the independent variable including the regression model. The regression coefficient average price of fuel wood (X_1), average price of substitute (X_2), and average income (X_3) (independent variables) positively relates with the quantity demanded(dependent variable) which implies that an increase in these independent variables will lead to an increase in quantity demanded(dependent variable), while season of the year (X_4) negatively relates with the quantity demanded. This implies that if season of the year changes from dry season to a wet season quantity demanded will decrease as the wood product won't be seasoned or desirable for use. But only price of fuel wood and season of the year significantly explains the variation in quantity demanded at 1% and 10% level of significant respectively. This result is in agreement with the findings of Imran and Barnes (1990). Price of fuel wood and season of the year and F-statistic are all significant at 1%, 10%, and 1% respectively.

Table 2: Factors affecting quantity demanded in the study area

Variables	Linear regression	Semi-log regression	Exponential regression	Double-log regression
Constant	-248.514	-1374.740	6.454	-1.321
	(-0.385)NS	(-2.885)***	(11.910)***	(-.347)NS
Price of fuel wood	0.764	1423.087	0.000	0.852
	(9.747)***	(9.264)***	(5.717)***	(5.719)***
Price of alternative(kerosene)	0.585	403.489	0.000	0.210
	(0.640)NS	(0.576)NS	(0.875)NS	(0.374)NS
Income	0.008	146.229	0.00000000351	0.092
	(0.872)NS	(0.868)NS	(0.429)NS	(0.668)NS
Season	-124.944	-198.396	-0.48	-0.98
	(-1.919)*	(-1.633)NS	(-0.875)NS	(-0.982)NS
R2	0.722	0.702	0.484	0.485
R2 Adjusted	0.692	0.670	0.425	0.426
F statistic	23.981***	21.817	8.218	8.228

Source: field survey data, 2009

Note: *** implies statistically significant @1%; ** implies statistically significant @5% * implies statistically significant @10%; NS implies Not Significant

Figures in parenthesis are the respective t-ratios

Table 3: Factors affecting quantity supplied in the study area.

Variables	Linear regression	Semi-log regression	Exponential regression	Double-log regression
Constant	-8985.019	-191572	6.959	-5.369
	(-2.714)***	(-4.608)NS	(36.350)***	(-7.941)
Average price of fuel wood X_1	8.550	22753.297	0.0004451	1.300
	(28.749)***	(14.010)NS	(25.877)***	(49.210)NS
Average cost of production X_2	1.250	5471.373	0.0001396	0.589
	(1.663)***	(1.252)NS	(3.211)***	(8.289)NS
Quantity produced X_3	0.666	1037.156	0.0000353	0.02261
	(0.676)NS	(1.046)NS	2	(1.402)NS
Season of the year	479.039	2201.260	(0.620)NS	0.04201
	(0.513)NS	(0.699)NS	-0.0240	(0.820)NS
R^2	0.958	0.851	(-0.444)NS	0.985
R^2 Adjusted	0.954	0.838	0.946	0.983
F-satistic	256.493	64.314	0.941	729.215
			196.224	

Source: field survey data, 2009

Note: *** implies statistically significant @1%; ** implies statistically significant @5%
* implies statistically significant @10%; NS implies Not Significant
Figures in parenthesis are the respective t-ratios

Supply function= Qs=6.959*+0.0004451pc***+0.0001396cp***+0.00003532qt-0.0240s**

Exponential regression was chosen as the lead equation for supply function (table 3). The value of coefficient of determination variable, R^2 indicates that about 94.6% of the variation in dependent variable was examined by the independent variable including the regression model. The regression coefficient average price of fuel wood (X_1), average cost of production (X_2), and average quantity produced (X_3) (independent variables) positively relates with quantity supplied, which implies that an increase in these variables will lead to an increase in quantity supplied (dependent variable), implying 1% increase in the average price and cost of production will lead to 1% increase in quantity supplied while the season of the year is inelastic because of its negative relationship with quantity supplied. It is known that dry season of the year enhances fuel wood production and supply, while production is negatively affected by the rainy season of the year and F-statistic are both significant at 1%. Average price of fuel wood and cost of production are both significant at 1%.

From the first equation it can be seen that the signs of the parameters met the *a-priori* expectation. Apart from the quantity produced and season of the year, the other variables are statistically significant at 99% level of confidence. The R^2 of 94.6% shows that the explanatory power of the equation is quite high, as supported by high F-statistic 256.493. This shows that the function is a good fit.

Table 4: Cost and Return

Location/product	Average quantity supplied /month	Average total cost of production/month	Average revenue on production/month	Average gross margin /month
Beji charcoal	24 bags	3500	11300	7800
Garatu firewood	truck load	3000	9600	6600
Garatu firewood	Pick up load	2500	4100	1600

Source; field survey, 2009

An average charcoal producer's average gross margin is about ₦7, 800, while an average dyna truck load generates an average gross margin of ₦6, 600 profit and an average pickup load generates an average gross margin of ₦1600. From this result, it can be said that firewood production is more profitable when it is produced in dyna truck than when it is produced in pick up load in quantity. Out of the two forms of fuel wood, charcoal production is the most profitable.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this research work, it was observed that women are the major producers of firewood while the men participate more in the production of charcoal. The major cost components of fuel wood production are cost of transportation and packaging. The cost of transportation is high due to lack of good road to the collection point. Because of government restriction and gradual effect of deforestation, fuel wood producers now travel more than 20km from the road side to acquire wood.

Since most of the consumers are average and low income earners this could justify why fuel wood is preferred as a cheaper and adequate cooking energy source instead of kerosene and other refined fuels. Although government campaign against deforestation is gradually killing the producers' confidence but not fully discouraging them as they still engage in this practice but in secrecy. Therefore a better way to combat this activity is to give them more enlightenment and education for better understanding of the effect of their activities on the environment and people's socio-economic well-being. Provide better job opportunities and more reliable energy source for cooking.

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