Perceived effects of charcoal production on the health status of rural dwellers in Rainforest and Guinea Savannah Agro-ecological zones of Nigeria

Abstract

Charcoal Production (CP) has negative health consequences which include respiratory diseases, back pains among others. Therefore, perceived health effects of CP among rural dwellers in the study area were investigated. A total of 83 and 85 charcoal producers in the rainforest and guinea savannah (GS) zones respectively were selected through multi stage sampling procedure. Data were collected through structured interview procedure and analysed using inferential and descriptive statistics. Descriptive analysis showed that 35 – 44 age is the modal age within the same age-range. Majority (88.0% and 90.5%) of respondents from rainforest and GS respectively were males. More respondents (59.0%) in the rainforest zone possessed primary school certificate, while, 30.6% of respondents in the GS attended Koranic School. The mean years of experience were 11 for the rainforest vegetation zone and 14 for the GS zones. All the respondents made use of earth mound method of CP in the study area and 36.1% of respondents from the rainforest zone produced greater than 128000kg/annum. Respondents perceived that CP may cause skin and respiratory tract irritation/infection (72.3%, 57.6%); charcoal production lead to cut, crush and laceration of hand (78.3%, 69.4%); lead to burns (90.0%, 49.4%); back and muscle pains (73.5, 70.6%) and CP cause body wounds (73.5%, 58.5%) in rainforest and GS zones respectively. Majority (84.3% and 84.7%) in the rainforest and GS respectively had negative perception of effects of CP on the health of rural dwellers. Significant difference existed in the perceived health effects of charcoal production between the agro-ecological zones (F=3.124).

Keywords: Charcoal production, respiratory diseases, rural dwellers perception

Introduction

Charcoal production as a means of livelihood, is no longer any news in many parts of Nigeria where people have access to wood. Its production has reached a destructive level to the environment and the health of the producers (Federal Ministry of Environment, 2006). Forest reservation in most parts of Nigeria reached its peak in the mid 1950's, particularly in the Northern States where approximately 42,000 km^2 were reserved. Between 1960 and 1972 an area of over 12,900 km^2 was proposed for reservation in the Northern States. In the south, forest reservation has been at a standstill and the prospects of creating more reserves in the future are not there. In recent times, most of the forest reserves are subjected to dereservation as a result of increase in population and economic expansion in other sectors of the economy.

Apart from the environmental consequences of charcoal production, there are also social, health and gender implications related to wood fuel consumption (UNDP, 2005). Shortages of wood fuels for subsistence users are becoming more pronounced, particularly for the landless poor due to deforestation resulting from large scale charcoal production, as well as reduced access to forests driven by the privatisation of resources (Arnold & Persson, 2005). These actions reduce the livelihood potential for subsistence users dependent on forests. As a result, they must seek alternative means to procure products previously gathered from forests. This is illustrated in firewood collection activities where both deforestation and privatisation of land increase the time spent searching for firewood, thereby preventing women and children from other more productive activities (UNDP, 2005).

There are significant health issues concerning the use of wood fuels where incomplete combustion results in various forms of accidents (Bailis *et al.,* 2005). Ellegard (1994) reported backache, heat, and cough among other ailments confronting charcoal producers. According to Elligard (1993), charcoal production entails much strenuous work for the producer during felling, cross cutting, log haulage, kiln building and management. There are also risks associated with a carbonising kiln particularly when repair work is being carried out. Accidents may occur which sometimes lead to death. Another health risk to the producer is the exposure to gases and smoke and also heat from the kiln. Of all the gases emitted, Carbon Monoxide (CO) is the major health risk. The following are the health risks associated with each stage of charcoal production.

Felling and cross-cutting: These include sore hands, backache, general exhaustion and chest pains.

Kiln covering: These include cough, chest pains, heat, burns, exposure to smoke and gases.

Kiln breaking: Heat and burns.

According to Tzanakis, Kallergis, Bouros, Samiou and Siafakas (2001), during the burning period of charcoal production, workers are exposed to incomplete combustion of wood burning and noxious smoke gases for several hours per day. Charcoal producers significantly experience symptoms such as cough, sputum production, sneezing, dyspnea, and hemoptysis. They also complained of headache, acute eye problem, nose, and throat irritation during the exposure period. The task of unloading the kiln increases the heat, but during the harsh weather, any type of charcoal production work is subjected to high humidity and temperature. The temperature of the working environment and the charcoal dust dispersed while unloading a kiln could also affect the workers' eyes.

