Journal of Forestry Research and Management. Vol. 15(3).37-56; 2018, ISSN 0189-8418
www.jfrm.org.ng

SOCIO-ECONOMIC DYNAMICS OF CHARCOAL PRODUCTION IN OGUN STATE, NIGERIA

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ABSTRACT

Charcoal production is an industry of economic importance in Ogun State, Nigeria. This study investigated the socio-economic dynamics of charcoal production in Ogun State. Multi-stage sampling technique was used with a sample frame of 250 respondents. A well-structured questionnaire with oral interview was administered to elicit information from the respondents. Descriptive statistics, logit model as well as budgetary analysis were used to analyze the data. The result revealed that about 44% of the respondents were between 40 – 49 years of age and most (95.6%) of the respondents were males. About 46% and 36% obtained West African School Certificate (WASC) and Senior Secondary School Certificate (SSCE) respectively. The average year of experience was 13 years. Only 33.9% of the total respondents were indigenes of the State. Most of the respondents lived in rented (84.7%) unpainted (95.6%) mud houses (77.6%) with thatched roof (77.6%) and their main means of feces disposal was bush/bare-ground (70.5%). Fifteen tree species belonging to 8 families were mostly used in charcoal production while annual Gross Profit (GP) and Net Profits (NP) were ₦90,757.33 and ₦78,117.66 respectively. The result showed that age was positively related to being a full time charcoal producer whereas, educational level of the spouse, participation in tree planting, income per annum from other sources, accessibility to credit and educational levels of the producer were negatively related to being a full time charcoal producer. The study concluded that most of the producers were in their economic active age, there were inadequate provision of basic amenities, indigenous tree species were mostly used for charcoal production and they belong mostly to Fabaceae family.

Keywords: Charcoal, producers, socio-economics, basic amenities, tree species, gross profit, net profit

INTRODUCTION

A forest is a resource of vital importance. It provides not only a range of environmental services that include soil and watershed conservation and carbon sequestration, but also extensive economic benefits from timber, non-timber, fuel-woods and recreation (Sengupta and Maginnis, 2005).In Africa, approximately 90 % of the woods supplied from the forests are used for energy production, and 30 % of wood-fuel extraction is used purposely for charcoal production (FAO 2011a and 2011b). Africa alone accounts for 63% (~30 million tonnes) of global charcoal production and since 2004 the production of charcoal in Africa has increased by 30%, the highest rate of increase globally (FAO 2011a) while literature also established that increasing demand from growing urban populations drives the charcoal market. An FAO projection of fuelwood (firewood and charcoal) consumption to 2030 was 46.1 million tonnes in Africa which will be highest in the world (FAO 2011a).

A wide variety of tree species are used for charcoal production nonetheless; the preferred size class is between 13-95 cm in diameter. Earth-mound kiln is the most common method of making charcoal in sub-Saharan Africa and between five to ten tons of wood are needed to make 1 ton of charcoal (at a mass-based conversion efficiency of 10-20%) thus, in using such kiln between 60-80% of the wood's energy is lost in the production process (Bailis, 2003). In addition, research on charcoal production shows that kiln efficiencies ranged from 14-28%. At an average of 19% kiln efficiency, 18 trees of 32 cm DBH (diameter at breast height, measured at 1.3 m) on average are used to produce 26 bags each weighing 53 kg of charcoal (CHAPOSA, 2002). Charcoal production technology was a method stumbled upon by the blacksmiths in the Old Oyo Empire in Nigeria around the 14th century during the shortage of wood used by the blacksmith as attested to by most of the charcoal producers. The technology had since spread to other parts of the country. Awoyemi, *et al*., (2006) upheld the fact that this product is virtually available all over Nigeria as many local communities have perfected the technology of charcoal production. CHAPOSA (2002) reported that there are three main categories of charcoal producer in the charcoal business, namely: full time, seasonal and occasional producers. However, in a study conducted by Ajadi *et al*., (2012), it was reported that charcoal enterprise is on part-time basis.

