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# Rural Economic Survival and Environmental Sustainability: The Charcoal Phenomenon of Ika Area of Delta State, Nigeria

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## ABSTRACT

*The economic determinants of demand and supply and environmental implications of charcoal production in Ika Area of Delta State, Nigeria was studied. The study became necessary because many rural economic activities undertaken by people for survival have some negative environmental and health consequences usually unknown to the entrepreneurs. Data were collected from 60 randomly selected charcoal producers from six communities in the area studied, using interview schedules. Analysis of data was done by the use of descriptive statistics, 4-point-likert scaling and multiple regression. Results show that quantity of charcoal demanded in the local markets was 68% influenced by the identified determinants ($R^2$ = 0.68), while the quantity the producers supplied was 51% influenced by the supply determinants ($R^2$ = 0.51). Producers/marketers identified and scored economic and environmental problems associated with charcoal production and marketing as the labour intensive and tasking nature of production, marketing difficulties especially transportation, and low profit margin from production. The factors that may dissuade them from continuing in the enterprise if addressed include: government ban on production, provision of alternative employment, subsidy on farm inputs, and provision of charcoal alternatives.*

**Keywords:** Environmental sustainability, charcoal production, survival strategy, Delta State

## INTRODUCTION

The need to banish rural poverty and raise living standards have always been the unrealised aim of the three levels of government in Nigeria. Rural people on their own have been engaged in many economic activities as coping strategies, especially since the economic adjustment period in Nigeria. However, some of these rural economic activities have been pursued to the neglect of the environment, giving rise to negative consequences that tend to impede sustainability. Intuitively, the society is inextricable 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,* 1993).

Charcoal production is one of those rural activities which is undertaken for survival, but which seem to have adverse environmental consequences. Charcoal is one of the products of wood, providing cooking aid for millions of people in this cosmic environment (Hayes, 1972). Many restaurants in both urban and rural areas use charcoal for cooking and baking. Charcoal is known to be used in many industries in many economies especially in the developing ones. For instance, it is used in sugar refinery, in gas mask industries, and in recovery of costly solvent vapour (Handerson, 1976). Different types of charcoal such as wood, animal and sugar charcoal have been identified, but the most common in southern Nigeria is wood charcoal.

Several studied have stressed the symbiotic relationship between man's expanded socio-economic activities and the environment. For instance, it is the opinion of Meadow's

(1972) that man's continued excessive use of the natural resources, especially wood products may deplete and eventually exhaust them. This pessimism is shared by Arnold (1983), Oseni (1983), Ayodele, *et al* (1996) when they stressed the adverse consequences of excessive fuel wood consumption through deforestation. They proposed subsidization as one of the appropriate policies aimed at creating incentives for people to consume more commercial energy substitutes to fuel wood such as kerosene, gas and electricity. However, Moss and Morgan (1981) had earlier emphasized the fact that the rates of wood production and consumption vary considerably with wood availability, and the availability of alternative fuels, cooking habits, heating requirements and the like.

In its analysis of population – environment nexus, the Food and Agricultural Organization (FAO, 1973), emphasized that population mobility has reinforced the tendency for the rural and urban societies to be open to one another, as the pace of migration has quickened, and as towns have become more ruralised. Therefore, the charcoal distribution network extends from countryside to town. The analysis further observed that the high cost of charcoal/fuel wood transport from the rural areas to towns has limited the productive areas around large cities and has caused pressure on demand on the local charcoal/fuelwood resources.

