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## **PRODUCTION AND MARKETING OF CHARCOAL IN KOKONA AND LAFIA LOCAL GOVERNMENT AREAS OF NASARAWA STATE**

<sup>1</sup>Akinyemi, O. <sup>2</sup>Egbewole, Z. T., <sup>3</sup>Kassali, R. and <sup>2</sup>Nwindag, W. L

<sup>1</sup>Forestry Research Institute of Nigeria, PMB 5054, Ibadan Nigeria.

<sup>2</sup>Department of forestry, wildlife and Ecotourism, Faculty of Agriculture (Shabu-Lafia campus) Nasarawa State University, Keffi. Nigeria.

<sup>3</sup>Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Nigeria  
akindapo4real@yahoo.com/08033690243

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### **ABSTRACT**

Charcoal is one of the non-timber forest products that serves as a major source of livelihood for both rural and Urban dwellers in most tropical countries, Therefore, economics of charcoal production and marketing in Kokona and Lafia local government areas of Nasarawa State was investigated. Three different sets of structured questionnaires were administered on Charcoal producer, wholesalers and retailers respectively. Purposive sampling techniques were adopted for the administration of the questionnaire. A total of 90 questionnaires were equally administered. Descriptive statistics, production function using linear regression method, budgetary analysis, marketing analysis and T-test analysis were used. The result shows that 15 preferred and used tree species for charcoal production were identified. Labour, experience and sources of wood were the three variables influencing charcoal production. The source of wood was significant at 1% while labour and experience were significant at 5% probability level. The  $R^2$  value of 0.49 indicating 49% of the variation in output was accounted for by the explanatory variables and F-statistics of 5.726 was significant at 1% probability level. The profit per mould was ₦12,300. The Rate of Return (ROR) was 2.04, the marketing margin ₦258 and ₦289 per bag were obtained for wholesalers and retailers respectively. The marketing profit accruable to wholesalers and retailers were estimated as ₦248 and ₦270 respectively. Wholesale and retail marketing of charcoal were not significantly different when subjected to T-test. The results obtained indicated that charcoal enterprise was highly profitable in the study area. It is therefore recommended that government should ensure that all charcoal stakeholders are under the same organizational body, set up policy guidelines for their operations and create structural framework that will support and encourage forest establishment by the charcoal stakeholders for sustainability of the business.

**Keywords:** Charcoal, Production, Marketing, Profitability, Sustainability

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### **Introduction**

Wood; a lignocellulosic material, is a product of photosynthetic processes in the tree. From years back, wood has been used by mankind in various forms for construction works, as basic raw material for pulp and paper production, particle board making, plywood manufacturing, veneer production, furniture making, as industrial raw material, as fuel in

industries and home and a host of other products. Wood is very important to the socio-economic development of any nation.

Wood utilization for household energy has been since time immemorial when man first learnt the art of cooking with fire. The increase in population couple with rapid urbanization in Nigeria has placed a strain on energy crisis in the household sector



(National Action Programme, 2000). A vital approach toward wood fuel is the production of charcoal. The process of making charcoal is ancient, with Archaeological evidence of charcoal production going back about 30,000 years (Goldwyn, 2013). Charcoal is the dark grey residue consisting of carbon and any remaining of heating wood and other substances in the absence of oxygen called pyrolysis (Energypedia, 2015). According to Seidel (2008) charcoal is produced from wood by a complex process called carbonization. Carbonization occurs at temperatures between 450 to 600°C in absence of air. Under these conditions organic vapours and gases are lost and part of the organic substances polymerizes, all of which increases the carbon content of the product. After the process is finished, charcoal is the final remains.

Charcoal is a prime source of energy in most African countries and is a driving force in their economies. According to Kammen and Lew (2005), half of the world's population uses biomass fuel for cooking and that in 1992, 24 million tons of charcoal were consumed worldwide, with developing countries accounting for nearly all the consumption while Africa alone accounted for 50%.

Charcoal is a multipurpose wood product. It is also used in the manufacture of carbon disulfide, carbon tetrachloride, sodium cyanide, and other industrial uses such as steel heating, non-ferrous smelting and metal case hardening (FPL, 1961). Production of charcoal will continue to expand as this use increases. The Multipurpose uses of charcoal have stimulated interest in its production and create market both at local and international levels. The importance of charcoal is also reflected by the fact that four African Countries rank among the eight countries with

charcoal production worldwide namely: Kenya, Nigeria, Sudan and Zambia (William, 2000). Kenya is the highest producer of charcoal in Africa and the third in the world.