For any economic sector to be more profitable, sustainable, react quicker and offer higher quality products and services; there is a need to assess the effectiveness of the existing knowledge, management tactics and resourcefulness of such sector. Data concerning the energy and forestry sectors continued to be collected and assessed for changes and the evaluation of this data revealed variations in the consumption patterns of wood-fuels, as well as the environmental and socioeconomic issues, (Arnold *et al*., 2006). Abah *et al*., (2011) also agreed that most of the problems associated with wood energy production and management of resources still are not resolved. In addition to all these, there is dearth of knowledge on the socio-economic factors that affect the mode of engagement in charcoal production in the study area. Hence, the need for judicious empirical study to effect positive transformation in the industry. In pursuance of this, this research focused on: identifying the socio-economic factors which determine mode of engagement in charcoal production in Ogun state, ascertaining the wood species used for charcoal production and evaluating the profitability of the business.

METHODOLOGY

The Study Area

Ogun State lies between Longitude 3^{o} 20'E and 4^{o}37'E and Latitude 7^{o} 15'N and 6^{o} 00'N. It is bounded in the West by the Republic of Benin, in the East by Ondo and Osun States, in the North by Oyo State while in the south by Lagos State and Atlantic Ocean. The total population of the State according to 2006 population and housing census was three million, seven hundred and fifty-one thousands one hundred and forty (3,751,140). However, the projected population as at 2011 census was 4,397,604 (OSG, 2016). It has twenty (20) Local Government Areas with a land area of about 16,980.55Km2 (NPC, 2010).

The State lies within a lowland area with an altitude of between 0 – 200m above sea level. Its natural vegetation can be broadly grouped into two. These are the forest and savanna. The forest vegetation types found in the State can be further sub-divided into two; fresh water swamp forest and lowland rain forest. The rainfall pattern allows for two distinct seasons; dry season and wet season. The dry season lasts from November to March while the wet season starts from April and

ends in October. The mean annual rainfall is between 2000 and 2002mm, maximum temperature is 32.5oC while relative humidity is 79.9% (OSG, 2016).

Data Collection and Sampling Technique

A well-structured questionnaire comprising open and closed ended questions with oral interviews were used to elicit information from charcoal producers in the study area while multi-stage sampling technique was used to capture the respondents. Firstly, the State was stratified into its Local Government Areas (LGAs). The second stage involved the purposive selection of LGAs notable for charcoal production based on reconnaissance survey information. Imeko-afon, Yewa North and Odeda LGAs were selected. In the third stage, systematic sampling procedure was employed to select respondents from the sampled LGAs; after determining the number of respondents to be selected and randomly selecting the ith respondent from the first K sampling interval, then (i+ K)th, (i+2K)th, (i +3K)th was taken and so on. The systematic random sampling was determined with Probability Proportionate to Size (PPS) based on the population distribution of the targeted respondents in the strata. Out of two hundred and fifty (250) questionnaires administered, a total of 183 (73.2%) were retrieved and analyzed.

Data analysis

Data were analyzed using descriptive statistics such as frequency, percentages, means and standard errors of means. Inferential statistical tools such as budgetary analysis and logit were also carried out appropriately. Logit model was used to investigate the socio-economic factors which determine mode of engagement in charcoal production, (Gujarati, 2004; Bland and Altman, 2000 and Deeks, 1996). Models tested were obtained by fitting all the independent variables together and backward elimination was done to obtain the best subset model.

The linear probability model can be expressed as:

$$P_i = E\left(Y = {}^{1}/_{Xi}\right) = \beta_1 + \beta_2 X_i \qquad \ldots\ldots 1$$

$$P_i = E\left(Y = {}^{1}/_{Xi}\right) = \frac{1}{1+exp^{[-(\beta_1+\beta_2 X_i)]}} = \frac{1}{1+exp^{(-Z_i)}} \qquad \ldots\ldots 2$$

$where\ Z_i = \beta_1 + \beta_2 X_i.$

Equation 2 is the cumulative logistic distribution function. Zi ranges from - 8 to +8 , Pi ranges between 0 and 1.

The probability of Producers who engaged in charcoal production only is specified as follow $\frac{1}{1+exp^{(-Z_i)}}$ while 1 - Pi is the probability of Producers who engage in charcoal production and other businesses. This can be expressed as $\frac{1}{1+exp^{(Z_i)}}$. Therefore, it can be said that

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

$\frac{P_i}{1-P_i}$ is the odds ratio in favour of Producers who engaged in charcoal production only to the probability of Producers who engage in charcoal production and other business. Taking natural log of equation 3, we obtained:

$$L_i = In\left[\left(\frac{P_i}{1-P_i}\right)\right] = Z_i = \beta_1 + \beta_2 X_i + U_i \text{.................... ....} \; 4$$

Where;

Li = Log of odds ratio (Logit)

Pi = Producers who engaged in charcoal production only, (Full Time).

