EFFECTS OF FOREST RESOURCES EXPLOITATION ON THE ECONOMIC WELL-BEING OF RURAL HOUSEHOLDS IN DELTA STATE, NIGERIA

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Abstract

In order to examine the effects of forest resources exploitation on the economic well-being of rural households, in Delta State, Nigeria, data were collected from 306 households in 12 rural communities in Ughelli South Local Government Area. The results showed that income from forest resources exploitation contributed 41.3% to 67.2% of total household's income; the proportion being greater for poorer families than high-income groups. The mean annual income per household was N,= 36,688.80 (US$ 286.63) while the mean income from forest products collection was N,= 14,009.93 (US$ 109.45). Forest resources extraction also provided 139.8 mandays of employment and supplied 78.2% of all households' energy requirements. The results of the econometric analysis indicated that household size, educational status, prices of products, distance of forest from home and income affected volume of forest products exploited in a manner consistent with economic theory, and were statistically significant; though the impact of the variables on the various forest products was mixed. The adjusted R^2 values were 0.40, 0.60, and 0.78 respectively for rattan cane, firewood and wild fruits.

Key words: forest resource exploitation, income generation, rural households, rural poverty, Delta State, Nigeria

INTRODUCTION

Forest resources are a key component of the natural resource base of any community, region or country, and they play a fundamental role in the socio-economic well-being of the people of those communities. This is particularly so in sub-Saharan Africa, where most of the countries have large rural populations that depend on natural resource exploitation for their livelihood.

Tropical forests are of great economic significance to both the rural and urban poor. Pimental et al. (1997) estimated that about 250 million people depend on the forest, while Roper and Roberts (1999) put the figure at 500 million. Apart from meeting the economic needs of rural people for food and shelter, tropical forests are also a major source of both industrial wood products and fuelwood. According to World Commission on Forests and Sustainable Development (1998), fuelwood and charcoal make up 56% of global wood production, and approximately 90% of this is produced in developing countries. Firewood is the most important source of energy for developing countries and the only source of energy for most of the world's rural areas (Roper and Roberts, 1999; IEA, 2002a). In sub-Saharan Africa, wood supplies about 70% of total energy used and firewood collectors account for over 85% of the wood removed from the forest and woodlands (Contreras-Hermosilla, 2000). Fuelwood is also the major source of energy among rural households and the urban poor in Nigeria (Anderson, 1987).

Furthermore, forest and forest trees are sources of a variety of foods that supplement and complement what is obtained from agriculture. According to Bryon and Arnold (1997), majority of rural households in developing countries, and a large proportion of urban households, depend on plant and animal products of forests to meet part of their nutritional needs. Forest foods seldom provide the bulk of staple items that people eat; and for rural people, they add variety to diets, improve palatability, and provide essential vitamins, minerals, protein and calories. Many agricultural communities suffer from seasonal food shortages, which commonly occur at the time of year when stored food supplies have dwindled and new crops harvest is just beginning. Forest foods are used extensively at such periods and during emergencies such as floods, famines and droughts.

Although, the exploitation of firewood is done primarily as a source of energy to the rural households in Nigeria, it has a great deal of effect on their economic well-being. This is so because firewood collectors do not gather fuelwood only for their own domestic use, but for sale in nearby peri-urban and urban areas to generate income. The significance of forest products income for most farm families is more in the way it fills gaps and complements other income, than in its share of overall household income. Though the contribution of income from forest products may be supplemental, the sales of non-timber forest products (NTFPs) have been found to contribute as much as a quarter of total household income (Malla, 2000).

Although, several studies have shown that rural households depend extensively on common pool resources (CPR) to meet their daily economic and social needs (Jodha, 1995), not many of such studies have captured the contribution of forest resources exploitation to their economic well-being in Nigeria. Heltberg (2001) and Dasgupta and Maler (1995) however, argued that compared to non-poor, poorer households may depend more on common property resources, but in absolute terms their dependency is lower than that of their wealthier compatriots. Similar findings were made by Jodha (1995) in India where he reported that though poor

households are relatively more dependent on forest resources for firewood collection, big farmers graze more animals and sell milk which provides good market opportunities, and thus derive higher economic benefit thereby. This implied that a key conditioning factor on how rural people use forest resources, and thus generate their income, is the wealth status of the farm family.