Therefore, the study examined the perceived health effects of charcoal production among the rural dwellers of rainforest and guinea savannah agro-ecological zones of Nigeria.

Objectives of the Study

The study aims to:

1. Assess the health effects of charcoal production among the rural dwellers in both study area.
2. Identify the socio-economic characteristics of charcoal producers in the study area
3. Determine the different charcoal production methods and level
4. Ascertain the perceived effects of charcoal production on the rural dwellers health of of the study area.

Methodology

The study area is the rainforest and guinea savannah zones of Nigeria. Guinea Savanna Zone which lies between the arid north and the moist south sometimes experiences mean annual rainfall of 1200mm. Yams, millet, sorghum, cowpeas, cassava, and corn, with rice are the important crop produced here. The southern edge represents the lower limits of the northern grain-dominated economy. Sesame (or benniseed) are the most significant commercial crop here. In the south, where rainfall is heaviest, experiences 2000mm during the pick period where the rainforests and woodlands benefit from abundant precipitation and relatively short dry seasons. Root crops such as, yams, cassava, taro (*cocoyams*), and sweet potatoes are the staples in the south. The main cash crops in the south are tree crops, which in general are grown on large plantations that include cacao, oil palm, and rubber. In the rainforest zone, the mean monthly temperature is 26.5 ^{0}C but could go above 30 ^{0}C in the guinea savannah zone.

Multi-stage sampling procedure was used to select respondents from the 277 and 284 population of charcoal producers in rainforest and guinea savannah zones respectively, which were purposively selected from the six agro-ecological zones in Nigeria because of their potential for charcoal population. Ijaye, Imeko, Gbongan, Awe, Ejigbo, Iwo, Ilora, Egbado and Jobele from the rain forest zone while Bida, Borgu, Lapai, Lavun, Obi, Edati, Katcha, Oju, Ubaya, and Mokwa from the guinea savannah zone are the major charcoal producing communities.

The simple random sampling technique were done with selected 50% of rural communities, whereas, 30% of the registered charcoal producers were selected from the population of all registered charcoal producers available in each of the selected communities. A total of 83 and 85 charcoal producers in the rainforest and guinea savannah zones respectively were used as respondents for this study. The coal production data come from verbal information. A Likert-type five point rating scale of " strongly agree" to "strongly disagree" (1-5 for negatively worded statements and 5-1 for positively worded statements respectively), respondents were requested to indicate their opinion on each of the 30 selected statements (15 positive, and 15 negative) about perceived health effects of charcoal production among rural dwellers in the study area. The questionnaire or survey was validated by subject experts.

The statistical analysis was done with SPSS version 17. Duncan's Multiple Range Test and Regression analysis was done in this regard.

Results and discussion

Table 1 indicates that the modal ages were within the age-range of 35 - 44 years with 35.1% and 48.1% representing rainforest and guinea savannah zones, indicating their productive ages. This result is similar with the study of Stockholm Environment Institute (SEI) (2002). Sex is a vital variable regarding livelihood strategies. Majority (88.0% and 90.5%) of respondents from rainforest and guinea savannah respectively were males. This may be as a result of the rigours involved in some of the activities of charcoal production. This finding agrees with SEI (2002), which revealed that males are more involved in charcoal production. Across the agro-ecological zone, 90.4% of respondents in the rainforest and 90.6% in the guinea savannah were married. This implies that a lot of money is realised from the sale of charcoal, which enables those who are married among them to cope with financial responsibilities in their families. Data revealed that in the rainforest zone possessed more