1 - Pi =Producers who engaged in charcoal production and other business, (Part Time).

$ß_1$ = Intercept

$ß_2$ = Slope (coefficient)

Xi = X_1, X_2, X_3, …………… X_n = Independent variables

u_i = error term.

The independent variables Xi in this model were described as follows:

X_1 = Age of the producer (Years)

X_2 = Sex of the producer (dummy variable where Male = 1, other = 0)

X_3 = Marital status (Dummy, Married = 1, others = 0)

X_4 = Spouse level of education

X_5 = Respondent engage in tree planting

X_6 = Respondent own a plantation

X_7 = Number of years outside state of origin

X_8 = Respondents with other sources of income

X_9 = Income per annum from other sources

X_{10} = Years of experience in production

X_{11} = Have access to credit

X_{12} = State of origin

X_{13} = Level of education of the charcoal producer

X_{14} = Total household size

X_{15} = Number of children in school

X_{16} = Revenue from charcoal production

Budgetary Analysis

Budgetary analysis revealed the relationship among costs, revenues and profits.

(a) Gross Revenue (GR) = Total output X Price/Unit of Product

(b) Variable Cost (VC): This includes labour wages and salaries, transportation cost etc.

Fixed Cost (FC): These costs are constant during production e.g. chain-saw, etc.

The straight-line method of depreciation was adopted. This is

C-S / Y

where;

C = cost of fixed assets in naira

S = salvage value will be the scrape value of the asset.

Y = economically productive years of fixed input.

(c) Total Cost = Variable Cost (VC) + Fixed Cost (FC)

(d) Gross Profit (GP) = Gross Revenue (GR) – Variable Cost (VC)

(e) Net Profit (NP) = Gross Profit (GP) – Fixed Cost (FC)

(f) Return on Investment (ROI)% = Net Profit/Total Cost X 100

(g) Operating Ratio = Total Operating Cost (TOC) / Gross Income

The ratio indicates the proportion of the GI that goes to pay for the operating costs. It is directly related to the variable input usage (Olukosi and Erhabor, 2005).

(h) Expense Structure Ratio (ESR) = Total Fixed Cost (TFC)/Total Variable Cost (TVC)

This indicates the proportion of the cost of production that forms the fixed cost component.

(i) Return per Capital Invested (RPCI) = NR/TC

It describes the amount of money return to the investor for every naira invested on the business.

RESULTS AND DISCUSSION

Table 1 revealed that the largest proportion (43.7%) of the respondents were between 40 – 49 years of age while 30.1% were between 50 – 59 years of age. About 18% were between 30 - 39 years, 4.9% were between 20 – 29 years of age and 3.8% were between 60 – 69 years of age. This shows that most the respondents were in their economic active age and is consistent with the findings of Jamala *et al*., (2013) on the socio-economic implications of charcoal production and marketing in Nigeria. Most (95.6%) of the respondents were males and a larger proportion obtained either WASC (45.9%) or SSCE (35.5%) certificates. This is contrary to the findings of Ogara (2011) in Nasarawa State, Nigeria where educational status attained by most of the respondents was primary school. Furthermore, majority (98.9%) of them were married and practiced monogamy (92.3%) with the largest proportion (64.5%) having a household size of between 6 – 10 persons.

The years of experience indicated 37.7% of the respondents had between 11 – 15 years of experience in charcoal production, 24.6% had between 6 – 10 years of experience while the mean years of experience was 13 years. The large years of experiences indicated that they were very familiar and persistent with charcoal production processes irrespective of any situations. The table also indicated that the mean years of residency outside home State was 6 years and only 33.9% of the total respondents were indigenes of the State. Others hailed from different States in the country: Benue (32.8%), Niger (0.5%) and the neighbouring countries: Benin-Republic (22.4%) and Togo (10.4%). This is consistent with the findings of Yusuf (2008) where 80% of the charcoal producers were migrants. This is because after exhausting the raw materials for charcoal production at the current location, they had to move to the adjacent location with abundant availability of the needed trees. The next available natural forests usually suffer the consequences.