Common property institutions have not been able to provide a significant contribution to the livelihood of the poor and marginalised people due to their failure to take into account broader socio-economic and distributional issues. According to Adhikari (2002), local elites and traditional decision makers dominate users' committee of community-based forest resource projects thereby neglecting the poor and excluding them from getting a fair share of forest products. Limitations on firewood collection for instance, have a devastating effect on households whose livelihoods are traditionally closely linked to firewood collection for both domestic use and for sale.

Most forests in Delta State are either privately or communally owned, but there are only a few functional and efficient community-based forest resource management institutions. In fact, there are no specialised forest resource management institutions. What is in place in most communities, are town or village committees headed by a Spokesman who is responsible to the community. These local committees restrict themselves to the regulation of timber harvesting while exploitation of NTFPs continue in most cases unregulated. Thus, the influence of socio-economic inequality on access to the commons is greatly minimised, except for the effect of wealth status on the intensity of resource use. Since majority of the population in the study area live in the rural area, exploitation of forest resources play a crucial role in their livelihood. The rural dwellers depend on natural resources for wild fruits and nuts, rattan cane, poles for agricultural implements and for staking yams, thatch for building, game and firewood; which is the most important source of energy for cooking and heating, as well as for cash income, for most rural households in Delta State.

The main objective of the study was to assess the effect of forest resources exploitation on the economic well-being of rural households in Ughelli South Local Government Area of Delta State, Nigeria. Specifically, the study aims to ascertain the effects of forest resources exploitation on income of rural households, the proportion of household income contributed by forest resources extraction, and to identify factors that affect the exploitation of major forest products in the study area.

MATERIALS AND METHODS

Area of study

Ughelli South Local Government Area (L.G.A) which is one of the twenty-five (25) LGAs that comprise Delta State, Nigeria is the location of study. Delta State lies approximately between longitude 5°00´ E and 6°45´E of the Greenwich Meridian, and latitude 5°00´N and 6°30´ N of the Equator. It is one of Nigeria's extremely southern states, and covers an area of 17 001 km^2 (Delta State Environmental Protection Agency, 1996). Ughelli South LGA is predominantly rural, and is traversed by flowing streams and rivers that empty into the western coast of the Niger Delta. The vegetation of the area is freshwater swamp forests, comprising of natural communal forests and rubber plantations. The prevailing climatic and hydrographic conditions favour a fishery and an agricultural economy. In fact, agriculture and fishing are the means of livelihood of the people of Ughelli South local government area.

Ughelli South is made up of three (3) major clans; Eghwu, Olomu and Ughievwen, with a population of 131 291 people (NPC, 1993).

Sampling method and data collection

Ughelli South L.G.A. was purposively chosen for the study for its rural outlook and the expanse of forested area. Copies of household questionnaire were used to obtain information on forest use from respondent households. The research survey was focused on the value of forest products to the livelihood of the rural dwellers. Forest products of interest included wild fruits and nuts, rattan cane, game and fuelwood. Data were collected on size of households, level of educational attainment, gender of households head, distance between forest and home, household income, price of firewood, and prices of alternative energy sources. Others included quantity of forest products collected, income generated from forest products and, the nutritional status of households.

Stratified random sampling technique was used to collect data on the aforementioned variables. Ughelli South L.G.A was stratified into three major clans that comprised the council. 4 communities were selected from each of the stratum to make a total of 12 rural communities. Subsequently, 28 households were chosen randomly from each of the 12 communities earlier sampled, thereby making a total of 336 respondents. Structured questionnaire and interview schedule were the instruments of data collection. It must be noted however, that data analysis was based on 306 questionnaire as the remainder were discarded due to inadequate information and non-response.