In spite of the environmental and social impacts, wood fuel production and consumption trade plays a significant role in the informal markets of developing countries (WEC, 2004). According to Mutimba (2005), the charcoal Industries contributes an estimated 400 million US Dollar annually to Kenya economy making it an important economic factor. If this amount is extrapolated over the whole Africa, it would run into a few billion dollars (Mutimba,2005). Several 100,000 people are involved in production and trade of charcoal making it number 4 in employment generation after Agriculture and Forestry Manufacturing, the public sector and services (Seidel, 2008) It is estimated that 2 million people are dependent on charcoal industry directly or indirectly in Kenya (Seidel,2008).

According to UNDP (2004), an estimate of 2.5 billion people lack access to modern energy services. This has constrained their opportunities for economic development and improved living standards. They rely on traditional biomass sources such as wood fuel, agricultural residues, and animal dung to meet their basic energy needs (WHO,2006). The growth of towns and cities in most developing countries of Africa necessitated the need for more charcoal (Adedokun *et al.*, 2018). The estimation therefore is for each 15% Increase in urbanization, there is a 14% increase in charcoal consumption (Hosier 1993). Current trend of wood charcoal shows a rising demand (CIFOR,2005). In Nigeria Charcoal has a multipurpose value as it is used as fuel for homes and industries. Common people have turned increased attention to the use of charcoal because of its availability,



cheapness, easy manipulation, easy storage, smokelessness, high heat output and portability over other domestic fuels (Yakubu and Idumah, 2002)

According to Essiet, (2009) Charcoal is an export commodity in Nigeria, with a large market in EU, USA and Asia. The price ranges from \$ 170-\$300 per ton. Tropical Africa accounts for 70% of the market and the market is all year round with a slight drop between July and September. From the above, it is evident that Charcoal is an important factor in many African economies. This study therefore examined the production and marketing of charcoal in Kokona and Lafia local government areas of Nasarawa state.

## **Methodology**

### **The study area**

Nasarawa state was created out of old Plateau State on October 1<sup>st</sup>, 1996 and its capital sited at Lafia. The state is centrally located in the middle belt region of Nigeria. The state lies between latitude 7°45<sup>1</sup> and 9°25<sup>1</sup> N of the equator and between longitude 7° and 9°37<sup>1</sup> E of the Greenwich Meridian. The state shares boundary with Kaduna State in the North, Plateau State in the East, Taraba and Benue state in the South and Kogi state and Federal Capital Territory flanks it in the West.

The state is 181.5m above sea level. The state has a total land area of 27,137.8 square kilometers and a population of about 1,826,883 according to the 2015 population estimate with a density of about 67 persons per square kilometre (Binbol and Marcus, 2010). The major ethnic groups in the state include Eggon, Alago, Hausa, Fulani, Mada, Rindre, Gwandara-Gade, Koro, Gbagyi, Ebira, Agatu, Bassa, Aho, Ake, Mama, Arum, Kambari, Tiv and Ayankpa (yeskwa) (Dalat and Filaba, 2007).

Rainfall in Lafia usually starts from March-October and average monthly rainfall ranges from 40mm-350mm. The month of July and August usually record heavy rainfall. The daily maximum temperature ranges from 20.0° – 38.5° and daily minimum range between 18.7-28.2. The relative humidity rises as from April to a maximum of about 75-90 percent in July (NIMET Lafia, 2010). The soil types of the study area composed of highly leached ultisols with low base saturation. The vegetation of the study area is that of the Southern Guinea Savanna with interspersed thicket, grassland scattered trees, fringing woodlands or gallery forest along the streams. (Dalat and Filaba, 2007).