(59.0%) primary school certificate, while, in the guinea savannah, 30.6% of respondents attended Koranic School. In the guinea savannah zone, 49.4% are crop farmers and 35.3% are fisher folks with only 14.1% taking charcoal production as their primary occupation (Eniola et al., 2015). In the rainforest zone, 54.2% of respondents are crop farmers. Inability to produce charcoal throughout the year prevents the producers not to take it as primary occupation. Farmers are inclined to be in charcoal production as they clear lands providing easy access to wood for charcoal production (Shacklon *et al*., 2006). SEI (2002) revealed that only those with required vegetation take charcoal production as their primary occupation. Across vegetation zones, 81.9% and 82.4% take charcoal production as secondary occupation in the forest and guinea savannah zones respectively. This implies that their standard of living will be improved. World Energy Council (WEC) (2004) noted that charcoal is produced by the poor people who live in rural communities. Charcoal production is, therefore, an activity for income diversification (Barret, *et al*, 2001and UNDP, 2005). Olawoye (2000) opined that many households engage in several income-generating activities in order to meet their household needs. In order to meet household needs, other sources of income are required. The mean years of experience are 11 for the rainforest vegetation zone and 14 for the guinea savannah zones. In a related study by Bada, *et al* (2009), it was revealed that the years of experience of charcoal producers in some parts of Nigeria is between 5 and19 years.

Across agro-ecological zones, mean income for rainforest is ₦190,421.9 (1,269.5 dollars) SD of 55819.4 and ₦135,929.4 (906.2 dollars) with SD of 559,11.4 for the guinea savannah. Kalumiana (2000) opined that 70.0% of the cash income realised annually in Tanzania was realised in an area suitable for charcoal production. In the guinea savannah zone, 96.6% practiced shifting cultivation and 38.8% practiced mono cropping, while 49.4% and 28.9% of respondents in the rainforest zone practiced mono-cropping and shifting cultivation respectively.

Table 1: Socio-economic characteristics of charcoal producers

Socio-economic characteristics	Rainforest zone Mean age =46 Std dev.=9.3		Guinea savannah zone Mean age =43 Std dev.=8.0	
Age (Years)	**F**	**%**	**F**	**%**
25-34	7	8.4	8	9.5
35-44	29	35.0	41	48.1
45-54	26	31.3	26	30.5
More than 54	21	25.3	10	11.9
Sex				
Male	73	88.0	77	90.5
Female	10	12.0	8	9.5
Educational Attainment				
No formal educ.	14	16.9	30	35.3
Koranic school	7	8.4	26	30.0
Pry. School	49	59.0	17	20.6
Secondary s	11	13.3	12	14.1
OND and above	2	2.4	-	-
Marital status				
Married	75	90.4	77	90.6
Single	5	6.0	5	5.9
Widow	3	3.6	3	3.5
Primary occupation				
Crop farming	45	54.2	42	49.4
Fishing	9	10.8	30	35.3
Charcoal production	11	13.3	12	14.1
Trading	14	16.9	1	1.2
Hunting	4	4.8	-	-
Secondary occupation				
Crop farming	10	12.0	14	16.4
Fishing	1	1.2	-	-
Charcoal production	68	81.9	70	82.4
Weaving	-	-	1	1.2
Hunting	4	4.9	-	-
Years of experience	Mean = 11 SD=4.3		Mean=14 SD=4.2	
less than 5years	9	10.8	6	7.1
6-10years	16	19.4	6	7.1
11-15years	51	61.4	39	45.8
more than15years	7	8.4	34	40.0

Income from charcoal production	Mean=190,421.9 SD=99,71.4		Mean=135,929.4 SD=559,11.4	
≤100.000.00	-	-	20	23.5
100.001-200.000.00	38	45.8	48	56.5
200.001-300.000.00	40	48.1	16	18.8
300.001-400.000.00	5	6.1	1	1.2
Farming system				
Crop rotation	-	-	1	1.2
Mono cropping	41	49.4	33	38.8
Shifting cultivation	24	28.9	82	96.5
Total	83	100.0	85	100.0

2.0: Methods of Charcoal Production

Table 2.0 shows that majority (100.0% and 80.0%) of the respondents make use of earth mound method of charcoal production in rainforest and guinea savannah zone respectively while, 20.0% make use of the pit method in guinea savannah zone. This suggests that earth mound is very prominent in zones. In a related study by Bada, *et al.* (2009), surface (earth mound) method was found to be the most commonly used method of charcoal production in many parts of Nigeria.