Model specification and estimation

A number of factors affect forest products exploitation among rural households. And since households depend on an array of forest resources, different econometric models were specified for the major forest products exploited in the study area, for estimation:

$$FC_{wd} = f(Y_{MN}, D_{FH}, P_{WD}, P_{OE}, \varphi, \varepsilon) \quad (1)$$

$$WD_{ft} = f(Y_{MN}, D_{FH}, P_{FT}, \varphi, \varepsilon) \quad (2)$$

$RT_{CN} = f(Y_{MN}, D_{FH}, P_{CN}, \varphi, \varepsilon)$ (3)

Where:
FC_{WD} = the quantity of firewood collected by households
WD_{FT} = amount of wild fruits/nuts harvested
RT_{CN} = equals the quantity of rattan cane exploited
Y_{MN} = mean annual income
D_{FH} = distance of forest from home
P_{WD} = equals price of firewood
P_{OE} = price of household's principal alternative source of energy
P_{FT} = price of wild fruits/nuts
P_{CN} = equals price of rattan cane
φ = a vector of household social and demographic characteristics (including household size, gender of household head and educational attainment), that may affect household resource exploitation behaviour, ε is the error term.

Because economic theory does not indicate the precise mathematical form of the relationship among the variables, different functional forms of the above models including the linear, semi-logarithm, logarithm and exponential functions were fitted. However, the logarithmic function was chosen as the lead equation on the bases of economic, statistical as well as econometric criteria (Koutsoyiannis, 1977; Olayemi, 1998). The logarithmic function is one of the most widely used in empirical studies because the regression coefficients are also direct elasticities of the dependent variable, with respect to the explanatory variables in such a model. The logarithmic models for firewood, wild fruits/nuts and rattan cane are specified respectively as follows:

$$\ln FC_{WD} = \ln \vartheta_0 + \vartheta_1 \ln Y_{MN} + \vartheta_2 \ln D_{FH} + \vartheta_3 \ln P_{WD} + \\ + \vartheta_4 \ln P_{OE} + \vartheta_5 \ln HH_Z + \vartheta_6 \ln EDU_{AT} + \vartheta_7 GEN_{HD} \quad (1\alpha)$$

$$\ln WD_{FT} = \ln \varphi_0 + \varphi_1 \ln Y_{MN} + \varphi_2 \ln D_{FH} + \varphi_3 \ln P_{FT} + \\ + \varphi_4 \ln HH_Z + \varphi_5 \ln EDU_{AT} + \varphi_6 GEN_{HD} \quad (2\alpha)$$

$$\ln RT_{CN} = \ln \gamma_0 + \gamma_1 \ln Y_{MN} + \gamma_2 \ln D_{FH} + \gamma_3 \ln P_{CN} + \\ + \gamma_4 \ln HH_Z + \gamma_5 \ln EDU_{AT} + \gamma_6 GEN_{HD} \quad (3\alpha)$$

Where:
HH_Z = household size, measured as number of persons resident in a household;
EDU_{AT} = level of education attained (no formal education = 1; primary education = 2; secondary education = 3; tertiary education = 4)
GEN_{HD} = gender of household head (Male = 1, Female = 2); and other variables are as defined earlier in equations (1) to (3) above.

The Ordinary Least Squares (OLS) technique was used to estimate the regression parameters.

RESULTS AND DISCUSSION

Socio-economic analysis

The socio-economic characteristics of respondents in the survey are presented in Table 1. The results show that households are almost equally headed by the female and male gender. This is so because polygamous marriages are dominant in the area, and many married women whose husbands live with their mates elsewhere and widows, were treated as heads of their households as major decisions on forest resource use are made by them.