### **Sampling Method, Sample Selection and Data collection**

For the purpose of data collection, three different sets of structured questionnaires were drawn and administered on relevant target groups namely charcoal producers, wholesalers and retailers. The first set of questionnaire were administered on charcoal producers in Kokona local government area. The questions sourced relevant production information such as cost incurred on production, cost price of inputs, selling price of output in addition to the bio-data of the respondents. Five villages were purposively sampled because of the prevalence of target group (charcoal producers) in such villages namely: Mararaba Arusu, Angwanyamu, Mandara, Campani and Bandu. Random sampling technique was used to select six charcoal producers in each village totaling Thirty (30) respondents

The second set of structured questionnaire were administered on charcoal wholesalers who were involved in marketing charcoal in bulk (bags) in Lafia local Government Area. The questionnaire aimed at obtaining

meaningful and relevant information on marketing activities of charcoal. To sample charcoal wholesalers, purposive sampling technique was adopted by selecting the major areas on the basis of availability of charcoal wholesalers. A total of 30 respondents were sampled accordingly.

The third sets of structured questionnaire were administered on charcoal retailers in Lafia local government Area. Similarly, purposive sampling technique was used to sample major areas where charcoal retailers were available. Thirty charcoal retailers were sampled. There were a total of ninety (90) respondents sampled for this study.

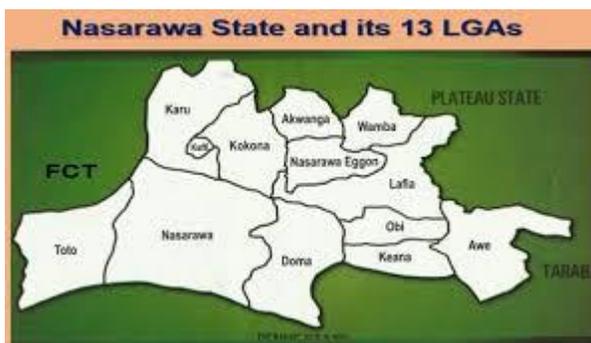


Figure1: Map showing study areas

**Data analysis**

Descriptive statistics such as frequency and distribution table were used to analyse the socio-economic characteristics of the respondents, as well as the identification of the preferred and used species for charcoal production in the study area. The production function using linear regression analysis was used to ascertain the determinants of charcoal production. The implicit form of the model is specified thus:

$$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, U_0) \text{-----(1)}$$

Where Y= Number of bags of charcoal produced per mould.

- X<sub>1</sub> = sex of producers (1 male; 2 female)
- X<sub>2</sub> = experience of producer (years)
- X<sub>3</sub> = season for production (1 dry; 2 rainy)
- X<sub>4</sub> = Labour (man hour)
- X<sub>5</sub> = type of producers (1 full; 2 part time)

X<sub>6</sub> = source of wood (1 farmland; 2 forest reserve)

U<sub>0</sub> = Error term.

The explicit form of the model is:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + U_0 \text{-----(2)}$$

To estimate the profit in charcoal production, the costs and returns analysis,

that is, budgetary analysis was used as indicated below:

Total revenue per mould (TR) = Number of bags produced X price per bag ----- (3)

Profit = Total Revenue (TR)-Total Cost (TC) ----- (4)

The Rate of Return (ROR) was determined by:

$$ROR = \frac{\text{Profit}}{\text{Total cost}} \text{----- (5)}$$



To estimate the marketing margin, the equation below was used:

$$MM = SP - (BP + MC) \text{ ----- (6)}$$

Where MM = marketing margin

SP = selling price

BP = buying price

MC = marketing cost

T-test analysis was used to compare the wholesalers and retailers marketing of charcoal.

## Result and Discussion

### Socio-demographic Characteristic of Charcoal Producers

The socio-demographic characteristics of the producers as shown in Table I revealed that of the total 30 respondents, 17 representing 56.7% were in the age group of 21-30 years. This is closely followed by those in the 31-41 years' category where 36.7 % of respondents were recorded. This implies that the majority were still active and physically capable of working on their production activities. This finding agrees with Alabi *et al.* (2015) that described persons in the age range of between 20 and 50 years as the active age group, because individuals within this age bracket were able to withstand the vigour involved in charcoal production. The majority (73.3%) of the respondents were male while the remaining were female (26.7%). This could be due to the nature of charcoal production which involves vigorous processes that females might not be able to cope with. The highest population of married producers (90%) in this study is in conformity with the findings of Taphone (2009) who reported that