Table 1: Socio-economic Characteristics of the Respondents

Variable	Category	Frequency
Age	20 – 29	9(4.9)
	30 – 39	32(17.5)
	40 – 49	80(43.7)
	50 – 59	55(30.1)
	60 – 69	7(3.8)
	Total	183(100)
	Mean	45.82±0.67
Sex	Male	175(95.6)
	Female	8(4.4)
	Total	183(100)
Educational status	No formal education	6(3.3)
	Primary six school leaving certificate	21(11.5)
	Modern school	
	West African School leaving certificate	1(5)
	Senior Secondary Certificate	84(45.9)
	Tertiary	
	Total	65(35.5)
		6(3.3)
		183(100)
Marital status	Married	181(98.9)
	Single	1(0.5)
	Divorced	1(0.5)
	Total	183(100)
Family type	Monogamy	169(92.3)
	Polygamy	14(7.7)
	Total	183(100)
Household size	1 – 5	63(34.4)
	6 – 10	118(64.5)
	>10	2(1.1)
	Total	183(100)
	Mean	6.18±0.14
Years of experience	1 – 5	9(4.9)
	6 – 10	45(24.6)
	11 – 15	69(37.7)
	16 – 20	36(19.7)
	21 – 25	22(12)
	26 – 30	2(1.1)
	Total	183(100)
	Mean	13.59±0.39
Years of residency outside home state	0	61(33.3)
	1 – 5	16(8.7)
	6 – 10	62(33.9)
	11 – 15	43(23.5)
	16 – 20	1(0.5)
	Total	183(100)
	Mean	6.28±0.38
State of origin	Ogun	62(33.9)
	Benue	60(32.8)
	Niger	1(0.5)
	Benin-Republic	41(22.4)
	Togo	19(10.4)
	Total	183(100)

Source : Field survey, 2017

Table 2 revealed that 69.4% of the total respondents were full time charcoal producers which imply that they did not have other sources of income. This would definitely increase the rate at which woods are harvested for charcoal production. However, among those with other sources of income i.e. those on part time charcoal production, 50.91% were into farming. Continuous usage of the land for agricultural purposes would prevent natural coppicing stumps of the forest trees thereby promoting inadequate forest cover. Also, among those with other sources of income, 16.36% were artisans. Others were into trading (14.56%), hunting (7.27%). About 6%, 3.64% and 1.82% received dividend/rent, pension and wages respectively. The largest (38.18%) percentage of the charcoal producers with other sources of income earned between ₦30,001 and ₦40,000 and they were concentrated among the farmers.

Table 2: Frequency Distribution of Respondents by other Income Sources in Ogun State in ₦/annum

Other sources	=10,000	10001 – 20000	20001 - 30000	30001 - 40000	40001 – 50000	50001 - 60000	Total	Percentage
None	128	0	0	0	0	0	128	69.4
Wage	0	0	0	1	0	0	1	1.82
Artisan	0	3	6	0	0	0	9	16.36
Trading	0	2	5	1	0	0	8	14.56
Farming	0	0	1	19	7	1	28	50.91
Pension	1	0	1	0	0	0	2	3.64
Dividend(rent)	0	2	1	0	0	0	3	5.45
Hunting	0	2	2	0	0	0	4	7.27
Total	1	9	16	21	7	1	55	
Percentage	1.82	16.36	29.09	38.18	12.73	1.82		100

Source: Field survey, 2017

Most of the respondents lived in rented (84.7%) unpainted (95.6%) mud houses (77.6%) with thatched roof (77.6%) and their main (70.5%) means of faecal disposal was bush/bare-ground, (Table 3). This corresponds with Mweemba and Web (2008) that homes of charcoal producers were constructed with mud and thatched roof.