Table 2.0: Distribution of respondents based on Methods of Charcoal Production

Methods used in charcoal production	**Rainforest zone**		**Guinea savannah**	
Earth mound	83	100.0	68	80.0
Pit method	-	-	17	20.0
Total	83	100.0	85	100.0

3.0: Respondents' annual output from Charcoal production

Table 3.0 reveals that 52.9% of respondents produced between 32-32000kg of charcoal per annum while 41.2% produced between 32032-64000kg in guinea savannah. However, 36.1% produced greater than 128000kg/annum in rainforest zone. CHAPOSA (2002) inferred that the output from charcoal production depends on the season, availability of water, types of wood, vegetation and occupation of the producer.

Table 3.0: Distribution of respondents based on the annual output from Charcoal production in the selected ecological zones

Kilogram of charcoal	**Rainforest zone**		**Guinea savannah**	
Total quantity per annum	F	%	F	%
32 – 32000kg	11	13.3	45	52.9
32032– 64000	13	15.6	35	41.2
64032– 96000	25	30.1	-	-
96032-128000	5	4.9	1	1.2
More than 128000	30	36.1	4	4.7
Total	83	100.0	85	100.0

4.0: Perceived effects of Charcoal Production on the health of rural dwellers

Table 4 reveals that majority (90.0%, 78.3% and 79.5%) of the respondents in the rainforest zone strongly agreed respectively that charcoal production may lead to burns, cut, crush and laceration of hand and that it is not hygienic for children to get near the charcoal kiln or store. Majority (73.5%, 73.5% and 72.3%) strongly agreed respectively, that charcoal production is likely to cause body wounds, and skin and respiratory tract irritation/infection, moreover, charcoal producers may not necessarily experience spinal hernia.

However, 69.9%, 67.5% 66.3%, and 65.1% of the respondents strongly disagreed respectively that poisonous bites has nothing to do with charcoal production; fatigue is not prominent to charcoal producers; falling and slipping are not common to charcoal producers and that children can play with charcoal during production without any harm. This implies that the respondents in the rainforest zone perceived that charcoal production could cause different diseases among normal people and could bring massive herm for children and pregnant women.

Table 5 reveals that majority (70.6%, 69.4% and 63.5%) of respondents in the guinea savannah zone strongly agreed respectively that back and muscle pains may be associated with charcoal production; and that charcoal production is likely to lead to cut, crush and laceration of hand. It is not also hygienic for children to get near the charcoal kiln. Furthermore, 60.0% and 57.6% strongly agreed respectively that charcoal production is likely to cause body wounds and may cause skin and respiratory tract irritation infection.

However, 60.0%, 55.3% and 54.1% of respondents strongly disagreed respectively that children can play with charcoal during production without harm, one's hand, foot or limbs may not be affected during charcoal production and fatigue is not prominent to charcoal producers.

It should be noted that respondents in the rainforest zone did not perceive spinal hernia cold flu, dizziness and regular medical check-up as health problems.

221 **Table 4: Distribution of respondents according to perceived effects of Charcoal production on the health of rural dwellers**

S/N	Statements on health related problems	Rainforest zone N=83										
		SA		A		U		D		SD		MEAN
		F	%	F	%	F	%	F	%	F	%	
1	Charcoal production is likely to cause body wounds.	61	73.5	18	21.7	-	-	3	3.6	1	1.2	4.6
2	Charcoal producers may not experience sinusitis.	52	62.7	6	7.2	-	-	13	15.6	12	14.5	3.9
3	Charcoal production may result to respiratory diseases.	21	25.3	19	22.9	3	3.6	22	26.5	18	21.7	3.0
4	Charcoal producers may not necessarily experience spinal hernia.	46	55.4	1	1.2	-	-	14	16.9	22	26.5	3.4
5	Charcoal production is likely to lead to cut, crush and laceration of hand.	65	78.3	14	16.9	-	-	-	-	4	4.8	4.6
6	Back and muscle pains may be associated to charcoal production.	61	73.5	17	20.5	-	-	-	-	5	6.0	4.6
7	Charcoal producers may likely experience frequent head ache.	20	21.4	10	12.0	4	4.8	10	12.0	39	47.0	2.4
8	Dust from charcoal production cannot cause asthma.	4	4.8	5	6.0	33	39.8	21	25.3	20	24.1	2.4
9	Charcoal production may cause skin and respiratory tract irritation/infection.	60	72.3	16	19.3	5	6.0	-	-	2	2.4	4.6
10	Charcoal production is not likely to cause body irritation.	13	15.7	6	7.2	1	1.2	13	15.7	50	60.2	2.0
11	Charcoal production may aids malaria attack.	8	9.6	12	14.5	7	8.4	39	47.0	17	20.5	2.5
12	Falling and slipping are not common to charcoal producers.	6	7.2	3	3.6	-	-	19	22.9	55	66.3	1.6
13	Charcoal production may lead to burns.	49	90.0	19	22.9	-	-	4	4.8	11	13.3	4.1