married persons have more responsibility taking care of their families, hence always making effort to involve in business that will increase their financial prowess. The result also indicated that 18 (60%) had the household size ranges between 6 and 10 while 11 (36.7%) and household size less or equal to 5. The largest family size recorded in this study for charcoal producers could imply that respondents had family labour to assist them in their businesses therefore reduce the amount incurred on hired labour. The results also revealed that 46.7% had secondary school education while 20% had no formal education. This confirmed the study of Yakubu and Idumah (2002) who reported that charcoal processing and marketing attract various categories of people irrespective of their educational background and its found to be an alternative source of employment and income generation. The experience of the respondents in charcoal production indicates that 46.7% of charcoal producers had between 6 and 10 years' experience ranging from 11 to 15 years. Only few (16.7%) had higher experience in charcoal production ranging from 16 and 20. Majority of respondents in this study has more than 5 years' experience; this implies that most of the respondents have adequate knowledge and exposure concerning charcoal production. This finding agrees with Garba *et al.* (2015) who reported that lengthy years of experience could stand as an added advantage in terms of efficiency in converting production inputs to output and could as well be added advantage towards making more profit.



**Table 1: socio-demographic characteristics of charcoal producers**

<b>Socio-economic characteristics</b>	<b>Respondents</b>	<b>Percentage</b>
<b>Age</b>		
< 20	1	3.3
21-30	17	56.7
31-40	11	36.7
41-50	1	3.3
Above 50	-	-
<b>Gender</b>		
Male	22	73.3
Female	8	2.7
<b>Marital status</b>	27	90.0
Married	3	10.0
Single		
<b>Household size</b>		
≤ 5	11	36.7
6-10	18	60.0
11-15	1	3.3
<b>Education</b>		
No formal education	6	20.0
Primary education	8	26.7
Secondary education	14	46.7
Tertiary education	2	6.6
<b>Years of experience</b>		
≤5	3	10.0
6-10	14	47.7
11-15	8	26.7
16-10	5	16.6

**Socio – demographic characteristics of marketers (wholesalers and retailers)**

The age distribution data as shown in Table 2 indicates that of the total 60 respondents, 27 representing 45% were in the age group of 21-30 years. This is closely followed by those in the 31-40 years where 35% of respondents were recorded. Only 20 % of the respondents were above 41 years. This implies that majority of the marketers were in the economically active age. This finding agrees

with Yakubu and Idumah, (2002) who reported that 20% of the charcoal producers and marketers falls within the 41-50 age class in selected local government area of Oyo state. The gender distribution shows that 60% were female while the remaining 40% were male. This also confirmed the study of Yakubu and Idumah, (2002) who reported that female were involved more in marketing charcoal. Married respondents were 48.3% while 31.7% were single. Others were either



widows or divorce. The result also revealed that 40 (66.7%) had household size of less than and equal to 5; 30% had household size ranging between 6 and 10. Only few (3.3%) of the marketers had household size above. Adedokun *et al.* (2018) reported that the family size of 2-4 were the majority for the charcoal retailers in Igbo-Ora, Oyo states. As shown in Table 2, the educational status of the marketers indicates that majority (38.3%) attended secondary. Those that attended primary school were 28.3% while 20% had no formal education. Only few (13.3%) attended tertiary institution. This implies that all

categories of people either educated or not could be charcoal marketer. The majority (23) representing (38.3%) had experience in marketing charcoal for the period ranging between 6 and 10 years while 18 (30%) had less than or equal to 5 years. Out of the 60 respondents, 12 (20%) had between 11 and 15 years of experience. Only 7 (11.7%) had more than 15 years' experience. This result is also similar to the findings of Adedokun *et al.* (2018) who reported that 90% of the charcoal retailers in Igbo-Ora had experience of less than 15 years.