Majority of the rural dwellers sampled had no formal education (34.6%), while 32% of them had only elementary education. On the whole 65.4% of the respondents had some form of formal education, an observation which tends to refute the alarming rate of illiteracy prevalent in rural communities. The mean level of educational attainment of 2.09 implied that on the average every respondent had primary education. According to the Nigerian educational system, persons that had primary school education (2) spent at least 6 years in school, people who attained secondary level education (3) had at least 12 years of schooling, while those that received tertiary education (4) had at least 14 years of training in school.

A relatively large household size was found in the study, with a mean size of 11 persons per household. About 48% of the households have a family size that ranged between 11–16 persons, thus supporting the preponderance of large family sizes among the poor in rural areas of Nigeria (Eboh, 1995). Though a very large family size may constitute a social burden, larger families use their labour input to an advantage in farming and forest products exploitation. In fact, the intensity of forest products exploitation has been found to have a direct relation to household size (Baland et. al., 2004; Adhikari, 2002).

The income levels of the respondent rural households are also presented in Table 1. It could be seen that a majority of the rural dwellers are low income earners with an average income of N,= 36 688.80 (US$ 286.63) per year. In fact about 77% of the farmers sampled earned an annual income ranging between N,= 16 000.00 – N,= 47 000.00. Because most rural inhabitants lack assets and skills, they remain unemployed and unable to invest in high income generating activities, thereby remaining poor. This and other factors could be implicated for the low average income found in the study. Income was unequally distributed amongst the sampled households with the top quintile receiving 39% of total income, while the lowest income group had only 10% of all income that accrued to households (Figure 1). High inequality of income exacerbates pressure on common pool resources resulting in consequent degradation of natural resources (Baland and Platteau, 1996). In order to improve their well-being, farmers in the study area exploit a range of forest products includ-

ing wild fruits and nuts, rattan cane and firewood. Income from forest products exploitation ranged between N,= 6 000.00–N,= 14 900.93 per household. In fact, about 54% of households generated income worth between N,= 11 000.00 and N,= 20 000.00 from forest products. The study found income from wild fruits and nuts, rattan cane and firewood to constitute 47.2 % of the annual income per household.

Descriptive statistics of the forest resources extracted in the study area are shown in Table 2. Firewood appeared to be the most exploited forest product by respondents compared to rattan cane and wild fruits/nuts. This is so because fuel wood is the major source of energy for cooking and heating among rural households and the urban poor in Nigeria (Anderson, 1987). In fact, firewood is the principal source of energy for more than 80% of the households. The mean quantity of firewood extracted was 439.69 kg with a standard deviation of 197.55, which implies that there was high variability in firewood collection among respondents.

Wild fruits and rattan cane exploitation on the other hand is very low due to their seasonality and the longer distance covered in order to extract them from the thick forest. Only 56.69 kg and 62.83 kg respectively of these products were collected on the average per household. Though small, these forest products make an important contribution to the well-being of rural households by the income generated from their sale (Pinto, da Silva, 2002).

Tab. 1: Socio-economic characteristics of respondent households (n = 306)

Parameter	Frequency	Mean/Mode
Gender of household head		
Female	148 (48.4)*	
Male	158 (51.6)	(Male)
Educational attainment		
No formal education (1)	106 (34.6)	
Primary school (2)	98 (32.0)	
Secondary school (3)	70 (22.9)	2.09
Tertiary education (4)	32 (10.5)	
Household size		
5–7	34 (11.1)	
8–10	114 (37.3)	
11–13	60 (19.6)	11 persons
14–16	86 (28.1)	
17–19	12 (3.9)	
Annual Income (N,=)[+]		
16000–26000	62 (20.3)	
27000–37000	100(32.7)	
38000–48000	74 (24.2)	
49000–59000	44(14.4)	36 688.80
60000–70000	26 (8.5)	
Income from Forest products (N,=)		
6000–10000	96 (31.4)	
11000–15000	98 (32.0)	
16000–20000	68 (22.2)	
21000–25000	34 (11.1)	14 900.93
26000–30000	10 (3.3)	
Income from Forest products as % of annual income (N,=)		
21–31	38 (12.4)	
32–42	96 (31.4)	
43–53	146 (47.7)	
54–64	24 (7.8)	
65–75	2 (0.7)	47.2