Table 3: Distribution of Respondents based on Types of Building Infrastructure

Variables	Frequency
Mud Only	142(77.6)
Plastered Mud	24(13.1)
Plastered Block	6(3.3)
Un-plastered Block	11(6.0)
Total	**183(100)**
Painted	8(4.4)
Not painted	175(95.6)
Total	183(100)
Thatched Roof	142(77.6)
Roofing sheet	41(22.4)
Total	**183(100)**
Owners Asset	8(4.4)
Rented	155(84.7)
Leased	18(9.8)
Family House	2(1.1)
Total	**183(100)**
Pit Latrine	42(23)
Flushed Toilet	12(6.6)
Bush/Bare Ground	129(70.5)
Total	**183(100)**

Source: Field survey, 2017

A larger proportion of the respondents used either local lamps (47.5%) or lanterns (44.8%) as the source of light; streams (42.1%) and rivers (39.9%) were the common sources of water. In addition, most (94.5%) of the respondents walked along foot paths to link up with other places by trekking (89.6%) the distances (Table 4). These findings agreed with Anyanwu (2013) that

most of the poor are disproportionately located in the rural areas and have extremely limited access to basic amenities.

Table 4: Distribution of Respondents by Amenities; Light, Water, Road infrastructure and Means of Transportation Asset.

Variables	Frequency
Source of Light	
Electricity	8(4.4)
Candle	6(3.3)
Lantern	82(44.8)
Local lamp	87(47.5)
Total	183(100)
Source of Water	
Tap	1(0.5)
Well	25(13.7)
Borehole	1(0.5)
Stream	77(42.1)
River	73(39.9)
Rain	6(3.3)
Total	183(100)
Road Infrastructure	
Footpath	173(94.5)
Un-tarred road	7(3.8)
Tarred road	2(1.1)
Tarred but damaged	1(0.5)
Total	183(100)
Means of Transportation	
Motor car	9(4.9)
Motor Bicycle	7(3.8)
Bicycle	3(1.6)
Trekking	164(89.6)
Total	183(100)

Source: Field survey, 2017

Table 5 shows that 15 tree species belonging to 8 families were used by the charcoal producers. A larger proportion of them used *Annogeissus leiocarpus* (95.1%), *Lophira alata* (92.3%), *Daniellia oliveri* (88%), *Terminalia avicennioides* (83.1%), *Azadiracta indica* (73.2%), *Parkia biglobosa* (72.1%), *Mangifera indica* (97.5%), *Albizia zyygia* (60.1%), *Cassia sieberiana* (56.3%) while others used *Erythropleum suaveolens* (48.1%), *Terminalia schimperiana* (38.8%), *Prosopis africana* (34.4%), *Vitellaria paradoxa* (32.8%), Mahogany (14.8%), *Milicia excelsa* (11.5%). It is evident that indigenous tree species were the most favourable species for charcoal production. This could be so because of its availability in the natural forest especially where there is no restriction to fell. This poses a terrible threat to the natural forest and the environment because these tree species will become extinct earlier than others will if harvesting continued without replacement. Izekor and Osayimwen, (2010) reported that continuous exploitation of these species is adversely affecting its population and some are already going into extinction.

Table 5: Frequency Distribution of Tree Species Used for Charcoal Production

Botanical name	**Local name**	**family**	**Frequency**	**Percentage**
Annogeissus leiocarpus	Ayin	Combretaceae	174	95.1
Vitellaria paradoxa	Emi	Sapotaceae	60	32.8
Prosopis africana	Aayan	Fabaceae	63	34.4
Mangifera indica	Mango	Anacardiaceae	129	70.5
Parkia biglobosa	Iru	Fabaceae	132	72.1
Azadiracta indica	Dongoyaro	Meliaceae	134	73.2
Erythropleum suaveolens	Obo	Fabaceae	88	48.1
Mahogany	Mahogany	Meliaceae	27	14.8
Milicia excelsa	Iroko	Moraceae	21	11.5
Daniellia oliveri	Iya	Fabaceae	161	88
Lophira alata	Ponhan	Ochnaceae	169	92.3
Terminalia avicennioides	Idi odan	Combretaceae	152	83.1
Terminalia schemperiana	Idi	Combretaceae	71	38.8
Albizia zygia	Ayunre	Fabaceae	110	60.1
Cassia sieberiana	Aridantooro	Caesalpinaceae	103	56.3