**Table 2: Socio-demographic characteristics of charcoal marketers (wholesalers and retailers)**

Socio-Economic Characteristics	Respondents	Percentage
<b>Age</b>		
<20	-	-
21-31	27	45
31-41	2	35
41-50	9	15
Above 50	3	5
<b>Gender</b>		
Male	24	40
Female	36	60
<b>Marital status</b>		
Married	29	48.3
Single	19	31.7
Widows	10	16.7
Divorce	2	3.3
<b>Household size</b>		
≤5	40	66.7
6-10	18	30.0
11-15	2	3.3
<b>Education</b>		
No formal education	12	20.0
Primary education	17	28.3
Secondary		38.3



education	23	13.4
Tertiary education	8	
<b>Years of experience</b>		
≤5	18	30.0
6-10	23	38.3
11-15	12	20.0
16-20	4	6.7
Above 20	3	5.0

### Preferred and used tree species for charcoal production.

Given the choice of species for the charcoal production, the respondents stated that the following preferred and used tree species as shown in the Table 3 below:

These preferred tree species stated by the charcoal producers in the study area are in conformity with the report of Egbewole and Ogunsawo (2014) who listed 20 tree species in Nasarawa State.

**Table 3: Checklist of preferred and used tree species for charcoal production**

S/N	Scientific name	Hausa name
1	<i>Prosopis africana</i>	Kirya
2	<i>Khaya senegalensis</i>	Mahogany
3	<i>Vitellaria paradoxa</i>	Kade
4	<i>Parkia biglobosa</i>	Dorowa
5	<i>Vitex doniana</i>	Dinya
6	<i>Terminalia superba</i>	Nkiwo
7	<i>Piliostigma reticulatum</i>	Kalgo
8	<i>Daniella oliverii</i>	Maje
9	<i>Anogeissus leiocarpus</i>	Marke
10	<i>Anacardium occidentale</i>	Yazawa
11	<i>Mangifera indica</i>	Mangoro
12	<i>Tamarindus indica</i>	Tsamiya
13	<i>Acacia Senegal</i>	Danko
14	<i>Newbodia laevis</i>	Aduruku
15	<i>Balanite aegyptica</i>	Aduwa

### Determinants of charcoal production

The result of the regression analysis is presented in the Table 4. From the table, the regression coefficient,  $R^2$  and F-statistics were used to evaluate the overall explanatory power of the regression model. The significance of the parameter estimates was evaluated by means of t-test at 1% and 5%

level of probability. The  $R^2$  value of 0.49, indicating that 49% of the variation in the output was accounted for by the explanatory variables included in the equation.

From Table 4, labour, experience and source of wood were positively related to the number of bags of charcoal being produced per mould. The source of wood was significant at



1% while labour and experience were significant at 5% probability level. The F-statistics which gives an indication of the overall statistical significance of the model was significant at 1% level of probability. The coefficients of the various variable

included shows that an increase in labour, experience and sources of wood will lead to an increase in output. This implies that these three variables positively influenced charcoal production in the study area.

**Table 4: Result of Regression Analysis**

Variable	Coefficients	Standard error	t-value	Level of significance
Constant	-8.72	6.892	-1.266	0.298
Gender	1.003	1.352	0.742	0.356
Experience	0.286**	0.134	2.143	0.041
Season	0.718	1.611	0.446	0.611
Labour	0.878**	0.358	2.454	0.020
Type of producer	1.527	1.059	1.442	0.207
Sources of wood	9.172***	1.889	4.856	0.000

\*\*\* significance at 1%, \*\* significance at 5%,  $R^2 = 0.49$ ,  $F = 5.726$  \*\*\*

**Profitability of charcoal production (per mould)**

The costs and returns analysis in charcoal production (per mould) is presented in the Table 5.

The average numbers of bags being produced from a mould was estimated to be 18.27 bags. The selling price per bags from the producer was ₦980. The total revenue (TR) in charcoal production per mould was obtained to be ₦17,903. The total cost (TC) of ₦5870 is the

addition of the cost of labour (₦ 1,650) and capital (₦ 4220). The cost of labour represent 28.11% of the TC while the capital cost is 71.89% of the TC. The profit was obtained to be ₦12,300 per mould (TR - TC) while the rate of return (ROR) was determine to be 2.04 (profit÷Tc). This rate of return implies that for every ₦1.00 invested about ₦2.04 was generated. From this analysis, it is evident that charcoal production is highly profitable in the study area.