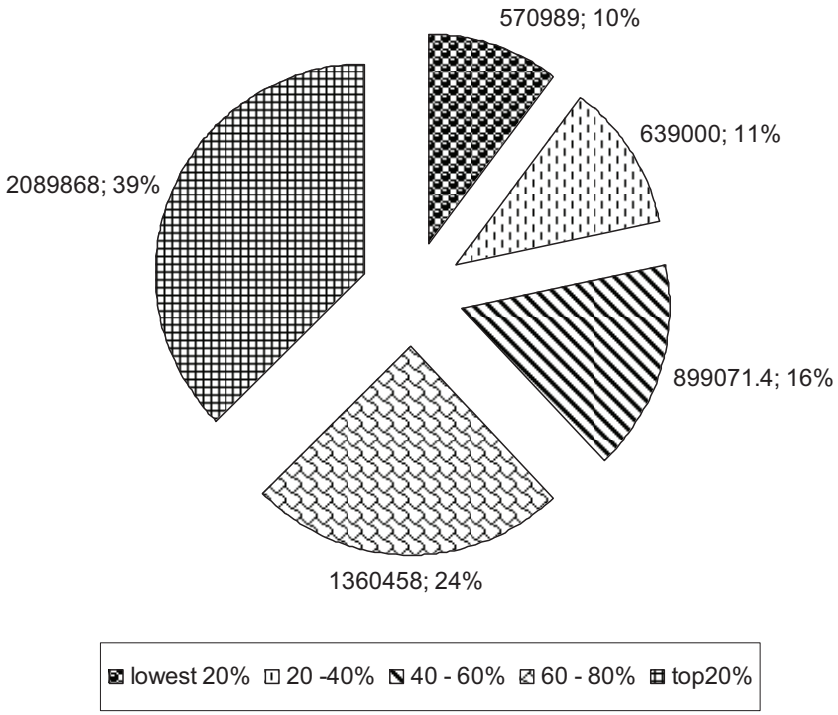
* Figures in parentheses ( ) are percentages
Source: Computed from Survey Data, 2007.
[+]N,= is the Nigerian currency, the naira; N,= 128 equals US$1

Dependence of households on forest products

Common property resources including a wide range of forest products constitute an important component of community assets in developing countries. They are sources of a range of physical products, offer employment and income generation opportunities to rural households, in addition to providing broader social and ecological benefits (Jodha, 1995). Rural households depend on common pool forest resources for fuel, employment and income. However, the dependence of low-income groups is more than that of relatively richer farmers. Table 3 shows the contribution of forest products to total income of different income groups in the sample. While income from forest resources exploitation made up 67.2% the total income of the lowest quintile of income distribution, it accounted for only 41.3% of the total income of the highest income group. For the entire sample forest products accounted for 47.2% of total income. This result corroborates that of other studies where common pool resources were found to contribute a substantial part of the income of the rural poor. (Jodha, 1995; Cavendish, 1999; Kerapeletswe and Lovett, 2001). The results imply that natural resource dependence varies inversely with the level of income. That is the share of income from forest resources increases as income decrease and vice versa.

Apart from income generation, rural households also depended on common pool forest resources for firewood supply and employment. Like income, the share of fuelwood as a proportion of total fuel used decreases with increasing income. Firewood supplied 87.3% of the total energy requirements of poorer households for cooking and heating, compared to 66% for the highest income group. Among all households, the value was 78.2% of total energy needs (Table 4). In fact, the dependence of households on forest resources for employment follows a similar trend with regards to income level, as for fuel supply and income generation.