Source: Field survey, 2017

Estimated production margin per annum for charcoal producers (Table 6) in the State revealed that the average quantity of bags produced at a mean bag weight of 35.36±0.10kg was 286.50±9.22 bags while the average price/bag was ₦457.28±2.91. The Gross Revenue (GR), Total Variable Cost (TVC) and Total Fixed Cost (TFC) from charcoal production were ₦129,848.90, ₦39,091.57 and ₦12,639.67 respectively while the Gross Profit (GP) was ₦90,757.33 and the Net Profits (NP) was ₦78,117.66. This is similar to the findings of Yusuf (2008) where the largest proportion (40.83%) of the producers earned between ₦5,000.00 and ₦10,000.00 per month. The calculated Rate of Return on Investment (RORI), Operating Ratio (OR), Expense Structure Ratio (ESR), and Return Per Capital Invested (RPCI) were 151.01, 0.40, 0.32 and 1.51 respectively. The RORI in this study is higher than the observation of Olagunju, (2006) which was 0.78 (78%). The higher RORI in this study could be attributed to; resource efficiency, access to capital as a result of low interest, contribution from angel investors (those who gave out capital in form of cash to producers to enable easy production processes) and improvement in production know how which resulted in improved output. The Gross Income (GI) is paid for by 40% of the operating costs and 32% of the cost of production formed the fixed cost. Return for every naira invested in charcoal production was ₦1.51.

Table 6: Estimated Production Margin for Charcoal Producers

Variable	Value (₦)/annum
Gross Revenue	129,848.90
Felling/Crosscutting	16,324.32
Log cost	2,713.22
Wood Stacking	1,783.30
Wood covering	1,812.51
Charcoal removal	2,644.81
Sorting/Packing	2,068.14

Rope	1,222.18
Loading	9,053.91
Other expenses	1,469.18
Total Variable Cost (TVC)	39,091.57
Depreciation for cutlass	974.80
Depreciation for chain saw	11,664.87
Total Fixed Cost (TFC)	12,639.67
Total Cost (TC)	51,731.24
Gross Profit (GP)	90,757.33
Net Profit (NP)	78,117.66
Return on Investment (ROI) %	151.01
Operating Ratio (OR)	0.40
Expense Structure Ratio (ESR)	0.32
Return per Capital Invested (RPCI)	1.51

Source: Field Survey, 2017

The odds ratio of being a full time charcoal producer is revealed in Table 7. Six variables were statistically significant at various levels and the likelihood ratio chi-square of 205.08 with p-value of 0.0000 indicated that the model is fit. The result showed that age was significant ($p<0.01$) and positively related to being a full time charcoal producer with odds ratio of 1.691969. Educational level of the spouse and participation in tree planting were significant and negatively related to being a full time charcoal producer at $p<0.10$ and $p<0.05$ with odds ratio of 0.4964957 and 0.0046213. Income per annum from other sources, accessibility to credit and educational levels of the producer were equally significant at $p<0.01$, $p<0.10$ and $p<0.01$ and

negatively related to being a full time charcoal producer with odds ratio of 0.9997965, 0.0424296 and 0.1224229, respectively. This is similar to the report of Babatunde and Qaim (2009) where socio-economic variables such as household size, sex, age education, electricity and distance were significant at different level and influenced participation in different off-farm employments. Among the factors that influence the choice of engagement in charcoal production, access to credit contributed enormously to reduction in the choice of being a full time charcoal producer followed by marital status, educational level and State of origin while income from other businesses was the least contributing factor. A few obtained tertiary education. Higher educational status discourages being a full time producer and could increase the chance for better employment opportunities. People with good employment/income have access to regular and better income, accommodation, health services and they possess the potentials to acquire assets that contribute to better standard of living. Education has been found to effectively reduce or cushion the effect of human activities that are inimical to his existence. It has been described by Adekoya, (2014) as a veritable tool for boosting productivity and for creating awareness of opportunities for earning a living. Though, owing a plantation is positively related to being a full time charcoal producer, it would greatly reduce destruction caused by charcoal activities to the natural forests and government reserves since charcoal production could be achieved in private forest establishments.

Table 7: Odds Ratio Result for Mode of Operation in Charcoal production

Variables	Odds Ratio	Std. Err.	z	P>|z|
age	1.691969	0.2597859	3.43	0.001***
educational level (spouse)	0.4964957	0.2118388	-1.64	0.101*
Do you engage in tree planting	0.0046213	0 .0101071	-2.46	0.014**
Do you own a plantation	1.006121	2.644125	0.00	0.998
Years outside state of origin	.870029	0.1640364	-0.74	0.460
Do you have other sources of income	1.393335	0.6078227	0.76	0.447