On the paradigm of fuel wood/charcoal substitutes, Ayodele (1987) via econometrics, analyzed the pattern of energy consumption in Nigeria, and emphasized energy prices as one main determinant of energy consumption, particularly in the non-industrialized sectors of the economy. This perhaps explains the wisdom of Nigeria's energy price subsidization policy which created significant incentives in the shift of energy consumption away from fuel wood/charcoal to other energy sources as kerosene, electricity, gas, coal and the like for cooking and heating in Nigeria. But Aina (2001) has observed in his study of domestic energy situation in Nigeria, that many families have gone back to the use of fuel wood/charcoal owing to high prices or scarcity of kerosene, liquefied gas and electricity. The high prices of these energy substitutes which is the result of price deregulation aimed at efficient allocation of resources in an evolving market-oriented economy constitutes one main policy instrument under the Structural Adjustment Programme (SAP). The deregulation of energy prices and subsequent withdrawal of subsidies have run counter to the environmental protection policy through forest conservation of the Nigerian government.

## RESEARCH PROBLEM

Production of charcoal by the burning of woodchips and wood flour causes the depletion of ozone layer, and may be hazardous to the health of the producers and those around the production environment. Although, it is commonly agreed by environmentalists that pollution caused during the production of charcoal is undesirable, there is no considerable agreement over who is responsible and what can be done about it. However, production and marketing of charcoal is becoming important subject now, since the issue of minimizing pollution and maximizing production has become legal as well as moral.

Ika area of Delta State is noted as important in charcoal production in Nigeria. Trees are randomly felled and logged from local forests for charcoal production, which is an all-year-round enterprise. The charcoal product from the burnt wood is in demand both within the area and urban towns. Consumers of charcoal include the local blacksmiths, the local restaurants, the roadside maize and plantain roasters in the urban areas, and the goldsmiths, among others.

The emitted air during charcoal production can be extremely injurious to vegetation, so that agricultural enterprises located around population centres such as market gardens are especially endangered. Air pollution caused during the production of charcoal is often harmful to urban greenery in parks, and residential plantings. Plants are injured by particulate matters as well as by gases such as sulphur dioxide and ozone (Arnold, 1983).

Charcoal production and marketing in Ika Areas, starts from allowing the tick logs of wood to dry before they are burnt. The producers of charcoal in the area obviously are not the rich but peasants who engage in the enterprise for survival. Hence, the production is usually arduous and irregular and the market is characterized by fractionalization of the produce at the retail end of the market. Charcoal is generally bulky like most extracted natural products, but not perishable. Because of the bulky nature, producers find it difficult transporting large quantities that will yield reasonable revenue to distant markets for sell. The producers of charcoal in the study area seem not to be deriving much economic benefits from the enterprise that should translate into improved quality of life. One would therefore want to ask if the returns to charcoal producers actually justify their efforts and the environmental problems involved. If the answer is no, should this enterprise be allowed to continue? It is expedient to understand the problems of charcoal production so as to suggest appropriate alternative for improved economic benefits to the entrepreneurs. This should be so, if charcoal production is found to be a desirable and sustainable income-generating venture.

The question however remains, to what extent is charcoal production actually desirable in the study area? What are the social and economic attributes of those in the enterprise? What are the determinants of charcoal demand and supply? Lastly, what are the possible factors/incentives that tend to encourage, and those that may continue to discourage charcoal production in the area. The specific objectives of the study therefore and to: (i) estimate the determinants of demand and supply of charcoal in the area; and (ii) find out the environmental and other factors which may serve as appropriate incentives and disincentives for charcoal production in the area. The findings of this study is expected to guide policy makers and environmentalists in designing a more environmentally friendly rural poverty alleviation programmes in Ika area in particular and similar areas in Nigeria.

## METHODOLOGY

Data for the study were collected from six communities in Ika North-east Local Government Area (LGA) of Delta State. The six communities are the ones most noted for

charcoal production and include Ute-okpu, Owa, Emuhu, Umunede, Otolokpo and Idumusa. The LGA is located within the rain forest belt of mid-western Nigeria. It has an average rainfall range of about 166mm to 200mm, and temperature could be up to 70°F.