14	Fatigue is not prominent to charcoal producers.	9	10.8	5	6.0	-	-	13	15.7	56	67.5	1.5
15	Eyes problem may be frequently encountered through charcoal production.	22	26.5	12	14.5	-	-	2	2.4	47	56.6	2.5
16	Poisonous bites have nothing to do with charcoal production.	7	8.4	1	1.2	-	-	17	20.5	58	69.9	1.6
17	Tuberculosis may not be contacted through charcoal production.	47	56.6	25	30.1	-	-	2	2.4	9	10.8	4.2
18	Charcoal producers may not experience cold/flu.	45	54.2	3	3.6	-	-	21	25.3	14	16.9	3.5
19	Charcoal producers may not experience dizziness.	48	57.8	3	3.6	-	-	11	13.3	21	25.3	3.6
20	Involvement in charcoal production may cause tetanus.	49	59.0	21	25.3	4	4.8	11	13.3	2	2.4	4.4
21	Traffic accidents are common during charcoal production.	39	47.0	25	30.1	-	-	17	20.5	2	2.4	4.0
22	Charcoal production is likely to cause ill health.	44	53.0	22	26.5	-	-	5	6.0	12	14.5	4.0
23	One can still feel body pains with little involvement in charcoal production.	20	21.4	14	16.9	-	-	15	18.1	34	41.0	2.7
24	None of my family members have experienced any form of disease as a result of charcoal production.	17	20.5	13	15.7	-	-	9	10.8	44	53.0	2.4
25	It is not hygienic for children to get near the charcoal kiln or store.	66	79.5	13	15.7	-	-	3	3.6	1	1.2	4.7
26	Fainting may not necessarily be associated to charcoal production.	47	56.6	21	25.3	-	-	5	6.0	10	12.0	4.1
27	Pregnant women may be exposed to danger during charcoal production.	46	55.4	19	22.9	-	-	4	4.8	14	16.9	4.0
28	One's hand, foot or limbs may not be affected during charcoal production.	2	2.4	6	7.2	-	-	26	31.3	49	59.0	1.6
29	Children can play with charcoal during production without any harm.	5	6.0	3	3.6	-	-	21	25.3	54	65.1	1.6

30	Involvement in charcoal production requires regular medical checkup.	18	21.7	26	31.3	4	4.8	30		5	6.0	3.3

222 **Table 5: Distribution of respondents according to perceived effects of charcoal production on the health of rural dwellers**

S/N	N= 85	Guinea savannah zone										
	Statements on health related problems	**SA**		**A**		**U**		**D**		**SD**		**MEAN**
		F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	%	
1	Charcoal production is likely to cause body wounds.	51	60.0	29	34.1	-	-	5	5.9	-	-	4.5
2	Charcoal producers may not experience sinusitis.	27	31.8	6	7.1	-	-	23	27.1	29	34.1	2.8
3	Charcoal production may result to respiratory diseases.	39	45.9	25	29.4	-	-	7	8.2	14	16.5	3.8
4	Charcoal producers may not necessarily experience spinal hernia.	26	30.6	1	1.2	1	1.2	29	34.1	28	32.9	2.6
5	Charcoal production is likely to lead to cut, crush and laceration of hand.	59	69.4	22	25.9	1	1.2	3	3.5	-	-	4.6
6	Back and muscle pains may be associated to charcoal production.	60	70.6	20	23.5	2	2.4	-	-	3	3.5	4.6
7	Charcoal producers may likely experience frequent head ache.	22	25.9	38	44.7	8	9.4	3	3.5	14	16.5	3.6
8	Dust from charcoal production cannot cause asthma.	14	16.5	19	22.4	13	15.3	23	27.1	16	18.8	2.9
9	Charcoal production may cause skin and respiratory tract irritation/infection.	49	57.6	26	30.6	3	3.5	3	3.5	4	4.7	4.3
10	Charcoal production is not likely to cause body irritation.	14	16.5	8	9.4	2	2.4	24	28.2	37	43.5	2.3
11	Charcoal production may aids malaria attack.	16	18.8	15	17.6	4	4.7	25	29.4	25	29.4	2.7
12	Falling and slipping are not common to charcoal producers.	7	8.2	6	7.1	-	-	30	35.3	42	49.4	1.7