Income/annum from other sources	0.9997965	0.0000802	-2.54	0.01***
Years of experience	1.127271	0.1239791	1.09	0.276
Do you have access to credit	0.0424296	0.0817934	-1.64	0.10*
State of origin	0.8966305	0.3361481	-0.29	0.771
Respondent's educational level	0.1224229	0.0695814	-3.70	0.000***
Total household size	0.9532125	0.3135021	-0.15	0.884
Number of children in school	1.383608	0.5028424	0.89	0.37
Revenue from charcoal production	0.9999553	0.0000418	-1.07	0.285
_cons	0.0015998	0.0068882	-1.50	0.135

*** 1% significant level, ** 5% significant level, * 10% significant level

Source: Field Survey, 2017.

Number of obs. = 182

LR $chi^2(16)$ = 205.08

Prob> chi^2= 0.0000

Log likelihood = -23.075947

Pseudo R^2= 0.8163

The result (Table 8) also indicated that a unit increase in age would increase the probability of being a full time charcoal producer by 0.12units. However, a unit change in educational level of the spouse, participation in tree planting, annual income from other sources, access to credit and educational level of the producer would reduce the probability of being a full time charcoal producer by 0.16, 0.71, 0.1x10-3, 0.66 and 0.47units, respectively.

Table 8: Marginal effects of the Mode of Operation in Charcoal production

Variable	dy/dx	Std. Err.	z	P>|z|
age	0.1188767	0.02913	4.08	0.000***
Educational level (spouse)	-0.1582741	0.09654	-1.64	0.101*
Do you engage in tree planting	-0.710317	0.14745	-4.82	0.000***
Do you own a plantation	0.0013806	0.59511	0.00	0.998
Years outside state of origin	-0.0314723	0.04231	-0.74	0.457
Do you have other sources of income	0.0749799	0.09558	0.78	0.433
Income/annum from other sources	-0.000046	0.00002	-2.82	0.005***
Years of experience	0.0270804	0.02414	1.12	0.262
Do you have access to credit	-0.65743	0.27504	-2.39	0.017**
State of origin	-0.0246644	0.08304	-0.30	0.766
Respondent educational level	-0.4747617	0.10103	-4.70	0.000***
Total household size	-0.0108316	0.07424	-0.15	0.884
Number of children in school	0.0733964	0.08021	0.92	0.360
Revenue from charcoal production	-0.0000101	0.00001	-1.08	0.282

*** 1% significant level, ** 5% significant level, * 10% significant level

Source: Field Survey, 2017.

CONCLUSION

It can be concluded from the research findings of this study that: Charcoal production was a thriving industry in the State. Charcoal producers were predominantly males while the average family size was larger than four persons. Most of the producers obtained secondary school

education. Generally, there were inadequate provision of basic amenities. Indigenous tree species were mostly used for charcoal production and they belong mostly to Fabaceae family. Livelihood diversification discouraged being a full time charcoal producer, which can help to promote forest conservation, reduced the spate of tree cutting for charcoal production which will reduce environmental degradation. Only age (Pa0.01) increased the probability of being a full time charcoal producer. Educational level of the spouse (Pa0.10), Participation in tree planting (Pa0.01), income from other sources (Pa0.01), access to credit(Pa0.05) educational status of the producers (Pa0.01) were significant and reduced the probability of being a full time charcoal producer.

RECOMMENDATIONS

Based on the preceding conclusions, the following key recommendations are proffered: There should be effective regulation on charcoal production in the State. Agroforestry practices should be encouraged. Hence, tree seedlings should be made available to farmers and charcoal producers. Modern method of charcoal production should be introduced and encouraged. This will reduce wastage and increase output thereby reduces the rate of wood harvest for charcoal production. Creation and promotion of sustainable rural employment opportunities and income diversification should be encouraged through provision of soft loans by financial institutions. Access to facilities such as portable water, electricity, health care and tertiary education should be made available for charcoal producers and the rural dwellers in order to stem the spate of charcoal production.

REFERENCES

Abah, G.B., Sotannde, O.A. and Adegoke, I.A (2011): Wood Energy: Panacea to Poverty and Hunger Eradication in Nigeria. Forestry in the context of the millennium development goals. Proceedings of the 34th annual conference of the forestry association of Nigeria. Edited by Labode Popoola, Kayode Ogunsanwo and Felix Idumah. Vol. 1 Pp 1 – 5.