The LGA is situated on a flat plain with majority of the people living in the rural areas mainly as farmers. The two main seasons are the dry and wet seasons, which are conducive to the growth of a variety of food and cash crops. Major crops grown in the area include cassava, yam, maize, plantain and vegetable(s) while palm trees and rubber are the major cash crops. Major crops grown in the area include cassava, yam, maize, plantain and vegetables while palm trees and rubber are the major cash crops. Major trees found in the sprawling forests include iroko, mahogany, obeche and teak, all of which are used for charcoal production. Some rural non-farm economic activities of the people include, petty trading, plantain frying/roasting, palm oil processing and hotelling all of which use a lot of fuelwood/charcoal. Each of the communities has a rural four-day market, where charcoal is sold at both wholesale and retail.

Following a reconnaissance survey, 140 regular charcoal producers and marketers were identified from the six communities for the study. Ten (10) producers who are also marketers were selected from each of the sampling technique. Altogether, 60 charcoal entrepreneurs were chosen for the study. Primary data were collected using structured interview schedulers.

Analyses of the data collected made use of descriptive statistics, 4-point likert scaling of responses, and multiple regressions. Drawing from the works of De-Montalembert and Clement (1983); Imran and Barnes (1990) and Ayodele *et al* (1996), as well as the rural economic environment of Nigeria, the demand for charcoal should depend on: average price of charcoal, average price of charcoal substitutes, average household income and season of the year. Conversely, the supply of charcoal is determined by the average price, average cost of production, average quantity produced per person per day, and the season of the year.

Symbolically, the charcoal demand and supply function can be specified as follows:

1. $Cd = f(Pc, Pa, Yh, Sy, e)$; $fp, f'yh < 0$.
   $f'pa > 0$, $f'Se \lessgtr 0$ (a-priori expectations).
   Where,
   Cd = average quantity of charcoal demanded per market day (kg).
   Pc = average price of charcoal in the market (naira)
   Pa = average price of alternatives to charcoal (naira)
   Yh = average household income (naira)
   Sy = season of the year (dummy)
   e = error term with OLS properties.
2. $Cs = f(Pc, Cp, Qt, Sy, e)$; $f'Pc > 0$, $f'Cp$, $f'qt < 0$, $f'Sy \gtrless 0$.
   Where,
   Cs = average quantity of charcoal supplied per market day (kg).
   Pc = average price of charcoal (naira)

Cp = average cost of charcoal production (naira)
Qt= average quantity of charcoal produced per day (kg).
Sy= season of the year (dummy).
E = error term with OLS properties.

## RESULTS

All the 6o interview schedules administered to charcoal producers/marketers were properly completed, hence suitable for use in further analyses.

On the socio-economic attributes of the entrepreneurs, 60% were aged between 41 – 50 years. All the charcoal producers were males but about 21% of the marketers were females (usually wives of the producers). Over 78% of the entrepreneurs had household size of between 3 and 40; the upper limit of household size is a reflection of the preponderance of extended family system in the area. About 70% of the respondents had full primary education and below, while average monthly income ranged from ₦500 to ₦5100. Daily charcoal consumption as a function of average market demand ranged from 5.6kg to 60kg per buyer. Average price of a 50kg jute bag of charcoal was ₦350 while the estimated average cost of production was ₦180.

## REGRESSION RESULTS

In order to empirically apply the model as specified in equation (1) and (2), a log-linear functional form was found most suitable, implying and underlying multiplicative relationship between market demand and supply of charcoal and their determinants. For the market demand, the identified determinants were: price of charcoal, price of charcoal alternatives, household income and season of at the year.

The regression results are presented as equation (3) below:

(3) $Cd = -13.0^{*} - 0.22Pc^{*} + 5.02Pa^{*} - 13.15Yn^{**} + 107.7Se^{*}$

(-6.35) (4.85) (6.21) (0.13) (6.34)

$R^2 = 0.68$, DW 1.74, $F = 28.98$

*Significant at 1% **Not significant.