13	Charcoal production may lead to burns.	42	49.4	21	24.7	-	-	4	4.7	18	21.2	4.6
14	Fatigue is not prominent to charcoal producers.	5	5.9	8	9.4	1	1.2	25	29.4	46	54.1	1.8
15	Eyes problem may be frequently encountered through charcoal production.	34	40.0	24	28.2	-	-	5	5.9	22	25.9	3.5
16	Poisonous bites have nothing to do with charcoal production.	11	12.9	6	7.1	-	-	31	36.5	37	43.5	2.1
17	Tuberculosis may not be contacted through charcoal production.	32	37.6	18	21.2	1	1.2	19	22.4	15	17.6	3.4
18	Charcoal producers may not experience cold/flu.	20	23.5	4	4.7	1	1.2	32	37.6	28	32.9	2.5
19	Charcoal producers may not experience dizziness.	21	24.7	6	7.1	-	-	29	34.1	29	34.1	2.5
20	Involvement in charcoal production may cause tetanus.	42	49.4	30	35.5	2	2.4	6	7.1	5	5.9	4.2
21	Traffic accidents are common during charcoal production.	43	38.8	35	41.2	3	3.5	9	10.6	5	5.9	4.6
22	Charcoal production is likely to cause ill health.	40	47.1	24	28.2	3	3.5	5	5.9	13	15.3	3.9
23	One can still feel body pains with little involvement in charcoal production.	15	17.6	11	12.9	-	-	27	31.8	32	37.6	2.4
24	None of my family members have experienced any form of disease as a result of charcoal production.	19	22.4	12	14.1	3	3.5	17	20.0	34	40.7	2.6
25	It is not hygienic for children to get near the charcoal kiln or store.	54	63.5	21	21.7	1	1.2	6	7.1	3	3.5	4.4
26	Fainting may not necessarily be associated to charcoal production.	36	42.4	22	25.9	-	-	13	15.3	14	16.5	3.6
27	Pregnant women may be exposed to danger during charcoal production.	38	44.7	26	30.6	-	-	10	11.8	11	12.9	3.6
28	One's hand, foot or limbs may not be affected during charcoal production.	9	10.6	2	2.4	-	-	27	31.8	47	55.3	1.8
29	Children can play with charcoal during production without any harm.	6	7.1	5	5.9	1	1.2	22	25.9	51	60.0	1.7

30	Involvement in charcoal production requires regular medical check up.	26	30.6	39	45.9	-	-	12	14.1	8	9.4	3.7	

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5.0: Level of respondents perceived effects of charcoal production on health of rural dwellers

Table 6.0 reveals that 84.3% of respondents in the rainforest and 84.7% in guinea savannah zone show negative perception on effects of charcoal production on the health of rural dwellers. The implication is that respondents encounter several health problems when producing charcoal. Eniola & Odebode, (2018), Kato, *et al*. (2005), Bailis, *et al.* (2005) and WEC (2004) observed that health problems, ranging from mild to chronic problems, result from involvement in charcoal production.

Table 6.0: Perception of respondents on the effects of Charcoal production on health of rural dwellers

		Rainforest n=83		Guinea savannah n=85	
Health related problems	**Scores**	**Mean score=98.5 Std. dev.=9.9**		**Mean score=94.1 Std. dev.=11.1**	
		F	**%**	**F**	**%**
Positive effects	30-98.5	13	15.7	13	15.3
Negative effects	98.6-150.0	70	84.3	72	84.7

6.0: Result of the Regression analysis showing the contribution of the selected socio-economic characteristics to perceived health effects of charcoal production in the rainforest zone of the study area

Table 7.0 shows that age (β= 0.316) and marital status (β= 0.301) are positively significant to perceived health effects of charcoal production. This implies that age and marital status influence the level of health hazards they perceived.