Adekoya O.A. (2014): Analysis of farm Household Poverty Status in Ogun State, Nigeria. Asian Economic and Financial Review, 2014, 4(3):325 – 340.

Ajadi, K. O., Alabi, F. M. and Adebisi, J.A. (2012): Subsistence living and global climate

change: implications of bio-charcoal Production for farmers in rural areas of Nigeria. *Ethiopian Journal of Environmental Studies and Management* 5 (1)

Anyanwu, J.C. (2013): "Marital status, Household size and Poverty in Nigeria: Evidence from the 2009/2010 Survey data". Working paper series, No 180 African Development bank, Tunisia, Tunisia.

Arnold, M.J.E., Kohlin, G., and Persson, R. (2006): Woodfuels, Livelihoods, and Policy Interventions: Changing Perspectives. World Development 34 (3): 596-611.

Awoyemi, T.T., Amao, A.O and Fatogun, O. (2006): Household Expenditure Pattern on Energy Consumption in Ibadan, Oyo State Nigeria. Journal of Economics and Rural Development 15(1):79-87.

Babatunde, R. O and Qaim, M. (2009): Poverty and income inequality in rural Nigeria: The role of off- farm income diversification.www.semanticscholar.org Pp 2 – 23.

Bailis, R. (2003): Environmental and Socioeconomic Impacts of Charcoal Production in Kenya. Paper presented in The International Seminar on Bioenergy and Sustainable Rural Development Morella, México, 26–28 June 2003.

Bland, J.M. and Altman, D.G. (2000): The odds ratio. *British Medical Journal*, 320 (7247), 1468.

CHAPOPSA. (2002): Charcoal potential in Southern Africa. INCO_DEV: International cooperation with developing countries (1998-2002).

Deeks, J. (1996): Swots corner: what is an odds ratio? Bandolier, 3 (3), Issue 25, 6-7.

FAO, (2011a): Highlights on wood charcoal: 2004-2009. FAO Forestry Department. FAOSTAT-ForesSTAT

FAO, (2011b): Highlights on wood fuel: 2004-2009. FAO Forestry Department. FAOSTATForesSTAT

Gujarati, D.N., (2004): Basic Econometrics, Fourth Edition. The MacGraw –Hill companies. Pp 595 – 608.

Izekor DN &Osayimwen FE (2010): Potentials of sawmill wood wastes utilization as household energy source in Benin City. African Scientist 2(1): 33–39.

Jamala, G.Y., Abraham, P. Joel, L and Asongo, A. (2013): Socio-Economic Implications of Charcoal Production and Marketing in Nigeria. *Journal of Agriculture and Veterinary Science*. 5(4): 41-45.

Mweemba, A. J. M. & E. Webb (2008): Residential Area as Proxy for Socio-economic Status, Paediatric Mortality and Birth Weight in Lusaka, Zambia. *Journal of Tropical Pediatrics*, 54, 406-409

NPC (2010): National Population Commission, Federal Republic of Nigeria 2006 Population and Housing Census, Priority table, volume III. Population Distribution by Sex, State, LGA & Senatorial District. Abuja Nigeria. April, 2010.

Ogara, J.I. (2011): Preliminary studies on charcoal production and producers' knowledge of environmental hazards in Nasarawa state, Nigeria. December, 2011; 7 (2): ISSN: 0794-5213 www.patnsukjournal.net/currentissue Pp 68-75. age, agree; environment, contradict.

OSG, (2016): www.ogunstate.gov.ng Accessed 2016.

Olagunju, F.I. (2006): Cost and Returns to Charcoal Production in Iseyin Local Government Area of Oyo State, Nigeria. *An International Journal. Asset series c* (2006) 1 (1): 21-37.

Olukosi, J.O. and Erhabor, P.O. (2005): Introduction to Farm management. Economic Principles and Application. Agifab Publications, Zaria Nigeria. ISBN: 978-2675-12-1 Pp. 77 – 83.

Sengupta, S. and Maginnis, S. (2005): Forests and development: Where do we stand? In, J. Sayer, ed. The Earthscan Reader in Forestry and Development. London, Eathscan.

Yusuf R.O. (2008): Charcoal Production and Sustainable Rural Development in Kwara State, Nigeria. *The Zarla Geographer* (2008), Vol. 17, No.l, pp.64-75.