On the supply side, the identified determinants of average quantity of charcoal supplied by a producer were: average price of charcoal, average cost of production, average quantity of charcoal produced per day, and season of the year. The regression results are presented as equation (4) below:

(4) $Cs = 19.93^{*} + 0.19Pc^{**} - 3.02Cp^{*} - 0.01Qt^{**} + 58.2Sy^{*}$

(0.53) (0.86) (1.12) (-0.02)(2.65)

$R^2 = 0.51$, DW 2.00, $F = 18.73$

*Significant at 1% **Not significant

From equation (3) it can be seen that the signs of the parameters met the a-prior expectation. Apart from average household income, the other variables are statistically significant at 99% level of confidence. The $R^2$ of 68% shows that the explanatory power of the equation is quite high, as supported by high F-statistic. This shows that the function is a good fit.

For the significant variables, price of charcoal (Pc) influenced the quantity purchased in the local market, but the coefficient of the regression indicates that the demand for charcoal is price inelastic. Also, the average price of alternatives to charcoal and the season of the year significantly influenced the demand for charcoal. Both of the coefficients show a high degree of elasticity. For instance, a 1% change in the price of charcoal alternatives such ass kerosene leads to more than 5% increase in the demand for charcoal.

On the supply side, the signs of the parameters were as hypothesized. However, average cost of charcoal production and season of the year were statistically significant at 90% level of confidence. The $R^2$ of 51% indicates that the power of the explanatory variables is quite high. This is supported by the high F-statistic; hence the function can be said to be good fit.

Cost of charcoal production negatively and significantly affects the quantity of charcoal supplied. It is shown that a 1%d change in average cost of production reduces supply by as much as 3%. Also the season of the year positively/negatively influences charcoal production and supply. It is known that dry season of the year enhances charcoal production and supply, while production is negatively affected by the rainy season. The fact that price of charcoal does not positively relate to the quantity supplied shows that charcoal supply is price inelastic. Producers do not respond sharply to price changes – the characteristic of peasant producers.

## PROBLEMS OF CHARCOAL PRODUCTION

Table 1 shows the rating by entrepreneurs of perceived environmental and economic problems of charcoal production. Table 2 shows entrepreneurs rating of factors, which may make them discontinue charcoal production.

**Table 1: Entrepreneurs Rating of Perceived Environmental and Economic Problems of Charcoal Production**

| Problems | 4. Very severe | 3 Severe | Fairly severe | No effect | Mean Scores XS |
|---|---|---|---|---|---|
| **Exposure to soil to erosion** | 12(.8) | 9(.45) | 16(.53) | 23(.38) | 2.16 |
| Effect of smoke on the environment | 2(.13) | 6(.30) | 8(.27) | 44(.73) | 1.43 |
| Health Hazard from smoke | 18(1.2) | 9(.45) | 6(.20) | 27(.45) | 2.30 |
| Labour Intensive/Tasking | 21(.40) | 22(1.10) | 8(.27) | 13(.22) | 2.98 |
| Marketing Difficulties | 34(2.27) | 16(.80) | 3(.10) | 7(.12) | 3.28 |
| Low Profit Margin | 24(1.60) | 13(.65) | 9(.30) | 14(.23) | 2.78 |

**Table 2: Entrepreneurs Rating of Factors that Discourages Charcoal Production**

| Factors | Very Effective | Effective | Fairly Effective | No effect | Mean Scores XS |
|---|---|---|---|---|---|
| **Government ban on Production** | 20(1.33) | 12(.60) | 6(.20) | 28(.47) | 2.60 |
| Provision of alternative Employment | 25(1.67 | 14(.70) | 8(.27) | 13(.22) | 2.85 |
| Subsidy on farm inputs | 18(1.2) | 16(.80) | 11(.37) | 15(.25) | 2.62 |
| Education of Entrepreneurs | 8(.53) | 19(.95) | 9(.30) | 24(.40) | 2.18 |
| Provision of Charcoal alternative | 12(.80) | 17(.85) | 26(.87) | 5(.08) | 2.60 |

Figures in parenthesis are the scores of individual issues.
Source: Field Survey, 2001

Using a 4-point likert-scaling the identified environmental and economic problems relating to charcoal production as rated by entrepreneurs was analyzed (Table 1). Items that scored 2.5 and above (i.e. XS $\geq$ 2.5) were rated as very strong issues against charcoal production. While those that scored below 2.5 were regarded as not strong enough issues to be addressed.