The result shows an R^2 value of 0.372 which implies that all the socio-economic characteristics considered in the study area contribute 37.0% of the variance of perceived health effect of charcoal production.

Table 8.0 reveals that years of experience (β= -0.319) of respondents is negatively significant to perceived health effects of charcoal production in the guinea savannah zone of the study area. This implies that the less the number of years of experiences, the higher the level of

perceived health effects of charcoal production. The result further shows that in the guinea savannah, the coefficient of determination is 0.390 which implies that all the socio-economic characteristics considered for the study contribute only 39.0% to perceived health effects of charcoal production.

Table 7.0: Regression analysis showing the contribution of the selected socio-economic characteristics to perceived health effects of charcoal production in the rainforest zone of the study area

Variables	B	β	t-ratio	Significant
(Constant)	92.177	-	6.378	0.000
Age	0.341	0.316*	2.212	0.030
Farming system	0.784	0.121	0.775	0.632
Sex	3.446	0.107	0.823	0.414
Marital status	0.319	0.301*	2.160	0.024
Educational attainment	-0.078	-0.009	-0.073	0.942
Primary occupation	0.342	0.077	0.630	0.531
Secondary occupation	1.837	0.187	1.597	0.115
Years of experience	-2.602	-0.202*	-0.887	0.036
Income from charcoal production	-3.153E-5	-0.175	-1.040	0.302

Coefficient of Determination (R^2) = 0.372

Table 8.0: Regression analysis showing the contribution of the selected socio-economic characteristics to perceived health effects of charcoal production in the guinea savannah zone

Variables	B	β	t-ratio	Significant
(Constant)	96.323	-	6.612	0.000
Age	0.178	0.129	1.032	0.306
Farming system	-3.547	-0.295	-1.298	0.339
Sex	5.468	.0145	1.289	0.202
Marital status	0.049	0.002	0.022	0.983
Educational attainment	0.966	0.092	0.819	0.415
Primary occupation	0.294	0.035	0.198	0.844
Secondary occupation	-0.575	-0.063	-0.496	0.622
Years of experience	-4.150	-0.319*	-2.049	0.044
Income from charcoal production	3.794E-6	0.019	0.176	0.861

R^2 =0.390

7.0 Significant difference in the perceived health effects of charcoal production across the agro-ecological zones

Table 9.0 revealed a significant difference in the perceived health effects of charcoal production across the agro-ecological zones (F=3.124). The rainforest zone with high mean

(98.18), perceived effects of charcoal production on the health implies that the health effects of charcoal production are of more negative effects in this zone. This could be as a result of the fact that more respondents are educated in the zone which makes them to understand the health implications of charcoal production.

Table 9.0: Differences in the level of perceived health effects of charcoal production across the agro-ecological zones

Parameter	Statistical tool	df	Sum of square	Mean square	F value	p value	Decision
Health	Analysis of variance	1	921.020	460.010	3.124	0.00	Significant

Duncan's Multiple Range Test

Duncan Grouping	Mean	N	Zone
	94.36_a	85	Guinea savannah
	98.18_b	83	Rainforest

Letters that are the same are not significantly different

Conclusion and Recommendations

The study concludes that charcoal production is dominated by male who are in their active age and married. Charcoal production constitutes several health challenges to the producers which may eventually reduce their productive years. The health status of charcoal producers may likely continue to get worse if they continue to produce charcoal and/or fails to improve on the method of CP.

1. The study therefore recommends that more foresters/environmental extension agents should be employed and equipped to monitor the activities of rural dwellers in the forest. Forest licensing and fees collection must be re-orgarnised and increased to prevent illegal logging. There is therefore the need for the government to quickly work on other available and affordable alternative household energy sources.

2. Regular training and workshop should be organised for rural dwellers on proper management of the forest and its future implications on the environment and human lives.

Consent Disclaimer:

As per international standard or university standard verbal participant consent has been collected and preserved by the authors.

Ethical Disclaimer:

As per international standard or university standard written ethical permission has been collected and preserved by the author(s).

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