**Table 5: Costs and Returns in Charcoal Production (Per Mould)**

Variable	Value (₦)	Percentage
Total revenue (TR)	17,903	
Labour cost		
1. cost of making mould	480	8.18
2. cost of moving log into mould	400	6.81
3. Storage/ packing charcoal	800	13.63
Total labour cost	1,650	28.11
Capital cost		
1. Cost of wood	4,000	68.14
2. Cost of empty bags	200	3.41
3. Association fee	20	0.34
Total capital cost	4220	71.89
Total cost (labour + capital cost)	5870	100
Profit (TR-TC)	12,300	
Rate of return (profit/TC)	2.04	

**Analysis of marketing margin and profitability (per bag)**

The result of the analysis of marketing margin and profitability (per bag) is presented in the Table 6. By deducting the buying price from the selling price, the marketing margin of ₦ 258 and ₦ 289 per bag were obtained for wholesalers and retailers respectively. The marketing profit accruable per bag to the

wholesalers and retailers were estimated as ₦248 and ₦270 respectively. While the selling and buying prices of charcoal by the wholesalers and retailers were significant at 1% probability level, other variables, that is, marketing margin, marketing cost and marketing profit were not statistically significant as indicates in the Table 6.

**Table 6: Analysis of marketing margin and profitability (per bag)**

Variable	Value (₦)		t-value
	Wholesaler	Retailers	
Selling price	1,211	1400	-672***
Buying price	953	1,111	-7.92***
Marketing margin	258	289	-1.173 NS
Marketing cost	10	19	
Marketing profit	248	270	-0.840NS

\*\*\* Significance at 1%, NS= not significant



From the above Table 6, it is evident that wholesale and retail marketing of charcoal are profitable in the study area.

### Wholesale and retail marketing of charcoal

The result of the T-test analysis used to compare wholesale and retail marketing of charcoal is presented in Table 7. It is evident from the table that, in terms of the considered variables, there was no significant difference

among wholesale and retail marketing of charcoal in the study area. This implies that one can involve in either wholesale or retail marketing of charcoal. This results agrees with the finding of Adedokun *et al.* (2018) who reported that wholesalers and retailers were able to cover the costs incurred in carrying out the marketing services and made some profit.

**Table 7: T-test analysis of wholesales and retails marketing of charcoal per bag**

Variable	Wholesales	Retail	T-value
Buying price	953±82 <sub>-</sub>	1111±71	-7.916ns
Selling price	1211±127	1400±86	-6.70ns
Marketing margin	258±126	288±61	-1.173ns
Profit per bags	247±126	269±60	-0.840ns

NS= Not significant

### Conclusion and Recommendations

From the analysis of the data obtained for this study, fifteen (15) preferred and used tree species for charcoal production were indicated by the charcoal producers and therefore, identified. Three variables namely labour, experience and sources of wood were positively related to the number of bags of charcoal being produced per mould. The sources of wood was significant at 1% while labour and years of experience were significant at 5% probability level.

The coefficients of the various variable included shows that an increase in labour, years of experience and sources of wood will lead to an increase in output. Charcoal production was highly profitable with the profit of ₦12,300 per mould and rate of return (ROR) of 2.04. The marketing profit accruable per bag to the wholesalers and retailers were ₦248 and ₦270 respectively.

It is evident from this study that production and marketing of charcoal through wholesale or retail are highly profitable in the study

area. The ROR of 2.04 obtained for charcoal production implies that for every ₦1.00 invested about N2.04 was generated.

For sustainable production of charcoal in Nigeria, the intervention of the government at state and National level is required. The state should set aside a forest estate for its production using the principle of sustained yield management. Land should be provided and allocated for the Association of charcoal exporters of Nigeria by the state governments for the establishment of forest taking into consideration the inclusion of the preferred tree species. Private establishment of forest plantation for charcoal production should be advocated and encouraged. This will reduce pressure through illegal encroachment and felling on the gazetted forest reserves and even “free areas” (off-reserved areas). The Federal government through the Federal Ministry of Environment should ensure that all charcoal stakeholders are under the same organizational body, set up a policy guideline for their operations and recommend



appropriately the annual quota for exportation. Emphasis should be laid on forest establishment by the stakeholders in the guideline. There is the compelling need for diversification of Nigerian economy. Through exportation of charcoal, the country can earn foreign exchange. Production and marketing of charcoal could be a viable source of employment for both rural and urban dwellers. This, in turn, will consequently improve the economy of the country.

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