Table 1 shows that issues such as erosion hazard, environmental pollution from smoke, and health problems caused by charcoal production processes to the producers were not considered as serious against charcoal production by the entrepreneurs X < 2.5). But issues such as high labour need, marketing difficulties and low profit margin were identified and rated high as serious problems militating against the enterprise. This result shows that charcoal entrepreneurs do not appreciate the enormity of the environmental and health hazards of their enterprise.

On the factors that may discourage the entrepreneurs from charcoal production, government ban on production, provision of more viable employment, subsidy on farms inputs which may translate to higher farm gross margin and provision of alternative cooking and heating systems such as coal bright were issues identified and rated high (XS > 2.5) by the entrepreneurs as capable of making the stop the enterprise. However, they did not agree that education especially on environmental issues could make them discontinue the enterprise; since they did not perceive the enterprise as having any serious environmental consequence.

## CONCLUSION

Rural people do not undertake most economic activities because of their viability, but rather as coping strategy. Charcoal production is one of such rural enterprise. The determinants of the demand and supply of charcoal have been identified. Also identified are issues, which the entrepreneurs consider as problems that relate to charcoal production, and other critical factors, which if addressed may dissuade the entrepreneurs from the enterprise. The study recommends further empirical investigation on the adverse environmental and health consequences of this enterprise which will compliment the issues

already identified for appropriate poverty alleviation policy that will be environment friendly.

**REFERENCES**

Aina, O.I. (2001). Domestic Energy Policy in Nigeria: Technological Implication and Policy Alternatives. *ATPS Working Paper* N0 25. African Technology Policy Studies Network, Nairobi, Kenya.

Arnold, J.E. (1983). *Fuel wood and Charcoal in Developing Countries*: UNASYLVA.

Ayodele, A.I. (1987). "Energy Development and Utilization in Nigeria" NISER, Ibadan, Nigeria.

Ayodele A.I., Falokun G.O., Chete L.N. and Fasehun F.E. (1996). "Population Environment and Sustainable Development in Nigeria; The Fuel wood Phenomenon: A Case Study of Ikire". In Philips A.O. and Ajakaiye D.O. (eds) *Population – Environment Interaction in Nigeria.* NISER Ibadan, Nigeria.

Handerson, E.E. (1976). *Chemistry of Today.* Macmillan Education Ltd, London P. 249.

Hayes I. (1972). "Landscape for Living. *USDA Year Book of Agriculture,* Washington D.C.

Imran, M and Barnes, P (1990). "Energy Demand in the Developing Countries: Prospects for the Future". *World Bank Staff Commodity Working Paper* No 23. The World Bank, Washington D.C.

Meadows, D.H. (1972). "*The Limits to Growth.* Earthscan London.

Montalembert, M.R. and Clement J. (1983). "Fuel wood Supplies in the Developing Countries. Forestry Paper No 42, Rome, FAO. Food and Agricultural Organization (1973), Year Book of Forest Products. Rome.

Moss, R.P. and Morgn, W.B. (1981). Fuelwood and Rural Energy Production and Supply in the Humid Tropics. *Natural Resources and the Environment Series vol. 4.*

Oseni, A.M. (1983). "Wood and Energy in the year 2000 "Paper presented at the science Association of Nigeria, 24th Annual Conference, Ibadan, Quoted by Ayodele A.I. *et al*, 1996 in *Population, Environment and Sustainable Development* NISER, Ibadan, Nigeria.