Figure 1: Income Shares by Income Groups among Sampled Households (October, 2006– September, 2007)
Source: Computed from Survey Data, 2007



Tab. 2: Descriptive statistics on quantity (kg) of forest products exploited

Activity	Mean	Std. Deviation	Minimum	Maximum	N
Firewood	439.69	197.55	120	950	306
Wild fruits/nuts	56.69	17.12	30	105	306
Rattan cane	62.83	18.81	35	122	306

Source: Computed from Survey Data, 2007.

Tab. 3: Contribution of major sources of income to total rural household income (October, 2006–September, 2007)

Source of Income	Lowest 20%	20–40%	Income Quintiles 40–60%	60–80%	Top 20%	All households
Wild fruits/nuts	24.9	24.0	14.4	9.1	4.9	13.4
Rattan	21.1	21.8	9.7	16.9	17.0	10.6
Firewood	21.2	17.8	33.4	24.5	19.4	18.2
Farming	20.0	24.3	28.5	19.9	21.5	30.5
Others	12.8	12.1	14.0	29.6	37.3	27.3
Total Income (%)	100	100	100	100	100	100
Income from forest products (%)	67.2	63.6	57.1	50.5	41.3	47.2

Source: Computed from Survey Data, 2007.

Tab. 4: Extent of household dependence on forest resources by income groups

Parameter	Lowest 20%	20–40%	40–60%	60–80%	Top 20%	All households
Fuel supply(%)	87.3	84	76.7	71.6	66	78.2
Employment (mandays)	178.6	163.1	137	123.6	96.2	139.8
Income from forest resources as % of total household income)	67.2	63.6	57.1	50.5	41.3	47.2

Source: Computed from Survey Data, 2007

Regression results

The results of the OLS estimate of the regression parameters in equations (1a), (2a) and (3a) for firewood, wild fruits/nuts, and rattan cane respectively are shown in Table 5. The results reveal that income, distance of forest from home, gender of household head and level of educational attainment exert a negative influence on wild fruits/nuts and firewood exploitation. However, the effects of price variables on the aforementioned forest products were positive.

The estimated regressions fit the data well for wild fruits and firewood with Adjusted R^2 values of 0.78 and 0.60 respectively. However, this could not be said for rattan cane where only 40% of the variation in rattan extraction is accounted for by variation in the explanatory variables. Furthermore, the results show that income, price of fruits, household size as well as educational level are statistically significant determinants of wild fruits harvesting in rural communities in Delta State, Nigeria. The results for rattan were similar, except that the influence of gender on resource extraction was significant. For the firewood model, distance and price of other sources of energy, were additional variables that significantly affected firewood collection. The principal alternative source of energy in the area of study was kerosene. The implications of the results are that as income grows the dependence of households on natural resources exploitation falls. This is so because with rising incomes rural dwellers are able to take advantage of other economic opportunities other than natural resources exploitation, in order to improve their well-being. Therefore, a number of authors have argued that poor households with little income earning alternatives tend to spend more time and effort collecting forest products (Lopez, 1998; Durraiappah, 1998; Baland et al., 2004).

The sign and size of the coefficients of the price variables are quite respectable judging by *a priori* expectation. Apart from the fact that prices of the various forest products are statistically significant determinants of forest resources extraction, their elasticity values are quite high. For instance, a 10% increase in price of wild fruits, rattan cane, and firewood, will result in a 6.7%, 2.7%, and 3.8% increase respectively in wild fruits, rattan and fuelwood on resource extraction was significant. For the firewood model, distance and price of other sources of energy, were additional variables that significantly affected firewood collection. The principal alternative source of energy in the area of study was kerosene.

Tab. 5: Regression results of determinants of forest resources exploitation in Delta State

FOREST RESOURCES									
Independent variable	Wild Fruits/Nuts			Rattan Cane			Firewood		
	Estimated Coefficients	t-statistic	p-value	Estimated Coefficients	t-statistic	p-value	Estimated Coefficients	t-statistic	p-value
Income	–0.066	–1.98	0.05*	0.04	0.74	0.46	–0.03	–0.51	0.61
Distance of forest from home	–0.03	–0.82	0.42	–0.10	–1.42	0.16	–0.43	–5.16	0.00**
Price of fruits/nuts	0.67	8.96	0.00**						
Price of cane				0.27	3.40	0.00**			
Price of firewood							0.38	7.01	0.00**
Price of other energy sources							0.16	2.21	0.03*
Household size	0.17	3.01	0.00**	0.21	2.44	0.02*	0.40	4.64	0.00**
Gender of household head	–0.04	–1.35	0.18	0.12	2.45	0.02*	–0.03	–0.64	0.53
Educational attainment	–0.12	–3.55	0.00**	–0.13	–2.72	0.01**	–0.11	–2.22	0.03*
	F-statistic = 80.55(0.00)**			F-statistic = 13.23(0.05*)			F-statistic = 33.79(0.01)**		
	DW-statistic = 1.99			DW-statistic = 2.6			DW-statistic = 1.56		
	Adjusted R^2 = 0.78			Adjusted R^2 = 0.40			Adjusted R^2 =0.60		
	n = 268			n = 218			n = 306		

** Significant at the 1% level; * Significant at the 5% level
Source: Author's calculation

The implications of the results are that as income grows the dependence of households on natural resources exploitation falls. This is so because with rising incomes rural dwellers are able to take advantage of other economic opportunities other than natural resources exploitation, in order to improve their well-being. Therefore, a number of authors have argued that poor households with little income earning alternatives tend to spend more time and effort collecting forest products (Lopez, 1998; Durraiappah, 1998; Baland et al., 2004).

The sign and size of the coefficients of the price variables are quite respectable judging by *a priori* expectation. Apart from the fact that prices of the various forest products are statistically significant determinants of forest resources extraction, their elasticity values are quite high. For instance, a 10% increase in price of wild fruits, rattan cane, and firewood, will result in a 6.7%, 2.7%, and 3.8% increase respectively in wild fruits, rattan and fuelwood collection. The highly significant effect of household size on forest products collection deserves further scrutiny. Families with larger labour force on account of their size can mobilise household labour in extracting more common pool forest resources, than households with a smaller labour force to meet their needs for fuel and income. The elasticity of natural resource exploitation with respect to household size is 0.17, 0.21, and 0.4 respectively for wild fruits, rattan and firewood.

Education is another variable which shows a negative and statistically significant effect on the volume of products extracted. Higher levels of educational attainment makes forest resource harvesting unattractive to the local elites, who rather employ the poor and unemployed to do so occasionally. Since education improves the wealth status of literate rural families, they tend to concentrate on more profitable activities, in the face of increasing overexploitation and degradation of natural resources.

Although the coefficient of gender of household head was negative and not significant for wild fruits and firewood, it was positive and a significant determinant of rattan cane collection in rural Delta State, Nigeria. The results reveal that wild fruits and firewood collection were traditionally female activities while rattan cane extraction is an arduous task dominated by men.

CONCLUSION

The paper has examined the effect of forest resources exploitation on the economic well-being of rural households in Delta State, Nigeria. The results give credence to the observed correlation between socio-economic characteristics of rural households and dependence on common pool forest resources. It also revealed that poorer households on the lowest rung of the income ladder depend more heavily on non-timber forest products than wealthier families. This is so because poorer rural families are resource constrained and thus cannot take advantage of more profitable income generating opportunities, thereby leading to resource overdependence. This situation results in resource overexploitation and ultimately, degradation with dire consequences for society. In fact, wanton forest resources exploitation in the face of rapidly declining natural resource base, aggravates the condition of resource users because the costs of extraction from common pool resources increase on the one hand while outputs decrease on the other hand.

Although the livelihood of the rural poor seems inextricably tied to natural resource exploitation, the inverse relationship between income and forest resource extraction deserves closer scrutiny. Therefore, rural development policies that address the issues of income inequality, and provide lucrative alternative income-generation opportunities to forest resource-dependent people, will mitigate pressure on the natural resource base and provide broader social and ecological benefits to society.

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